


# City of Rochester Roadway/Street Lighting Design Guide

PREPARED FOR THE CITY OF ROCHESTER, MN

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# 1.0 INTRODUCTION

## 1.1 OVERVIEW

This roadway lighting design manual has been developed for the City of Rochester. This is a standalone document that provides design professionals with the lighting design guidelines for various roadway/street types within the City of Rochester.

## 1.2 BACKGROUND

The City of Rochester has multiple departments that are involved in roadway lighting. The general breakdown is as follows:

Rochester Public Works and the Rochester Parks Department are responsible for the design, installation, and maintenance of lighting associated with sidewalks and pathways that are publicly lit around the City of Rochester. Most bike and pedestrian paths are not illuminated other than in areas of safety concerns. These installations are separately metered.

Rochester Public Works is responsible for the design, installation, and maintenance of traffic signals and roadway lighting that are installed on traffic signal structures. These installations are separately metered.

Rochester Public Works is responsible for the design of roadway lighting installed as part of roadway projects along with coordinating the associated civil work. Rochester Public Utilities, owns, and maintains the roadway lighting system other than the fixtures on traffic signal structures. Rochester Public Utilities bills Public Works a per fixture/pole amount to recover capital, maintenance, and energy costs.

Rochester Public Utilities is responsible for the design of roadway lighting installed as part of new commercial and residential subdivisions. Rochester Public Utilities installs and maintains these lighting systems and invoices Public Works a per fixture/pole amount to recover capital, maintenance, and energy costs.

Prior to this Design Manual Rochester Public Utilities based its lighting designs loosely on recommendations from a 1982 study that was performed at the time the City of Rochester was examining converting their roadway lighting system from incandescent/mercury vapor to high pressure sodium. Prior to this Design Manual the consultants used by Public Works on road projects typically used applicable IES standards or MNDOT standards.

Prior to this Design Manual there was not a lighting design guideline consistently applied and as redevelopment and development occurred within the City of Rochester the neighboring developments lost the desired uniformity and consistency with the lighting systems currently in use. Additionally, the departments within the City are typically installing light-emitting diodes (LED) fixtures for outside lighting which results in additional lighting concerns related to light levels, correlated color temperature, and glare.

# CITY OF ROCHESTER ROADWAY/STREET LIGHTING DESIGN GUIDE

## Introduction

July 22, 2019

This comprehensive lighting design guide will assist the City of Rochester in developing a high-quality standard of lighting installations and will improve the consistency of the lighting systems throughout the City of Rochester.

# 2.0 LIGHTING BASICS

## 2.1 OVERVIEW

Roadway and street lighting is used to increase visibility for both the drivers and the pedestrians interacting with the vehicular traffic. Safety for both the drivers and the pedestrians is critical when designing roadway lighting systems along with improving traffic flow by improving driver visibility

## 2.2 PURPOSE OF ROADWAY LIGHTING

According to Illuminating Engineering Society (IES) Recommended Practice for roadway lighting IES RP-8 the principal purpose of roadway and street lighting is to allow accurate and comfortable nighttime visibility of possible hazards in sufficient time to allow appropriate action. For a pedestrian, this can mean better visibility of the surroundings and the sidewalk. For the driver of the motor vehicle, it will mean time to stop or to maneuver around an obstacle. Good lighting has been shown to significantly reduce nighttime accidents. For most streets and sidewalks, good lighting has been reported to increase the feeling of personal security of pedestrians.

## 2.3 VISIBILITY OF OBJECTS AND LIGHTING QUALITY

Visibility is the ability for the eye to see an object. The driver requires a level of visibility to be able to see the changing environment such as the alignment changes to the road, signage, or other obstacles that require visual detection. The visual detection may then require a physical response, so the visual detection needs to be accurate, precise, and quick to allow for the driver to respond to the changing condition.

Lighting Quality refers to the ability of the light to make the object visible. There are several factors that need to be considered when designing roadway and street lighting. Reduction in glare from either the light source or reflected sources is one of the factors that needs to be considered. For example, reducing the glare from these sources will increase the lighting quality and therefore will increase the visibility in the driving environment.

## 2.4 EFFECTS OF LIGHT EMITTING DIODE (LED)

The intent of this chapter of the Design Guide is to summarize the findings of the American Medical Association (AMA) CSAPH Report 2-A-16: Human and Environmental Effects of Lighting Emitting Diode (LED) Community Lighting. There is still ongoing research being conducted by scientific organization regarding the findings issued by the AMA in the report. As such this Design Guide will not provide a specific response to the findings until all scientific findings are completed and made public. The AMAs report and the subsequent responses to the reports from other agencies are included in the attachments in their entirety for the reader to review in full and make their own findings regarding the impact and effects of Light Emitting Diodes (LED) on humans and the environment.

**CITY OF ROCHESTER ROADWAY/STREET LIGHTING DESIGN GUIDE**

Lighting Basics
July 22, 2019

*American Medical Association (AMA) CSAPH Report 2-A-16: Human and Environmental Effects of Lighting Emitting Diode (LED) Community Lighting.*

The AMA reports states the advantage of using LED lighting for street and roadway lighting include the energy efficiency and longer lamp life of LED lighting. This leads to energy savings and reduced operating costs in addition to savings in taxes, and maintenance costs as well with benefit seen in lowering air pollution and reduction in the use of fossil-based carbon fuels. The AMA report identifies several potential adverse health effects of electric light exposure at night. The report states the core concern is the disruption of circadian rhythmicity. The report explains that the short wavelengths (blue) electric light sources as disrupting the transition to nighttime physiology from evening exposure. This is similar to the exposure seen from tablet computer screens, backlit e-readers, and room lighting typically seen in homes. The report states that these effects are not seen from longer wavelength light such as from wood fires or lower wattage incandescent lamps. The report states that there are detrimental effects to the environment as well using the short wavelength (blue) LED lights. Examples are given such as the birds that navigate via the moon and star reflections at night, insects that fly around a light source until exhausted and die, and that lightning bugs cannot “see” each other when light pollution is pronounced reducing the reproduction rates of lightning bugs.

The following is the conclusion stated in the CSAPH Report 2-A-16: Human and Environmental Effects of Lighting Emitting Diode (LED) Community Lighting in its entirety.

> CONCLUSION
>
> Current AMA Policy supports efforts to reduce light pollution. Specific to street lighting, Policy H-135.932 supports the implementation of technologies to reduce glare from roadway lighting. Thus, the Council recommends that communities considering conversion to energy efficient LED street lighting use lower CCT lights that will minimize potential health and environmental effects. The Council previously reviewed the adverse health effects of nighttime lighting and concluded that pervasive use of nighttime lighting disrupts various biological processes, creating potentially harmful health effects related to disability glare and sleep disturbance.

The following is the recommendations stated in the CSAPH Report 2-A-16: Human and Environmental Effects of Lighting Emitting Diode (LED) Community Lighting in its entirety.

> RECOMMENDATIONS
>
> The Council on Science and Public Health recommends that the following statements be adopted, and the remainder of the report filed.
>
> 1. That our American Medical Association (AMA) support the proper conversion to community-based Light Emitting Diode (LED) lighting, which reduces energy consumption and decreases the use of fossil fuels. (New HOD Policy)
>
> 2. That our AMA encourage minimizing and controlling blue-rich environmental lighting by using the lowest emission of blue light possible to reduce glare. (New HOD Policy)

3. That our AMA encourage the use of 3000K or lower lighting for outdoor installations such as roadways. All LED lighting should be properly shielded to minimize glare and detrimental human and environmental effects, and consideration should be given to utilize the ability of LED lighting to be dimmed for off-peak time periods. (New HOD Policy)

The entire AMA report can be found in Appendix I in this Design Guide.

The Department of Energy (DOE) released a statement: Street Lighting, Blue Light, and Light at Night and the DOE has assembled a variety of resources on these topics, to provide accurate, in-depth information to clarify the current state of the scientific understanding. The DOE states that as the Earth's population grows so too will the lighting increase throughout the world. The DOE goes on to say the increase in lighting has sparked a wide-ranging set of concerns about the increase in energy use, light pollution, and the potential health impacts stating the difference between what has and has not been scientifically established is often blurred. DOE states that with the invention of electric lamps came issues such as energy use, environmental impacts, potential health effects in both flora and fauna and sky glow.

The DOE states the following Concerns:

> Concerns have recently surfaced over the rapid conversion to LED technologies in general illumination applications, mostly stemming from the perceived (but typically misunderstood) increased content of short (i.e., "blue") wavelengths that can play important roles in some of the costs noted above. In actuality, the concerns being raised pertain to all broad-spectrum or "white" light sources in use today (interior as well as exterior). A key factor, however, is that the bulk of the incumbent outdoor lighting in the U.S., especially in street and roadway lighting applications, is presently supplied by a narrower-spectrum source (high-pressure sodium – HPS) with considerably lower amounts of short wavelength content. Much of the new concern therefore arises from projected abrupt increases in short wavelength content that could be introduced to the night environment from converting such narrower-band exterior sources to white light LEDs.

The DOE states the following potential of LEDS

> A critical factor often missing in the popular discourse, however, is that LEDs bring numerous attributes to the table in addition to their high energy efficiency and long lifetimes, including an intrinsic ability to engineer their spectral content and inherent compatibility with controls. Combined, these capabilities enable many potential benefits like dimming and dynamic alteration of spectral output: features that no other outdoor lighting technology has offered in any practical sense to date.
>
> LEDs thereby represent a lighting source for the 21st Century. No other lighting technology comes close to their ability to address the seemingly inevitable increases in the myriad costs otherwise coming to our global future; in fact, LEDs and associated controls may be the *only* practical means of addressing them.

The statement by the DOE can be found at the following link. There are a number of topics in the DOE website in the form of additional links the go into greater detail on these topics.

https://www.energy.gov/eere/ssl/street-lighting-blue-light-and-light-night

The Illuminating Engineering Society (IES) issued a statement the same month the AMA report was issued. The IES statement is as follows in its entirety:

> NEW YORK, June 28, 2017 – Last year, the American Medical Association (AMA) announced a Policy that encourages restrictions on the spectral properties of outdoor area and roadway lighting, based on CSAPH Report 2-A-16 from their Council on Science and Public Health. The IES reviewed the report and issued a statement that same month, emphasizing our intent to do a more thorough review of the report and to establish a dialog with the AMA.
>
> After completing our review, we joined with the International Association of Lighting Designers (IALD) and approached the AMA about revisiting the report. A process was put in place to revisit the report with expanded expert input from our organizations, and we worked diligently on this effort for throughout the year. The effort remains a work in progress, but given the current uncertainty of a resolution, the IES Board of Directors issued Position Statement PS-09-17 in response to the AMA Policy and Report.
>
> Our IES/IALD emphasis has been to work toward developing a collaborative process with the AMA Council for the benefit of our constituencies and the general public. Through our discussions with the AMA during this past year, we identified several significant issues within the CSAPH 2-A-16 Report that deserve more careful and comprehensive analysis, and our members have provided review and commentary. The AMA process unfortunately did not allow our organizations or our members to have direct dialog with the AMA Council. The CSAPH will continue deliberations on the topic, but our ability to participate directly in these deliberations remains questionable.
>
> Our IES/IALD organizations have worked together to provide balance and accuracy to the AMA on this important topic. Our responsibility is to comprehensively review the AMA Policy within the context of the applications affected for the benefit of the public: the AMA has published a policy that affects roadway lighting, without including input from those with expertise in roadway lighting; and the AMA policy purports to be directed at health effects due to sleep disruption, but does not address the many various parameters and inputs known to have an equal or greater effect on sleep than spectrum or CCT. The AMA Policy encourages restrictions on spectral quality of light, absent any qualifications for light level or duration of exposure and does not consider the possible positive aspects that spectral content might contribute to vehicular and pedestrian safety. These are positions that the IES Board of Directors enunciates in PS-09-17.
>
> The IES is dedicated to continuing working with the AMA on these issues. In 2012, the AMA adopted Policy H-135.932, noting in particular the “need for further multidisciplinary research of occupational and environmental exposure to light-at-night”, the recognition of how interior lighting and the use of electronic media affect sleep disruption especially in children and adolescents, and

> the need for work environments operating in 24/7 fashion to have employee fatigue risk management plans in place. We believe that these are critical topics to pursue with the AMA, and we hope that through this process of working through the issues with the 2016 AMA report, the IES can find common ground to address these very important concerns.

The IES Board of Directors Position Statement PS-09-17 can be found at the following link:

> https://ies.org/advocacy/ps-09-17/

The International Association of Lighting Designer (IALD) issued a statement on AMA CSAPH Report 2-A-16, Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting. The IALD statement is as follows in its entirety:

> In July 2016, the American Medical Association (AMA) issued a policy statement (AMA Policy H-135.927) recommending spectral and CCT limits on outdoor and roadway lighting. Since the publication of the policy, the IALD has worked with the IES (Illuminating Engineering Society) to persuade the AMA to revisit both the policy statement and the report on which it is based, "Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting" (Report 2-A-16). Specifically, we have been working with the AMA's Council on Science and Public Health, the AMA group that issued the initial report.
>
> On 27 June 2017, the IES issued "Position Statement PS-09-17", which places the organization on record as disagreeing with both the AMA report and the AMA policy statement of 2016 regarding outdoor lighting. The IALD fully supports IES Position Statement PS-09-17.
>
> While we believe that the scientific research cited by the AMA does not support its policy recommendations, we welcome the AMA's interest in the impact of light on human beings. The IALD and the IES will continue our efforts to bring all interested groups together to devise standards and policies that are scientifically sound and environmentally friendly.

This Design Guide reinforces the importance of energy efficiency while maintaining a high standard of human health and environmental wellbeing. The Design Guide supports the further research in understanding the impact of artificial lighting in general and recognizes the expanding role that LED lighting has in the future and understands the expansion of lighting and specifically the expansion that will occur with LED lighting as population grows and LED lighting becomes even more affordable in term of capital cost and the increasing efficiencies being seen by the LED resulting in more and more energy efficient solutions. This will result in the Earth's population as a whole moving toward LED lighting solutions and as such this Design Guide looks forward to future publications from scientific entities furthering the debate and reaching an undisputed conclusion.

Finally, Sernberg Lighting published a paper in an attempt to abbreviate the topics and list in bullet format the central point's being made on each side. This paper is included in this Design Guide and can be found in the Appendix I.

## 2.5 LIGHTING WARRANTS

This Roadway Design Guide is intended to be used for roadway or street lighting projects when and after the roadways or streets have been determined to warrant lighting.

## 2.6 ROCHESTER'S FUNCTIONAL CLASSIFICATIONS

According to the Rochester Comprehensive Plan 2040 Travel patterns and Link Analysis report the ROCOG 2040 Long Range Transportation Plan classifies streets in the region based on intended function and character. This "functional classification" serves as a general street network plan and designates each street role for different types of travel markets. The classification not only identifies the purpose of the street, but it can be used to apply design standards like lighting levels and criteria such as lighting unit spacing guidelines.

The following are the Functional Classifications for Roadways and Streets in the City of Rochester and is taken from the Rochester Comprehensive Plan 2040 Travel patterns and Link Analysis report.

A. Interstate and Interregional Corridors

    1. Description: Serve inter-city, inter-regional, or interstate travel at higher speeds with a high level of continuity to minimize indirection of travel between regional origins and destinations. Serve as primary freight routes, handling movements having trip length and travel density characteristics indicative of substantial statewide or interstate travel.

    2. Examples: Interstate 90, US 52 North of Interstate 90.

    3. IES Classification of Area or Roadway: Freeway.

B. Strategic Arterials

    1. Description: On a regional basis, Strategic Arterials supplement the Interstate/Interregional Corridors by providing connections to smaller cities and other important economic activity centers not on the interregional system. The major function of Strategic Arterials is to provide for the mobility of traffic. Service to abutting land is a secondary concern. The speed limit on Strategic Arterials can range from 30 to 65 mph depending on the land use environment in which they are located. By nature of their size, most small urban areas will not generate internal travel warranting an urban Strategic Arterial network. The Strategic Arterial system for these small urban areas will largely consist of extensions of rural strategic arterials into and through an area. In larger urban areas, Strategic Arterials are of regional importance, carrying high volumes of higher speed traffic, including through traffic, with limited service to abutting land and design characteristics such as medians and limited traffic signalization to enhance traffic flow.

    2. Examples: East and West Circle Drive, 12$^{th}$ Street SE.

3. IES Classification of Area or Roadway: Expressway.

C. Primary Arterials

1. Description: Primary Arterials provide service to trips of moderate length at a somewhat lower level of travel mobility than Interregional Corridors or Strategic Arterials. This system distributes travel to smaller geographic areas than the travel sheds typically associated with the higher order systems. On a regional basis, Primary Arterials serve trip lengths characteristic of intra-county service. Travel served will primarily be between significant traffic generators (either individual uses or concentrations of development) or will be part of a collection function routing travel to higher level routes. Regional Primary Arterials are roadways generally not of statewide importance but of countywide importance. On a regional basis, Primary Arterials should be spaced at such intervals, consistent with population density, that all developed areas of the county are within a reasonable distance of a primary arterial or higher order highway. While Primary Arterials allow for the integration of both local and regional travel, the majority of traffic on the system is not typically low speed local access traffic. Arterials should be managed to provide safe and efficient through movement, while providing some access to abutting lands. On an urban basis, Primary Arterials serve to connect major activity centers of sub-areas not served by higher order streets. Major commercial streets will typically be of a Primary Arterial classification. Arterials are important in providing the “last mile” ling for commuters and freight service to major employment areas within cities. Such facilities will typically carry local bus routes and provide important network connectivity and continuity, but ideally should not penetrate identifiable neighborhoods.

2. Examples: 2nd Street SW, 4th Avenue SW/NW, and 19th Street NW.

3. IES Classification of Area or Roadway: Major.

D. Secondary Arterials

1. Description: Secondary Arterials are similar in function to Primary Arterials but carry lower volumes, serving trips of shorter distances and with a higher degree of property access. Corridors will typically be shorter length routes that serve important mobility functions within urban or regional subareas. Secondary Arterials will improve the connectivity of the overall network on a localized basis and will typically provide access to a mixture of land uses. In non-residential or higher density residential areas, these routes will be important for truck and transit accessibility. They serve secondary traffic generators such as community business centers, neighborhood shopping centers, and multi-family residential areas.

2. Examples: 41st Street NW.

3. IES Classification of Area or Roadway: Major.

E. Primary Collectors.

1. Description: Primary Collector streets typically provide land access and traffic circulation among multiple adjacent residential neighborhoods and within commercial districts and industrial areas. They distribute traffic movements from such areas to the arterial street system and keep local area movements off the major road system. Collectors typically do not accommodate through traffic and are not continuous for any great length. In rural areas, Primary Collectors should be spaced at intervals, consistent with population density, to collect traffic from local roads and bring all developed areas within a reasonable distance of a collector or higher order road. Primary collectors are predominantly two lane roads, with at-grade intersections. Individual access for every lot should be discouraged unless lots are of sufficient frontage to provide adequate spacing between driveways. The cross section of a collector street may vary widely depending on the type, scale, and density of the adjacent land uses. This type of roadway differs from the arterial system in that on-street parking is typically permitted, posted speed limits typically range between 30-35 mph, and traffic volumes typically range between 2,000 and 7,000 vehicles per day. In the central business district, and in other areas of like development and traffic density, the collector system may (and desirably will) include a grid of streets which forms a logical entity for traffic circulation.

2. Examples: 6th Street SW, and Pinewood Road SE

3. IES Classification of Area or Roadway: Collector

F. Local Collectors

1. Description: Local Collectors will primarily serve residential areas, serving to connect adjacent neighborhoods, to deliver residential traffic to neighborhood activity centers and to deliver traffic from local streets to the higher order street network. At the level of local collectors, individual access for every lot is compatible with the function of the street and the street should operate at lower speeds, incorporating as necessary traffic management features to minimize travel speed. While local collectors are designed to discourage through traffic, it is with the understanding that traffic generated in adjacent neighborhoods is not considered through traffic where these neighbor hoods are not divided by a higher order street. Long segments of the continuous local collector streets are not compatible with functional design of the street network. Long Continuous collectors will encourage through traffic, essentially turning them into secondary arterials. Ideally, collectors should be no longer than 1/2 to 3/4 miles without the introduction of discontinuity into the route.

2. Examples: 31st Street/12th Avenue SW, and 20th Street SW.

3. IES Classification of Area or Roadway: Collector.

G. Local Street

1. Description: Although local streets are not included in the city's functional classification system, they are the most prevalent street type in Rochester and are included in this design guide. These streets provide low speed and low volume access to residential neighborhoods but also represent pedestrian and bicycle connections to major destination and off-street multi-use paths. These streets are typically designed to encourage lower speeds and may have numerous intersections that require vehicles to stop.

1. Examples: Viking Drive NW.

2. IES Classification of Area or Roadway: Local.

H. Street with Multiple Classifications

1. Description: A single roadway or street may have multiple classifications in different areas along it. For example, 19th St NW includes both local street and Primary Arterial street classification.

2. Examples: 19th St NW.

3. IES Classification of Area or Roadway: The roadway or street will have multiple IES classifications. For example, Local at the Local Street portion and Major at the Primary Arterial Street portion of the street.

## 2.7 CLASSIFICATION OF AREA OR ROADWAY

The following definition for the classification were taken from the IES RP-8

A. Freeway

Divided Highway with full control of access.

Refer to Table 1 – Recommended Lighting Design Criteria for Roadways (IES RP-8-2014) below for lighting level design guidelines for Freeway type roadways.

B. Expressway

Divided Highway with partial control of access.

Refer to Table 1 – Recommended Lighting Design Criteria for Roadways (IES RP-8-2014) below for lighting level design guidelines for Freeway type roadways.

C. Major

The Major is the part of the roadway system that serves as the principal network for through-traffic flow. The routes connect areas of principal traffic generation and important rural roadways

entering and leaving the City. These routes are often known as arterials, thoroughfares, or preferential. They are sometimes subdivided into primary and secondary; however, such distinctions are not necessary in roadway lighting. These routes primarily serve through traffic and secondarily provide access to abutting property.

Refer to Table 2 – Recommended Lighting Design Criteria for Streets (IES RP-8-2014) for lighting level design guidelines using street classification type Major.

D. Collector

Collectors are a roadway serving traffic between major and local streets. These are streets used mainly for traffic movements within residential, commercial and industrial areas. They do not handle long, through trips. Collector streets may be used for truck or bus movements and give direct service to abutting properties.

Refer to Table 2 – Recommended Lighting Design Criteria for Streets (IES RP-8-2014) for lighting level design guidelines using street classification type Collector.

E. Local

Local Streets are used primarily for direct access to residential, commercial, industrial, or other abutting property. They make up a large percentage of the total street system but carry a small percentage of the vehicular traffic.

Refer to Table 2 – Recommended Lighting Design Criteria for Streets (IES RP-8-2014) for lighting level design guidelines using street classification type Local.

F. Local Residential

Local Residential Streets are used primarily for direct access to residential property. They make up a large percentage of the total street system but carry a small percentage of the vehicular traffic.

Refer to Table 6 – Recommended Lighting Design Criteria for isolated Intersections (IES RP-8-2014) for lighting level design guidelines using the appropriate roadway/street classifications and pedestrian conflict classifications for the lighting levels and uniformity ratios for the intersections and midblock lighting areas.

G. Intersection (Continuously Lighted Streets)

An intersection is a lighted area in which two or more continuously lighted roadways/streets join or cross at the same level. This area includes roadway and roadside facilities for traffic movement in that area. A special type is the channelized intersection, in which traffic is directed into definite paths by islands with raised curbing.

Refer to Table 5 – Recommended Lighting Design Criteria for isolated Intersections (IES RP-8-2014) for lighting level design guidelines using the appropriate roadway/street classifications and pedestrian conflict classifications for the lighting levels and uniformity ratios.

H. Isolated Intersection (Non-Continuously Lighted Streets)

An isolated intersection is a lighted area in which two or more non-continuously lighted roadways join or cross at the same level. This area includes roadway and roadside facilities for traffic movement in that area. A special type is the channelized intersection, in which traffic is directed into definite paths by islands with raised curbing.

Refer to Table 6 – Recommended Lighting Design Criteria for isolated Intersections (IES RP-8-2014) for lighting level design guidelines using the appropriate roadway/street classifications and pedestrian conflict classifications for the lighting levels and uniformity ratios.

I. Roundabout

According to IES DG-19 Roundabout Lighting a roundabout is a type of circular intersection where entering traffic yields to circulating traffic and all traffic is slowed by appropriate geometric features.

Refer to Table 7 – Recommended Lighting Design Criteria for Roundabouts (IES DG-19-2008) for lighting level design guidelines using the appropriate street classifications and pedestrian conflict classifications for the lighting levels and uniformity ratios.

J. Crosswalk

A crosswalk is any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by lines on the surface, which may be supplemented by contrasting pavement texture, style, or color.

Horizontal: Refer to Table 3 – Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014) for lighting level design guidelines using the appropriate pedestrian density level and pedestrian conflict area classifications for the horizontal lighting levels.

Vertical: Refer to Table 3 – Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014) for lighting level design guidelines using the appropriate pedestrian density level and pedestrian conflict area classifications for the vertical lighting levels.

K. Sidewalk

Sidewalks are a paved or otherwise improved area for pedestrian use, located within public street right-of-ways, which also contain roadways for vehicular traffic.

Horizontal: Refer to Table 3 – Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014) for lighting level design guidelines using the appropriate pedestrian density level and pedestrian conflict area classifications for the horizontal lighting levels.

Vertical: Refer to Table 3 – Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014) for lighting level design guidelines using the appropriate pedestrian density level and pedestrian conflict area classifications for the vertical lighting levels.

L. Bikeway

A bikeway is any road, street, path, or way that is specifically designed as being open to bicycle travel, regardless of whether such facilities are designed for exclusive use of bicycles or are to be shared with other transportation modes.

Refer to Table 3 – Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014) for lighting level design guidelines using the appropriate pedestrian density level and pedestrian conflict area classifications for the horizontal lighting levels.

Refer to Table 3 – Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014) for lighting level design guidelines using the appropriate pedestrian density level and pedestrian conflict area classifications for the vertical lighting levels.

Five basic types of facilities are used to accommodate bicyclists:

1. Shared Lane

   Shared lane is a shared motor vehicle/bicycle use of a “standard”-width travel lane.

2. Wide outside Lane

   Wide outside lane is an outside travel lane with a width of at least 4.2 m (13.8 ft.).

3. Bike Lane

   Bike lane is a portion of the roadway designated by striping, signing, and/or pavement markings for preferential or exclusive use of bicycles.

4. Shoulder

   A shoulder is a paved portion of the roadway adjacent to the edge stripe.

5. Separate Bike Path

A sperate bike path is a facility physical separated from the roadway and intended for bicycle use.

# 2.8 TYPES OF LIGHTING SYSTEMS

A. Roadway Lighting

Roadway lighting is provided for freeways, expressways, limited access roadways, and roads on which pedestrians, cyclists, and parked vehicles are generally not present. The primary purpose of roadway lighting is to help the motorist remain on the roadway and help with the detection of obstacles within and beyond the range of the vehicle's headlights.

Roadway Lighting is typically a continuous lighting system where the entire roadway meets the recommended lighting levels.

B. Street Lighting

Street lighting is provided for major, collector, and local streets were pedestrians and cyclists are generally present. The primary purpose of street lighting is to help the motorist identify obstacles, provide adequate visibility of pedestrians and cyclists, and assist in visual search tasks, both on and adjacent to the street.

Street Lighting is typically a continuous lighting system where the entire street meets the recommended lighting levels.

C. Intersection Lighting – Continuously lighted Roadways/Streets

Intersection lighting at continuously lighted roadways/streets is provided for intersections at both roadways/streets. It is important to note that there is an increase in both vehicular conflict and pedestrian conflict at intersection. The primary purpose of Intersection lighting at continuously lighted streets is to help the motorist identify obstacles, provide adequate visibility of pedestrians and cyclists, and assist in visual search tasks, both on and adjacent to the street.

Intersection Lighting is typically provided for the entire intersection and is usually a higher light level than the surrounding roadways/streets.

D. Isolated Intersection Lighting – Non-Continuously lighted Streets

Isolated intersection lighting at non-continuously lighted streets is provided for streets. It is important to note that there is an increase in both vehicular conflict and pedestrian conflict at intersection. The primary purpose of isolated intersection lighting at non-continuously lighted streets is to help the motorist identify obstacles, provide adequate visibility of pedestrians and cyclists, and assist in visual search tasks, both on and adjacent to the street.

Isolated Intersection Lighting is typically provided for the entire intersection. An isolated intersection can be a lower light level than an intersection at a continuously lighting roadway/street.

E. Roundabout Lighting

Roundabout lighting is provided for roundabouts to operate safely and to help the motorist identify the roundabout from a distance and to ensure the conflict areas with both vehicular and pedestrian traffic are visible.

Roundabout lighting systems typically provide lighting for the entire roundabout circle and the immediate approaches paying special attention to the crosswalks and pedestrian conflict areas. Roundabout lighting may also include lighting for extended approach areas to help the motorists identify the roundabout sooner on the approaches.

F. Partial Residential Street Lighting – Intersection lighting and Partially Continuous Lighted Streets

Residential street lighting is provided for residential streets were pedestrians and cyclists are generally present typically at intersections and midblock locations as necessary. The primary purpose of residential street lighting is to help the motorist identify obstacles, provide adequate visibility of pedestrians and cyclists, and assist in visual search tasks, both on and adjacent to the street at conflict areas such as intersection and midblock areas identified as conflict areas and to provide a sense of safety and security in the residential areas.

Partial Residential Street Lighting typically provides isolated intersection lighting and midblock lighting strategically placed between the intersections and usually located on residential property lines. Partial residential street lighting is typically not considered continuous street lighting.

G. Types of lighting subsystems

Lighting subsystems are lighting design techniques that may be applied to the lighting systems described above.

1. Crosswalk Lighting

Crosswalk lighting is provided for midblock crosswalks on streets. The primary purpose of crosswalk lighting is to help the motorist identify pedestrians and cyclists in the crosswalks.

Special care needs to be considered at crosswalks so motorists can identify pedestrians in the crosswalk. It is recommended that lighting is placed at the approach side of the crosswalk and not directly over the crosswalk, so the pedestrians are illuminated to make them visible to the motorists. Horizontal and vertical illumination calculation should be completed at medium and high pedestrian conflict areas.

2. Adaptive Lighting

Adaptive lighting is lighting that can be adjusted based on changing characteristics such as pedestrian conflict levels.

Adaptive lighting may be implemented on projects by dimming LED light fixtures to adjust the light level based on changing classifications levels.

3. Transition Lighting

   Transition Lighting is a section of lighting that is reduced for a section of street between a lighted section and a non-lighted section.

   Luminaire lighting lumen levels may be lower at a transition area to allow the motorist eyes to adjust going from the lighted section to the non-lighted section of roadway/street.

4. Grade Changes and Sharp Curves Lighting

   Grade changes and curves are sections of street/roadways that may require changes to the lighting design to maintain the lighting levels and uniformity.

   Luminaire space may have to be adjusted to account for grade changes or sharp curves

5. Underpass and Overpass Lighting

   Underpass and Overpass Lighting is a section of street/roadway that may require changes to the lighting design to maintain the lighting levels and uniformity due to grade separation in which the street/road goes over/under the intersecting street/road.

   Wall mounted luminaires may be required for underpasses because light from the lighting units may not reach the roadway/street underpass area.

   Lighting unit mounting requirements may need to be changed to account for overpass applications such as bridge mounted lighting units, handhole locations to coordinate with railing so the handhole is located above the railing and is accessible from the road.

6. Railroad Grade Crossing Lighting

   Railroad grade crossing lighting is a section of the street/roadway with a railroad crossing. The main purpose of railroad grade crossing lighting is to provide effective lighting, so the railroad conflict area is visible to the motorist.

   Special lighting levels may be required at railroad grade crossings and approaches to railroad grade crossings.

7. Trees Adjacent to Roadways

   Trees adjacent to roadways may affect the lighting system layout with respect to spacing, mounting heights, pole locations, and bracket arm length. Tree trimming may also be required.

H. Other Lighting Systems Not Included in This Design Manual.

1. High Mast Lighting.

2. Toll Plazas.

## 2.9 CLASSIFICATION OF PEDESTRIAN CONFLICT AREAS

The following definition for the classification were taken from the IES RP-8.

I. High – over 100 Pedestrians Per Hour

Areas with significant numbers of pedestrians expected to be on the sidewalks or crossing the street during darkness. Examples are downtown retail areas, near theaters, concert halls, stadiums, and transit terminals.

J. Medium – 10 to 100 Pedestrians Per Hour

Areas where lesser numbers of pedestrians utilize the streets at night. Examples are downtown office areas, blocks with libraries, apartments, neighborhood shopping, industrial, parks, and streets with transit lines.

K. Low – 9 or Fewer Pedestrians Per Hour

Areas with very low volumes of night pedestrian usage. These can occur in any of the cited roadway classifications. Examples are suburban streets with single family dwellings, very low-density residential developments, and rural or semi-rural areas.

## 2.10 CLASSIFICATION OF ROADWAY SURFACES

The following definition for the classification were taken from the IES RP-8.

Concrete roadway / streets are always Class R1, and most asphalt roadways are Class R2/R3. It should be noted that the IES lighting levels combine types R2/R3 into one category for lighting level guidelines. Most projects are either Class R1, or Class R2/R3 roadway surfaces with Class R4 being rarely used. Lighting design team should confirm the roadway surfaces classification with the roadway design team to confirm the roadway surface classification to be used for each project and each roadway/street.

A. Class R1 – Portland Cement Concrete

R1 roadway surfaces are portland cement concrete road surfaces and are mostly diffuse.

B. Class R2/R3 – Standard Asphalt Road Surfaces

R2 roadway surfaces are asphalt road surfaces with an aggregate comprised of a minimum of 60 percent gravel, or asphalt road surfaces with 10 to 15 percent artificial brightener in aggregate mix and are mixed diffuse and specular.

R3 roadway surfaces are asphalt road surfaces (regular and carpet seal) with dark aggregates and mixed diffuse and specular.

C. Class R4 – Special Purpose Asphalt Road Surfaces

R4 roadway surfaces are special asphalt road surface with very smooth texture and are mostly specular.

## 2.11 MINNESOTA ENERGY LAW

The following was taken from the Minnesota Statutes 216C.19 ENERGY CONSERVATION.

Subdivision 1. Roadway lighting; rules.

After consultation with the commissioner and the commissioner of public safety, the commissioner of transportation shall adopt rules under chapter 14 establishing minimum energy efficiency standards for street, highway, and parking lot lighting. The standards must be consistent with overall protection of the public health, safety, and welfare. No new highway, street, or parking lot lighting may be installed in violation of these rules. Existing lighting equipment, excluding roadway sign lighting, with lamps with initial efficiencies less than 70 lumens per watt must be replaced when worn out with light sources using lamps with initial efficiencies of at least 70 lumens per watt.

# 3.0 LIGHTING EQUIPMENT

## 3.1 OVERVIEW

The following will identify the lighting equipment used by the City of Rochester. The lighting equipment that will be identified will include the Lamps, Luminaires, Ballasts, Drivers, Service Cabinets, Poles, Light Bases (Concrete Foundation), Equipment Pads, and information related to Selection of the Lighting Equipment.

## 3.2 LAMPS

A lamp is the artificial light source that is inside the luminaire. The following are the lamps used by the City of Rochester in the existing infrastructure and the new lamps to be selected from for redevelopment or development.

A. Existing Lamps in the City of Rochester

   1. High Intensity Discharge Lamps (HID)

      a. 100 Watt High Pressure Sodium (HPS).

      b. 250 Watt High Pressure Sodium (HPS).

      c. 400 Watt High Pressure Sodium (HPS).

      d. 175 Watt Metal Halide (MH).

      e. 250 Watt Metal Halide (MH).

   2. Light-emitting Diode Lamps (LED)

      a. Multiple variation of LED lamps varying in both lumen output and Wattage.

B. New Lamps in the City of Rochester shall be selected from the following:

   1. Multiple variations of LED lamps varying in both lumen output and Wattage. The lumen outputs and Wattages are identified in the Luminaire section.

## 3.3 LUMINAIRES

A luminaire according to IES RP-8 is a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps and to connect the lamps to the power supply. Sometimes these include ballasts and photocells.

The following are the typical luminaires used by the City of Rochester in the existing infrastructure and the new luminaires to be selected from for redevelopment or development. The City of Rochester reserves the right to add or remove lighting units to this approved products list.

A. Existing Luminaires in the City of Rochester

    1. Multiple variations of High Intensity Discharge Lamps (HID)

        a. Holophane RS2L (100W HPS),

        b. Wesco OVX (400W HPS),

        c. Eeaton OVZ (250W HPS).

        d. Kim Lighting SRS1-HID.

        e. MnDOT Standard Cobra Head.

    2. Multiple variations of Light-emitting Diode (LED)

        a. BetaCREE LWY.

        b. Cree (BetaLED) ARE-EDG.

        c. GE ERS2.

        d. GE ERMC.

        e. Holophane LEDG.

B. City of Rochester Approved Products List for New Luminaires:

1. Light Emitting Diode (LED) Luminaire for Roadway/Street Lighting Applications

a. Luminaire for Non- Residential Applications:

1) Philips RoadFocus:
RFM-108W48LED3K-T-[R2M-R3M]-UNV-DMG-RCD7-SP2-GY3
   a) 108W48LED4K: 108 Watt, 3000K, 10,965 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   b) [R2M-R3M]: Type 2 Medium, or Type 3 Medium as required.
   c) UNIV: Universal Voltage120-277VAC.
   d) DMG: Dimmable driver 0-10V.
   e) RCD7, 7-pin Twist-Lock Receptacle.
   f) SP2: 20kV / 20kA Surge Protector.
   g) GY3: Color shall be gray.

2) American Electric Lighting Autobahn Series ATBM:
ATBM-D-MVOLT-[R2-R3]-3B-NL-P7-20-DM
   a) D: 95 Watt, 3000K, 11,769 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   b) MVOLT: Universal Voltage120-277VAC.
   c) [R2-R3]: Type 2, or Type 3 as required.
   d) 4B: 4 Bolt Mounting.
   e) NL: Nema Label.
   f) P7, 7-pin Twist-Lock Receptacle.
   g) 20: 20kV / 10kA Surge Protector.
   h) DM: Dimmable driver 0-10V.
   i) (Blank) Color shall be gray.

3) Cooper Eaton Lighting: Verd Verdeon:
VERD-GA028-D-U-[T2-T3]-3N7-10K-4B-AP
   a) GA028: 103 Watt, 3000K, 12,064 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   b) D: Dimmable driver 0-10V.
   c) U: Universal Voltage120-277VAC.
   d) [T2-T3]: Type 2 Medium, or Type 3 Medium as required.
   e) 4N7, 7-pin Twist-Lock Receptacle.
   f) 10K: 10kV UL 1449 Surge Protective Device.
   g) 4B: 4 Bolt Mounting.
   h) AP: Color shall be gray.

4) GE Lighting Evolve:
   ERLH-0-10-[B3-C3]-30-D-GRAY-A-I-R
   a) 0: Universal Voltage120-277VAC.
   b) 10: 82 Watt, 3000K, 10,000 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   c) [B3-C3]: Type 2 Medium, or Type 3 Medium as required.
   d) 40: 3000K.
   e) D, 7-pin Twist-Lock Receptacle with Shorting Cap.
   f) GRAY: Color shall be gray.
   g) A: 4 Bolt Mounting.
   h) I: IP66 Optical.
   i) R: 10kV / 5kA Surge Protective Device.
   j) (Blank): Dimmable driver 0-10V.

b. Luminaire for Residential Applications:

1) Philips RoadFocus:
   RFM-72W32LED3K-T-[R2M-R3M]-UNV-DMG-RCD7-SP2-GY3
   a) 72W32LED4K: 73 Watt, 3000K, 7,042 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   b) [R2M-R3M]: Type 2 Medium, or Type 3 Medium as required.
   c) UNIV: Universal Voltage120-277VAC.
   d) DMG: Dimmable driver 0-10V.
   e) RCD7, 7-pin Twist-Lock Receptacle.
   f) SP2: 20kV / 20kA Surge Protector.
   g) GY3: Color shall be gray.

2) American Electric Lighting Autobahn Series ATBM:
   ATBM-3K-B-MVOLT-[R2-R3]-4B-NL-P7-20-DM
   a) 3K: 3000K.
   b) B: 70 Watt, 8,090 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   c) MVOLT: Universal Voltage120-277VAC.
   d) [R2-R3]: Type 2, or Type 3 as required.
   e) 4B: 4 Bolt Mounting.
   f) NL: Nema Label.
   g) P7, 7-pin Twist-Lock Receptacle.
   h) 20: 20kV / 10kA Surge Protector.
   i) DM: Dimmable driver 0-10V.
   j) (Blank) Color shall be gray.

3) Cooper Eaton Lighting: Verd Verdeon:
VERD-7030-A028-D-U-[T2-T3]-4N7-10K-4B-AP
   a) 7030: 70 CRI, 3000K.
   b) A028: 72 Watt, 7,858 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   c) D: Dimmable driver 0-10V.
   d) U: Universal Voltage120-277VAC.
   e) [T2-T3]: Type 2 Medium, or Type 3 Medium as required.
   f) 4N7, 7-pin Twist-Lock Receptacle.
   g) 10K: 10kV UL 1449 Surge Protective Device.
   h) 4B: 4 Bolt Mounting.
   i) AP: Color shall be gray.

4) GE Lighting: Evolve:
ERL1-0-8-[B3-C3]-30-D-GRAY-A-I-R
   a) 0: Universal Voltage120-277VAC
   b) 8: 71 Watt, 3000K, 8,000 Lumens (Lumen output may need to be adjusted to meet recommended lighting levels).
   c) [B3-C3]: Type 2 Medium, or Type 3 Medium as required.
   d) 30: 3000K.
   e) D, 7-pin Twist-Lock Receptacle with Shorting Cap.
   f) GRAY: Color shall be gray.
   g) A: 4 Bolt Mounting.
   h) I: IP66 Optical.
   i) R: 10kV / 5kA Surge Protective Device.
   j) (Blank): Dimmable driver 0-10V.

2. LED Luminaire for Roadway/Street Lighting Underpass Applications

   a. Luminaire for Non- Residential and Residential Applications:

      1) Cooper, Eaton Lighting (With Bird Spikes):
      XNV2-AF-02-D-U-SL3-10K-800-4N7-IP66-WM-AP.
         a) AF: Light Engine Version AF.
         b) 02: Number of Light Squares shall be 2.
         c) 85 Watt, 3000K, 9,294 Lumens.
         d) D: Dimmable Driver 0-10V.
         e) U: Universal Voltage 120-277VAC.
         f) D: Dimmable driver 0-10V.
         g) U: Universal Voltage120-277VAC.
         h) SL4: Type IV with Spill Control.
         i) 10K: 10kV Surge Protective Device.
         j) 800: Drive Current Set to Nominal 800mA.
         k) 4N7, 7-pin Twist-Lock Receptacle.
         l) IP66: IP66 Rated.
         m) WM: Wall Mounted.
         n) AP: Color shall be gray.

2) Lithonia, D-Series (With Bird Spikes):
DSXW2-LED-30C-1000-30K-TFTM-MVOLT-PER7-BBW-SC-BSW-U
   a) 30C: 30 LEDs, 71 Watts, 11,121 Lumens.
   b) 1000: 1000 mA Drive Current.
   c) 30K: 3000K.
   d) TFTM: Forward Throw Medium.
   e) MVOLT: Universal Voltage 120-277VAC.
   f) PER7: 7-pin Twist-Lock Receptacle.
   g) BBW: Surface Mounted Back Box.
   h) SC: Shorting Cap.
   i) BSW-U, Bird Deterrent Spikes.
   j) Color shall be gray.

3. LED Luminaire for Street Side Pedestrian Lighting Applications

   a. New Applications:

      1) Kim Lighting:
      PT-SRS1-H5-E35-60L-3K-120-BL-DIM
         a) PT: Pipe Tennon Mounting for Poles.
         b) SRS1: Housing Size 1.
         c) H5: IES Type 5 Distribution.
         d) E35: 350mA Driver Current.
         e) 60L: 60 LED's, 67 Watt, 3000K, 3,972 Lumens.
         f) 3K: 3000K Color Temperature.
         g) 120: 120 Volts.
         h) BL: Color Shall be Black.
         i) DIM: 0-10V Dimmable Driver.

   b. Retrofit Applications: Kim Lighting SRS-LED-KIT

      1) Kim Lighting:
      SRS1-LED-KIT-5-60L-3K-120
         a) SRS1-LED-KIT: Upgrade Kit.
         b) 5: IES Type 5 Distribution.
         c) 60L: 60 LED's, 67 Watt, 3000K, 3,972 Lumens.
         d) 3K: 3000K Color Temperature.
         e) 120: 120 Volts.
         f) DIM: 0-10V Dimmable Driver.

C. City of Rochester Specifications

   1. Light Emitting Diode (LED) Luminaire for Roadway/Street Lighting

      a. LISTING REQUIREMENTS

         1) The Luminaire shall be listed by a National Recognized Testing Laboratory (NRTL) as defined by the U.S. Department of Labor. The testing laboratory must be listed by OSHA in its scope of recognition for the applicable tests being conducted as required by this specification. A list of recognized testing labs for products sold in the United States may be found on the U.S. Department of Labor's web site:

2) The Luminaire shall be listed and labeled by a NRTL as being in compliance with UL 1598 and suitable for use in wet locations.

3) Light source and drivers shall be RoHS compliant.

4) Shall have an International Electrotechnical Commission (IEC) 529 Ingress Protection (IP) rating of IP 66 or greater for the optical assemblies of the luminaire.

5) Shall be in compliance with Electro Magnetic Interference (EMI) requirements as defined by FCC Title 47 CFR, Chapter 1, Subchapter A, Part 15, Subparts A and B.

6) Shall be tested according to the most current version of Illuminating Engineering Society of North America (IESNA) LM-79 See section 6 below.

7) Shall have lumen maintenance measured in accordance the most current version of Illuminating Engineering Society of North America (IESNA) LM-80.

8) Shall have long term lumen maintenance documented according to the most current version of Illuminating Engineering Society of North America (IESNA) TM-21 See section 6 below.

9) Shall have LM-79, LM-80 and In-situ temperature testing conducted by U.S. Department of Energy Lighting Facts Program LED Lighting Facts approved testing laboratories.

10) Shall meet the light level performance guidelines of this specification.

b. HOUSING:

1) Shall have an aluminum housing.

2) Shall be painted gray.

3) All hardware on the exterior of the housing including cover and latch shall be stainless steel, zinc or steel with zinc alloy electroplate and chromate topcoat.

4) Shall be easy to open when properly mounted.

5) Shall be easy to open when sitting on its top side when placed on the ground.

6) Shall have readily accessible internal parts.

7) Shall have provisions for a 4-bolt slip fitter type mounting on nominal 2 inch (2 3/8 OD) pipe (tenon) brackets.

    a) Pole tenon clamping assembly must be internal to the luminaire housing.

8) Slip fitter mount shall allow 4 inches of the pole bracket to be inserted in the luminaire mounting assembly.

    a) The mounting assembly shall permit any necessary adjustment to orient the luminaire with the roadway for proper light distribution.

9) Shall have a clamping assembly with 4 bolts for securing the assembly to the light pole.

10) Shall not weigh more than 40 pounds when fully assembled.

11) Shall have an effective projected area of no more than 1.5 square feet (when viewed from either side or either end).

12) Shall be compliant with American National Standard (ANSI) IEE0 C136.31, Table 2 Roadway Lighting Equipment -Luminaire Vibration for both normal applications and bridge and overpass applications.

13) Shall have area on the top of the housing to allow for a level to be used for proper orientation of the Luminaire.

14) Shall have a 7 pin photocontrol receptacle in full compliance with ANSI C136.41-2013 “For Roadway and Area Lighting Equipment-Dimming Control an External Locking Type Photocontrol and Ballast or Driver”

    a) Shall be rotatable up to 359 degrees.
    b) Rotation of the receptacle in 90 degree increments is an acceptable alternative
    c) Housing shall provide a stop to prevent the internal twisting of wire assemblies resulting in potential electrical shorts.
    d) Shall be fully wired.
    e) Shall have a rain tight twist lock shorting cap.
    f) Shall allow the luminaire to turn on and off using a single photocell at the lighting service cabinet when a shorting cap is installed in the luminaire.
    g) Shall allow a simple replacement of the shorting cap with a smart photocontrol to enable dimming and performance monitoring of the luminaire.

15) Housing shall be designed to allow water shedding.

16) Passive cooling method shall be employed to manage thermal output of LED light engine and power supply.

17) Shall have a label that states operating voltage and current range.

18) The label must be clearly visible on the inside of the housing.

c. ELECTRICAL:

1) Shall fully operate in a temperature range -40º C to 40° C (-40º F to 104 º F).

2) AC line input power as follows:

   a) Non-Residential shall be 108 watts.
   b) Residential shall be 70 watts.

3) Shall have an integral power supply (electronic driver).

4) Shall have a power supply (electronic driver) that will operate within the following voltage range options: (120 to 277 VAC (rms)) ±10% at 60 hertz.

5) Shall have a power supply (electronic driver) that has a power factor of .90 or greater at full load.

6) Shall have a power supply (electronic driver) that has total harmonic distortion of 20 percent or less at full load.

7) Shall have a power supply (electronic driver) that has 0 to 10 volts dimming.

   a) Shall be in compliance with IEC 60929, Annex E, “Control Interface for Controllable Ballasts”.
   b) Open circuit (floating) dimming (violet & gray) conductors will force 0 percent dimming. The driver will provide 100 percent current on the outputs.
   c) 1 VDC applied to the dimming circuit will provide 10 percent current out of the driver.
   d) 10 VDC applied to the dimming circuit will provide 100 percent current out of the driver.
   e) See Section 2 photocontrol receptacle for additional information.

8) Shall have power supply (electronic driver) with a rated life of 100,000 hours with a luminaire operated at an ambient temperature of 25 degrees C (77 degrees F).

9) Shall have a power supply (electronic driver) that has thermal overload protection.

10) Shall have a power supply (electronic driver) that is self-limited short circuit protected and overload protected.

11) Shall have a power supply (electronic driver) that is NRTL certified for use in dry or damp locations when installed inside an electrical enclosure.

12) Shall have a power supply (electronic driver) that is terminated with quick disconnect wire harnesses for easy maintenance. Wire nut termination is not acceptable.

13) Shall have a terminal block for terminating pole wiring to the Luminaire. The terminal block shall be a 3 station, tunnel lug terminal board that will accommodate #6 thru #18 AWG pole wire.

14) The luminaire shall have an integral electrical transient suppressor meeting the following requirements.

a) The electrical environment shall be defined by ANSI/IEEE standard C62.41.1™-2002 " IEEE Guide on the surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits" or the most current version.
b) In accordance with ANSI/IEEE standard C62.41.2™-2002 "IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits" (or the most current version of the specification) the luminaire will be in a Category C High exposure environment.
c) Scenario 2 (Direct lightning flash).
d) Testing wave forms shall be in accordance with Table 1 standard and additional testing waveforms.
e) Surge test waveforms shall be characterized in accordance with IEEE C62.41-1 ™ -2002 or the most current version.
f) Location Category C
g) Outside, service entrance and equipment.
h) Shall be tested in accordance with IEEE C62.45™- 2002 "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits" or the most current version.
i) Scenario 2 (Direct Lightning flash).
j) Testing wave forms shall be in accordance with Table 1 standard and additional testing waveforms.
k) Shall be a 3 wire device providing protection from Line to Ground, Line to Neutral and Neutral – Ground.
l) The transient suppressor is not required to be RoHS compliant.
m) The transient suppressor shall be a NRTL listed or recognized and labeled in accordance with the most current edition of UL 1449.
n) Fusing shall not be used to achieve required suppression levels.

d. LED PERFORMANCE REQUIREMENTS:

1) Shall have a minimum Luminaire efficacy of 70 lumens/watt.

2) Shall meet the Chromaticity requirements as follows:

a) The standard color for the LED Luminaire shall be White. The colors shall conform to the following:
- color regions based on the 1931 CIE chromaticity diagram.

b) Nominal Correlated Color Temperature shall be:
- Non-Residential shall be 3000K.
- Residential shall be 3000K.

3) Shall have a minimum Color Rendering Index (CRI) of 70.

4) Chromaticity as stated above must be confirmed by an Independent or certified test lab or shown on the LM 79 test report.

e. OPTICAL REQUIREMENTS:

1) Shall have a completely sealed optical system.

2) Shall have a (IEC) (IP) rating of 66 or greater

3) Shall have an Illuminating Engineering Society of North America (IESNA) Backlight, Uplight and Glare (BUG) rating as follows:

   a) Backlight rating shall not exceed 3.
   b) Uplight rating shall not exceed 0.
   c) Glare rating shall not exceed 3.

4) Shall have a light distribution pattern at the road surface that has an evenly dispersed appearance.

5) Shall not have a perceptible light level flicker to the unaided eye over the voltage range as specified.

6) Shall provide independent test laboratories IES photometrics which verify light levels.

7) Product submittal shall be accompanied by IES TM-21 compliant test reports from a CALiPER qualified or NVLAP accredited testing laboratory for the specific model being submitted.

f. LUMINAIRE PERFORMANCE:

1) Luminaire performance shall be required to meet the guidelines of the City of Rochester standard plans including meeting the lighting average foot-candle and uniformity guidelines.

2) Option 1: Component Performance

   Under this compliance path, the manufacturer must submit calculations per TM-21 predicting lumen maintenance at the luminaire level using In Situ Temperature Measurement Testing (ISTMT) and LM-80 data. To be eligible for the Component Performance option, ALL the conditions below must be met. If any of the conditions are not met, the component performance option may not be used, and the applicant must use Option 2 for compliance.

   a) The LED light source(s) have been tested according to LM-80.
   b) The LED drive current specified by the luminaire manufacturer is less than or equal to the drive current specified in the LM-80 test report.
   c) The LED light source(s) manufacturer prescribes/indicates a temperature measurement point (TS) on the light source(s).
   d) The TS is accessible to allow temporary attachment of a thermocouple for measurement of in situ temperature. Access via a temporary hole in the housing, tightly resealed during testing with putty or other flexible sealant is allowable.
   e) For the hottest LED light source in the luminaire, the temperature measured at the TS during ISTMT is less than or equal to the temperature specified in the LM-80

test report for the corresponding drive current or higher, within the manufacturer's specified operating current range.

f) The ISTMT laboratory must be approved by OSHA as a Nationally Recognized Testing Lab (NRTL), must be qualified, verified, and recognized through DOE's CALiPER program, or must be recognized through UL's Data Acceptance Program.

g) The ISTMT must be conducted with the luminaire installed in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires), with bird-fouling appropriately simulated (and documented by photograph) as determined by the manufacturer.

3) Option 2: Luminaire Performance

Under this compliance path, the applicant must submit TM-21 calculations based on LM-79 photometric test data for no less than three samples of the entire luminaire.

a) Duration of operation and interval between photometric tests shall conform to the TM-21 criteria for LED light sources. For example, testing solely at 0 and 6000 hours of operation would not be adequate for the purposes of extrapolation.

b) Between LM-79 tests, the luminaire test samples must be operated long-term in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires).

c) The test laboratory must hold NVLAP accreditation for the LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy (DOE)'s CALiPER program.

d) The extent of allowable extrapolation (either 5.5 or 6 times the test duration) depends on the total number of LED light sources (no less than 10 and preferably more than 19) installed in the luminaire samples, as per TM-21.

4) Under either compliance path option 1 or 2 above, values used for extrapolation shall be summarized per TM-21 Tables 1 and 2 at 25C degrees C (77 degrees F). Submitted values for lumen maintenance lifetime and the associated percentage lumen maintenance shall be "reported" rather than "projected" as defined by TM-21. Supporting diagrams are required to facilitate interpretation.

g. WARRANTY:

1) The entire Luminaire assembly including material, workmanship, photometrics, labor, power supply and LED modules shall have a minimum of ten (10) year warranty from the date of installation.

2) If more than 10 percent of the individual LED's fail within the warranty period, the luminaire must be repaired or replaced.

3) The City will remove the unit from the field and ship it to the manufacturer for repair or replacement.

4) Shall have a 10-year warranty on the paint finish.

h. MINIMUM REQUIRED SUBMITTALS FOR PRE-APPROVAL:

1) Luminaire specification sheet.

2) LED driver specification sheet.

3) LM-79 Luminaire photometric report.

4) The vendor must submit LM-79 in-situ test data to confirm thermal operating temperatures of the luminaire.

   a) Supplied in-situ test data must include thermal measurements from the worst case (hottest) thermal test point on the electronic driver (power supply).

5) LM-80 Lumen maintenance report.

6) TM-21 calculations as defined in section 6.

7) Backlight, Uplight, Glare (BUG) rating of the luminaire.

8) Computer generated point by point photometric analysis using AGI 32 or Visual lighting design software.

9) A complete certified test lab report that shows the electrical transient suppression meets the requirements as set forth in this specification.

10) Written product warranty.

11) Independent test lab IES photometric reports.

   a) Including IES electronic file.

12) IES chromaticity data from an LED Lighting Facts approved testing laboratory.

13) Instructions for installation and maintenance.

14) As part of the submittal process when a manufacturer submits a luminaire for pre-approval a Microsoft Word version of the LED luminaire specification will be provided to the manufacturer. On each line of the provided LED luminaire specification the manufacturer must identify in writing where and on which manufacturer submitted documents the item in the specification is shown to be in compliance.

i. ACCEPTANCE TESTING:

1) Luminaire will be reviewed against each item listed on this specification. If the fixture is not in compliance with each item on this specification it will not be placed on the Lighting Approved Products List.

2) Shall be installed by the city on a pole to verify light levels and light pattern.

3) The City of Rochester will verify light levels using the independent test laboratories photometrics.

4) The City of Rochester reserves the right to perform random sample testing on all shipments at its own expense. Random sample testing will be completed within 60 days, and as soon as possible, after delivery. City of Rochester shall determine the sampling parameters to be used for the random testing. If the units tested fail random testing the units will be removed from the Approved Products list for Lighting.

5) Once the Luminaire has been placed on the City of Rochester Approved Products List for Lighting no substitution of materials will be allowed unless the manufacturer has received written permission in advance from the City of Rochester allowing the substitution.

6) The City of Rochester must be notified of any change to the catalog number. This notification must include the reason for the change in catalog number. Failure to meet this requirement may cause the luminaire to be eliminated from the Approved Products List.

2. (LED) Luminaire for Roadway/Street Lighting Underpass Applications

a. LISTING REQUIREMENTS

1) The Luminaire shall be listed by a National Recognized Testing Laboratory (NRTL) as defined by the U.S. Department of Labor. The testing laboratory must be listed by OSHA in its scope of recognition for the applicable tests being conducted as required by this specification. A list of recognized testing labs for products sold in the United States may be found on the U.S. Department of Labor's web site:

2) The Luminaire shall be listed and labeled by a NRTL as being in compliance with UL 1598 and suitable for use in wet locations

3) Light source and drivers shall be RoHS compliant.

4) Shall have an International Electrotechnical Commission (IEC) 529 Ingress Protection (IP) rating of IP 66 or greater for the optical assemblies of the luminaire.

5) Shall be in compliance with Electro Magnetic Interference (EMI) requirements as defined by FCC Title 47 CFR, Chapter 1, Subchapter A, Part 15, Subparts A and B.

6) Shall be tested according to the most current version of Illuminating Engineering Society of North America (IESNA) LM-79 See section 6 below.

7) Shall have lumen maintenance measured in accordance the most current version of Illuminating Engineering Society of North America (IESNA) LM-80.

8) Shall have long term lumen maintenance documented according to the most current version of Illuminating Engineering Society of North America (IESNA) TM-21 See section 6 below.

9) Shall have LM-79, LM-80 and In-situ temperature testing conducted by U.S. Department of Energy Lighting Facts Program LED Lighting Facts approved testing laboratories.

10) Shall meet the light level performance guidelines of this specification.

b. HOUSING:

1) Shall have an aluminum housing.

2) Shall be anodized to increase corrosion resistance.

3) All hardware on the exterior of the housing including cover and latch shall be stainless steel, zinc or steel with zinc alloy electroplate and chromate topcoat.

4) Shall be easy to open when properly mounted.

5) Shall have readily accessible internal parts.

6) Shall not weigh more than 30 pounds when fully assembled.

7) Shall have an effective projected area of no more than 1.4 square feet (when viewed from either side or either end).

8) Shall be compliant with American National Standard (ANSI) IEEE C136.31, Table 2 Roadway Lighting Equipment -Luminaire Vibration for both normal applications and bridge and overpass applications.

9) Shall have area on the top of the housing to allow for a level to be used for proper orientation of the Luminaire.

10) Shall have a 7 pin photocontrol receptacle in full compliance with ANSI C136.41-2013 “For Roadway and Area Lighting Equipment-Dimming Control an External Locking Type Photocontrol and Ballast or Driver”

a) Shall be rotatable up to 359 degrees.
b) Housing shall provide a stop to prevent the internal twisting of wire assemblies resulting in potential electrical shorts.
c) Shall be fully wired.

d) Shall have a rain tight twist lock shorting cap.
e) Shall allow the luminaire to turn on and off using a single photocell at the lighting service cabinet when a shorting cap is installed in the luminaire.
f) Shall allow a simple replacement of the shorting cap with a smart photocontrol to enable dimming and performance monitoring of the luminaire.

11) Shall support installation of an Electronic Control Module (ECM) for dimming and luminaire performance monitoring.

12) Housing shall be designed to allow water shedding.

13) Passive cooling method shall be employed to manage thermal output of LED light engine and power supply.

14) Shall have a label that states operating voltage and current range.

a) The label must be clearly visible on the inside of the housing.

15) Shall have a replaceable fuse.

a) Shall be fused as shown in section 3 Figure A below.

16) Shall have an anodized aluminum or stainless steel mounting bracket with stainless steel hardware when required to properly mount and aim the luminaire.

17) Shall have bird spikes to prevent bird nesting on the top of the luminaire.

c. ELECTRICAL:

1) Shall fully operate in a temperature range -40º C to 40° C (-40º F to 104º F).

2) AC line input power of 150 watts maximum.

3) Shall have an integral power supply (electronic driver).

4) Shall have a power supply (electronic driver) that will operate within the following voltage range options: (120 to 277 VAC (rms)) ±10% at 60 hertz.

5) Shall have a power supply (electronic driver) that has a power factor of .90 or greater at full load.

6) Shall have a power supply (electronic driver) that has total harmonic distortion of 20% or less at full load.

7) Shall have a power supply (electronic driver) that has 0 to 10 volts dimming.

a) Shall be in compliance with IEC 60929, Annex E, “Control Interface for Controllable Ballasts”.
b) Open circuit (floating) dimming (violet & gray) conductors will force 0 percent dimming. The driver will provide 100 percent current on the outputs.

c) VDC applied to the dimming circuit will provide 10 percent current out of the driver.
d) VDC applied to the dimming circuit will provide 100 percent current out of the driver.

8) Shall have power supply (electronic driver) with a rated life of 100,000 hours with a luminaire operated at an ambient temperature of 25 degrees C (77 degreesF).

9) Shall have a power supply (electronic driver) that has thermal overload protection.

10) Shall have a power supply (electronic driver) that is self-limited short circuit protected and overload protected.

11) Shall have a power supply (electronic driver) that is NRTL certified for use in dry or damp locations when installed inside an electrical enclosure.

12) Shall have a power supply (electronic driver) that is terminated with quick disconnect wire harnesses for easy maintenance. Wire nut termination is not acceptable.

13) Shall have one of the following methods for terminating the luminaire conductors to the source of power conductors:

a) A terminal block for terminating wiring to the Luminaire. The terminal block shall be a 3 station, tunnel lug terminal board that will accommodate #6 thru #18 AWG wire.
b) Pigtail conductors which would allow wire nut connections in the junction box for #6 thru #18 AWG wire.

14) The luminaire shall have an integral electrical transient suppressor meeting the following requirements.

a) The electrical environment shall be defined by ANSI/IEEE standard C62.41.1™-2002 " IEEE Guide on the surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits" or the most current version.
b) In accordance with ANSI/IEEE standard C62.41.2™-2002 "IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits" (or the most current version of the specification) the luminaire will be in a Category C High exposure environment.
c) Scenario 2 (Direct lightning flash)
d) Testing wave forms shall be in accordance with Table 1 standard and additional testing waveforms.
e) Surge test waveforms shall be characterized in accordance with IEEE C62.41-1 ™ -2002 or the most current version.
f) Location Category C
g) Outside, service entrance and equipment.
h) Shall be tested in accordance with IEEE C62.45™- 2002 "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits" or the most current version.
i) Scenario 2 (Direct Lightning flash)
j) Testing wave forms shall be in accordance with Table 1 standard and additional testing waveforms.

k) Shall be a 3 wire device providing protection from Line to Ground, Line to Neutral and Neutral – Ground.
l) The transient suppressor is not required to be RoHS compliant.
m) The transient suppressor shall be a NRTL listed or recognized and labeled in accordance with the most current edition of UL 1449.
n) Fusing shall not be used to achieve required suppression levels.

d. LED PERFORMANCE REQUIREMENTS:

1) Shall have a minimum Luminaire efficacy of 70 lumens/watt.

2) Shall meet the Chromaticity requirements as follows:

a) The standard color for the LED Luminaire shall be White. The colors shall conform to the following color regions based on the 1931 CIE chromaticity diagram.
b) Nominal Correlated Color Temperature CCT = 3000K.
c) Shall have a minimum Color Rendering Index (CRI) of 70.

3) Chromaticity as stated above must be confirmed by an Independent or certified test lab or shown on the LM 79 test report.

e. OPTICAL REQUIREMENTS:

1) Shall have a completely sealed optical system.

a) Shall have a (IEC) (IP) rating of 65 or greater.

2) Shall have an Illuminating Engineering Society of North America (IESNA) Backlight, Uplight and Glare (BUG) rating as follows:

a) Backlight rating shall not exceed 3.
b) Uplight rating shall not exceed 2.
c) Glare rating shall not exceed 3.

3) Shall have a light distribution pattern at the road surface that has an evenly dispersed appearance.

4) Shall not have a perceptible light level flicker to the unaided eye over the voltage range as specified.

5) An LED replacement for a 250 Watt HPS wall mounted underpass luminaire shall meet the required light levels at the following mounting and setback requirements when:

a) It would be mounted at a height of 17 ft.
b) It would be mounted on one side of the roadway (wall mounted).
c) It would light 3 lanes that are each twelve feet wide.
d) It would have a 20 foot set back from the right lane fog line (right edge of driving lane).
e) It shall illuminate a rectangular area 36 feet (three lanes each 12 feet wide) by 50 feet long. See figure 1 below.

f) No light from luminaires placed on the opposite side of the roadway shall be included in any light level calculations.
g) Using ANSI/IES RP8-00, American National Standard Practice for Roadway Lighting.

6) With the mounting requirements stated above the lighting unit shall provide light levels as follows:

   a) Shall have average maintained horizontal illuminance in the range of 0.8 to 1.1-foot candles using a roadway classification of R2 & R3. These light levels must be documented using AGI 32 or Visual Lighting design software utilizing a Light Loss Factor (LLF) as defined below:
   b) Calculations shall be for maintained values (Light Loss Factor (LLF) < 1.0.) where: LLF = LLD X LDD
   c) Lamp Lumen Depreciation Factor (LLD) shall be the specified percentage of LED lumen maintenance at 70,000 hours at 25C degrees C (77 degrees F) from the TM-21 report.
   d) Luminaire Dirt Depreciation (LDD) = .9.

7) The TM-21 Report must show the drive current used for the submitted luminaire. The report can show a larger drive current to represent a worst case scenario.

8) The Lumen Maintenance Life L70 from the TM-21 Report must not be below 70% at 70,000 hours at 25C degrees C (77 degrees F).

9) Shall have a maximum average to minimum uniformity of 4.00:1.

10) The luminaire shall meet the required veiling luminance values at the following mounting and setback requirements when:

    a) It would be mounted at a height of 17 ft.
    b) It would be mounted on one side of the roadway.
    c) It would light 3 lanes that are each twelve feet wide.
    d) It would have a 20-foot set back from the right lane fog line (right edge of driving lane).
    e) It would be mounted on a davit extending 0 feet from the pole towards the roadway.
    f) It would be mounted on poles spaced at 50 feet.
    g) Using ANSI/IES RP8-00, American National Standard Practice for Roadway Lighting.

11) Shall have a maximum allowed veiling luminance ratio (LV(max)) / (L(avg)) of ≤ 0.34:1.

12) Shall provide independent test laboratories IES photometrics which verify light levels.

13) Product submittal shall be accompanied by IES TM-21 compliant test reports from a CALiPER qualified or NVLAP accredited testing laboratory for the specific model being submitted.

f. LUMINAIRE PERFORMANCE:

The manufacturer shall submit performance documentation under either option as defined below. Submitted documentation must clearly show which option the manufacturer has chosen.

Option 1: Component Performance

1) Under this compliance path, the manufacturer must submit calculations per TM-21 predicting lumen maintenance at the luminaire level using In Situ Temperature Measurement Testing (ISTMT) and LM-80 data. To be eligible for the Component Performance option, ALL of the conditions below must be met. If any of the conditions are not met, the component performance option may not be used, and the applicant must use Option 2 for compliance.

2) The LED light source(s) have been tested according to LM-80.

3) The LED drive current specified by the luminaire manufacturer is less than or equal to the drive current specified in the LM-80 test report.

4) The LED light source(s) manufacturer prescribes/indicates a temperature measurement point (TS) on the light source(s).

5) The TS is accessible to allow temporary attachment of a thermocouple for measurement of in situ temperature. Access via a temporary hole in the housing, tightly resealed during testing with putty or other flexible sealant is allowable.

6) For the hottest LED light source in the luminaire, the temperature measured at the TS during ISTMT is less than or equal to the temperature specified in the LM-80 test report for the corresponding drive current or higher, within the manufacturer's specified operating current range.

7) The ISTMT laboratory must be approved by OSHA as a Nationally Recognized Testing Lab (NRTL), must be qualified, verified, and recognized through DOE's CALiPER program, or must be recognized through UL's Data Acceptance Program.

8) The ISTMT must be conducted with the luminaire installed in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires), with bird-fouling appropriately simulated (and documented by photograph) as determined by the manufacturer.

Option 2: Luminaire Performance

1) Under this compliance path, the applicant must submit TM-21 calculations based on LM-79 photometric test data for no less than three samples of the entire luminaire.

2) Duration of operation and interval between photometric tests shall conform to the TM-21 criteria for LED light sources. For example, testing solely at 0 and 6000 hours of operation would not be adequate for the purposes of extrapolation.

3) Between LM-79 tests, the luminaire test samples must be operated long-term in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires).

4) The test laboratory must hold NVLAP accreditation for the LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy (DOE)'s CALiPER program.

5) The extent of allowable extrapolation (either 5.5 or 6 times the test duration) depends on the total number of LED light sources (no less than 10 and preferably more than 19) installed in the luminaire samples, as per TM-21.

6) Under either compliance path option, values used for extrapolation shall be summarized per TM-21 Tables 1 and 2 at 25C degrees C (77 degrees F). Submitted values for lumen maintenance lifetime and the associated percentage lumen maintenance shall be "reported" rather than "projected" as defined by TM-21. Supporting diagrams are required to facilitate interpretation.

g. WARRANTY:

1) The entire Luminaire assembly including material, workmanship, photometrics, labor, power supply and LED modules shall have a minimum of ten (10) year warranty from the date of installation.

2) If more than 10 percent of the individual LED's fail within the warranty period, the luminaire must be repaired or replaced.

3) The department will remove the unit from the field and ship it to the manufacturer for repair or replacement.

4) Shall have a 10-year warranty on the paint finish.

h. MINIMUM REQUIRED SUBMITTALS:

1) Luminaire specification sheet.

2) LED driver specification sheet.

3) LM-79 Luminaire photometric report.

4) The vendor must submit LM-79 in-situ test data to confirm thermal operating temperatures of the luminaire.

5) Supplied in-situ test data must include thermal measurements from the worst case (hottest) thermal test point on the electronic driver (power supply).

6) LM-80 Lumen maintenance report.

7) TM-21 calculations.

8) Backlight, Uplight, Glare (BUG) rating of the luminaire.

9) Computer generated point by point photometric analysis using AGI 32 or Visual lighting design software.

10) A complete certified test lab report that shows the electrical transient suppression meets the requirements as set forth in this specification.

11) Written product warranty.

12) Independent test lab IES photometric reports.

    a) Including IES electronic file.
    b) Including intensity and chromaticity data.

13) IES chromaticity data from an LED Lighting Facts approved testing laboratory.

14) As part of the submittal process when a manufacturer submits a luminaire for inclusion on the City of Rochester Approved Product List a Microsoft Word version of the City of Rochester LED luminaire specification will be provided to the manufacturer. On each line of the provided LED luminaire specification the manufacturer must identify in writing where and on which manufacturer submitted documents the item in the specification is shown to be in compliance.

i. ACCEPTANCE TESTING:

1) Luminaire will be reviewed against each item listed on this specification. If the fixture is not in compliance with each item on this specification it will not be placed on the Lighting Approved Products List.

2) May be installed by the City wall mounted at 17 feet to verify light levels and light pattern.

3) The City of Rochester will verify light levels using the independent test laboratories photometrics.

4) The City of Rochester reserves the right to perform random sample testing on all shipments at its own expense. Random sample testing will be completed within 60 days, and as soon as possible, after delivery. The City shall determine the

sampling parameters to be used for the random testing. If the units tested fail random testing the units will be removed from the Approved Products list for Lighting.

5) Once the Luminaire has been placed on the City of Rochester Approved Product List for Lighting no substitution of materials will be allowed unless the manufacturer has received written permission in advance from the City of Rochester allowing the substitution.

6) The City 0f Rochester must be notified of any change to the catalog number. This notification must include the reason for the change in catalog number.

7) Failure to meet this requirement may cause the luminaire to be eliminated from the City of Rochester Approved Products List.

## 3.4 BALLASTS

A ballast according to IES RP-8 is a device used with an electric discharge lamp to obtain the necessary circuit conditions (voltage, current, and waveform) for starting and operating the lamp.

Proper disposal of the HID lamp ballast shall be included in the project manual.

## 3.5 DRIVERS

A driver is a device used with a light-emitting diode lamp to obtain the necessary circuit condition for starting and operating the LED lamp.

Proper disposal of the LED lamp drivers shall be included in the project manual.

New LED lamp drivers shall be provided as specified above.

## 3.6 SERVICE CABINETS

A. Rochester Public Utilities

For projects by the City of Rochester Public Utilities (RPU) there will be no service cabinet and no utility meter. The source of power will be determined by RPU and will in general be the nearest utility transformer or other source of power.

B. Rochester Public Works

For projects by the City of Rochester Public Works the electrical service cabinet will be designed by a consultant hired by the Rochester Public Works. The project will include a service cabinet and a utility meter for pedestrian and traffic control. The roadway lighting that will be operated by RPU under the NESC will not be metered. The electrical service from the utility transformer to the service cabinet will be coordinated with RPU by the consultant hired for the work.

C. The following service cabinets are approved for use in the City of Rochester.

1. MnDOT Service Cabinet, Secondary Type L1.

2. MnDOT Service Cabinet, Secondary Type L2.

## 3.7 POLES

A. Existing Poles in the City of Rochester

1. 2012-2013: Marathon Composite direct burial pole: 27 ft with 22 ft mounting height with a 19.25 inch Valmont extension.

2. Pre 2012: Marathon Composite direct burial pole: 22 ft with 18 ft mounting height.

3. Pre 1999: Concrete direct burial pole 22ft with 18ft mounting height.

4. Prior to the City of Rochester using concrete poles various steel poles were used and is detailed as follows:

    a. 22+/- ft steel.

    b. 26 ft with a 4 ft arm.

5. 23ft mounting height with a 10 ft arm installed in Graystone subdivision.

6. Millerbernd SR-XSTDH40-120-PT black poles, arms, and luminaires for downtown (RAL905 or approved similar).

B. New poles in the City of Rochester shall be selected from the following:

1. 2013 - Present: Marathon Composite direct burial pole: 25 ft with a 4 ft embedment and a 19.25 inch Valmont extension

2. Holophane WDA20L5J17P15BK with a concrete base.

3. Millerbernd Pole SR-XSTDH40-120-PT black poles, arms, and luminaires for downtown (RAL905 or approved similar) with a concrete base.

    a. The City will be using a Clamshell base type for this pole so the bolts will be on the outside of these poles and there will be additional space on the inside for wiring etc.

4. RPU standard is 30ft Millerbernd 10B304-2 with a 6 ft arm.

5. Contact RPU for pole selection due to specific applications requiring breakaway or non-breakaway options.

6. The destination Medical Center District black poles, arms, and luminaires shall be black (RAL905 or approved similar).

C. Breakaway Pole

The decision to provide breakaway poles needs to be carefully considered. Most poles can be provided as a breakaway pole but not all applications should include breakaway poles. For example, a pole falling on a pedestrian could result in more harm than not having the pole fall.

The following are traffic speed and breakaway pole guidelines for the City of Rochester.

1. Speeds greater than 40 mph:

   Poles located in the clear zone (not separated by a traffic barrier) shall be provided with breakaway bases.

2. Speeds between 30 mph and 40 mph with pedestrian's present:

   The decision of poles being breakaway or non-breakaway and located in the clear zone (not separated by a traffic barrier) shall be at the discretion of the design team. The reason for this is that roadways with these speeds can have a higher pedestrian interaction with vehicular traffic than roadways with higher speeds (above 40 mph). The design team needs to determine if allowing the pole to fall may introduce a higher risk factor than not having it fall.

3. Speeds below 30 mph with pedestrian's present:

   Poles located in the clear zone (not separated by a traffic barrier) shall be provided with non-breakaway bases.

D. Placement Issues

Pole placement is an important task of the design team. Care shall be taken when consider pole placement and coordination with various item in and around the roadway is a key aspect of roadway lighting design. The conflicts that need to be coordinated include but not necessarily limited to the following:

1. Overhead power lines. All roadway lighting in the City of Rochester shall maintain a 10'-0" clearance from overhead power lines.

2. Roadway alignment. This includes possible pole location likely to be in an area where vehicles may inadvertently go off the road.

3. Guard rails

4. Airports may require shorter poles or air obstruction lighting.

5. Retaining wall or other walls near the roadway.

6. Underground utilities.

7. Poles required to be located behind a fence that is not accessible from the road such as on a bridge will require the location of the handhole in the base of the pole to be raised above the fence so the handhole is accessible.

E. Pole Designations

1. The City of Rochester does not currently have a pole designation procedure.

## 3.8 LIGHT BASES (CONCRETE FOUNDATIONS)

A. Direct burial poles

1. Direct burial poles do not require a light base (concrete foundation). The direct burial pole shall be installed as required by the pole manufacturer.

B. Light base mounted poles

1. Light bases (concrete foundations) shall be provided for poles that require a concrete foundation. Concrete foundations provided for the City of Rochester projects shall be selected from one of the following:

   a. Rochester Standard Light Foundation – RPU Drawing SL9FD03

      - Shall be used with Roadway Streetlight – 30 foot lighting units or less.

   b. Rochester Standard Light Foundation – RPU Drawing SL9FD04

      - Shall be used decorative residential street Lighting units.

## 3.9 EQUIPMENT PADS

A. Equipment pad for the service cabinet provided for projects related to the City of Rochester Public Works shall be selected from the following.

1. MnDOT Standard Equipment Pad B – Cast in Place. Refer to MnDOT standard plate 8106D for details.

2. MnDOT Standard Equipment Pad B – Precast. Refer to MnDOT standard plate 8106D for details.

## 3.10 CITY OF ROCHESTER EXISTING LIGHTING SURVEY

The following is taken from a survey of the existing lighting systems in the City of Rochester. The intent of this survey is to show a sample of the existing lighting in the City of Rochester and to provide examples of classifications of street type within the City of Rochester. It can also be used to identify existing lighting

unit types within the city and a possible replacement plan for the existing lighting unit including the luminaire and the pole.

A. LOCAL RESIDENTIAL STREET (55th Avenue NW and Duvall Street)

1. IES Roadway Street Classification: Local.
2. IES Roadway Pedestrian Area Classification: Low.
1. Existing Fixture type: Holophane RSL, 100W High Pressure Sodium.
2. Existing Pole: 16 foot fiberglass pole.
3. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with Philips RoadFocus RFM (Set to 66W) when ballast fails or other (non-lamp/photocell) failure.
4. Unique characteristics: add 18 inch extension to pole with new fixture.
5. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans.

**Figure 1: 55th Avenue NW and Duvall Street**



B. LOCAL RESIDENTIAL STREET (Florence Drive NW and Ridgeview)

1. IES Roadway Street Classification: Local.
2. IES Roadway Pedestrian Area Classification: Low.
3. Existing Fixture type: Philips RoadFocus RFM (Set to 66W).
4. Existing Pole: Marathon Composite pole: 25 ft with a 4 ft embedment and a 19.25 inch Valmont extension.
5. Unique characteristics: NA.
6. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans.

**Figure 2: Florence Drive NW Ridgeview**



C. LOCAL RESIDENTIAL STREET (19TH STREET NW AND 21ST AVENUE NW)

6. IES Roadway Street Classification: Local
7. IES Roadway Pedestrian Area Classification: Low
8. Existing Fixture type: Holophane RSL, 100W High Pressure Sodium
9. Existing Pole: Utility wood pole
10. Maintenance Procedures:
    a. Lamp and Photocell replacements.
    b. Replace with Philips RoadFocus RFM (Set to 66W) when ballast fails or other (non-lamp/photocell) failure.
11. Unique characteristics: Short arm mounted to wood pole.
12. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

**Figure 3: 19th Street NW Facing East**



D. LOCAL RESIDENTIAL STREET (VIKING DRIVE NW AND NORDIC)

1. IES Roadway Street Classification: Local.
2. IES Roadway Pedestrian Area Classification: Low.
3. Existing Fixture type: Holophane RSL, 100W High Pressure Sodium.
4. Existing Pole: Millerbernd #SDA4-220.
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with Philips RoadFocus RFM (Set to 66W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: Steel pole with no handhole in pole and is hard to install and maintain.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans.

**Figure 4: Viking Drive NW Facing South**



E. LOCAL RESIDENTIAL STREET (5th Avenue NW and 8th Street NW)

1. IES Roadway Street Classification: Local.
2. IES Roadway Pedestrian Area Classification: Low.
3. Existing Fixture type: Holophane RSL, 100W High Pressure Sodium.
4. Existing Pole: Utility power pole.
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with Philips RoadFocus RFM (Set to 66W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: Steel pole with no handhole in pole and is hard to install and maintain.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

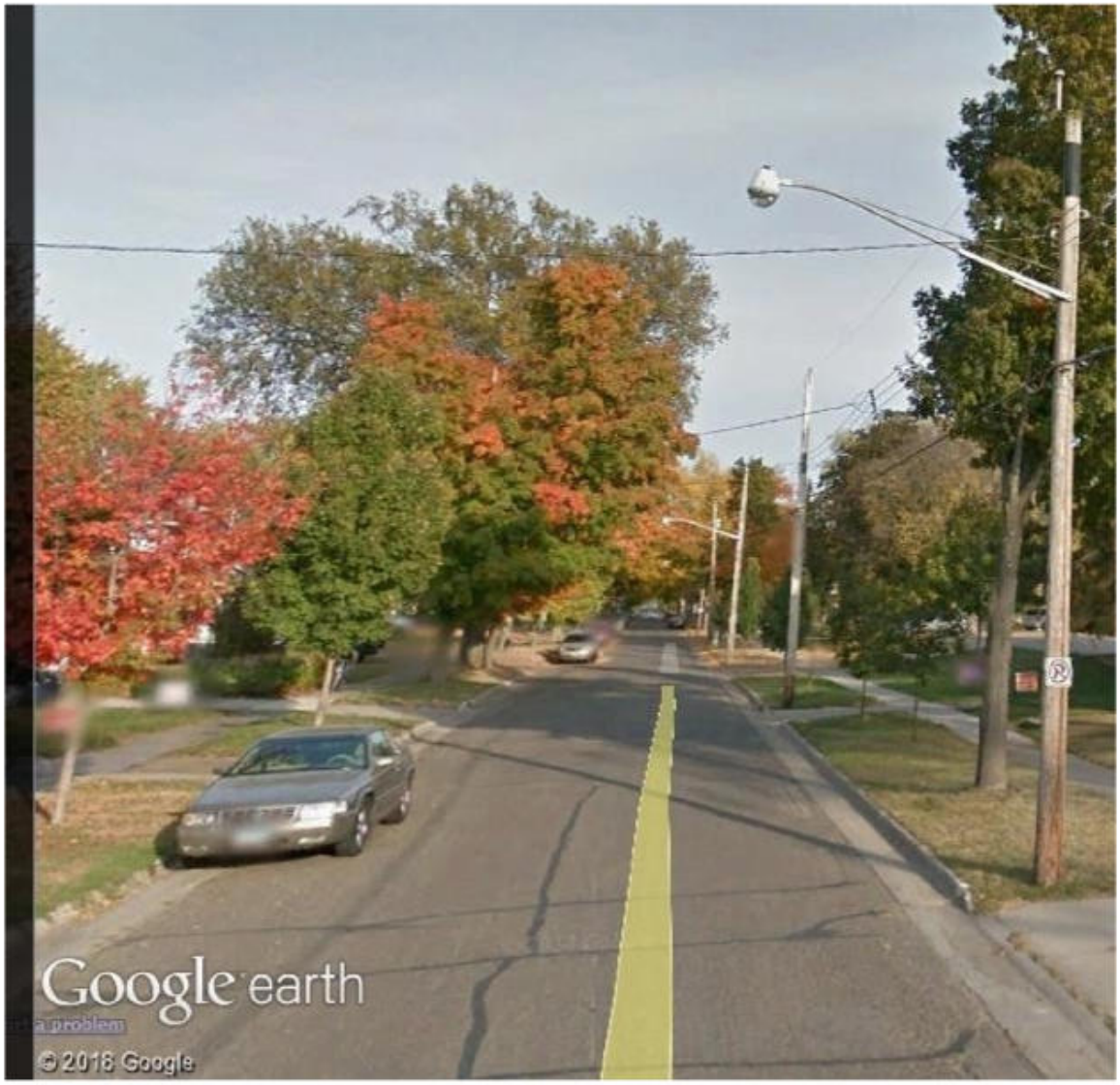
**Figure 5: 8TH Street NW Facing West**



F. LOCAL RESIDENTIAL STREET (1st Street NW and 11th Avenue)

1. IES Roadway Street Classification: Local.
2. IES Roadway Pedestrian Area Classification: Low.
3. Existing Fixture type: Holophane RSL, 100W High Pressure Sodium.
4. Existing Pole: Utility wood pole.
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with Philips RoadFocus RFM (Set to 66W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: Long arm mounted to wood pole.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans.

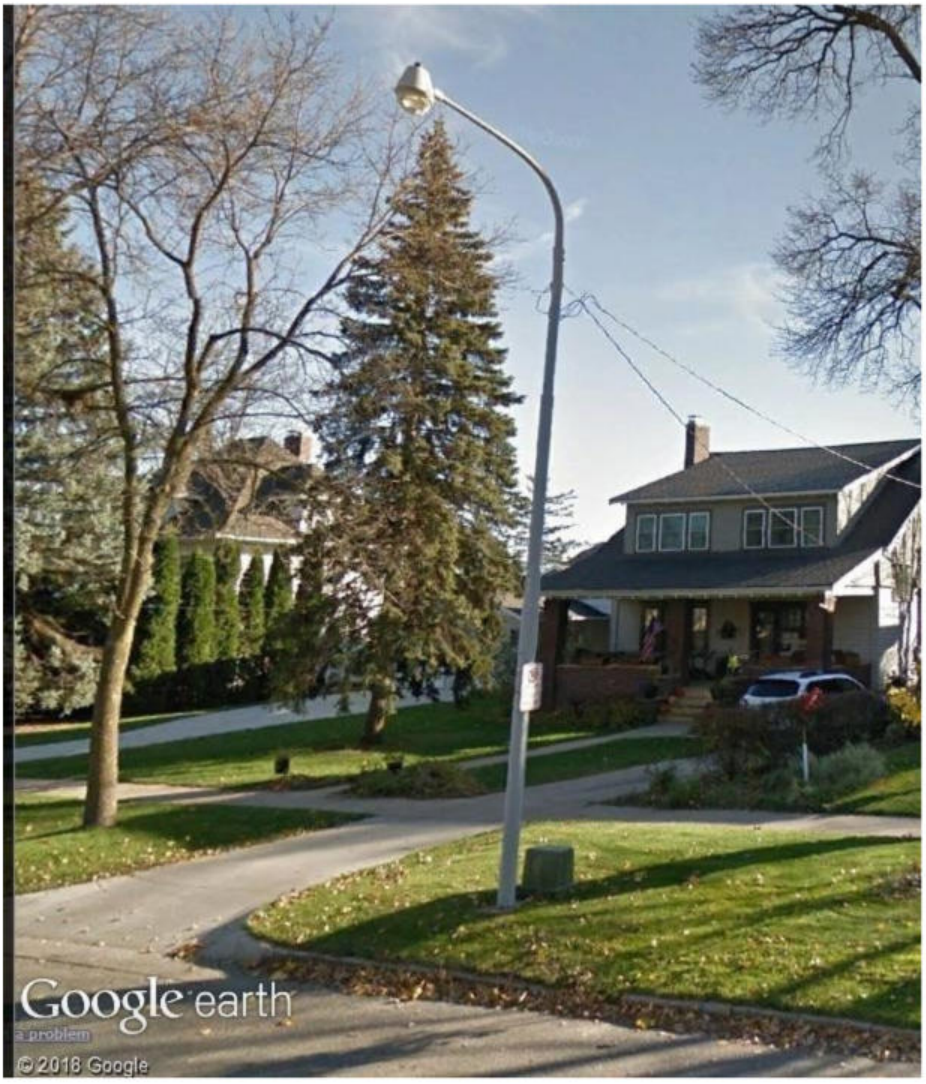
**Figure 6: 1ST Street NW Facing East**



G. LOCAL RESIDENTIAL STREET (4th Street SW)

1. IES Roadway Street Classification: Local
2. IES Roadway Pedestrian Area Classification: Low
3. Existing Fixture type: Holophane RSL, 100W High Pressure Sodium
4. Existing Pole: Make and Model #, 25-foot pole direct burial pole (30 foot overall)
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with Philips RoadFocus RFM (Set to 66W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: Long arm and utility overhead feed point to houses.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

**Figure 7: 4TH Street SW Facing East**



H. COMMERCIAL SUBDIVISION STREET (TECHNOLOGY DRIVE NW)

1. IES Roadway Street Classification: Local.
2. IES Roadway Pedestrian Area Classification: Low.
3. Existing Fixture type: Cobra Head Style – Manufacturer Varies.
4. Existing Pole: Millerbernd
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with Philips RoadFocus RFM (Set to 108W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: NA.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

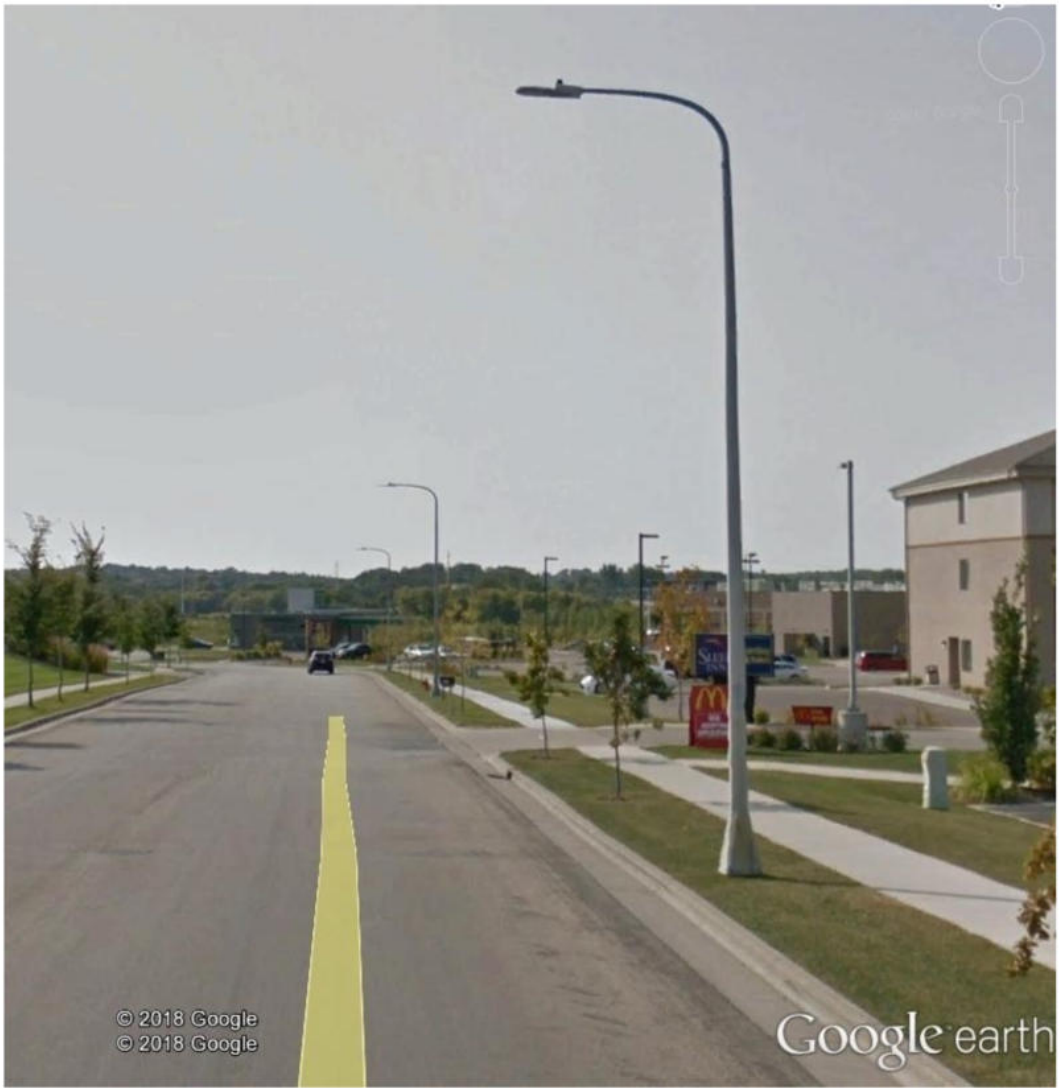
**Figure 8: 4TH Technology Drive Facing West**



I. COMMERCIAL SUBDIVISION STREET (COMMERCE DRIVE AND 22ND STREET NW)

1. IES Roadway Street Classification: Arterial
2. IES Roadway Pedestrian Area Classification: Low
3. Existing Fixture type: Cobra Head Style – Manufacturer Varies
4. Existing Pole Marathon Composite pole: 27 ft with 22 ft mounting height with a 19.25 inch Valmont extension.
5. Maintenance Procedures:
   a. Replace with Philips RoadFocus RFM (Set to 108W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: NA.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

**Figure 9: Commerce Drive Facing South**



J. COMMERCIAL SUBDIVISION STREET (22nd Street NW and 32nd Avenue NW)

1. IES Roadway Street Classification: Arterial
2. IES Roadway Pedestrian Area Classification: Low
3. Existing Fixture type: Holophane RSL, 250W High Pressure Sodium
4. Existing Pole: Utility wood pole
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with Philips RoadFocus RFM (Set to 108W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: Long arm mounted to wood pole.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

**Figure 10: 32nd Avenue NW Facing North**



K. COMMERCIAL SUBDIVISION STREET (SOUTH BRADWAY AND 14TH STREET NE)

1. IES Roadway Street Classification: Arterial.
2. IES Roadway Pedestrian Area Classification: Medium.
3. Existing Fixture type: 400W HPS Cobra Head Style – Manufacturer Varies.
4. Existing Pole: MnDOT standard 12-40 lighting unit.
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace with GE: ERL 2016B340AGRAYL (120W) when ballast fails or other (non-lamp/photocell) failure.
6. Unique characteristics: MnDOT standard 12-10 lighting unit.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

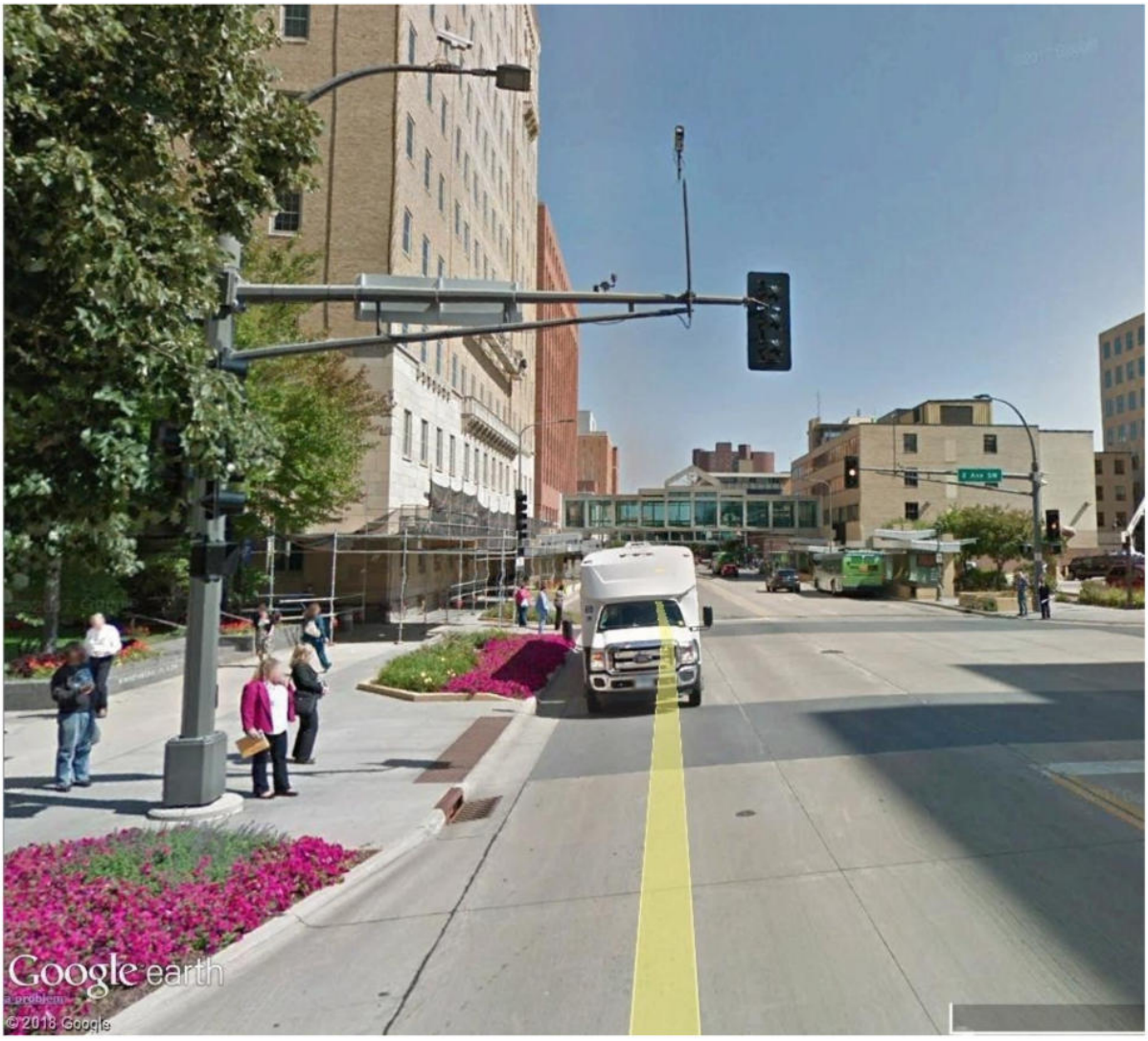
**Figure 11: South Broadway Facing North**



L. REDEVELOPMENT DOWNTOWN/DESTINATION MEDICAL CENTER ZONE STREET (2ND STREET SW AND 1ST AVENUE SW)

1. IES Roadway Street Classification: Arterial.
2. IES Roadway Pedestrian Area Classification: High.
3. Existing Fixture type: Cree ARE-EDG.
4. Existing Pole: MNDOT Standard.
5. Maintenance Procedures:
   a. Replace fixture with Philips RoadFocus RFM (Set to 108W).
6. Unique characteristics: Overhead lighting units' fixtures are the same as the overhead signal unit fixtures.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

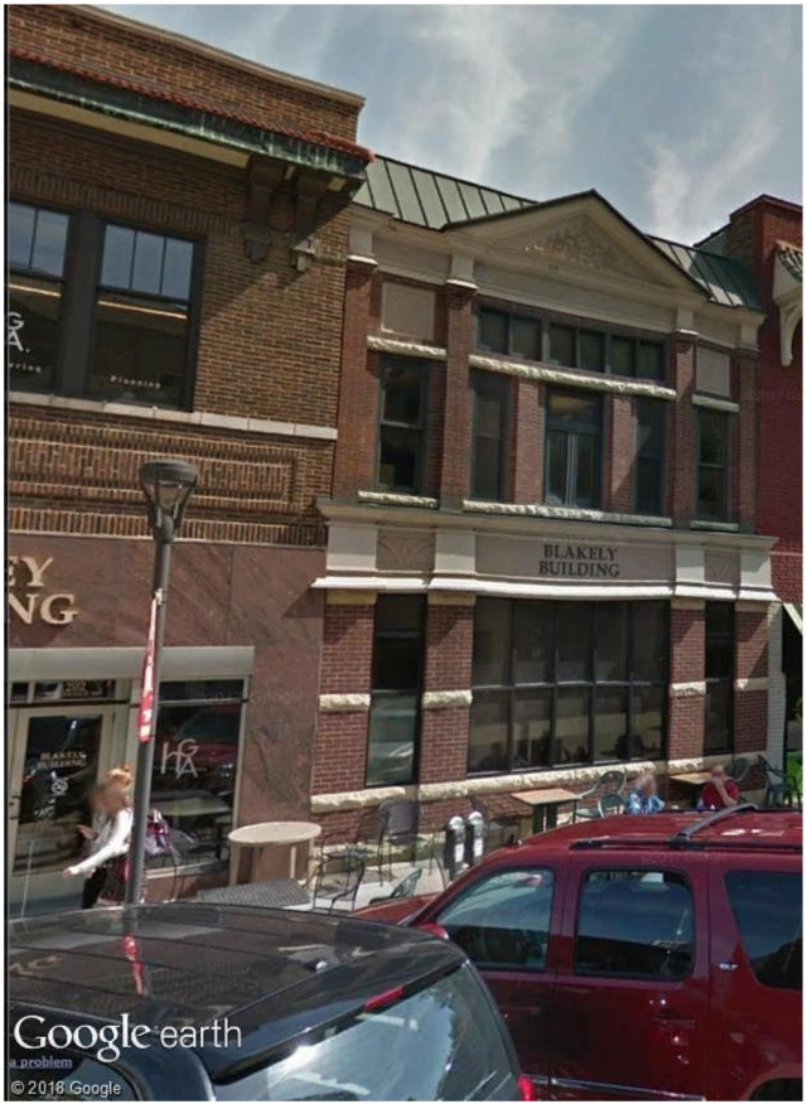
**Figure 12: 2ND Street SW Facing East**



M. REDEVELOPMENT DOWNTOWN/DESTINATION MEDICAL CENTER ZONE STREET (2ND STREET SW AND 1ST AVENUE SW)

1. IES Roadway Street Classification: Arterial.
2. IES Roadway Pedestrian Area Classification: High.
3. Existing Fixture type: Kim Lighting SRS1-HID.
4. Existing Pole: Millerbernd SR-XSTDH40-120-PT (MED GRAY).
5. Maintenance Procedures:
   a. Replace fixture with retro fit kit SRS-LED-KIT.
6. Unique characteristics: The only fixture approved for retrofit kit.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

**Figure 13: 1ST Avenue SW Facing South**



N. REDEVELOPMENT DOWNTOWN/DESTINATION MEDICAL CENTER ZONE STREET (2ND STREET SW AND 1ST AVENUE SW)

1. IES Roadway Street Classification: Arterial.
2. IES Roadway Pedestrian Area Classification: High.
3. Existing Fixture type: NA.
4. Existing Pole: NA.
5. Maintenance Procedures:
   a. Lamp and Photocell replacements.
   b. Replace existing fixture with: Kim Lighting SRS1-HID.
   c. Replace existing pole with: Millerbernd SR-XSTDH40-120-PT (black poles, arms, and luminaires for downtown.
   d. Replace existing concrete base with new concrete base to accommodate the new pole.
6. Unique characteristics: There is currently no available globe fixture with a solid top to reduce up light. The new fixture and pole will require a new concrete base to be provided.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

**Figure 14: South Broadway Facing South**



O. ROUNDABOUT (Badger Hills Drive NW and Superior Drive NW)

1. IES Roadway Street Classification: Arterial.
2. IES Roadway Pedestrian Area Classification: Low.
3. Existing Fixture type: MnDOT standard 9-40, 268W LED.
4. Existing Pole: MnDOT standard 9-40, 9 foot arm and 40 foot pole.
5. Maintenance Procedures:
   a. Replace fixture with GE: ERL 2016B340AGRAYL (120W).
6. Unique characteristics: MnDOT standard 9-40.
7. Refer to Appendix C for City of Rochester Existing Lighting System Lighting Scans

**Figure 15: Badger Hills Drive NW Facing West**



# 4.0 PHOTOMETRY

## 4.1 PHOTOMETRICS

The City of Rochester Roadway lighting design guide includes three different methods for use in evaluating different aspects of roadway and street lighting designs. The three methods are luminance, Illuminance, and Small Target Visibility (STV).

The photometrics calculations shall be as described in section 5.2 – Measurement and Field Verification so the field measurements and verifications can be measured in the field in the same general location as the calculation values.

A. Photometric Methods of Evaluation

1. Luminance

   According to the IES RP-8-14 the luminance method of roadway lighting design determines how bright the road is by determining the amount of light reflected from the pavement in the direction of the driver. It uses the reflective characteristics noted in the r-tables for the standard roadway surface types and a specific observer position. It is measured with a luminance meter.

2. Illuminance

   a. Illuminance Horizontal

      According to the IES RP-8-14 the Illuminance method of roadway lighting design determines the amount of light incident on the roadway surface from the roadway lighting systems. Because the amount of light seen by the driver is the portion that reflects from the pavement towards the driver, and because different pavements exhibit varied reflectance characteristics, different illuminance levels are needed for each type of standard roadway surface. Illuminance is easily calculated and measurable and is not observer or pavement dependent.

   b. Illuminance Vertical:

      According to the IES RP-8-14 the Illuminance method of roadway lighting design determines the amount of light incident on vertical surfaces from the roadway lighting systems. Because the amount of light seen by the driver is the portion that reflects from the pavement towards the driver, and because different pavements exhibit varied reflectance characteristics, different illuminance levels are needed for each type of standard roadway surface. Illuminance is easily calculated and measurable and is not observer or pavement dependent.

The following areas shall include vertical illumination calculations.

1) Crosswalk with High pedestrian conflict zone.

2) Crosswalk with Medium pedestrian conflict zone.

3) Sidewalks with High Pedestrian conflict zone.

4) Sidewalks with Medium Pedestrian conflict zone.

5) Bike lanes with High Pedestrian conflict zones.

6) Bike lanes with Medium Pedestrian conflict zones.

7) Underpasses with High Pedestrian conflict zones.

8) Underpasses with Medium Pedestrian conflict zones.

3. Small Target Visibility (STV)

The STV value is the weighted average of the visibility level of these targets. This method is still underground evaluation but may be a valuable tool when comparing the expected results of two designs delivering approximately the same luminance and illuminance performance.

According to the IES RP-8-14 the STV method of design is based on the visibility levels of an array of small tarts on the roadway considering the following factors:

a. The luminance of the targets.

b. The luminance of the immediate background.

c. The adaptation level of the adjacent surroundings.

d. The disability glare.

B. Photometric Submittal Requirements

Photometrics related to roadway lighting includes software for calculating light levels and information required for the software such as lumen levels, lamp depreciation factors, and luminaire depreciation factors.

The purpose of the photometric study is to assist the design team in analyzing the lighting design and verifying the lighting levels meet the project requirements.

The design team shall submit a photometric study to the City of Rochester for review.

The submittal shall include the following:

1. Roadway lighting level for road segments meeting the calculation requirements of IES RP-8 Including the following information. One software that meets these requirements is the Visual Lighting Software's Roadway Design Tool.

    a. Design Information

        1) Project Name.

        2) Project Description.

        3) Username.

        4) Company Name.

        5) Phone Number.

        6) Email.

    b. Roadway Information

        1) Calculation Method.

        2) Road Surface Classification.

        3) Roadway/Street Classification.

        4) Pedestrian Conflict Classification.

        5) Lane Quantity.

        6) Lane Width.

        7) Median Width.

        8) Sidewalk Width Left and Right.

        9) Sidewalk Setback Left and Right.

        10) Bike lane Width Left and Right.

        11) Bike lane Setback Left and Right.

    c. Luminaire Information

        1) Manufacturer Make and Model Number.

        2) Lumens.

3) Watts.

4) Quantity.

5) Spacing.

6) Setback.

7) Orientation.

8) Mounting height.

9) Staggered.

10) Light loss factor.

11) Configuration.

12) Arm length.

13) Tilt.

d. Roadway/Street Luminance Calculation Results

1) Average Left and Right (Ave) (cd/m2).

2) Maximum Left and Right (Max) (cd/m2).

3) Minimum Left and Right (Min) (cd/m2).

4) Average/Minimum Ratio (Ave/Min) Left and Right.

5) Maximum/Minimum Ratio (Max/Min) Left and Right.

6) Veiling Luminance Ratio (Lv).

7) Small Target Visibility Ratio (STV).

e. Roadway/Street Illuminance Horizontal Calculation Results

1) Average (Ave) Left and Right (fc).

2) Maximum (Max) Left and Right (fc).

3) Minimum (Min) Left and Right (fc).

4) Average/Minimum Ratio (Ave/Min) Left and Right.

5) Maximum/Minimum Ratio (Max/Min) Left and Right.

f. Sidewalk Illuminance Calculation Results

1) Horizontal Average (Ave) Left and Right (fc).

2) Horizontal Minimum (Min) Left and Right (fc).

3) Horizontal Average/Minimum (Ave/Min) Left and Right.

4) Vertical Minimum Ev Min (fc).

g. Crosswalk Illuminance Calculation Results

1) Horizontal Average (Ave) Left and Right (fc).

2) Horizontal Minimum (Min) Left and Right (fc).

3) Horizontal Average/Minimum (Ave/Min) Left and Right.

4) Vertical Minimum (Ev Min) (fc).

h. Bike lane Illuminance Calculation Results

1) Horizontal Average (Ave) Left and Right (fc).

2) Horizontal Minimum (Min) Left and Right (fc).

3) Horizontal Average/Minimum (Ave/Min) Left and Right.

4) Vertical Minimum (Ev Min) (fc).

i. The submittal requirements include both Illuminance and Luminance because the IES RP-8-14 recommendations and the guidelines listed in this design guide are listed in either Illuminance or Luminance but not both. All field measurements and verification shall be done in Illuminance. The Luminance values submitted shall be used to confirm the design meets the requirements of this design guide where Luminance is listed. The Illuminance values submitted shall be used to confirm the design meets the requirements of this design guide where Illuminance is listed.

2. Roadway lighting level for the entire project meeting the calculation requirements of showing the lighting levels for the entire project for both illuminance and luminance. One software that meets these requirements is the Visual Lighting Software.

a. Design Information

1) Project Name.

2) Project Description.

3) Username.

4) Company Name.

5) Phone Number.

6) Email.

b. Roadway Information

1) Drawing shall include the actual roadway linework and surrounding area.

c. Luminaire Information

1) Drawing shall include information such as lighting unit location, orientation, etc.

2) Manufacturer Make and Model Number.

3) Lumens.

4) Watts.

5) Quantity.

6) Mounting height.

7) Light loss factor.

8) Arm length.

9) Tilt.

d. Roadway/Street Luminance Calculation Results

1) Average (Ave) (cd/m2).

2) Maximum (Max) (cd/m2).

3) Minimum (Min) (cd/m2).

4) Average/Minimum Ratio (Ave/Min).

5) Maximum/Minimum Ratio (Max/Min).

e. Roadway/Street Illuminance Horizontal Calculation Results

1) Average (Ave) (fc).

2) Maximum (Max) (fc).

3) Minimum (Min) (fc).

4) Average/Minimum Ratio (Ave/Min).

5) Maximum/Minimum Ratio (Max/Min).

f. Intersection Lighting Illuminance Horizontal Calculation Results

1) Average (Ave) (fc).

2) Maximum (Max) (fc).

3) Minimum (Min) (fc).

4) Average/Minimum Ratio (Ave/Min).

5) Maximum/Minimum Ratio (Max/Min).

g. Isolated Intersection Lighting Illuminance Horizontal Calculation Results

1) Average (Ave) (fc).

2) Maximum (Max) (fc).

3) Minimum (Min) (fc).

4) Average/Minimum Ratio (Ave/Min).

5) Maximum/Minimum Ratio (Max/Min).

h. Roundabout Lighting Illuminance Horizontal Calculation Results

1) Average (Ave) (fc).

2) Maximum (Max) (fc).

3) Minimum (Min) (fc).

4) Average/Minimum Ratio (Ave/Min).

5) Maximum/Minimum Ratio (Max/Min).

i. Crosswalk Illuminance Calculation Results

1) Horizontal Average (Ave) (fc).

2) Horizontal Minimum (Min) (fc).

3) Horizontal Average/Minimum (Ave/Min).

4) Vertical Minimum (Ev Min) (fc).

j. Sidewalk Illuminance Calculation Results

1) Horizontal Average (Ave) (fc).

2) Horizontal Minimum (Min) (fc).

3) Horizontal Average/Minimum (Ave/Min).

4) Vertical Minimum Ev Min (fc).

k. Bikeway Illuminance Calculation Results

1) Horizontal Average (Ave) (fc).

2) Horizontal Minimum (Min) (fc).

3) Horizontal Average/Minimum (Ave/Min).

4) Vertical Minimum (Ev Min) (fc).

l. Lighting subsystems are additional categories that may require additional calculation zones. The lighting subsystems are as follows:

1) Adaptive Lighting may require additional lighting calculation submitted to show lighting levels for all applications.

2) Transition Lighting Zones may require additional zone to show the lighting level in this zone is reduced to accommodate the reduced light level required for the eye to adjust while traveling from the lighted street section to the non-lighted street section.

3) Areas with Grade Changes and Sharp Curves may require additional lighting calculation zone to show the lighting design meets the lighting recommendations in these areas.

4) Underpasses and Overpasses may require additional lighting calculation zones to show the lighting design meets the lighting recommendations in these areas.

5) Railroad Grade Crossing may require additional lighting calculation zones to show the lighting design meets the lighting recommendations for both the railroad grade crossing area and the approach area.

6) The submittal requirements include both Illuminance and Luminance because the IES RP-8-14 recommendations and the guidelines listed in this design guide are listed in either Illuminance or Luminance but not both. All field measurements and verification shall be done in Illuminance. The Luminance values submitted shall be used to confirm the design meets the requirements of this design guide where

Luminance is listed. The Illuminance values submitted shall be used to confirm the design meets the requirements of this design guide where Illuminance is listed.

## 4.2 LAMP AND LUMINAIRE DEPRECIATION FACTORS

Light Loss Factor (LLF) shall be applied to the lighting design which is composed of the following factors Lamp Lumen Depreciation (LLD), Luminaire Dirt Depreciation (LDD), Maintenance Factor (MF), Luminaire Ambient Temperature Factor (LATF), and, Ballast Factor (BF). In the case of using LED lighting the Ballast Factor is the Driver Factor. The factors listed above shall be multiplied together to calculate the LLF as shown below.

LLF=LLD*LDD*MF*LATF*BF

The following calculation is a typical calculation for LLF for an LED fixture. The actual LLF shall be calculated and shown during submittals for each project.

Lamp Lumen Depreciation (LLD) is based on the chosen lamp and its lumen depreciation and are available from lamp manufacturers tables and graphs. A typical LLD is 0.95.

Luminaire Dirt Depreciation (LDD) is the accumulation of dirt on luminaires that results in a loss of light output from the luminaire. A typical LDD is 0.96.

Maintenance Factor (MF) is the result of the depreciation effects considered in the initial design due to maintenance schedule. A typical MF is 0.98.

Luminaire Ambient Temperature Factor (LATF) is the result of the depreciation effects considered in the initial design due to high or low ambient temperatures. A typical (LATF) is 1.00.

Ballast Factor (BF) or in the case of LED luminaire the LED Driver Factor is the result of the depreciation effects considered in the initial design due to characteristics of the LED Driver. A typical (BF) is 1.00.

A typical LLF when calculated with the above factors is as follows:

LLF=0.95*0.96*0.98*1.00*1.00=0.90

# 5.0 LIGHTING DESIGN

## 5.1 LIGHTING DESIGN

The following is a typical guide that can be used for lighting design. The design team may need to modify the guide as needed to provide a lighting design that meets the needs of the project.

A. Step 1: Determine specific lighting needs and recommended foot-candles.

1. Project Lighting guidelines

   Identify the classifications and other requirements / systems for the project. Use the Roadway Lighting Design Checklist to assist in answering the required questions. Note that specific project requirements may warrant additional questions to be asked. The Roadway Lighting Design Checklist is found in Appendix A.

2. Project Lighting foot-candle guidelines

   It is important to note that the lighting design guidelines list are based on IES RP-8-14 and that the guidelines list either Illuminance or Luminance for a given roadway/street lighting category but it does not list both. This guide includes both in the example and sample plans and submittal requirements due to the fact that the confirmation of design to requirements needs to be done with either Illuminance or Luminance based on what is included in the recommendations but Illuminance will be used for field verification regardless of what is included in the recommendation.

   a. Determine the type of lighting system required for the project and determine if there are any lighting subsystems that need to be accounted for during the design process.

   b. Determine and identify the classification of areas or roadway/street.

   c. Determine and identify the classification of pedestrian conflict areas.

   d. Determine and identify the classification of roadway/street surfaces.

   e. Use the roadway lighting design checklist to assist in assigning the type of lighting systems and classifications used on this project.

3. Roadway Lighting Design Checklist Notes and Comments.

   a. Type of Rochester's Functional Classification shall be identified to assist in selecting the recommended lighting level for the roadway/street and identify other lighting requirements such as continuous lighting or partial lighting.

b. Type of Classification of the area or roadway shall be identified to assist in selecting the recommended lighting level for the roadway/street and identify other lighting requirements such as continuous lighting or partial lighting.

c. Type of lighting system shall be identified prior to any additional work so the designers understand the scope of work.

d. Identify the type of lighting subsystems required for the project. A curve may require a change in spacing at the curve to maintain the lighting level.

e. Identify the pedestrian conflict area classification to assist in selecting the recommended lighting level for the roadway/street.

f. Identify the roadway surface classification to assist in selecting the recommended lighting level for the roadway/street.

g. The number of lanes may affect pole height, lumen output, or the need to provide lighting units on both sides.

h. Use the information above to identify the lighting level recommendations from the tables listed below.

i. Retaining walls or guardrails in the area will affect the pole location and may affect the requirements for lumen levels, or breakaway pole. Lighting anchorages may be needed in retaining walls. The height of the wall also affects pole height. Poles may be placed closer to roadway if guardrail is in place.

j. Ground mounted for overhead signing may affect lighting unit locations and heights. Power may be required to light sign. Lights should not be placed too close to sign as this may reflect on sign and affect visibility.

k. Overhead power lines may affect lighting unit locations and pole heights. Lighting units should remain a safe distance from power lines (10 feet is recommended). Coordinate this with Rochester Public Utilities.

l. Width of the shoulder may affect pole height and wattage.

m. Sidewalks and paths indicate pedestrian conflict areas and higher foot-candle levels may be desirable. It also indicates that pole placement may need to be adjusted to clear the sidewalk or pathway.

n. Steep grade may require higher poles or modified concrete bases.

o. Urban areas generally have continuous lighting while rural areas may not. Also, light pollution and light trespass are issues in urban areas.

p. Additional lighting may be needed at intersections.

q. Identify the geometry of the roadway/street including intersection, curves, hill, and grades of the surrounding area as the geometry affects lighting layout and luminaire selection.

r. Speeds are one factor that is used to identify the need for breakaway bases.

s. Ambient lighting can reduce or increase the need for lighting.

t. A combined signal and lighting pad (SOP) may be required. Lights on signals will affect spacing and may require strategic lighting unit placement to coordinate with the signal lighting.

u. Lights may be placed on a barrier if there is no room on the outside of the roadway or if median barrier lighting is desired. Generally, lights should not be placed in median because they are hard to maintain.

v. The City of Rochester approved product list shall be used for fixture selection. Non-standard or other ornamental lighting will be reviewed on a case by case basis.

w. The age of the system or maintenance problems may affect removal. The existing systems that need to be removed and that are existing to remain need to be identified so the design team can account for both the removal, salvage and reinstallation of the existing systems, but the design team shall also account for the existing lighting units that are considered existing to remain and make sure these lighting units are re-connected to the new system as needed.

x. The design team needs to accommodate the work required for existing and/or relocated electrical service cabinets.

y. Bridges may require special attention given to overpasses and underpasses including vertical illumination calculations for safety and security purposes. Bridges also may require light pole handhole locations, so they are not located behind a fence.

z. Cutoff lighting may be required near airports. Lighting unit heights may be restricted.

aa. Navigational lights should have a separate SOP so the lighting will be controlled separately from the street lighting.

bb. Pole mounted receptacles will require additional details and coordination as to the location of the receptacles and may require a separate circuit to allow the receptacles to be controlled separately from the lighting.

cc. Banner arms require coordination on size of banner and mounting heights for banner arms and number of banner arms.

4. According to IES RP-8-14 for determining what horizontal illuminance levels should be used as an equivalent to the recommended luminance level, a ratio of 1cd/m2 = 15 lux for an R2 or

R3 pavement and 1cd/m2 = 10 lux for an R1 pavement can be used. Field validation of a lighting system performance may be done by the luminance or illuminance method.
10 Lux = 1 fc

5. The Recommended Lighting Levels shall be as shown in the tables.

## Table 1 Required Lighting Design Criteria for Roadways (IES RP-8-2014)

| RECOMMENDED LIGHTING DESIGN CRITERIA FOR ROADWAYS (IES RP-8-2014) | | | | |
|---|---|---|---|---|
| LUMINANCE | | | | |
| Road Classification | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) | AVG. UNIFORMITY RATIO $L_{avg}/L_{min}$ | MAX. UNIFORMITY RATIO Lmax/Lmin | MAX. VEILING LUMINANCE RATIO LVmax/Lavg |
| Freeway Class A | 0.6 | 3.5 | 6.0 | 0.3 |
| Freeway Class B | 0.4 | 3.5 | 6.0 | 0.3 |
| Expressway | 1.0 | 3.0 | 5.0 | 0.3 |
| ILLUMINANCE | | | | |
| Road Classification | Average Maintained Illumination at Pavement by Pedestrian Area Classifications | | | Uniformity Ratio Eavg/Emin |
| | R1 (Lux/fc) | R2&R3 (Lux/fc) | R4 (Lux/fc) | |
| Freeway Class A | 6.0/0.6 | 9.0/0.9 | NA | 3.5 |
| Freeway Class B | 4.0/0.4 | 6.0/0.6 | NA | 3.5 |
| Expressway | 10.0/1.0 | 15.0/1.5 | NA | 3.0 |

$L_{avg}$ = Minimum Maintained AveragePavement Luminance.

$L_{min}$ = Minimum Pavement Luminance

$LV_{MAX}$ = Maximum Veiling Luminance.

$E_{avg}$ = Minimum Maintained AveragePavement Illuminance.

$E_{min}$ = Minimum Pavement Illuminance

$EV_{MAX}$ = Maximum Veiling Illuminance.

## Table 2 Required Lighting Design Criteria for Street (IES RP-8-2014)

| Recommended Lighting Design Criteria for Streets (IES RP-8-2014) | | | | | |
|---|---|---|---|---|---|
| LUMINANCE | | | | | |
| Street Classification | Pedestrian Area Classification | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) | AVG. UNIFORMITY RATIO $L_{avg}/L_{min}$ | MAX. UNIFORMITY RATIO Lmax/Lmin | MAX. VEILING LUMINANCE RATIO LVmax/Lavg |
| | High | 1.2 | 3.0 | 5.0 | 0.3 |
| Major | Medium | 0.9 | 3.0 | 5.0 | 0.3 |
| | Low | 0.6 | 4.0 | 6.0 | 0.3 |
| | High | 0.8 | 3.0 | 5.0 | 0.4 |
| Collector | Medium | 0.6 | 3.5 | 6.0 | 0.4 |
| | Low | 0.4 | 4.0 | 8.0 | 0.4 |
| | High | 0.6 | 6.0 | 10.0 | 0.4 |
| Local | Medium | 0.5 | 6.0 | 10.0 | 0.4 |
| | Low | 0.3 | 6.0 | 10.0 | 0.4 |
| ILLUMINANCE | | | | | |
| Street Classification | Pedestrian Area Classification | Average Maintained Illumination at Pavement by Pedestrian Area Classifications | | | Uniformity Ratio Eavg/Emin |
| | | R1 (Lux/fc) | R2&R3 (Lux/fc) | R4 (Lux/fc) | |
| | High | 12.0/1.2 | 18.0/1.8 | NA | 3.0 |
| Major | Medium | 9.0/0.9 | 13.5/1.35 | NA | 3.0 |
| | Low | 6.0/0.6 | 9.0/0.9 | NA | 4.0 |
| | High | 8.0/0.8 | 12.0/1.2 | NA | 3.0 |
| Collector | Medium | 6.0/0.6 | 9.0/0.9 | NA | 3.5 |
| | Low | 4.0/0.4 | 6.0/0.6 | NA | 4.0 |
| | High | 6.0/0.6 | 9.0/0.9 | NA | 6.0 |
| Local | Medium | 5.0/0.5 | 7.5/0.75 | NA | 6.0 |
| | Low | 3.0/0.3 | 4.5/0.45 | NA | 6.0 |

## Table 3 Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014)

| Recommended Lighting Design Criteria for Pedestrian Conflict Areas (IES RP-8-2014) | | | | | |
|---|---|---|---|---|---|
| ILLUMINANCE | | | | | |
| Conflict Area | Average Maintained Illumination at Pavement by Pedestrian Area Classifications | | | EV min (Lux/fc) | Uniformity Ratio Eavg/Emin |
| | High (Lux/fc) | Medium (Lux/fc) | Low (Lux/fc) | | |
| Mixed Vehicle and Pedstrian | 20.0/2.0 | NA | NA | 10.0/1.0 | 4.0 |
| Pedestrian Only (High) | 10.0/1.0 | NA | NA | 5.0/0.5 | 4.0 |
| Pedestrian Only (Medium) | NA | 5.0/0.5 | NA | 2.0/0.2 | 4.0 |
| Rural/Semi Rural Areas | NA | NA | 2.0/0.2 | 0.6/0.06 | 10.0 |
| Low Density Residential (2 or Fewer Dwelling Units Per Acre) | NA | NA | 3.0/0.3 | 0.8/0.08 | 6.0 |
| Medium Density Residential (2.1 to 6.0 Dwelling Units Per Acre) | NA | NA | 4.0/0.4 | 1.0/0.1 | 4.0 |
| $E_{avg}$ = Minimum Maintained Average horizontal Illuminance at Pavement | | | | | |
| $E_{min}$ = Minimum Horizontal Illuminance at Pavement | | | | | |
| EVmin = Minimum Vertical Illuminance at 1.5m Above Pavement (Horizontal Only) | | | | | |

## Table 4 Recommended Lighting Design Criteria for Pedestrian Portion of Pedestrian / Vehicular Underpasses (IES RP-8-2014)

| Maintained Illuminance Values for Walkways | | | |
|---|---|---|---|
| | Eavg (lux/fc) | Evmin (lux/fc) | Eavg/Emin) |
| Day | 100.0/10.0 | 50.0/5.0 | 3.0 |
| Night | 40.0/4.0 | 20.0/2.0 | 3.0 |

## Table 5 Required Lighting Design Criteria for Intersections (IES RP-8-2014) (Continuously lighted streets)

| Recommended Lighting Design Criteria for Intersections (IES RP-8-2014) (Continuously Lighted Streets) | | | | |
|---|---|---|---|---|
| ILLUMINANCE | | | | |
| Functional Classification | Average Maintained Illumination at Pavement by Pedestrian Area Classifications | | | Uniformity Ratio Eavg/Emin |
| | High (Lux/fc) | Medium (Lux/fc) | Low (Lux/fc) | |
| Major/Major | 34.0/3.4 | 26.0/2.6 | 18.0/1.8 | 3.0 |
| Major/Collector | 29.0/2.9 | 22.0/2.2 | 15.0/1.5 | 3.0 |
| Major/Local | 26.0/2.6 | 20.0/2.0 | 13.0/1.3 | 3.0 |
| Collector/Collector | 24.0/2.4 | 18.0/1.8 | 12.0/1.2 | 4.0 |
| Collector/Local | 21.0/2.1 | 16.0/1.6 | 10.0/1.0 | 4.0 |
| Local/Local | 18.0/1.8 | 14.0/1.4 | 8.0/0.8 | 6.0 |
| LUMINANCE | | | | |
| Functional Classification | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) HIGH PED CONFLICT | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) MEDIUM PED CONFLICT | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) LOW PED CONFLICT | AVG. UNIFORMITY RATIO $L_{avg}/L_{min}$ |
| Major/Major | 3.4 | 2.6 | 1.8 | 3.0 |
| Major/Collector | 2.9 | 2.2 | 1.5 | 3.0 |
| Major/Local | 2.6 | 2 | 1.3 | 3.0 |
| Collector/Collector | 2.4 | 1.8 | 1.2 | 4.0 |
| Collector/Local | 2.1 | 1.6 | 1 | 4.0 |
| Local/Local | 1.8 | 1.4 | 0.8 | 6.0 |

## Table 6 Required Lighting Design Criteria for Isolated Intersections (IES RP-8-2014) (Non-Continuously lighted streets)

| Recommended Lighting Design Criteria for isoclated Intersections (IES RP-8-2014) (Non-Continuously Lighted Streets) | | | | |
|---|---|---|---|---|
| Road Classification | Pavement Classifications | | | Uniformity Ratio Eavg/Emin |
| | R1 (Lux/fc) | R2&R3 (Lux/fc) | R4 (Lux/fc) | |
| Freeway Class A | 6.0/0.6 | 9.0/0.9 | 8.0/0.8 | 3.0 |
| Freeway Class B | 4.0/0.4 | 6.0/0.6 | 5.0/0.5 | 3.0 |
| Expressway | 6.0/0.6 | 9.0/0.9 | 8.0/0.8 | 3.0 |
| Major | 6.0/0.6 | 9.0/0.9 | 8.0/0.8 | 3.0 |
| Collector | 4.0/0.4 | 6.0/0.6 | 5.0/0.5 | 4.0 |
| Local | 3.0/0.3 | 4.0/0.4 | 4.0/0.4 | 6.0 |
| LUMINANCE | | | | |
| Road Classification | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) | | | AVG. UNIFORMITY RATIO $L_{avg}/L_{min}$ |
| Freeway Class A | 0.6 | | | 3.0 |
| Freeway Class B | 0.4 | | | 3.0 |
| Expressway | 0.6 | | | 3.0 |
| Major | 0.6 | | | 3.0 |
| Collector | 0.4 | | | 4.0 |
| Local | 0.3 | | | 6.0 |

## Table 7 Required Lighting Design Criteria for Roundabouts (IES DG-19-2008)

| Recommended Lighting Design Criteria for Roundabouts (IES DG-19-2008) | | | | |
|---|---|---|---|---|
| ILLUMINANCE | | | | |
| Functional Classification | Average Maintained Illumination at Pavement by Pedestrian Area Classifications | | | Uniformity Ratio Eavg/Emin |
| | High (Lux/fc) | Medium (Lux/fc) | Low (Lux/fc) | |
| Major/Major | 34.0/3.4 | 26.0/2.6 | 18.0/1.8 | 3.0 |
| Major/Collector | 29.0/2.9 | 22.0/2.2 | 15.0/1.5 | 3.0 |
| Major/Local | 26.0/2.6 | 20.0/2.0 | 13.0/1.3 | 3.0 |
| Collector/Collector | 24.0/2.4 | 18.0/1.8 | 12.0/1.2 | 4.0 |
| Collector/Local | 21.0/2.1 | 16.0/1.6 | 10.0/1.0 | 4.0 |
| Local/Local | 18.0/1.8 | 14.0/1.4 | 8.0/0.8 | 6.0 |
| LUMINANCE | | | | |
| Road Classification | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) HIGH PED CONFLICT | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) MEDIUM PED CONFLICT | AVG. LUMINANCE $L_{avg}$ (cd/m$^2$) LOW PED CONFLICT | AVG. UNIFORMITY RATIO $L_{avg}/L_{min}$ |
| Major/Major | 3.4 | 2.6 | 1.8 | 3.0 |
| Major/Collector | 2.9 | 2.2 | 1.5 | 3.0 |
| Major/Local | 2.6 | 2 | 1.3 | 3.0 |
| Collector/Collector | 2.4 | 1.8 | 1.2 | 4.0 |
| Collector/Local | 2.1 | 1.6 | 1 | 4.0 |
| Local/Local | 1.8 | 1.4 | 0.8 | 6.0 |

B. Step 2: Luminaire and Pole Selection.

This step involves selection of the luminaire and pole equipment. Use the roadway lighting design checklist to assist in the luminaire and pole selection.

The Luminaire shall be selected from the City of Rochester Approved Product List and shall be a Light Emitting Diode (LED) type. The lumen output shall be selected from the standard products listed in the Approved Product List, so the City of Rochester has a standard product throughout the City of Rochester.

The color temperature of the LED light shall be selected during this step. The color temperature of the LED shall be selected on a project by project bases with the intent to provide a uniform lighting system throughout the City of Rochester. In general, the roadway/street lighting shall be 3000K correlated color temperature.

Optically the LED lighting shall be selected from the Approved Product List and selected to maximize the coverage on the roadway/street using type 2 or type 3 distribution.

Pole equipment shall be selected from the City of Rochester Approved Product List. Pole heights and color shall be selected to standardize on pole equipment within the City of Rochester.

The Luminaire and pole shall be selected at the same time and together shall be considered the lighting unit. The actual light output shall be calculated with the characteristics of the lighting taking into account the lumen output and distribution of the luminaire and the mounting height of the pole. The IES file shall be used with the photometric design software in conjunction with lighting unit characteristics.

The final selection of the lighting unit and spacing requirements will produce a lighting design that meets the light level guidelines in this guide. The lighting designer may be required to run the lighting design photometrics and rerun them with modifications to spacing, lumen output, or light distribution to achieve the lighting design requirements.

C. Step 3: Luminaire Spacing and Luminaire Placement.

The lateral and longitudinal luminaire mounting dimensions will be determined in this step. The following is a guide to be used as a starting point. The actual lateral and longitudinal dimensions should be confirmed and/or modified as required with the photometric calculation software.

The lateral dimension is the distance from the roadway edge to the luminaire. This is required to place the luminaire over the roadway edge. This distance will assist in determining arm length to locate the pole taking care to locate the pole out of the clear zone while maintaining the luminaire position in the desired location.

Longitudinal spacing is the pole spacing along the roadway/street and is calculated by using the following equation:

Luminaire Spacing = (LL*CU*LLD*LDD)/(Eh*W)

LL = Initial lamp lumens; The LL is determined above using the photometric data for the light source the designer selected.

CU = Coefficient of utilization; CU is determined using the utilization curves specific to the source and roadway characteristics.

LLD = Lamp lumen depreciation factor; The LLD is determined from above.

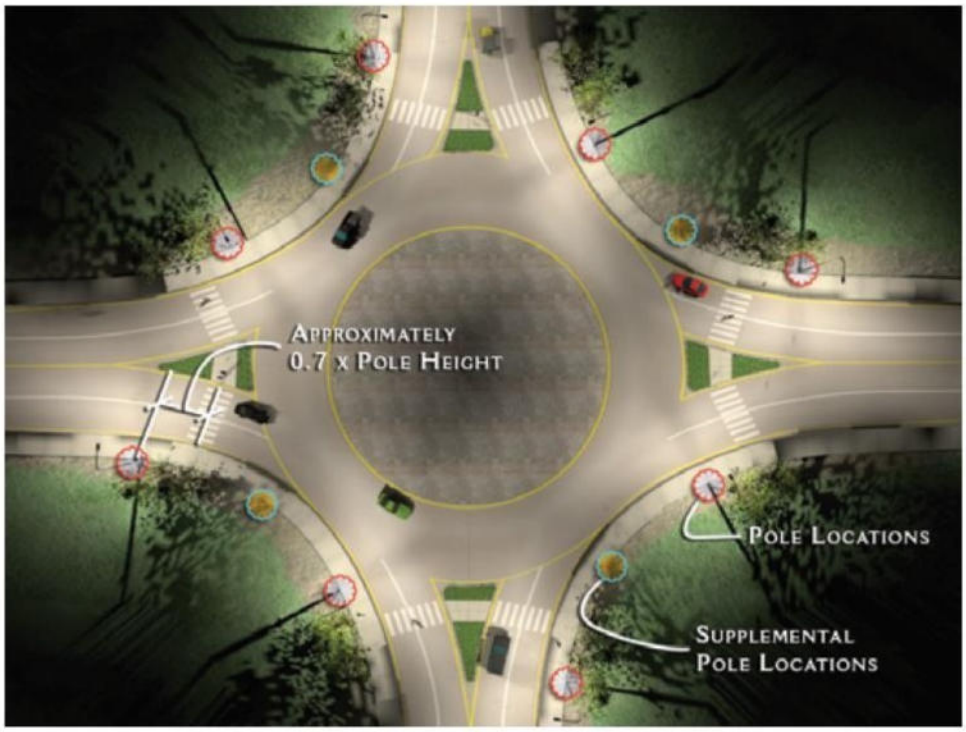
LDD = Luminaire dirt depreciation factor; The LLD is determined from above.

Eh = Average maintained level of illumination; The Eh is determined from above.

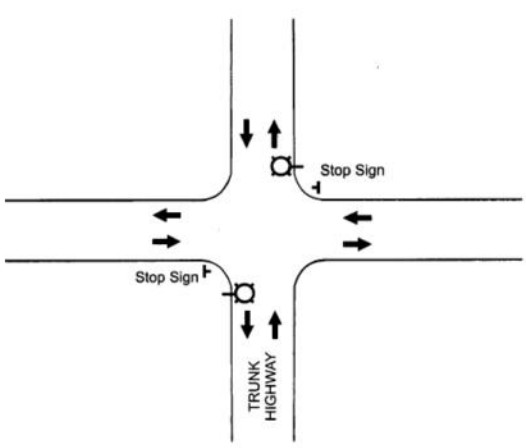
W = Width of lighted roadway; W is determined from the curb to curb or pavement edge to pavement edge lateral distance of the roadway.

The following graphics are the spacing and lighting unit location guidelines for Roundabout Lighting, Intersection Lighting.

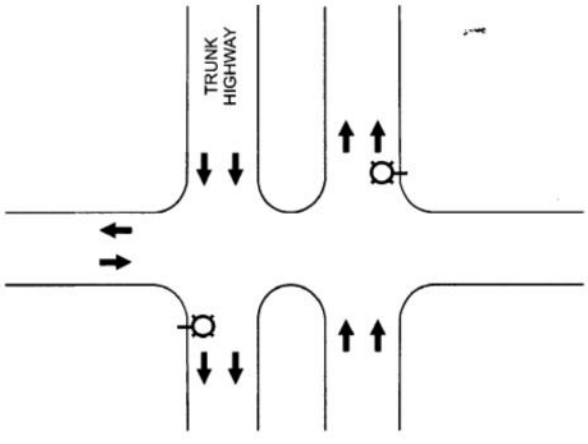
### Figure 16: Typical Roundabout Placement of Lighting Units




### Figure 17: Typical Intersection Placement of Lighting Units




Simple Intersection




Divided Intersection

D. Step 4: Design Verification

The luminaire spacing equation as defined in the previous design step is based on the average level of illumination or lumens per square foot on the area of roadway under consideration. This establishes the quantity of illumination. Up to this point, nothing has been calculated regarding the quality of illumination.

The uniformity ratio is used as one way of specifying the quality of lighting. For the purpose of this design guide, it is defined as the average maintained illumination value divided by the minimum maintained illumination value. Because the average maintained level of illumination is already defined by the design process (Eh), the next step involves finding the minimum point of illumination.

The minimum point of illumination can be determined by inspection of the photometric lighting calculation software calculation results.

The uniformity ratio can be determined by inspection of the photometric lighting calculation software calculation results. The Uniformity Ratio (Ave/Min) is included in the photometric calculation results.

If the uniformity ratio in the photometric calculation results is less than the required uniformity ratio (Ave/Min) given in this design manual than the lighting design is acceptable. If it is higher than the design team shall adjust the photometric software to meet the design guidelines.

The uniformity ratio shall be used to determine the quality of the lighting design. The uniformity ratio is determined with the following ratio:

Note that the design team must verify the LLF when reviewing the photometric calculation results.

Uniformity Ratio = [Average Maintained Illumination (Eh)]/[Minimum Maintained Illumination (Emin)].

E. Step 5: Determine the Source of Power (SOP)

The lighting designer must meet and discuss the source of power with Rochester Public Utilities and document all decisions made. Use the checklist in Appendix B to determine the source of power.

1. The following notes correspond with each numbered item in the Source of Power Checklist in the Appendix B.

    a. Type of Construction and Possible Implications: If major roadway construction is involved, utility lines may need to be relocated. This can affect the location of a combined

signal and lighting pad (SOP) for temporary lighting. New lighting systems will need new utility equipment and coordination is required. Modifications to existing lighting system may require existing utility equipment to be modified to accommodate the modified lighting systems. When modifying a lighting system, power to all units should be maintained at all times. Also, when replacing a system, the old system must remain operational until the new system is operational.

b. Electrical Service: Check condition of cabinet and pad. Additionally, check for correct voltage. New Service: To save installation costs, combine same location service for temporary and permanent. Have permanent cabinet installed during early stages if possible. Generally, permanent service will be pad mounted but could be pole mounted, so coordination is required.

c. Coordination of Work with Rochester Public Utilities: The contractor will be responsible for portions of the utility-related work, and the Rochester Public Utilities will be responsible for portions of the utility-related work as well. These work responsibilities shall be coordinated and specified accordingly.

d. Location of Service – Topography of Area: Location of transformer will affect concrete pad requirements and may affect grading requirements. Lighting systems projects by the City of Rochester Public Works are typically metered. Lighting systems projects by Rochester Public Utilities are typically not metered.

e. Signals: If signals are involved, a combined pad with all signal and lighting cabinets may be desirable. If signals are involved the lighting on the signals may change the roadway/street lighting requirements because the intersections will be lighted with the signal system.

f. Meter Address / or Transformer #: An address should be established for the SOP and confirm this with the utility.

F. Step 6: Lighting System Layout

Utilize the information from the steps above to layout the lighting system.

The exact locations of light poles may be adjusted to avoid obstructions encountered in the field. Such items as solid rock, power lines, slopes, existing guard rail, etc., may make it necessary or desirable to locate the pole differently than is indicated in the plans.

The project engineer may stake the poles up to 10 feet along the direction of the roadway from the locations indicated in the plans. If a greater change is required, the project engineer should consult with the lighting system designer to determine if such a change requires changing the placement of other light poles in the system.

If a guardrail or noise wall exists at the location and is not indicated in the plans, light poles should be placed behind it if possible. Clearance between the back of the guardrail and the front of the light pole should be at least 2 feet.

Poles should not be closer than 10 feet in any direction from power lines. If 10 feet cannot be maintained, contact the power company.

Poles should not be closer than 25 to 50 feet in any direction from overhead signs.

Poles should not be placed in ditches for maintenance reasons.

G. Step 7: Lighting Distribution System Layout

The electrical service for most roadway lighting systems will be 100A, 120/240V, 1-Phase. Coordinate voltage and amperage requirements with the City of Rochester on a project by project basis.

1. The City of Rochester conduit and wire system shall be provided as follows:
    a. The entire roadway lighting system shall be provided with conduit and the wire shall be pulled thought the conduit. In general, for most roadway lighting system in the City of Rochester the conduit system shall be 1.5 inch PVC Schedule 40 conduit or HDPE conduit in lengths greater than 50 feet.
    b. 1.5 inch Rigid Steel Conduit shall be used for bridges, retaining walls, and jersey barriers.
    c. Follow 40 percent fill rule for conduit requirements where required.
    d. Provide XHHW-2 type copper stranded wire suitable for underground conduit installation.
2. The City of Rochester used the following color as standard for conduits.
    a. Red for Power
    b. Orange for Fiber
    c. Lighting conduit shall not be red or orange
3. The City of Rochester does not have a color standard for wire.

H. Step 8: Voltage Drop Calculation

Voltage Drop shall be calculated for each lighting circuit and appropriate wire sizes shall be used based on voltage drop calculations to the last lighting unit on each circuit. The voltage drop shall not exceed 2 percent for the electrical service and 3 percent for the roadway lighting branch circuit or 5 percent total.

The driver input currents shall be used (in lieu of the fixture wattage) to calculate load requirements and related circuit breaker sizes. The driver input current shall also be used to calculate voltage drop.

I. Step 10. Wiring Diagram, Service Cabinet, and Number Poles

Step 10 involves completing the wiring diagram, service cabinet, and numbering poles. Locate the service cabinet with considerations for the following:

1. Maintenance (Can a vehicle get. to the location? Can all the lights be seen from the cabinet?).
2. Place outside the clear zone
3. Place approximately equidistant to all wiring to minimize voltage drops.

J. Step 11. Determine Salvage and Removal Items

Design Step 11 is to determine salvage and removal items. To complete this design step, obtain lighting exhibits or as built in-place plans from the lighting system owner and conduct a field review of the new system.

Design team shall coordinate the existing lighting to be removed, salvaged, and reinstalled. The design team shall coordinate the existing lighting to remain and confirm that it will be reconnected to the new system as needed.

K. Step 12. Determine Temporary Lighting Needs

Generally, temporary lighting is not included. If the City of Rochester requires temporary lighting, provide temporary lighting. Temporary lighting is designed to the same standards as permanent lighting.

L. Step 13. Quantities

To determine quantities the design team shall coordinate the pay items located in the special provisions and coordinated the units and quantities with the drawings.

M. Step 14. Plan Preparation

The following is a typical guide that can be used for plan preparation. The design team may need to modify the following information as needed to provide a lighting design that meets the needs of the project.

N. The following lists includes typical sheets required.

1. Title sheet.
2. Site Plan – Lighting Layout Plan.
3. Details.
4. Line Diagram.
5. Schedules.

O. Typical sheet sizes are as follows.

1. 11x17.
2. 22x34.

P. Sign and Seal Requirements

1. Plan sheets shall be signed and sealed as required per the State of Minnesota requirements.

## 5.2 MEASUREMENT AND FIELD VERIFICATION

The guidelines listed in this design guide are listed in either Illuminance or Luminance but not both. All field measurements and verification shall be done using Illuminance. The Luminance values submitted shall be used to confirm the design meets the guidelines of this design guide where Luminance is listed. The Illuminance values submitted shall be used to confirm the design meets the guidelines of this design guide where Illuminance is listed. The Illuminance values shall also be used for field measurements to confirm and validate the installation meets the design requirements for all projects.

Where luminance is used as the design recommendation both Luminance and Illuminance shall be submitted for review. During the review process luminance will be used to verify the design meets the recommended levels. During the verification process the Illuminance levels will be used to verify the installation meets the design recommendations.

According to IES RP-8-14 for determining what horizontal illuminance levels should be used as an equivalent to the recommended luminance level, a ratio of 1cd/m2 = 15 lux for an R2 or R3 pavement and 1cd/m2 = 10 lux for an R1 pavement can be used. Field validation of a lighting system performance may be done by the luminance or illuminance method. 10 Lux = 1 fc.

A. Methods of Field Measurement

Field measurements can be made of both permanent luminance and visibility level of a target. The instrument is both expensive and time-consuming to use. Therefore, Illuminance will be used for field measurements as part of this Design Manual.

According to IES PR-8-14 illuminance is the density of luminous flux incident on a surface. It is measured using a light sensitive cell. If the cell surface is horizontal it is termed horizontal illuminance or if the cell is vertical it is called vertical illuminance.

B. Straight Roadway Areas

For illuminance calculations the luminaire/point combinations shall be included as long as the calculated result is not zero. The grid of calculation points shall be selected so that, for straight roadway sections between traffic conflict areas, the area of all grid cells is identical. A grid cell is defined as the area bounded by an imaginary line that is equidistant from all adjacent grid intersections and touches the edge of traveled way. There should be two grid lines per lane located one-quarter (1/4) of the distance from the edge of each lane. In the event that the roadway varies in the number of lanes (e.g., left turn lanes added before the intersections), the grid shall be based on the number of lanes for the majority of the length of the roadway. In the event that the roadway width and number of lanes change, the revised grid shall be used for the new width of the roadway. In the longitudinal direction there shall be at least ten points, not more than 5 meters on center, between the luminaires. The starting point for the grid lines shall not be located directly under the luminaire but shall start at a point one-half (1/2) the grid cell size from the luminaire. In the event that the luminaire location geometry is constant the length of the gridded portion of the roadway need be no longer than the spacing between luminaries. In the event the luminaire geometry is not uniform along the length of the roadway, the gridded portion should continue until it has reached the point where the luminaire geometry remains constant.

The calculation points for horizontal and vertical illuminance in the pedestrian area adjacent to the street shall match the street grid spacing, be positioned in the center of the sidewalk / pedestrian area, be located 1.5 meters in height, and be calculated in assuming a meter aimed along the sidewalk in both walking directions.

Calculation points for the vertical illuminance in crosswalks shall be positioned at a height of 1.5 meters spaced at 0.5 meters. A single line of calculation points shall be placed in the center of the crosswalk extending from the curb line to the centerline of the roadway with the meter oriented in the direction of the approaching driver for both sides of the roadway.

Calculation point for intersections shall extend from the stop bar at each street across the entire intersection. The grid spacing for the points shall be at 2.0 meters throughout the calculation area.

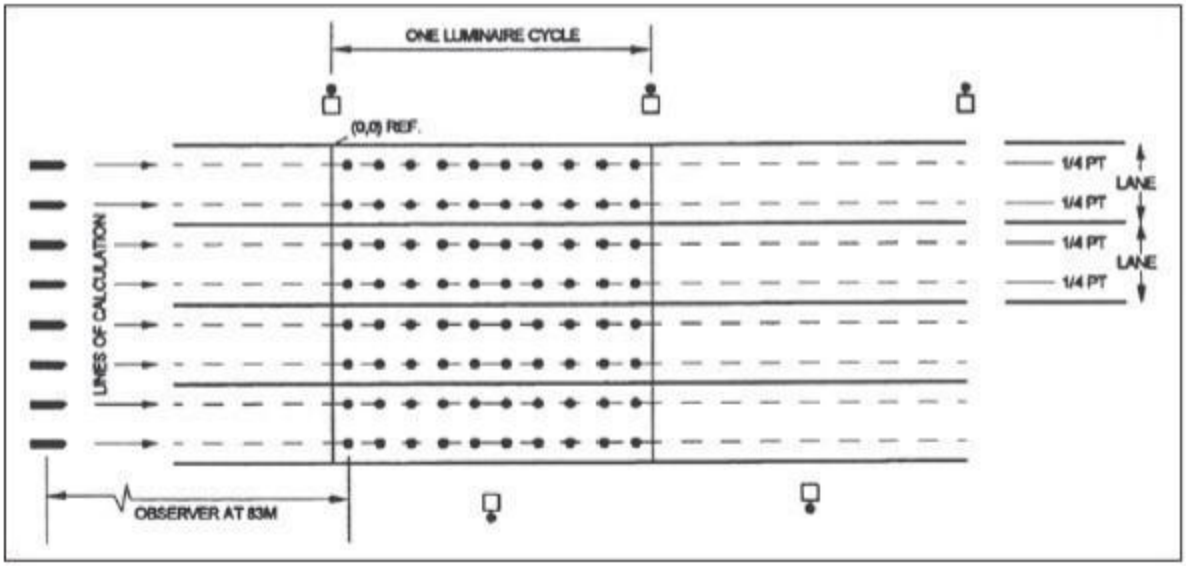
For curved roadway sections (less than 600 meter radius) or roads with steep and variable grades (6 percent or greater) can be calculated using the horizontal illuminance method. Grids should be placed across the travel lanes, at the same locations defined above for straight roadways.

Traffic conflict areas can be divided into two types of areas where vehicles conflict with crossing vehicles and pedestrians, and areas where vehicular traffic must merge, diverge, or weave to reach either a through traffic lane or an exit lane. Where traffic conflict areas do not involve

merging or diverging vehicles lanes, the normal grid should continue without change and any grid point falling within the defined traffic conflict area should meet the criteria for that area as defined in this design guide. Where traffic conflict areas do involve merging, diverging or weaving there should be two grids superimposed on that area. Each grid should follow the rules for its lanes prior to entering the traffic conflict area. The grids can be separate or forced to coincide, depending upon the desire of the designer and the capability of the calculation program. In any event, the driver of the vehicle approaching the traffic conflict area should be considered as an observer and calculations made for the appropriate grid points that define the lanes(s) that the driver might use to enter the traffic conflict area.

The following shows typical location of calculation points taken from IES RP-8-14 and as described above.

### Figure 18: Typical Location of Calculation Points



# 6.0 CITY OF ROCHESTER LIGHTING TEMPLATES

## 6.1 CLASSIFICATION TYPE MAJOR

Refer to Appendix D for the City of Rochester lighting template for classification type Major.

## 6.2 CLASSIFICATION TYPE COLLECTOR

Refer to Appendix D for the City of Rochester lighting template for classification type Collector.

## 6.3 CLASSIFICATION TYPE LOCAL

Refer to Appendix D for the City of Rochester lighting template for classification type Local.

City of Rochester Sample Lighting Plans
July 22, 2019

# 7.0 CITY OF ROCHESTER SAMPLE LIGHTING PLANS

## 7.1 SAMPLE LIGHTING PLANS

Refer to the Appendix E for the City of Rochester Sample Lighting Plans

# 8.0 SPECIFICATIONS AND AGREEMENTS

## 8.1 SPECIFICATION BOOK

The City of Rochester Public Works uses the latest version of the MnDOT standard specifications for construction for lighting.

## 8.2 SPECIAL PROVISIONS

The City of Rochester Public Works issues a Special Lighting Provisions (SL) specification to identify any necessary information that is not given in the plans or in the MnDOT standard specifications book. The SL specification also includes any information where the City of Rochester differs from the MnDOT standard Specifications book such as the specification for the City of Rochester standard lighting units.

Refer to Appendix F for the City of Rochester Sample Special Provisions

City of Rochester Standard Plates
July 22, 2019

# 9.0 CITY OF ROCHESTER STANDARD PLATES

## 9.1 LIGHT FOUNDATION – DESIGN E PRECAST, MNDOT 8127E

Refer to the Appendix for standard plate MnDOT 8127E Light Foundation – Design E Precast for 40-foot pole or less.

## 9.2 LIGHT FOUNDATION – DESIGN E CAST IN-PLACE, MNDOT 8127E

Refer to the Appendix for standard plate MnDOT 8127E Light Foundation – Design E Cast In-Place for 40-foot pole or less.

## 9.3 EQUIPMENT PAD B – EQUIPMENT PAD B PRECAST, MNDOT 8106D

Refer to the Appendix for standard plate MnDOT 8106D Equipment Pad B Precast

## 9.4 EQUIPMENT PAD B – EQUIPMENT PAD B CAST IN PLACE, MNDOT 8106D

Refer to the Appendix G for standard plate MnDOT 8106D Equipment Pad B Cast in Place

# 10.0 REFERENCES

IES RP-8-14 – ROADWAY LIGHTING

IES DG-19-08 – DESIGN GUIDE FOR ROUNDABOUT LIGHTING

MnDOT ROADWAY LIGHTING DESIGN MANUAL

Rochester Comprehensive Plan 2040 Travel patterns and Link Analysis report

# CITY OF ROCHESTER ROADWAY LIGHTING DESIGN GUIDE

## APPENDIX

# Appendix A

## ROADWAY LIGHTING DESIGN CHECKLIST

A. The Roadway Lighting Design Checklist is attached.

**CITY OF ROCHESTER ROADWAY LIGHTING DESIGN CHECKLIST**

Project Name _____

Project Number _____

Designer Name_____

**A. Type of Rochester's Functional Classification: _____**

1. Interstate and Interregional Corridors
2. Strategic Arterials
3. Primary Arterials
4. Secondary Arterials
5. Primary Collectors
6. Local Collectors
7. Local Street
8. Street with Multiple Classifications

**B. Classification of the area or roadway (Listed Below): _____**

1. Freeway
2. Expressway
3. Major
4. Collector
5. Local
6. Local Residential
7. Intersection (Continuously Lighted Streets)
8. Isolated Intersection (Non-Continuously Lighted Streets)
9. Roundabout
10. Crosswalk
11. Sidewalk
12. Bikeway

**C. Type of lighting system (Listed Below): _____**

9. Roadway Lighting
10. Street Lighting
11. Intersection Lighting – Continuously Lighted Roadways/Streets
12. Isolated Intersection Lighting – Non-Continuously Lighted Streets
13. Roundabout Lighting
14. Partial Residential Street Lighting – Intersection Lighting and Partially Continuously Lighted Streets.

**D. Circle Types of Lighting Subsystems that are Part of this Project (Listed Below)**

1. Crosswalk Lighting
2. Adaptive Lighting
3. Transition Lighting
4. Grade Changes and Sharp Curves Lighting
5. Underpass and Overpass Lighting
6. Railroad Grade Crossing Lighting
7. Trees Adjacent to Roadways
8. Median

**E. Classification of Pedestrian Conflict Areas (Listed Below): _____**

1. High
2. Medium
3. Low

**F. Classification of Roadway Surfaces: _____**

1. Class R1 – Portland Cement Concrete
2. Class R2 & R3 – Standard Asphalt Road Surfaces
3. Class R4 – Special Purpose Asphalt Road Surface

**G. Alignment of traffic lanes or number of lanes: _____**

**H. Identify Footcandle Requirements from the appropriate tables. _____**

I. Retaining walls or guardrail in the area: _____

J. Any ground mounted or overhead signing: _____

K. Any overhead power lines: _____

L. Width of shoulders (include median shoulders): __

M. Any sidewalks/paths: _____

N. What is the topography (Slopes, grades, etc.): ____

O. Urban or rural: _____

P. Any intersecting roadways: _____

Q. Describe the basic geometry: _____

R. Speed: _____

S. Any ambient lighting: _____

T. Traffic signals or beacons: _____

U. Median barrier: _____

V. Any non-standard or ornamental lighting required: _____

W. Do we need to remove or relocate any lighting? ___

X. Do we need to relocate any utilities? _____

Y. Are there bridges involved: _____

Z. Air obstruction lights required: _____

AA. Navigation lights required: _____

BB. Are pole-mounted receptacles required? _____

CC. Are banner arms required? _____

# Appendix B
# SOURCE OF POWER (SOP) CHECKLIST

A. The Source of Power (SOP) Checklist is Attached

**CITY OF ROCHESTER SOURCE OF POWER (SOP) CHECKLIST**

Feed Point #: _____ New _____, Inplace _____

Location of SOP: _____

Date: _____

Designer: _____

Power.Co. Field Rep. Name, Telephone, Address: _____

_____

Power Company: _____

Proposed Letting Date: _____

## A. TYPE OF CONSTRUCTION AND POSSIBLE IMPLICATIONS

1. Identify the type of roadway / street lighting construction: _____
   a. New lighting System
   b. Modification of existing System
   c. Replacement of Existing System
   d. Temporary Lighting System

2. Discuss construction staging, timeline of project and proposed letting date. Record discussion below:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

## B. ELECTRICAL SERVICE

Identify the following electrical service characteristics for both the existing electrical service (if any) and the new electrical service (if required)

1. Existing Service: □Yes □ No
   Service Wiring Type: □ Overhead □ Underground
   Service Mounting Type: □ Pole □ Pad
   Service Voltage: □120/240 Volt □Other_____

   Record Existing Transformer size in KVA _____

2. Install new service: □ Yes □ No
   Temporary Service Needed □ Yes □ No
   Permanent Service □ Yes □ No
   Service Wiring Type □ Overhead □ Underground
   Service Mounting Type □ Pole □ Pad
   Service Voltage □ 120/240 Volt □ Other_____

   Record Transformer size in KVA _____

3. Record discussion below:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
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_____
_____
_____
_____
_____
_____
_____

**C. Coordination of Work with Rochester Public Utilities**

Verify and Confirm the Following work responsibilities:

1. Rochester Public Utilities will be responsible for the following:
   e. Furnishing and installing the primary conduit, conductors, poles, and related primary equipment.
   f. Furnishing and installing transformer.
   g. Furnishing and installing the transformer pad.
   h. Termination of underground primary cables.
   i. Furnish meter.

2. The contractor will be responsible for the following:
   a. Make all arrangements with the power company for obtaining electrical service, obtaining and completing all forms required by the utility, and furnish all labor and material required for the electrical service which the utility does not provide.
   b. Verifying locations of power company equipment with the power company.
   c. Furnish and install secondary conduits and cables.
   d. Furnish and install a power company approved metering enclosure.
   e. Terminating all secondary conductors at the service entrance equipment.
   f. Terminating and providing conductors required for metering.
   g. Installing equipment which is supplied but not installed by the Rochester Public Utilities.

3. Record discussion below:

**D. LOCATION OF SERVICE – TOPOGRAPHY OF AREA**

1. Describe quadrant and define approx. location of transformer/pole/pad (face door away from roadway traffic).

   _____
   _____
   _____

2. Electrical Service is Metered or Unmetered: _____

3. Record discussion below:

   _____
   _____
   _____
   _____
   _____

**E. SIGNALS**

1. Is signal system involved w/project? If so, coordinate activities:

2. Record discussion below:

   _____
   _____
   _____
   _____
   _____

**F. METER ADDRESS / OR TRANSFORMER #:**

1. Record Meter Address Here_____

2. Record Transformer # Here _____

3. Record AIC Available at the Transformer Here _____

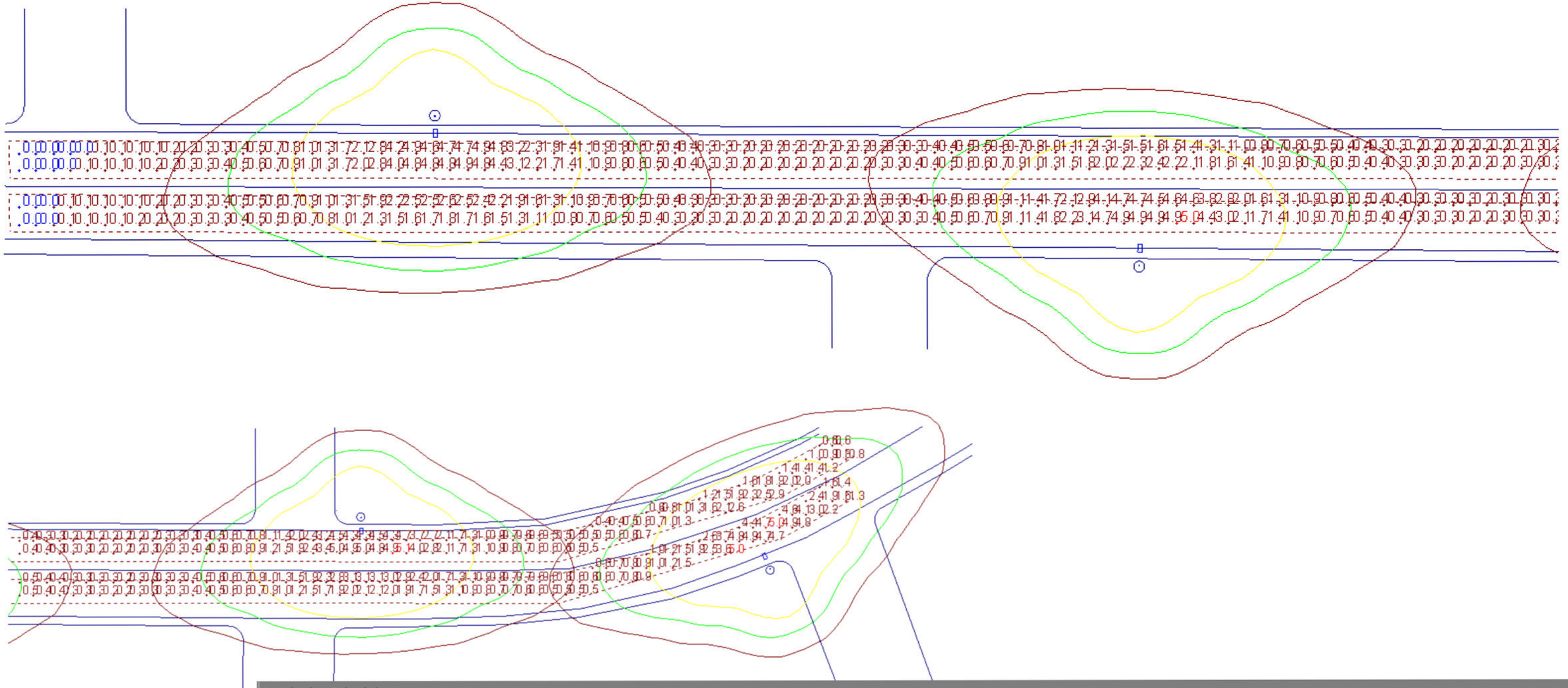
4. Billing Address:

   _____
   _____
   _____

# Appendix C
## CITY OF ROCHESTER EXISTING LIGHTING SYSTEMS

A. The sample lighting plans are as follows and attached.

1. EXISTING-COMMERCIAL SUBDIVISION STREET_TECHNOLOGY DRIVE NW
2. NEW-COMMERCIAL SUBDIVISION STREET_TECHNOLOGY DRIVE NW
3. EXISTING-LOCAL RESIDENTIAL STREET_19TH ST NW AND 21ST AVE NW
4. NEW-LOCAL RESIDENTIAL STREET_19TH ST NW AND 21ST AVE NW
5. EXISTING-REDEVELOPMENT DOWNTOWN_MEDICAL CENTER ZONE STREET 2ND SW AND IST AVE NW
6. NEW-REDEVELOPMENT DOWNTOWN_MEDICAL CENTER ZONE STREET 2ND SW AND IST AVE NW
7. EXISTING-ROUNDABOUT (BADGER HILLS DRIVE NW AND SUPERIOR DRIVE NW) ILLUMINANCE
8. EXISTING-ROUNDABOUT (BADGER HILLS DRIVE NW AND SUPERIOR DRIVE NW) LUMINANCE
9. NEW-ROUNDABOUT (BADGER HILLS DRIVE NW AND SUPERIOR DRIVE NW) ILLUMINANCE
10. NEW-ROUNDABOUT (BADGER HILLS DRIVE NW AND SUPERIOR DRIVE NW) LUMINANCE



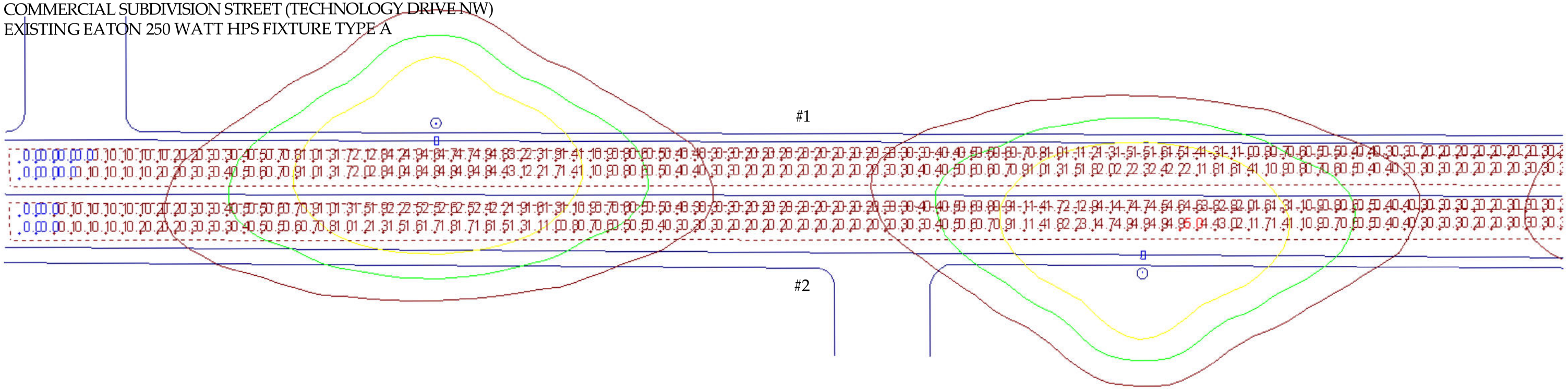
**Luminaire Schedule**

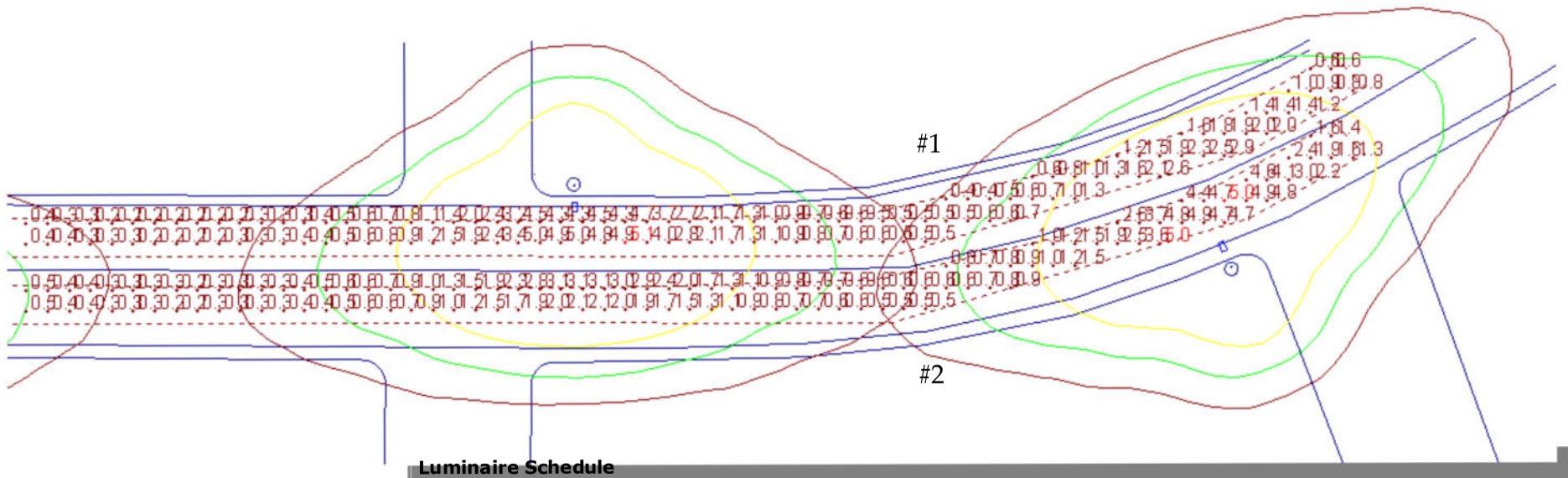
| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens Per Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | 4 | EATON - STREETWORKS (FORMER COOPER LIGHTING) Retail, Roadway, Sidewalk, Site, Street, Substation, Security, Corrosion Resistant, Vandal Resistant, Wet Location | OVZ25SXX3EG | 250W HPS TYPE III ROADWAY | 250W HPS CL E-18 | 1 | OVZ25SXX3EG_TYPE 3_250W.ies | 27500 | 0.7 | 250 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 1.3 fc | 5.1 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #2 | + | 1.3 fc | 5.0 fc | 0.0 fc | N/A | N/A | 0.3:1 |

COMMERCIAL SUBDIVISION STREET (TECHNOLOGY DRIVE NW)
EXISTING EATON 250 WATT HPS FIXTURE TYPE A




**Luminaire Schedule**

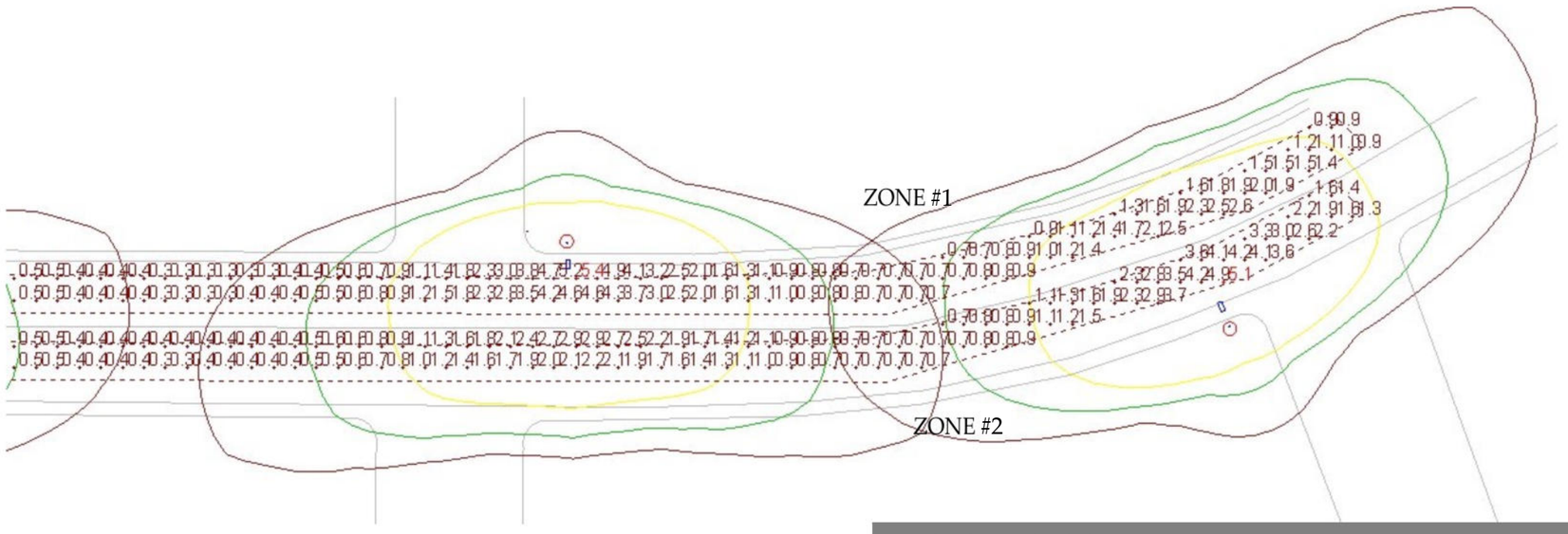
| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens Per Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | 4 | EATON - STREETWORKS (FORMER COOPER LIGHTING) Retail, Roadway, Sidewalk, Site, Street, Substation, Security, Corrosion Resistant, Vandal Resistant, Wet Location | OVZ25SXX3EG | 250W HPS TYPE III ROADWAY | 250W HPS CL E-18 | 1 | OVZ25SXX3EG_TYPE 3_250W.ies | 27500 | 0.7 | 250 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 1.3 fc | 5.1 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #2 | + | 1.3 fc | 5.0 fc | 0.0 fc | N/A | N/A | 0.3:1 |

COMMERCIAL SUBDIVISION STREET (TECHNOLOGY DRIVE NW)
NEW PHILIPS RFM 106 WATT LED FIXTURE TYPE A



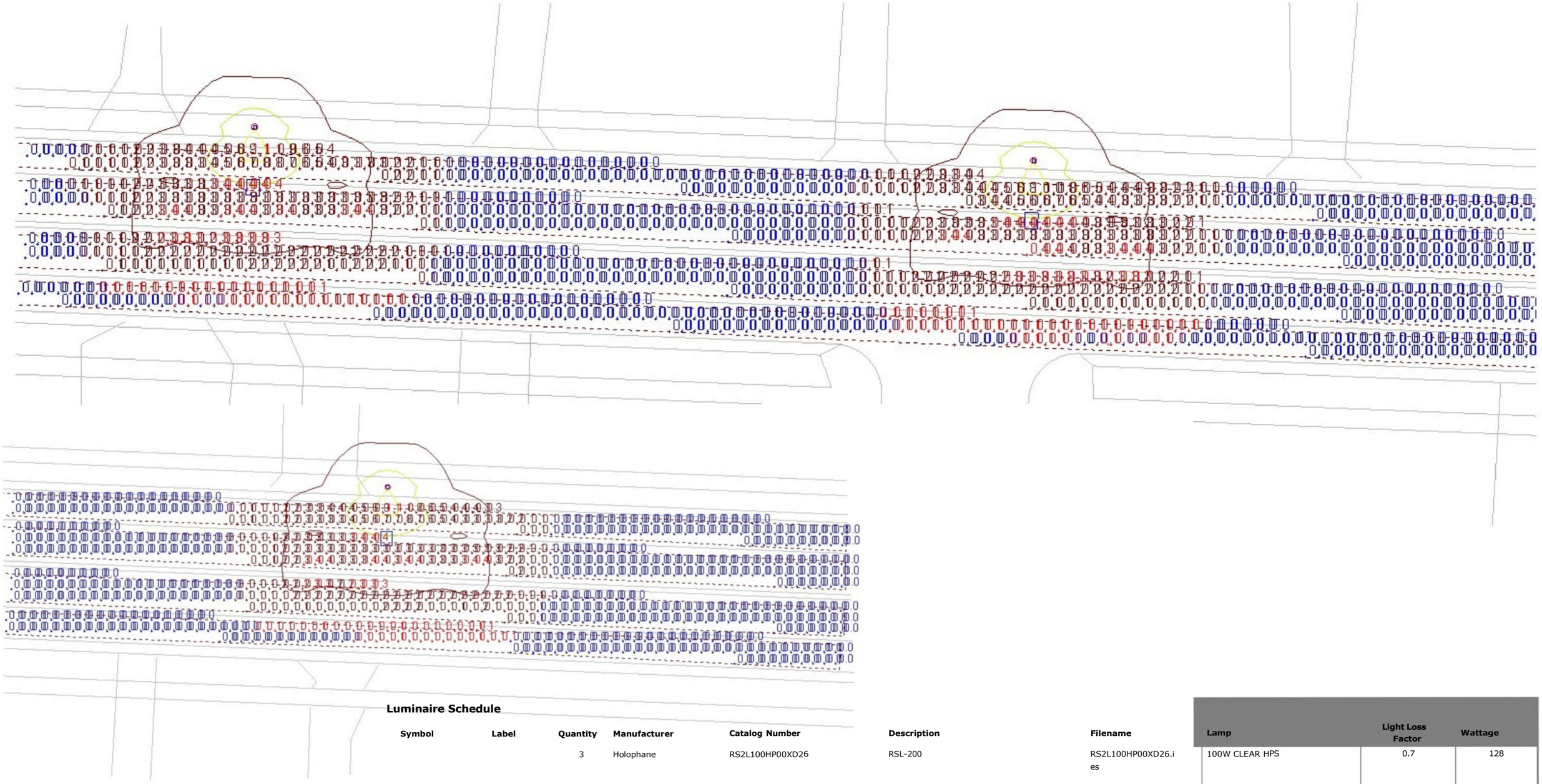




**Luminaire Schedule**

| Symbol | Label | QTY | Catalog Number | Description | Lamp | Number Lamps | Lumens per Lamp | LLF | Wattage |
|---|---|---|---|---|---|---|---|---|---|
| | A | 4 | RFM-108W48LED4K--G2-R3M | RoadFocus LED Cobra Head - Medium (RFM), 48 LED's, 4000K CCT, TYPE R3M OPTIC, | (3) LEDgine ARRAY(S) DRIVEN AT 700mA | 1 | 13169.55 | 0.95 | 106 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 1.3 fc | 5.4 fc | 0.0 fc | N/A | N/A | 0.2:1 |
| Zone #2 | + | 1.3 fc | 5.1 fc | 0.0 fc | N/A | N/A | 0.3:1 |



**Luminaire Schedule**

| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Filename | Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|
| | | 3 | Holophane | RS2L100HP00XD26 | RSL-200 | RS2L100HP00XD26.ies | 100W CLEAR HPS | 0.7 | 128 |

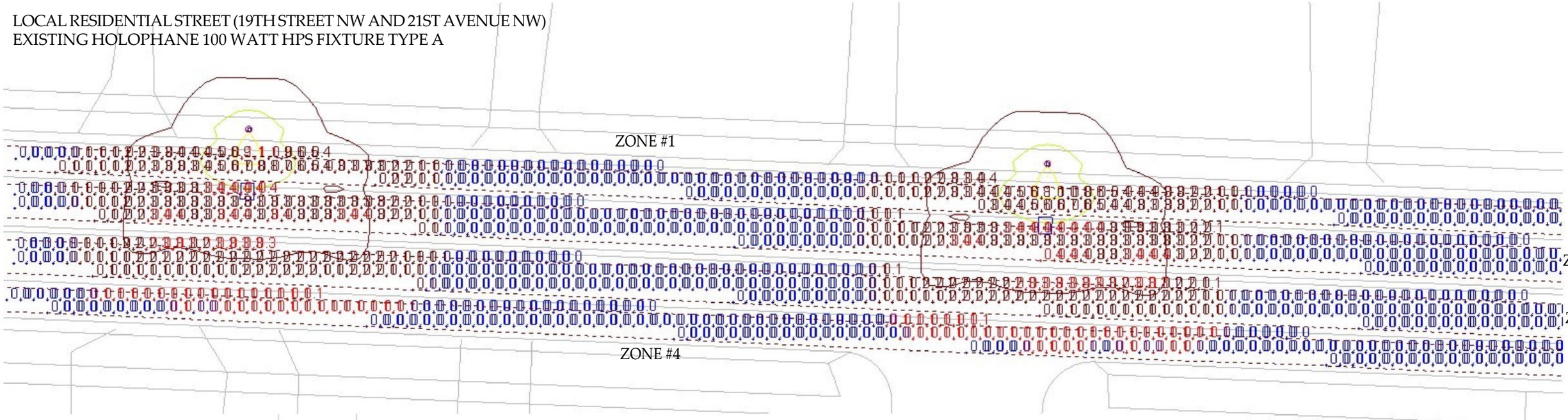
A

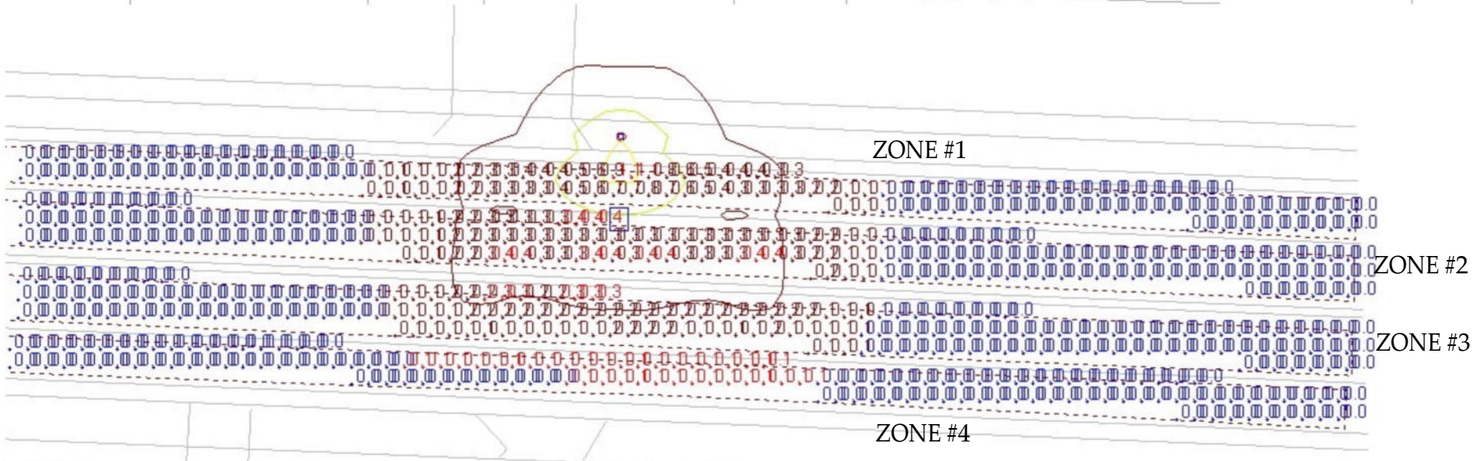
View #1

## Statistics

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | | 0.2 fc | 1.1 fc | 0.0 fc | N/A | N/A | 0.2:1 |
| Zone #2 | | 0.1 fc | 0.4 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #3 | | 0.1 fc | 0.3 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #4 | | 0.0 fc | 0.1 fc | 0.0 fc | N/A | N/A | 0.0:1 |

LOCAL RESIDENTIAL STREET (19TH STREET NW AND 21ST AVENUE NW)
EXISTING HOLOPHANE 100 WATT HPS FIXTURE TYPE A




View #1

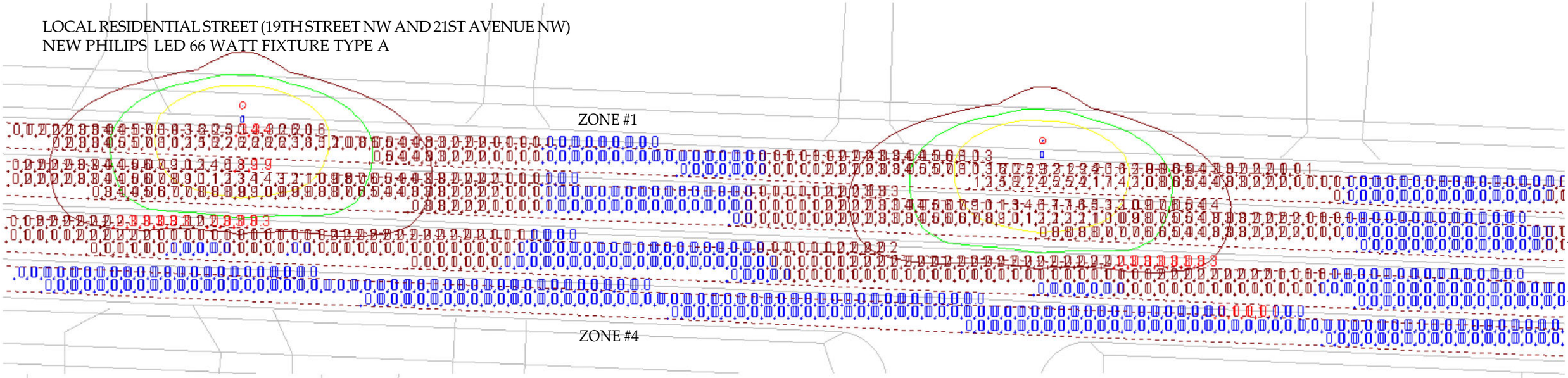
**Luminaire Schedule**

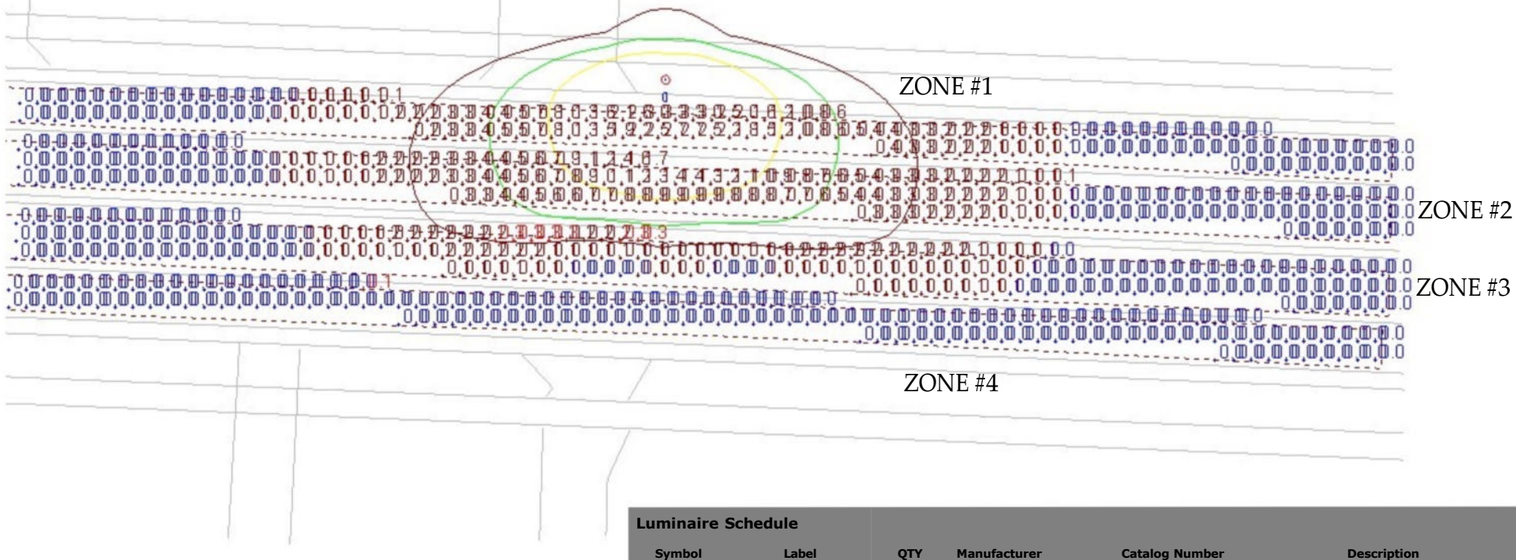
| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Filename | Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|
| | A | 3 | Holophane | RS2L100HP00XD26 | RSL-200 | RS2L100HP00XD26.ies | 100W CLEAR HPS | 0.7 | 128 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 0.2 fc | 1.1 fc | 0.0 fc | N/A | N/A | 0.2:1 |
| Zone #2 | + | 0.1 fc | 0.4 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #3 | + | 0.1 fc | 0.3 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #4 | + | 0.0 fc | 0.1 fc | 0.0 fc | N/A | N/A | 0.0:1 |

LOCAL RESIDENTIAL STREET (19TH STREET NW AND 21ST AVENUE NW)
NEW PHILIPS LED 66 WATT FIXTURE TYPE A



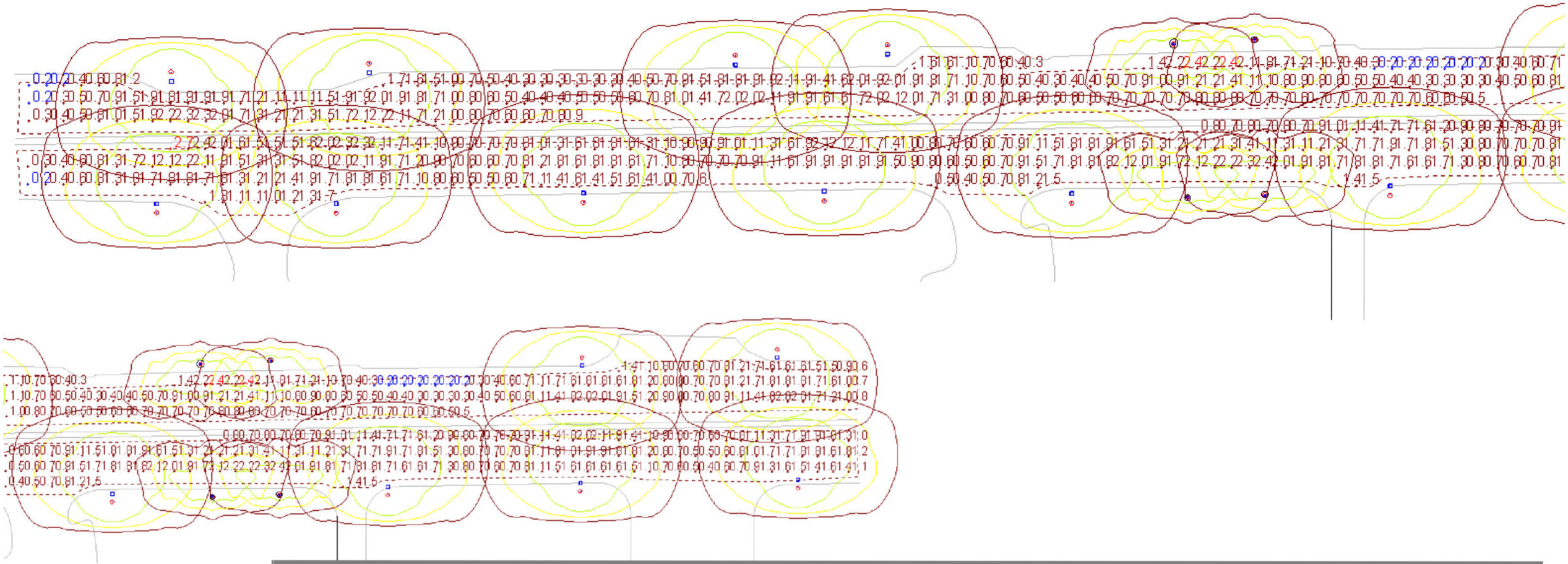




**Luminaire Schedule**

| Symbol | Label | QTY | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens per Lamp | LLF | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | 3 | Philips Lumec | RFM-72W32LED4K-G2-R3M | RoadFocus LED Cobra Head - Medium (RFM), 32 LED's, 4000K CCT, TYPE R3M OPTIC, | (2) LEDgine ARRAY(S) DRIVEN AT 700mA | 1 | RFM-72W32LED4K-G2-R3M.ies | 8780.053 | 0.95 | 73 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 0.6 fc | 3.4 fc | 0.0 fc | N/A | N/A | 0.2:1 |
| Zone #2 | + | 0.4 fc | 1.9 fc | 0.0 fc | N/A | N/A | 0.2:1 |
| Zone #3 | + | 0.1 fc | 0.3 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #4 | + | 0.0 fc | 0.1 fc | 0.0 fc | N/A | N/A | 0.0:1 |



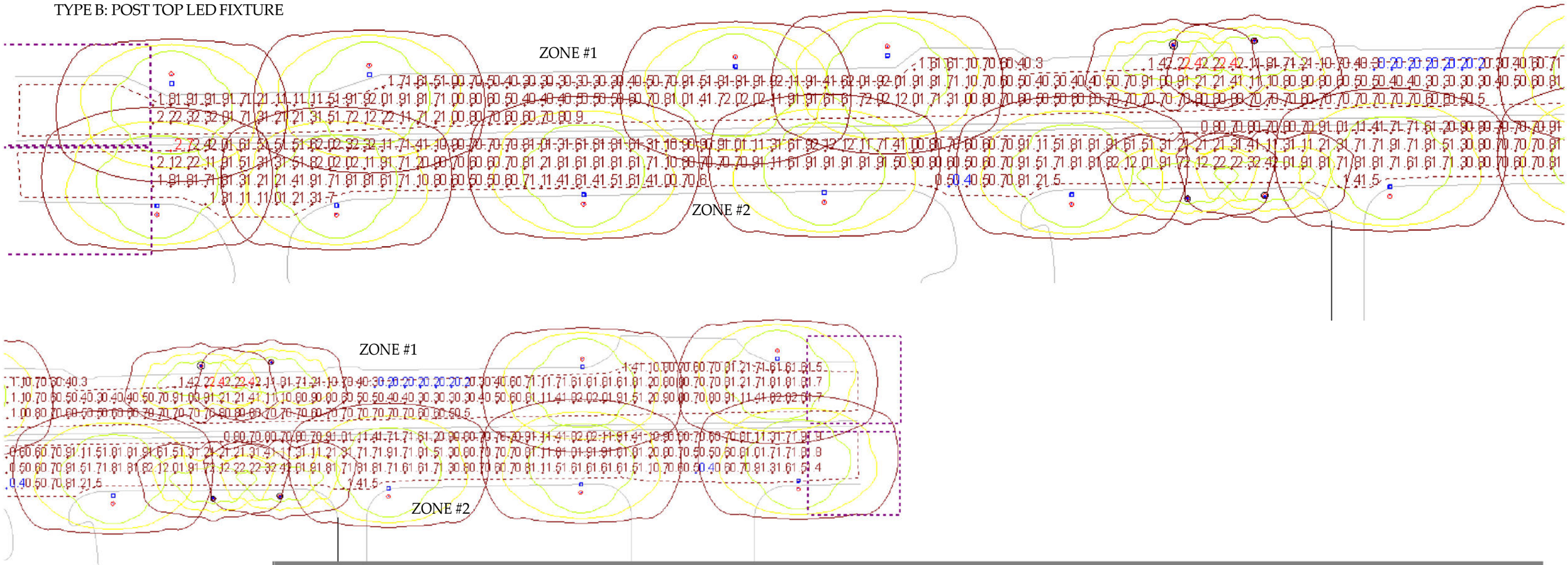
**Luminaire Schedule**

| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens Per Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | 14 | CREE, INC. | For use with Series E Edge, Edge High Output, 228, 304 and LEDway luminaires. | Edited from 60 LED Type III Medium w/ Partial Backlight 700mA 4000K LEDway Streetlight | SIXTY WHITE LIGHT EMITTING DIODES (LEDS), VERTICAL BASE-UP POSITION. | 1 | 3MP-E.ies | 9593 | 0.95 | 132 |
| | B | 4 | KIM LIGHTING | SRS1-3E35-60L4K | SOLITAIRE LED DIE-CAST ALUMINUM HOUSING, LENS FRAME, AND ARMS. CONICAL ACRYLIC LENS. LED EMITTER DECK INCLUDES LEDS, HEATSINKS, AND PRISMS. | 60 219B DIODES. 4200K | 1 | DR_TYPEB_srs1-3e35-60l4k.ies | 4602.36 | 0.95 | 63.2 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 1.1 fc | 2.4 fc | 0.2 fc | 12.0:1 | 5.5:1 | 0.5:1 |
| Zone #2 | + | 1.3 fc | 2.7 fc | 0.2 fc | 13.5:1 | 6.5:1 | 0.5:1 |

REDEVELOPMENT DOWNTOWN (MEDICAL CENTER ZONE STREET 2ND SW AND IST AVENUE NW)
EXISTING CREE EDGE LED 132 WATT FIXTURE
TYPE A: CREE POLE MOUNTED
TYPE B: POST TOP LED FIXTURE



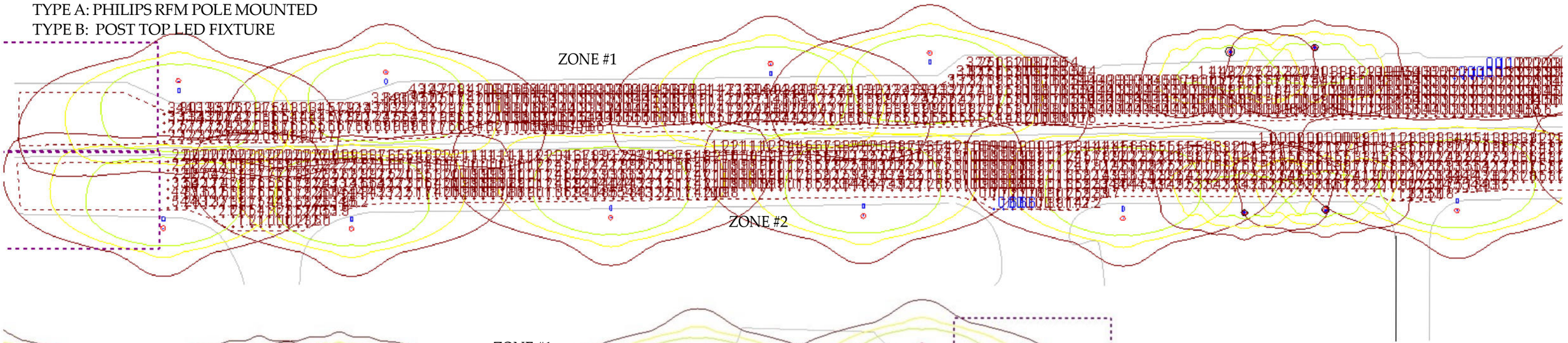

**Luminaire Schedule**

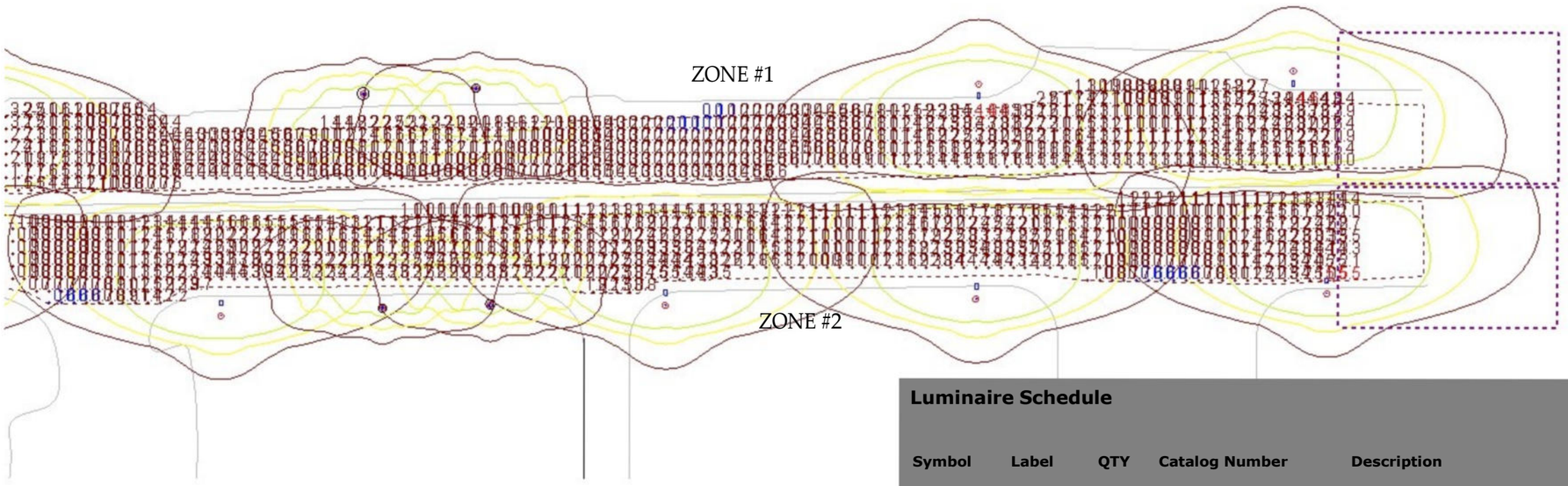
| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens Per Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | 14 | CREE, INC. | For use with Series E Edge, Edge High Output, 228, 304 and LEDway luminaires. | Edited from 60 LED Type III Medium w/ Partial Backlight 700mA 4000K LEDway Streetlight | SIXTY WHITE LIGHT EMITTING DIODES (LEDS), VERTICAL BASE-UP POSITION. | 1 | 3MP-E.ies | 9593 | 0.95 | 132 |
| | B | 4 | KIM LIGHTING | SRS1-3E35-60L4K | SOLITAIRE LED DIE-CAST ALUMINUM HOUSING, LENS FRAME, AND ARMS. CONICAL ACRYLIC LENS. LED EMITTER DECK INCLUDES LEDS, HEATSINKS, AND PRISMS. | 60 219B DIODES. 4200K | 1 | DR_TYPEB_srs1-3e35-60l4k.ies | 4602.36 | 0.95 | 63.2 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 1.1 fc | 2.4 fc | 0.2 fc | 12.0:1 | 5.5:1 | 0.5:1 |
| Zone #2 | + | 1.3 fc | 2.7 fc | 0.4 fc | 6.8:1 | 3.3:1 | 0.5:1 |

REDEVELOPMENT DOWNTOWN (MEDICAL CENTER ZONE STREET 2ND SW AND IST AVENUE NW)
NEW PHILIPS LED RFM 106 WATT FIXTURE
TYPE A: PHILIPS RFM POLE MOUNTED
TYPE B: POST TOP LED FIXTURE



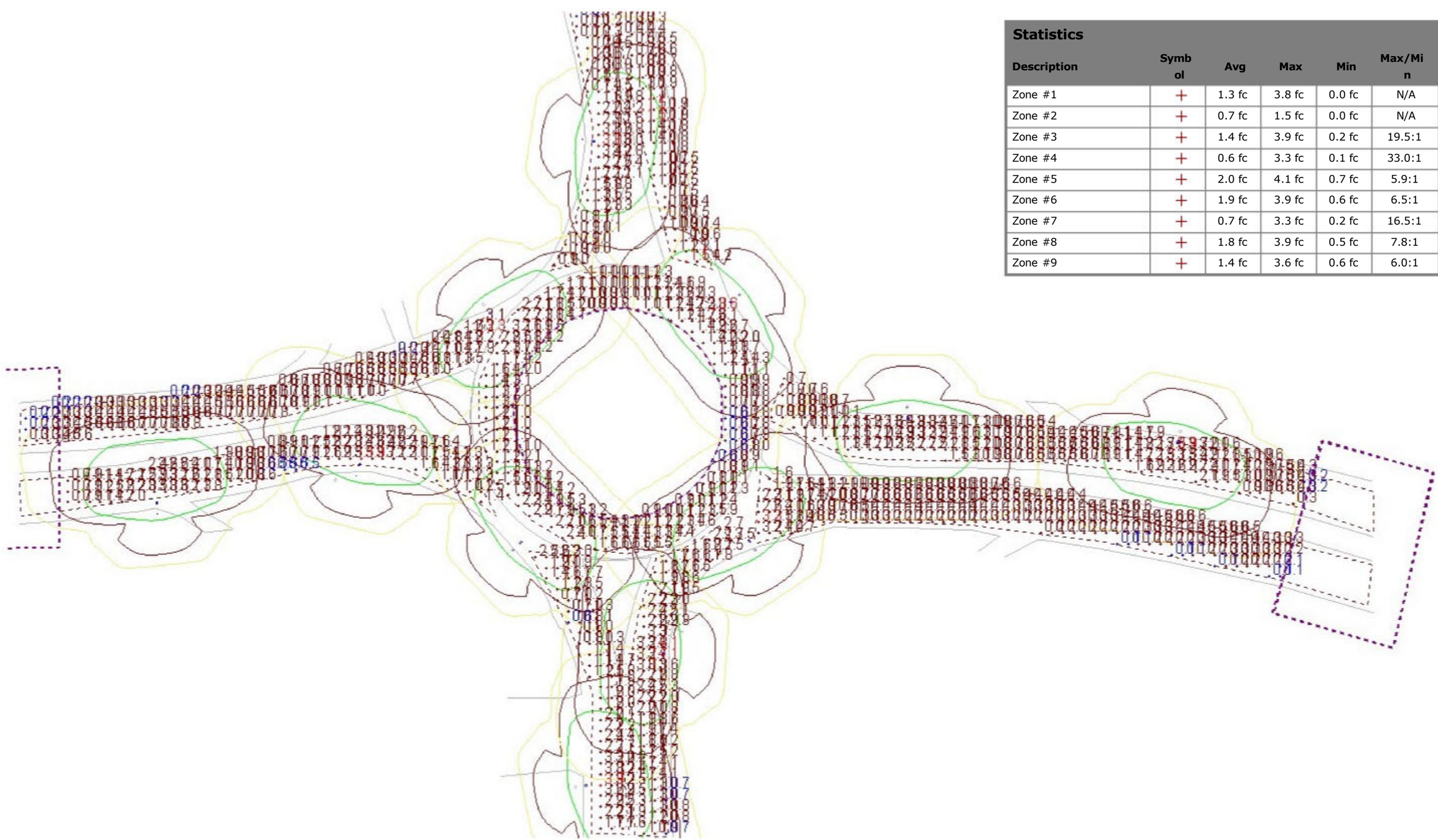




**Luminaire Schedule**

| Symbol | Label | QTY | Catalog Number | Description | Lamp | Number Lamps | Lumens per Lamp | LLF | Wattage |
|---|---|---|---|---|---|---|---|---|---|
| | A | 14 | RFM-108W48LED4K--G2-R3M | RoadFocus LED Cobra Head - Medium (RFM), 48 LED's, 4000K CCT, TYPE R3M OPTIC, | (3) LEDgine ARRAY(S) DRIVEN AT 700mA | 1 | 13169.55 | 0.95 | 106 |
| | B | 4 | SRS1-3E35-60L4K | SOLITAIRE LED DIE-CAST ALUMINUM HOUSING, LENS FRAME, AND ARMS. CONICAL ACRYLIC LENS. LED EMITTER DECK INCLUDES LEDS, HEATSINKS, AND PRISMS. | 60 219B DIODES. 4200K | 1 | 4602.36 | 0.95 | 63.2 |

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 1.4 fc | 4.6 fc | 0.1 fc | 46.0:1 | 14.0:1 | 0.3:1 |
| Zone #2 | + | 1.9 fc | 5.5 fc | 0.6 fc | 9.2:1 | 3.2:1 | 0.3:1 |



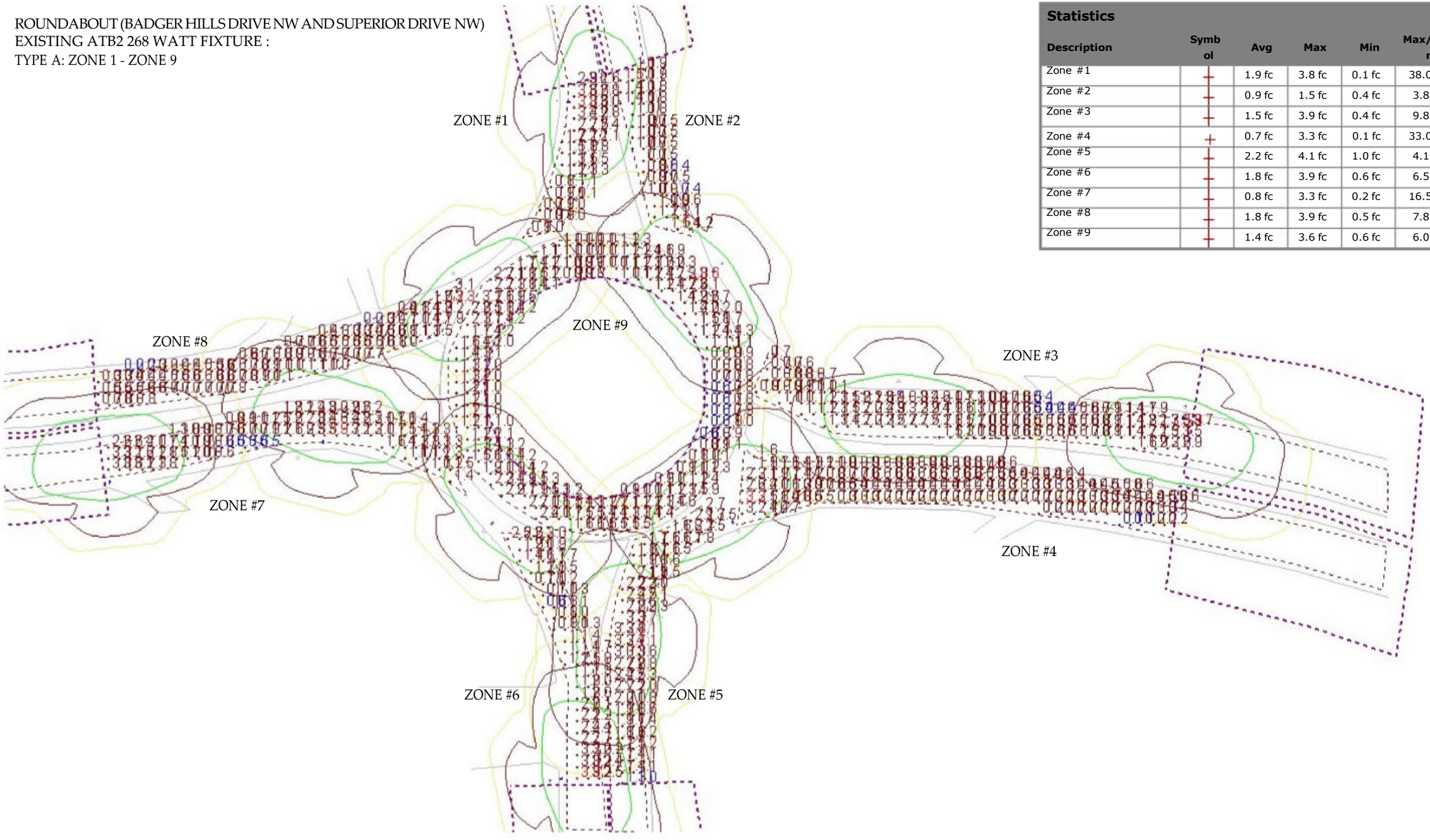
## Statistics

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 1.3 fc | 3.8 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #2 | + | 0.7 fc | 1.5 fc | 0.0 fc | N/A | N/A | 0.5:1 |
| Zone #3 | + | 1.4 fc | 3.9 fc | 0.2 fc | 19.5:1 | 7.0:1 | 0.4:1 |
| Zone #4 | + | 0.6 fc | 3.3 fc | 0.1 fc | 33.0:1 | 6.0:1 | 0.2:1 |
| Zone #5 | + | 2.0 fc | 4.1 fc | 0.7 fc | 5.9:1 | 2.9:1 | 0.5:1 |
| Zone #6 | + | 1.9 fc | 3.9 fc | 0.6 fc | 6.5:1 | 3.2:1 | 0.5:1 |
| Zone #7 | + | 0.7 fc | 3.3 fc | 0.2 fc | 16.5:1 | 3.5:1 | 0.2:1 |
| Zone #8 | + | 1.8 fc | 3.9 fc | 0.5 fc | 7.8:1 | 3.6:1 | 0.5:1 |
| Zone #9 | + | 1.4 fc | 3.6 fc | 0.6 fc | 6.0:1 | 2.3:1 | 0.4:1 |

## Luminaire Schedule

| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens Per Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ▯ · | A | 11 | American Electric Lighting | ATB2 80BLEDE10 XXXXX R3 4K/5K | ATB2 SERIES LED 1000MA TYPE 3 4000K/5000K CCT | LED Array | 1 | ATB2_80BLEDE10_XXXXX_R3_4K_5K_268W.ies | 32414.28 | 0.95 | 268 |

ROUNDABOUT (BADGER HILLS DRIVE NW AND SUPERIOR DRIVE NW)
EXISTING ATB2 268 WATT FIXTURE :
TYPE A: ZONE 1 - ZONE 9



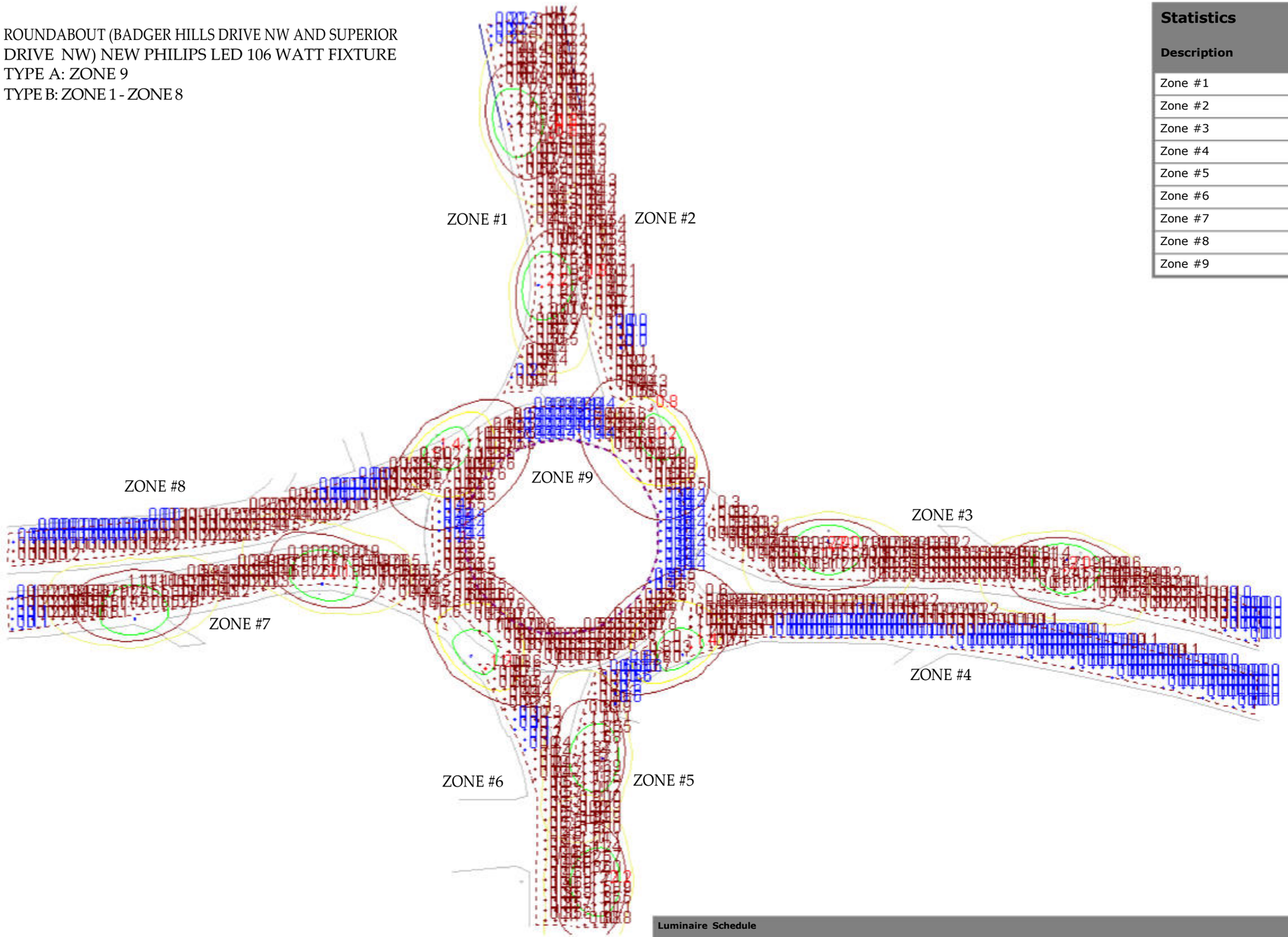

**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | | 1.9 fc | 3.8 fc | 0.1 fc | 38.0:1 | 19.0:1 | 0.5:1 |
| Zone #2 | | 0.9 fc | 1.5 fc | 0.4 fc | 3.8:1 | 2.3:1 | 0.6:1 |
| Zone #3 | | 1.5 fc | 3.9 fc | 0.4 fc | 9.8:1 | 3.8:1 | 0.4:1 |
| Zone #4 | | 0.7 fc | 3.3 fc | 0.1 fc | 33.0:1 | 7.0:1 | 0.2:1 |
| Zone #5 | | 2.2 fc | 4.1 fc | 1.0 fc | 4.1:1 | 2.2:1 | 0.5:1 |
| Zone #6 | | 1.8 fc | 3.9 fc | 0.6 fc | 6.5:1 | 3.0:1 | 0.5:1 |
| Zone #7 | | 0.8 fc | 3.3 fc | 0.2 fc | 16.5:1 | 4.0:1 | 0.2:1 |
| Zone #8 | | 1.8 fc | 3.9 fc | 0.5 fc | 7.8:1 | 3.6:1 | 0.5:1 |
| Zone #9 | | 1.4 fc | 3.6 fc | 0.6 fc | 6.0:1 | 2.3:1 | 0.4:1 |

**Luminaire Schedule**

| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens Per Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | 11 | American Electric Lighting | ATB2 80BLEDE10 XXXXX R3 4K/5K | ATB2 SERIES LED 1000MA TYPE 3 4000K/5000K CCT | LED Array | 1 | ATB2_80BLEDE10_XXXXX_R3_4K_5K_268W.ies | 32414.28 | 0.95 | 268 |

ROUNDABOUT (BADGER HILLS DRIVE NW AND SUPERIOR DRIVE NW) NEW PHILIPS LED 106 WATT FIXTURE
TYPE A: ZONE 9
TYPE B: ZONE 1 - ZONE 8




**Statistics**

| Description | Symbol | Avg | Max | Min | Max/Min | Avg/Min | Avg/Max |
|---|---|---|---|---|---|---|---|
| Zone #1 | + | 0.9 fc | 2.2 fc | 0.2 fc | 11.0:1 | 4.5:1 | 0.4:1 |
| Zone #2 | + | 0.4 fc | 0.8 fc | 0.0 fc | N/A | N/A | 0.5:1 |
| Zone #3 | + | 0.6 fc | 2.0 fc | 0.0 fc | N/A | N/A | 0.3:1 |
| Zone #4 | + | 0.1 fc | 1.4 fc | 0.0 fc | N/A | N/A | 0.1:1 |
| Zone #5 | + | 1.2 fc | 2.2 fc | 0.6 fc | 3.7:1 | 2.0:1 | 0.5:1 |
| Zone #6 | + | 0.5 fc | 1.2 fc | 0.1 fc | 12.0:1 | 5.0:1 | 0.4:1 |
| Zone #7 | + | 0.2 fc | 1.4 fc | 0.0 fc | N/A | N/A | 0.1:1 |
| Zone #8 | + | 0.7 fc | 2.1 fc | 0.1 fc | 21.0:1 | 7.0:1 | 0.3:1 |
| Zone #9 | + | 0.6 fc | 1.2 fc | 0.4 fc | 3.0:1 | 1.5:1 | 0.5:1 |

**Luminaire Schedule**

| Symbol | Label | Quantity | Manufacturer | Catalog Number | Description | Lamp | Number Lamps | Filename | Lumens Per Lamp | Light Loss Factor | Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | 4 | Philips Lumec | RFM-108W48LED4K-G2-4 | RoadFocus LED Cobra Head - Medium (RFM), 48 LED's, 4000K CCT, TYPE 4 OPTIC, | (3) LEDgine ARRAY(S) DRIVEN AT 700mA | 1 | LRS_PHILIPS_RFM-108W48LED4K-G2-4.ies | 13049.08 | 0.95 | 106 |
| | B | 8 | Philips Lumec | RFM-108W48LED4K-G2-R3M | RoadFocus LED Cobra Head - Medium (RFM), 48 LED's, 4000K CCT, TYPE R3M OPTIC, | (3) LEDgine ARRAY(S) DRIVEN AT 700mA | 1 | RFM-108W48LED4K-G2-R3M.ies | 13169.55 | 0.95 | 106 |

# Appendix D
## CITY OF ROCHESTER LIGHTING TEMPLATES

A. The sample lighting plans are as follows and attached.

1. MAJOR, HIGH PEDESTRIAN CONFLICT, 4 LANE STREET, LUMINANCE
2. MAJOR, MEDIUM PEDESTRIAN CONFLICT, 4 LANE STREET, LUMINANCE
3. MAJOR, LOW PEDESTRIAN CONFLICT, 4 LANE STREET, LUMINANCE
4. MAJOR, HIGH PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
5. MAJOR, MEDIUM PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
6. MAJOR, LOW PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
7. COLLECTOR, HIGH PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
8. COLLECTOR, MEDIUM PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
9. COLLECTOR, LOW PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
10. LOCAL, HIGH PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
11. LOCAL, MEDIUM PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE
12. LOCAL, LOW PEDESTRIAN CONFLICT, 2 LANE STREET, LUMINANCE

# Visual - Roadway Tool

www.Visual-3D.com

## Design Information

Monday, January 07, 2019

| | | | |
|---|---|---|---|
| Project Name | CITY OF ROCHESTER, MINNESOTA | User Name | MICHAEL T. FITZPATRICK |
| Project Description | LUMINANCE CALCULATION FOR STREET TYPE: MAJOR-HIGH | Company Name | STANTEC |
| | | Your Phone | 612-712-2045 |
| | | Your Email | mike.fitzpatrick@stantec.com |

## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 9 ft | |
| Road Class | Major | | **Sidewalk** | | |
| Pedestrians | High | | Width | Left: 6 ft | Right: 6 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 11 ft | Right: 11 ft |
| Lane Quantity | Left: 2 | Right: 2 | **Bikelane** | | |
| Lane Width | Left: 11 ft | Right: 11 ft | Width | Left: 6 ft | Right: 6 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Median - Philips Lumec: RFM-108W48LED4K-G2-R3M

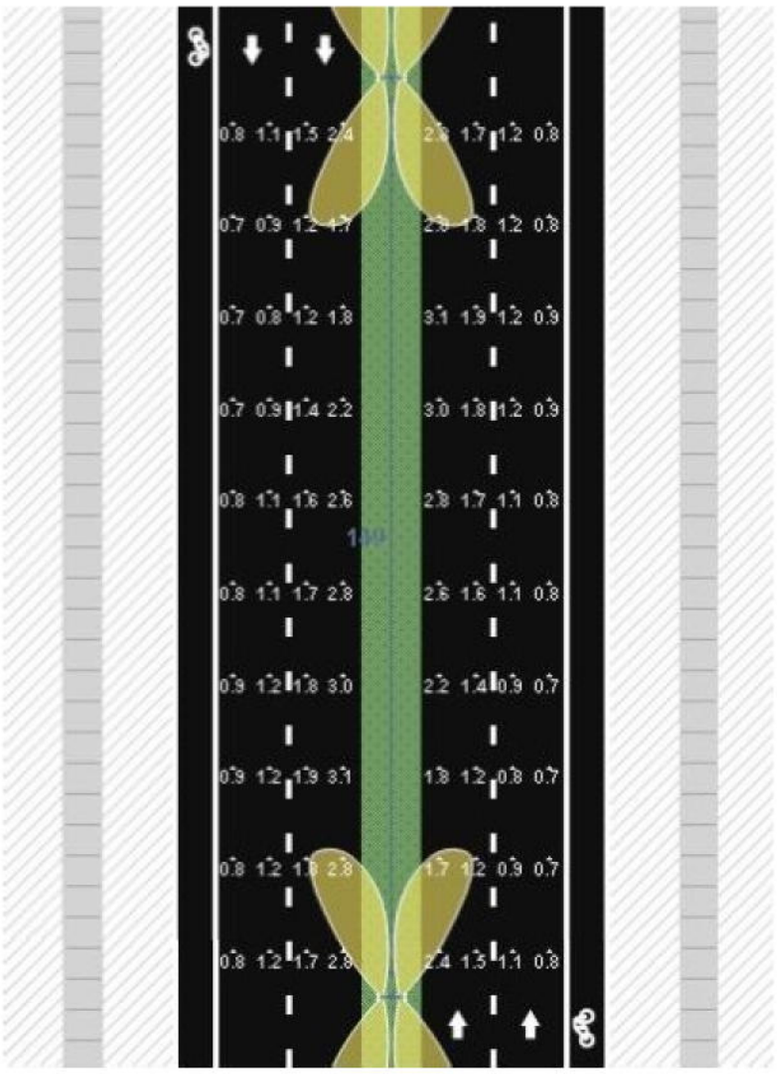
| | | | |
|---|---|---|---|
| Cycle Spacing: | 148.95 ft | Configuration: | Twin |
| Setback: | 0 ft | Arm Length: | 1 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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AcuityBrands.

## Visual - Roadway Tool

www.Visual-3D.com




**Luminance**

### Calculation Results

| **Luminance** | Left | Right | |
|---|---|---|---|
| Average: | 1.5 | 1.5 | cd/m² |
| Max: | 3.1 | 3.1 | cd/m² |
| Min | 0.7 | 0.7 | cd/m² |
| Ave/Min: | 2.3 | 2.3 | |
| Max/Min: | 4.7 | 4.7 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 4.1 | 4.1 | |

| **Illuminance** | Left | Right | |
|---|---|---|---|
| Average: | 2 | 2 | fc |
| Max: | 6.8 | 6.8 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 2.8 | 2.8 | |
| Max/Min: | 9.5 | 9.5 | |

| **Sidewalk** | Left | Right | |
|---|---|---|---|
| Average: | 0.3 | 0.3 | fc |
| Min | 0.3 | 0.3 | fc |
| Ave/Min: | 1.4 | 1.4 | |
| Ev Min: | 0 | 0 | fc |

| **Bikelane** | | | |
|---|---|---|---|
| Average: | 1.1 | 1.1 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 1.6 | 1.6 | |
| Ev Min: | 0 | 0 | fc |

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# Visual - Roadway Tool

www.Visual-3D.com

Monday, January 07, 2019

## Design Information

| | |
|---|---|
| Project Name | CITY OF ROCHESTER, MINNESOTA |
| Project Description | LUMINANCE CALCULATION FOR STREET TYPE: MAJOR-HIGH |



| | |
|---|---|
| User Name | MICHAEL T. FITZPATRICK |
| Company Name | STANTEC |
| Your Phone | 612-712-2045 |
| Your Email | mike.fitzpatrick@stantec.com |



## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 9 ft | |
| Road Class | Major | | **Sidewalk** | | |
| Pedestrians | Medium | | Width | Left: 6 ft | Right: 6 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 11 ft | Right: 11 ft |
| Lane Quantity | Left: 2 | Right: 2 | **Bikelane** | | |
| Lane Width | Left: 11 ft | Right: 11 ft | Width | Left: 6 ft | Right: 6 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Median - Philips Lumec: RFM-108W48LED4K-G2-R3M

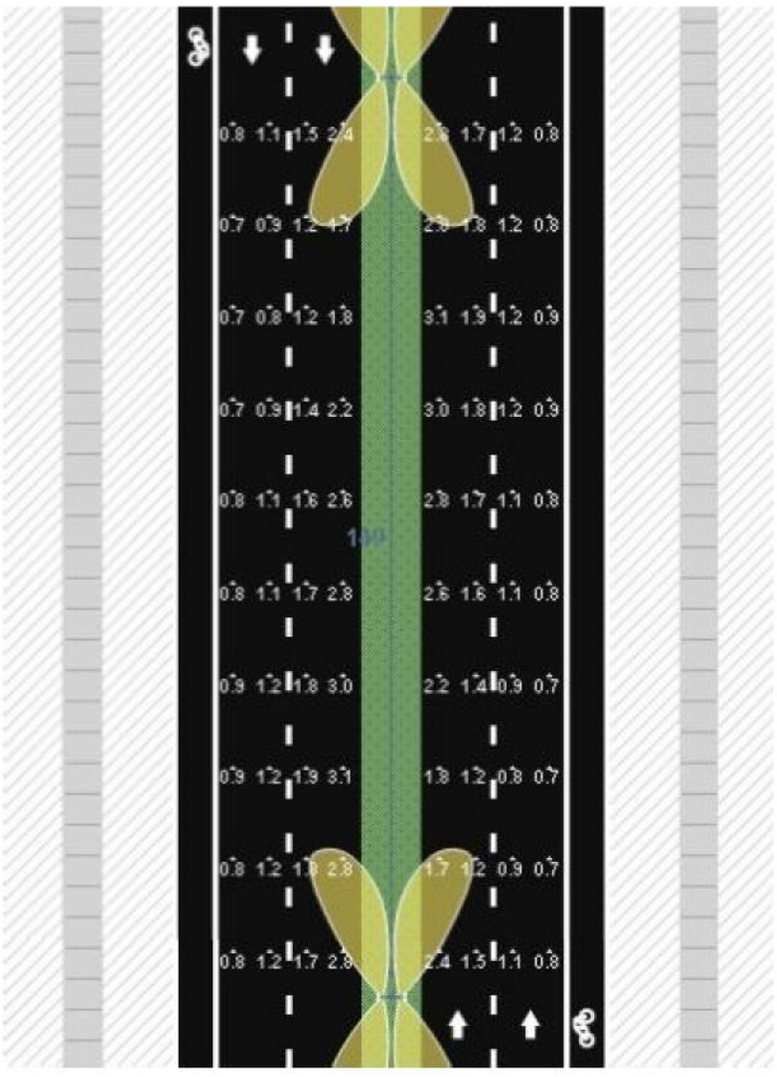
| | | | |
|---|---|---|---|
| Cycle Spacing: | 148.95 ft | Configuration: | Twin |
| Setback: | 0 ft | Arm Length: | 1 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




**Luminance**

### Calculation Results

| **Luminance** | Left | Right | |
|---|---|---|---|
| Average: | 1.5 | 1.5 | cd/m² |
| Max: | 3.1 | 3.1 | cd/m² |
| Min | 0.7 | 0.7 | cd/m² |
| Ave/Min: | 2.3 | 2.3 | |
| Max/Min: | 4.7 | 4.7 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 4.1 | 4.1 | |

| **Illuminance** | Left | Right | |
|---|---|---|---|
| Average: | 2 | 2 | fc |
| Max: | 6.8 | 6.8 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 2.8 | 2.8 | |
| Max/Min: | 9.5 | 9.5 | |

| **Sidewalk** | Left | Right | |
|---|---|---|---|
| Average: | 0.3 | 0.3 | fc |
| Min | 0.3 | 0.3 | fc |
| Ave/Min: | 1.4 | 1.4 | |
| Ev Min: | 0 | 0 | fc |

| **Bikelane** | | | |
|---|---|---|---|
| Average: | 1.1 | 1.1 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 1.6 | 1.6 | |
| Ev Min: | 0 | 0 | fc |

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# Visual - Roadway Tool

www.Visual-3D.com

Monday, January 07, 2019

## Design Information

| | |
|---|---|
| Project Name | CITY OF ROCHESTER, MINNESOTA |
| Project Description | LUMINANCE CALCULATION FOR STREET TYPE: MAJOR-HIGH |



| | |
|---|---|
| User Name | MICHAEL T. FITZPATRICK |
| Company Name | STANTEC |
| Your Phone | 612-712-2045 |
| Your Email | mike.fitzpatrick@stantec.com |



## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 9 ft | |
| Road Class | Major | | **Sidewalk** | | |
| Pedestrians | Low | | Width | Left: 6 ft | Right: 6 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 11 ft | Right: 11 ft |
| Lane Quantity | Left: 2 | Right: 2 | **Bikelane** | | |
| Lane Width | Left: 11 ft | Right: 11 ft | Width | Left: 6 ft | Right: 6 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Median - Philips Lumec: RFM-108W48LED4K-G2-R3M

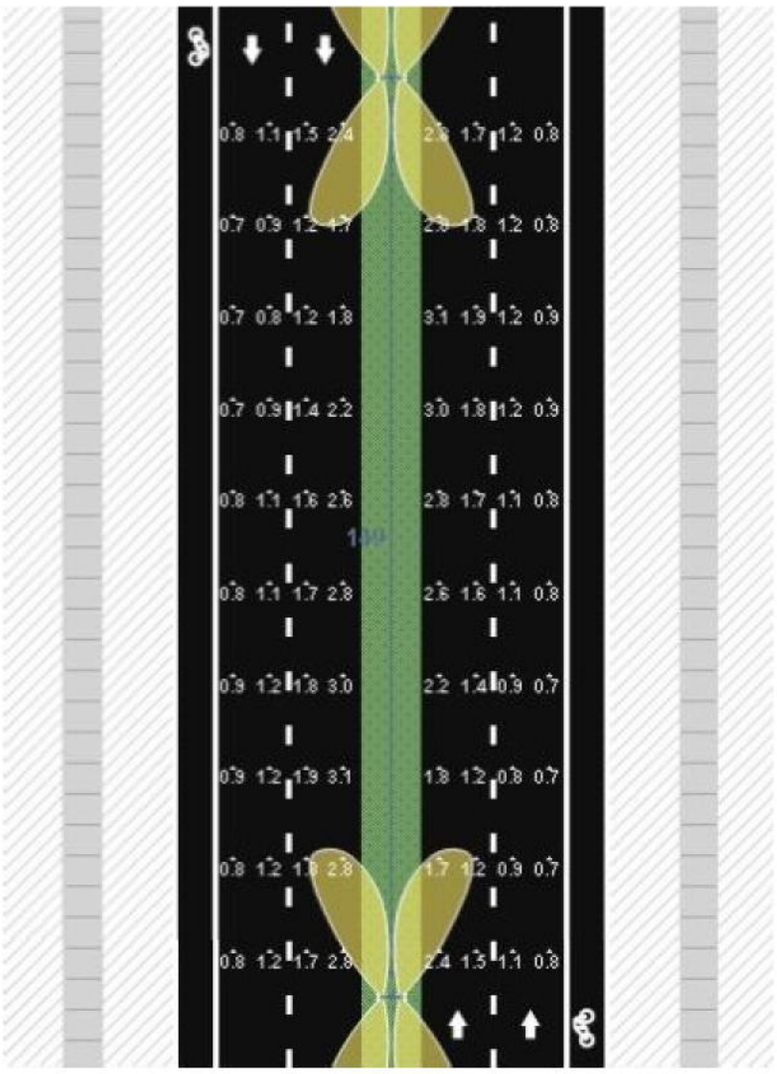
| | | | |
|---|---|---|---|
| Cycle Spacing: | 148.95 ft | Configuration: | Twin |
| Setback: | 0 ft | Arm Length: | 1 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




**Luminance**

### Calculation Results

| **Luminance** | Left | Right | |
|---|---|---|---|
| Average: | 1.5 | 1.5 | cd/m² |
| Max: | 3.1 | 3.1 | cd/m² |
| Min | 0.7 | 0.7 | cd/m² |
| Ave/Min: | 2.3 | 2.3 | |
| Max/Min: | 4.7 | 4.7 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 4.1 | 4.1 | |

| **Illuminance** | Left | Right | |
|---|---|---|---|
| Average: | 2 | 2 | fc |
| Max: | 6.8 | 6.8 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 2.8 | 2.8 | |
| Max/Min: | 9.5 | 9.5 | |

| **Sidewalk** | Left | Right | |
|---|---|---|---|
| Average: | 0.3 | 0.3 | fc |
| Min | 0.3 | 0.3 | fc |
| Ave/Min: | 1.4 | 1.4 | |
| Ev Min: | 0 | 0 | fc |

| **Bikelane** | | | |
|---|---|---|---|
| Average: | 1.1 | 1.1 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 1.6 | 1.6 | |
| Ev Min: | 0 | 0 | fc |

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# Visual - Roadway Tool

www.Visual-3D.com

## Design Information

Tuesday, January 08, 2019

| | | | |
|---|---|---|---|
| Project Name | CITY OF ROCHESTER, MINNESOTA | User Name | MICHAEL T. FITZPATRICK |
| Project Description | LUMINANCE CALCULATION FOR STREET TYPE: MAJOR-HIGH-Two Lane | Company Name | STANTEC |
| | | Your Phone | 612-712-2045 |
| | | Your Email | mike.fitzpatrick@stantec.com |

Ac

## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Major | | **Sidewalk** | | |
| Pedestrians | High | | Width | Left: 6 ft | Right: 6 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 8 ft | Right: 8 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 12 ft | Right: 12 ft | Width | Left: 6 ft | Right: 6 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 218.96 ft | Configuration: | Single |
| Setback: | 10 ft | Arm Length: | 6 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

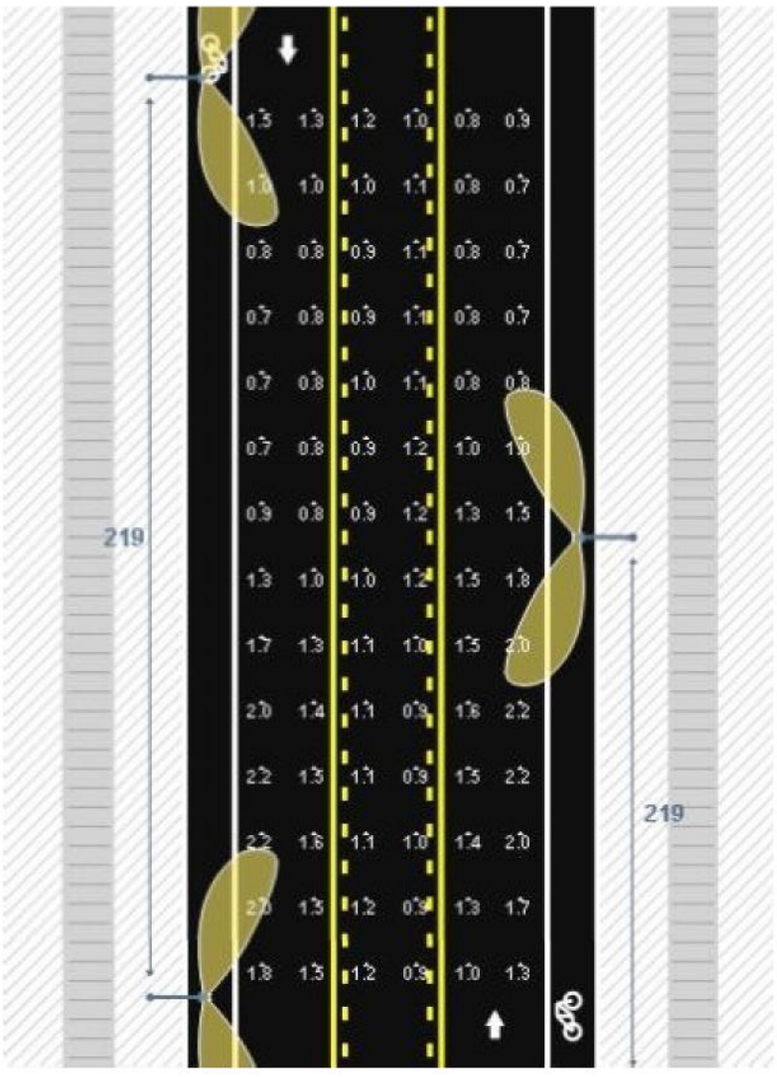
### Right Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 218.96 ft | Configuration: | Single |
| Setback: | 10 ft | Arm Length: | 6 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | True | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




Luminance

### Calculation Results

| Luminance | Left | Right | |
|---|---|---|---|
| Average: | 1.2 | 1.2 | cd/m² |
| Max: | 2.2 | 2.2 | cd/m² |
| Min | 0.7 | 0.7 | cd/m² |
| Ave/Min: | 1.7 | 1.7 | |
| Max/Min: | 3.2 | 3.2 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 3.2 | 3.2 | |

| Illuminance | Left | Right | |
|---|---|---|---|
| Average: | 1.7 | 1.7 | fc |
| Max: | 4.4 | 4.4 | fc |
| Min | 0.8 | 0.8 | fc |
| Ave/Min: | 2.2 | 2.2 | |
| Max/Min: | 5.6 | 5.6 | |

| Sidewalk | Left | Right | |
|---|---|---|---|
| Average: | 0.4 | 0.4 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 3.4 | 3.6 | |
| Ev Min: | 0 | 0 | fc |

| Bikelane | | | |
|---|---|---|---|
| Average: | 1.4 | 1.6 | fc |
| Min | 0.4 | 0.4 | fc |
| Ave/Min: | 3.4 | 3.7 | |
| Ev Min: | 0.1 | 0.1 | fc |

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# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

| | |
|---|---|
| Project Name | CITY OF ROCHESTER, MINNESOTA |
| Project Description | LUMINANCE CALCULATION FOR STREET TYPE: MAJOR-HIGH-Two Lane |



| | |
|---|---|
| User Name | MICHAEL T. FITZPATRICK |
| Company Name | STANTEC |
| Your Phone | 612-712-2045 |
| Your Email | mike.fitzpatrick@stantec.com |



## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Major | | **Sidewalk** | | |
| Pedestrians | Medium | | Width | Left: 6 ft | Right: 6 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 8 ft | Right: 8 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 12 ft | Right: 12 ft | Width | Left: 6 ft | Right: 6 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 241.51 ft | Configuration: | Single |
| Setback: | 10 ft | Arm Length: | 6 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

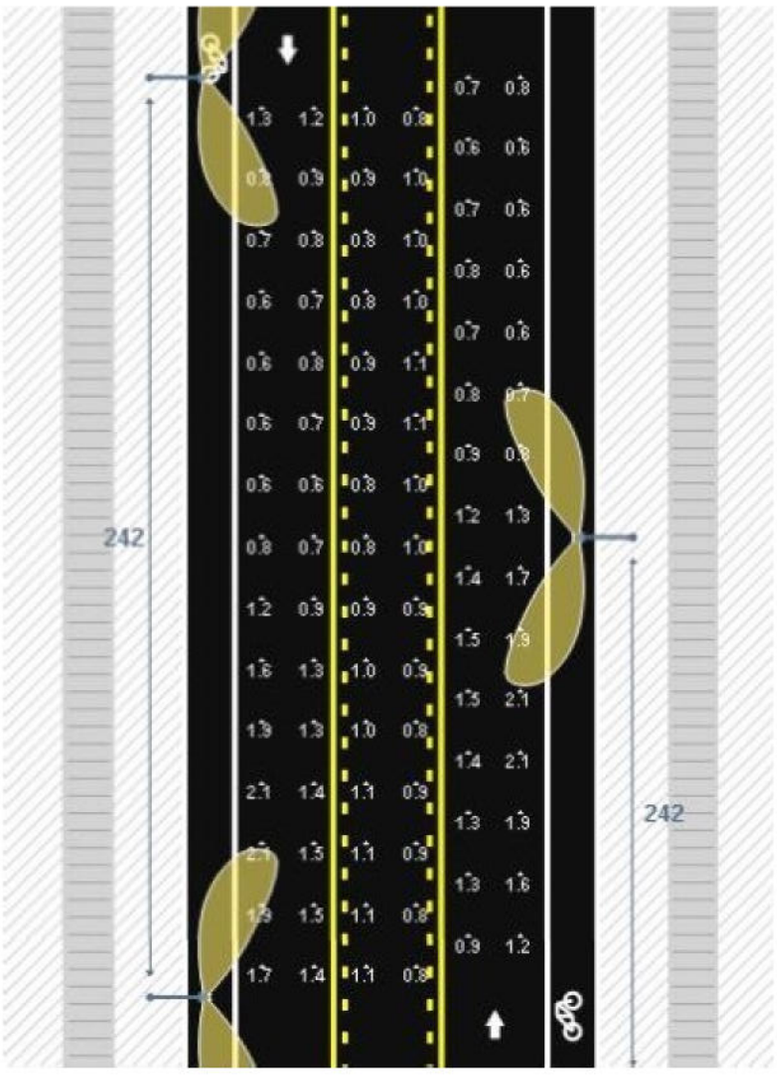
### Right Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 241.51 ft | Configuration: | Single |
| Setback: | 10 ft | Arm Length: | 6 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | True | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




Luminance

### Calculation Results

| Luminance | Left | Right | |
|---|---|---|---|
| Average: | 1 | 1 | cd/m² |
| Max: | 2.1 | 2.1 | cd/m² |
| Min | 0.6 | 0.6 | cd/m² |
| Ave/Min: | 1.8 | 1.8 | |
| Max/Min: | 3.8 | 3.8 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 3.5 | 3.5 | |

| Illuminance | Left | Right | |
|---|---|---|---|
| Average: | 1.6 | 1.6 | fc |
| Max: | 4.3 | 4.3 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 2.3 | 2.3 | |
| Max/Min: | 6.2 | 6.2 | |

| Sidewalk | Left | Right | |
|---|---|---|---|
| Average: | 0.4 | 0.4 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 4.6 | 4.4 | |
| Ev Min: | 0 | 0 | fc |

| Bikelane | | | |
|---|---|---|---|
| Average: | 1.5 | 1.4 | fc |
| Min | 0.4 | 0.4 | fc |
| Ave/Min: | 4.1 | 3.7 | |
| Ev Min: | 0.1 | 0 | fc |

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AcuityBrands.

# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

| | |
|---|---|
| Project Name | CITY OF ROCHESTER, MINNESOTA |
| Project Description | LUMINANCE CALCULATION FOR STREET TYPE: MAJOR-HIGH-Two Lane |



| | |
|---|---|
| User Name | MICHAEL T. FITZPATRICK |
| Company Name | STANTEC |
| Your Phone | 612-712-2045 |
| Your Email | mike.fitzpatrick@stantec.com |



## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Major | | **Sidewalk** | | |
| Pedestrians | Low | | Width | Left: 6 ft | Right: 6 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 8 ft | Right: 8 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 12 ft | Right: 12 ft | Width | Left: 6 ft | Right: 6 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 241.51 ft | Configuration: | Single |
| Setback: | 10 ft | Arm Length: | 6 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

### Right Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

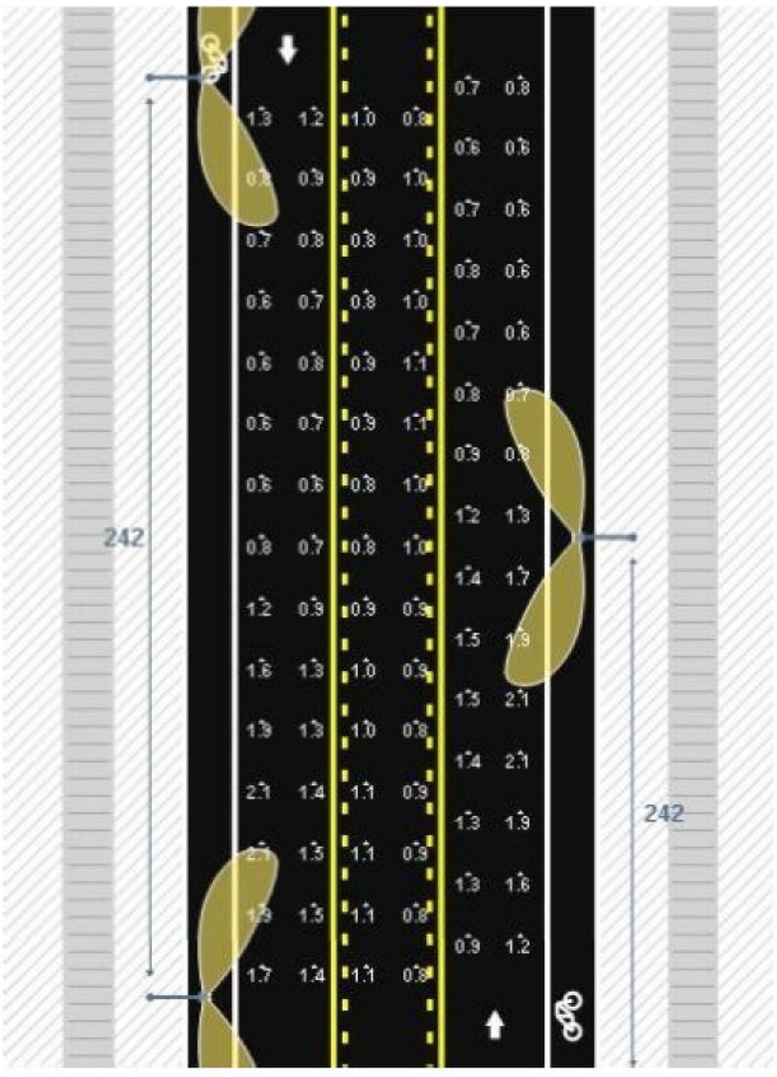
| | | | |
|---|---|---|---|
| Cycle Spacing: | 241.51 ft | Configuration: | Single |
| Setback: | 10 ft | Arm Length: | 6 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | True | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




Luminance

### Calculation Results

| Luminance | Left | Right | |
|---|---|---|---|
| Average: | 1 | 1 | cd/m² |
| Max: | 2.1 | 2.1 | cd/m² |
| Min | 0.6 | 0.6 | cd/m² |
| Ave/Min: | 1.8 | 1.8 | |
| Max/Min: | 3.8 | 3.8 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 3.5 | 3.5 | |

| Illuminance | Left | Right | |
|---|---|---|---|
| Average: | 1.6 | 1.6 | fc |
| Max: | 4.3 | 4.3 | fc |
| Min | 0.7 | 0.7 | fc |
| Ave/Min: | 2.3 | 2.3 | |
| Max/Min: | 6.2 | 6.2 | |

| Sidewalk | Left | Right | |
|---|---|---|---|
| Average: | 0.4 | 0.4 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 4.6 | 4.4 | |
| Ev Min: | 0 | 0 | fc |

| Bikelane | | | |
|---|---|---|---|
| Average: | 1.5 | 1.4 | fc |
| Min | 0.4 | 0.4 | fc |
| Ave/Min: | 4.1 | 3.7 | |
| Ev Min: | 0.1 | 0 | fc |

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# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

Project Name

Project Description

User Name MICHAEL T. FITZPATRICK
Company Name STANTEC
Your Phone 612-712-2045
Your Email mike.fitzpatrick@stantec.com

## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Collector | | **Sidewalk** | | |
| Pedestrians | High | | Width | Left: 5 ft | Right: 5 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 9 ft | Right: 9 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 11 ft | Right: 11 ft | Width | Left: 7 ft | Right: 7 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 345.45 ft | Configuration: | Single |
| Setback: | 8 ft | Arm Length: | 6 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

### Right Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

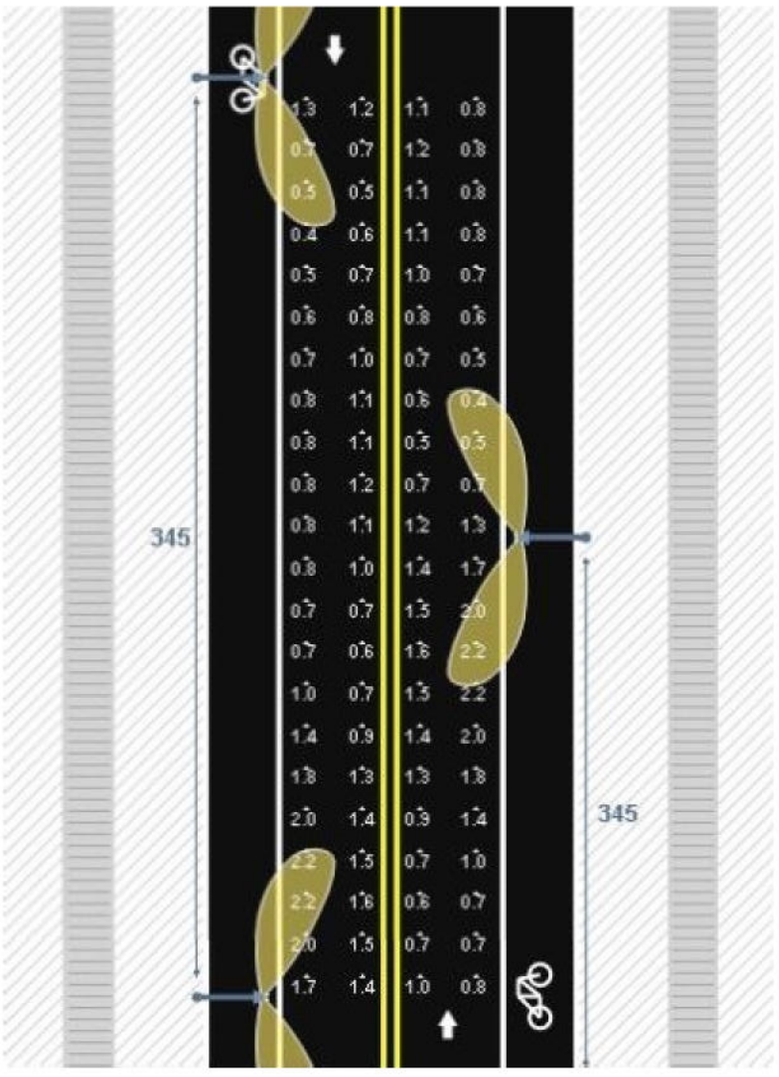
| | | | |
|---|---|---|---|
| Cycle Spacing: | 345.45 ft | Configuration: | Single |
| Setback: | 8 ft | Arm Length: | 6 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | True | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




Luminance

### Calculation Results

| Luminance | Left | Right | |
|---|---|---|---|
| Average: | 1.1 | 1.1 | cd/m² |
| Max: | 2.2 | 2.2 | cd/m² |
| Min | 0.4 | 0.4 | cd/m² |
| Ave/Min: | 2.5 | 2.5 | |
| Max/Min: | 5 | 5 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 4.5 | 4.5 | |

| Illuminance | Left | Right | |
|---|---|---|---|
| Average: | 1.4 | 1.4 | fc |
| Max: | 4.4 | 4.4 | fc |
| Min | 0.4 | 0.4 | fc |
| Ave/Min: | 3.3 | 3.3 | |
| Max/Min: | 10.5 | 10.5 | |

| Sidewalk | Left | Right | |
|---|---|---|---|
| Average: | 0.3 | 0.3 | fc |
| Min | 0.2 | 0.2 | fc |
| Ave/Min: | 2 | 1.9 | |
| Ev Min: | 0 | 0 | fc |

| Bikelane | | | |
|---|---|---|---|
| Average: | 1.2 | 1.2 | fc |
| Min | 0.4 | 0.4 | fc |
| Ave/Min: | 3.3 | 3.3 | |
| Ev Min: | 0 | 0 | fc |

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# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

Project Name

Project Description

User Name MICHAEL T. FITZPATRICK
Company Name STANTEC
Your Phone 612-712-2045
Your Email mike.fitzpatrick@stantec.com

## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Collector | | **Sidewalk** | | |
| Pedestrians | Medium | | Width | Left: 5 ft | Right: 5 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 9 ft | Right: 9 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 11 ft | Right: 11 ft | Width | Left: 7 ft | Right: 7 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 367.16 ft | Configuration: | Single |
| Setback: | 8 ft | Arm Length: | 6 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

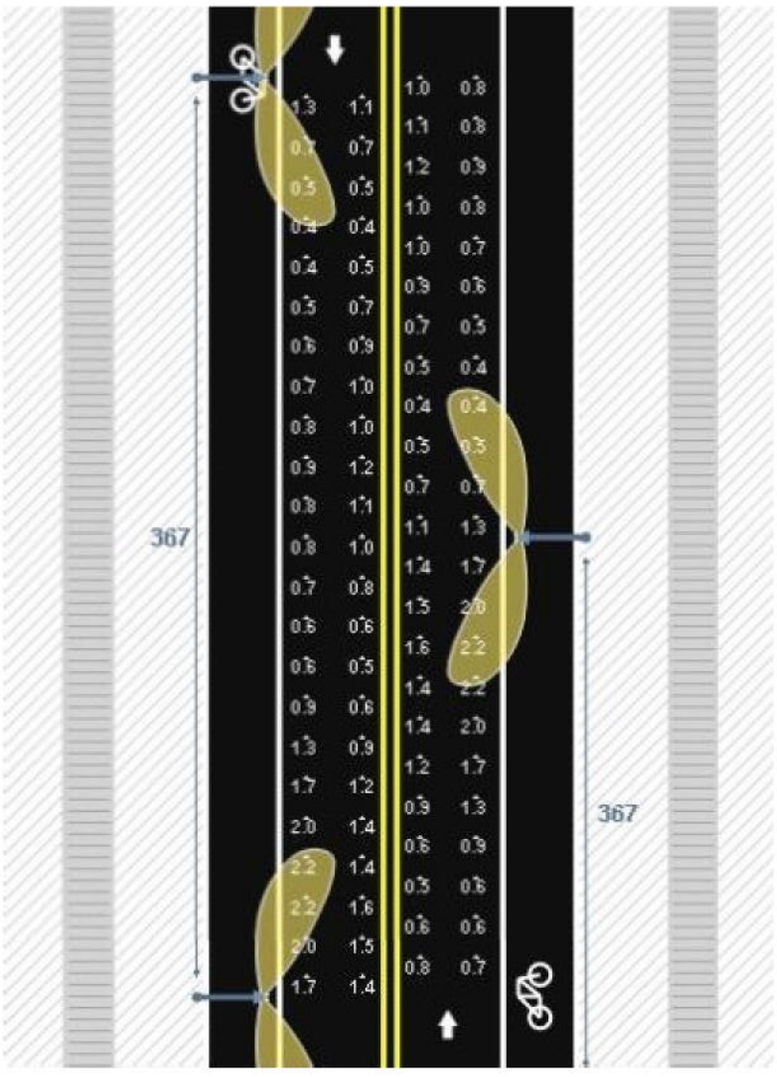
### Right Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 367.16 ft | Configuration: | Single |
| Setback: | 8 ft | Arm Length: | 6 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | True | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




Luminance

### Calculation Results

| Luminance | Left | Right | |
|---|---|---|---|
| Average: | 1 | 1 | cd/m² |
| Max: | 2.2 | 2.2 | cd/m² |
| Min | 0.4 | 0.4 | cd/m² |
| Ave/Min: | 2.7 | 2.7 | |
| Max/Min: | 6 | 6 | |
| Lv Ratio: | 0.3 | 0.3 | |
| STV: | 5.1 | 5.1 | |

| Illuminance | Left | Right | |
|---|---|---|---|
| Average: | 1.3 | 1.3 | fc |
| Max: | 4.4 | 4.4 | fc |
| Min | 0.3 | 0.3 | fc |
| Ave/Min: | 3.9 | 3.9 | |
| Max/Min: | 12.9 | 12.9 | |

| Sidewalk | Left | Right | |
|---|---|---|---|
| Average: | 0.3 | 0.3 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 2.3 | 2.2 | |
| Ev Min: | 0 | 0 | fc |

| Bikelane | | | |
|---|---|---|---|
| Average: | 1.1 | 1.1 | fc |
| Min | 0.3 | 0.3 | fc |
| Ave/Min: | 3.5 | 3.6 | |
| Ev Min: | 0 | 0 | fc |

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AcuityBrands.

# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

Project Name
Project Description

User Name MICHAEL T. FITZPATRICK
Company Name STANTEC
Your Phone 612-712-2045
Your Email mike.fitzpatrick@stantec.com

## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Collector | | **Sidewalk** | | |
| Pedestrians | Low | | Width | Left: 5 ft | Right: 5 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 9 ft | Right: 9 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 11 ft | Right: 11 ft | Width | Left: 7 ft | Right: 7 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 400.21 ft | Configuration: | Single |
| Setback: | 8 ft | Arm Length: | 6 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | False | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

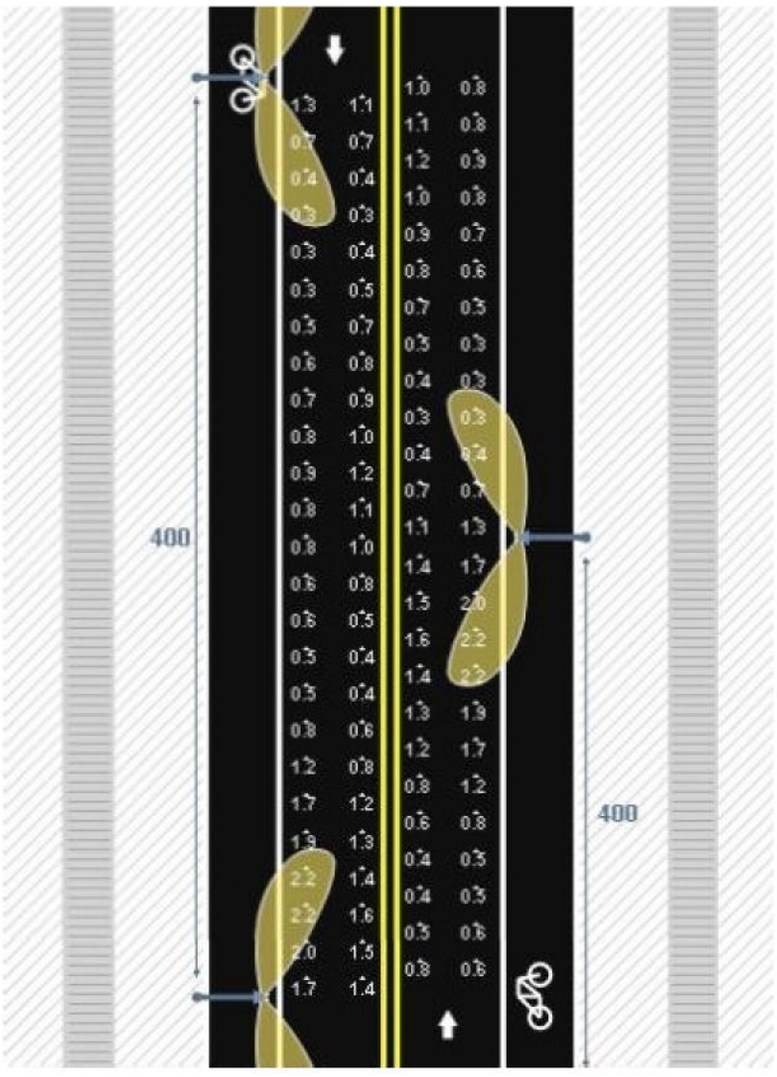
### Right Side - Philips Lumec: RFM-108W48LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 400.21 ft | Configuration: | Single |
| Setback: | 8 ft | Arm Length: | 6 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 13170 |
| Staggered: | True | Wattage: | 106 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




Luminance

### Calculation Results

| Luminance | Left | Right | |
|---|---|---|---|
| Average: | 0.9 | 0.9 | cd/m² |
| Max: | 2.2 | 2.2 | cd/m² |
| Min | 0.3 | 0.3 | cd/m² |
| Ave/Min: | 3.3 | 3.3 | |
| Max/Min: | 7.9 | 7.9 | |
| Lv Ratio: | 0.4 | 0.4 | |
| STV: | 5.5 | 5.5 | |

| Illuminance | Left | Right | |
|---|---|---|---|
| Average: | 1.2 | 1.2 | fc |
| Max: | 4.4 | 4.4 | fc |
| Min | 0.2 | 0.2 | fc |
| Ave/Min: | 5 | 5 | |
| Max/Min: | 18.2 | 18.2 | |

| Sidewalk | Left | Right | |
|---|---|---|---|
| Average: | 0.3 | 0.3 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 2.8 | 2.8 | |
| Ev Min: | 0 | 0 | fc |

| Bikelane | | | |
|---|---|---|---|
| Average: | 1 | 1 | fc |
| Min | 0.2 | 0.2 | fc |
| Ave/Min: | 4.6 | 4.9 | |
| Ev Min: | 0 | 0 | fc |

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# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

| | |
|---|---|
| Project Name | City of Rochester, Minnesota |
| Project Description | |

| | |
|---|---|
| User Name | MICHAEL T. FITZPATRICK |
| Company Name | STANTEC |
| Your Phone | 612-712-2045 |
| Your Email | mike.fitzpatrick@stantec.com |

## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Local | | **Sidewalk** | | |
| Pedestrians | High | | Width | Left: 0 ft | Right: 0 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 0 ft | Right: 0 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 12 ft | Right: 12 ft | Width | Left: 5 ft | Right: 5 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-72W32LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 422.65 ft | Configuration: | Single |
| Setback: | 6 ft | Arm Length: | 4 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 8780 |
| Staggered: | False | Wattage: | 73 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

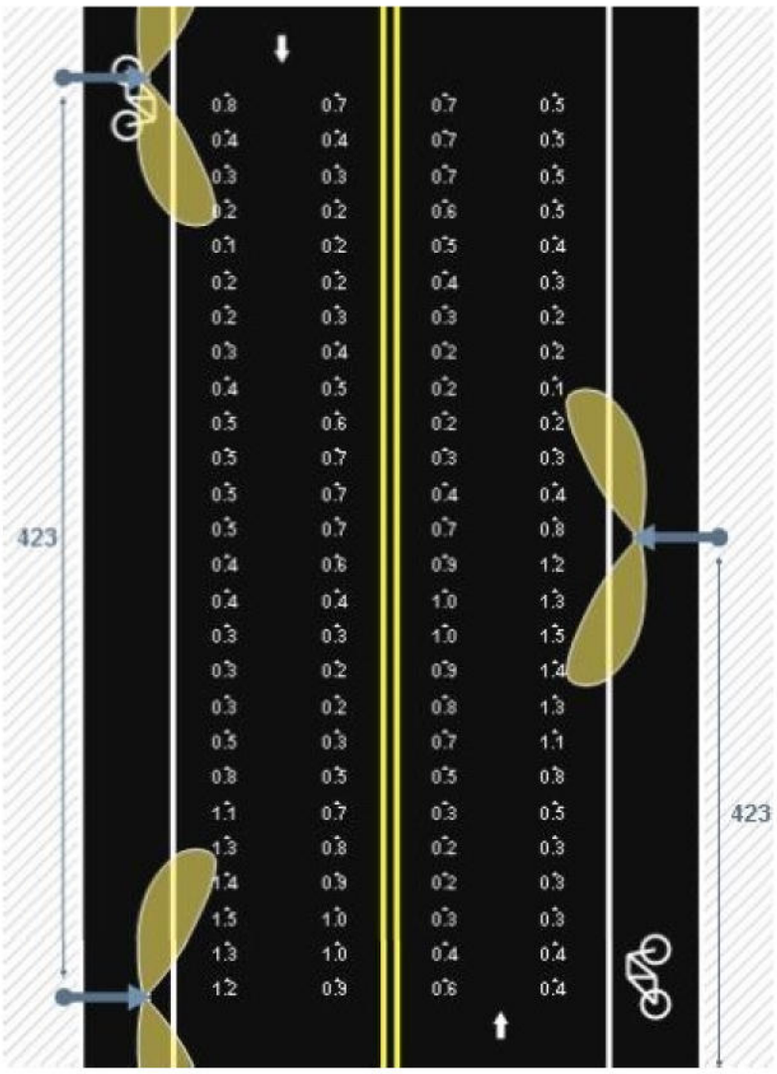
### Right Side - Philips Lumec: RFM-72W32LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 422.65 ft | Configuration: | Single |
| Setback: | 6 ft | Arm Length: | 4 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 8780 |
| Staggered: | True | Wattage: | 73 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




**Luminance**

### Calculation Results

| Luminance | Left | Right | |
|---|---|---|---|
| Average: | 0.6 | 0.6 | cd/m² |
| Max: | 1.5 | 1.5 | cd/m² |
| Min | 0.2 | 0.2 | cd/m² |
| Ave/Min: | 3.7 | 3.7 | |
| Max/Min: | 9.7 | 9.7 | |
| Lv Ratio: | 0.4 | 0.4 | |
| STV: | 4.9 | 4.9 | |

| Illuminance | Left | Right | |
|---|---|---|---|
| Average: | 0.7 | 0.7 | fc |
| Max: | 2.9 | 2.9 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 6.2 | 6.2 | |
| Max/Min: | 24.2 | 24.2 | |

| Sidewalk | Left | Right | |
|---|---|---|---|
| Average: | -- | -- | fc |
| Min | -- | -- | fc |
| Ave/Min: | -- | -- | |
| Ev Min: | -- | -- | fc |

| Bikelane | | | |
|---|---|---|---|
| Average: | 0.7 | 0.7 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 6.2 | 5.5 | |
| Ev Min: | 0 | 0 | fc |

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AcuityBrands.

# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

| | |
|---|---|
| Project Name | City of Rochester, Minnesota |
| Project Description | |



| | |
|---|---|
| User Name | MICHAEL T. FITZPATRICK |
| Company Name | STANTEC |
| Your Phone | 612-712-2045 |
| Your Email | mike.fitzpatrick@stantec.com |



## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Local | | **Sidewalk** | | |
| Pedestrians | Medium | | Width | Left: 0 ft | Right: 0 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 0 ft | Right: 0 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 12 ft | Right: 12 ft | Width | Left: 5 ft | Right: 5 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-72W32LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 422.65 ft | Configuration: | Single |
| Setback: | 6 ft | Arm Length: | 4 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 8780 |
| Staggered: | False | Wattage: | 73 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

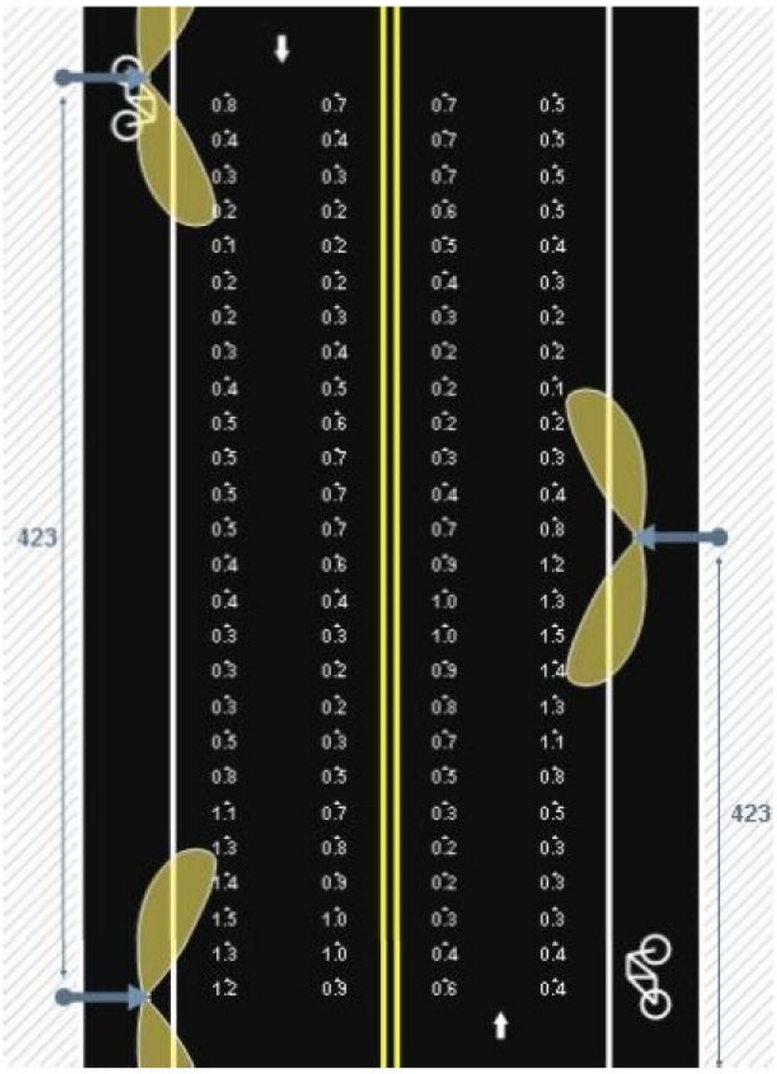
### Right Side - Philips Lumec: RFM-72W32LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 422.65 ft | Configuration: | Single |
| Setback: | 6 ft | Arm Length: | 4 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 8780 |
| Staggered: | True | Wattage: | 73 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




**Luminance**

### Calculation Results

| **Luminance** | Left | Right | |
|---|---|---|---|
| Average: | 0.6 | 0.6 | cd/m² |
| Max: | 1.5 | 1.5 | cd/m² |
| Min | 0.2 | 0.2 | cd/m² |
| Ave/Min: | 3.7 | 3.7 | |
| Max/Min: | 9.7 | 9.7 | |
| Lv Ratio: | 0.4 | 0.4 | |
| STV: | 4.9 | 4.9 | |

| **Illuminance** | Left | Right | |
|---|---|---|---|
| Average: | 0.7 | 0.7 | fc |
| Max: | 2.9 | 2.9 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 6.2 | 6.2 | |
| Max/Min: | 24.2 | 24.2 | |

| **Sidewalk** | Left | Right | |
|---|---|---|---|
| Average: | -- | -- | fc |
| Min | -- | -- | fc |
| Ave/Min: | -- | -- | |
| Ev Min: | -- | -- | fc |

| **Bikelane** | | | |
|---|---|---|---|
| Average: | 0.7 | 0.7 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 6.2 | 5.5 | |
| Ev Min: | 0 | 0 | fc |

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AcuityBrands.

# Visual - Roadway Tool

www.Visual-3D.com

Tuesday, January 08, 2019

## Design Information

| | |
|---|---|
| Project Name | City of Rochester, Minnesota |
| Project Description | |



| | |
|---|---|
| User Name | MICHAEL T. FITZPATRICK |
| Company Name | STANTEC |
| Your Phone | 612-712-2045 |
| Your Email | mike.fitzpatrick@stantec.com |



## Roadway

| | | | | | |
|---|---|---|---|---|---|
| Calculation Method | RP-8-2000 2007 errata | | **Median** | | |
| Road Surface | R3 | | Width | 0 ft | |
| Road Class | Local | | **Sidewalk** | | |
| Pedestrians | Low | | Width | Left: 0 ft | Right: 0 ft |
| Roadway Length | 0 (0 Pole Locations) | | Setback | Left: 0 ft | Right: 0 ft |
| Lane Quantity | Left: 1 | Right: 1 | **Bikelane** | | |
| Lane Width | Left: 12 ft | Right: 12 ft | Width | Left: 5 ft | Right: 5 ft |
| | | | Setback | Left: 0 ft | Right: 0 ft |

## Luminaire Information

### Left Side - Philips Lumec: RFM-72W32LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 422.65 ft | Configuration: | Single |
| Setback: | 6 ft | Arm Length: | 4 ft |
| Orientation: | 90 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 8780 |
| Staggered: | False | Wattage: | 73 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

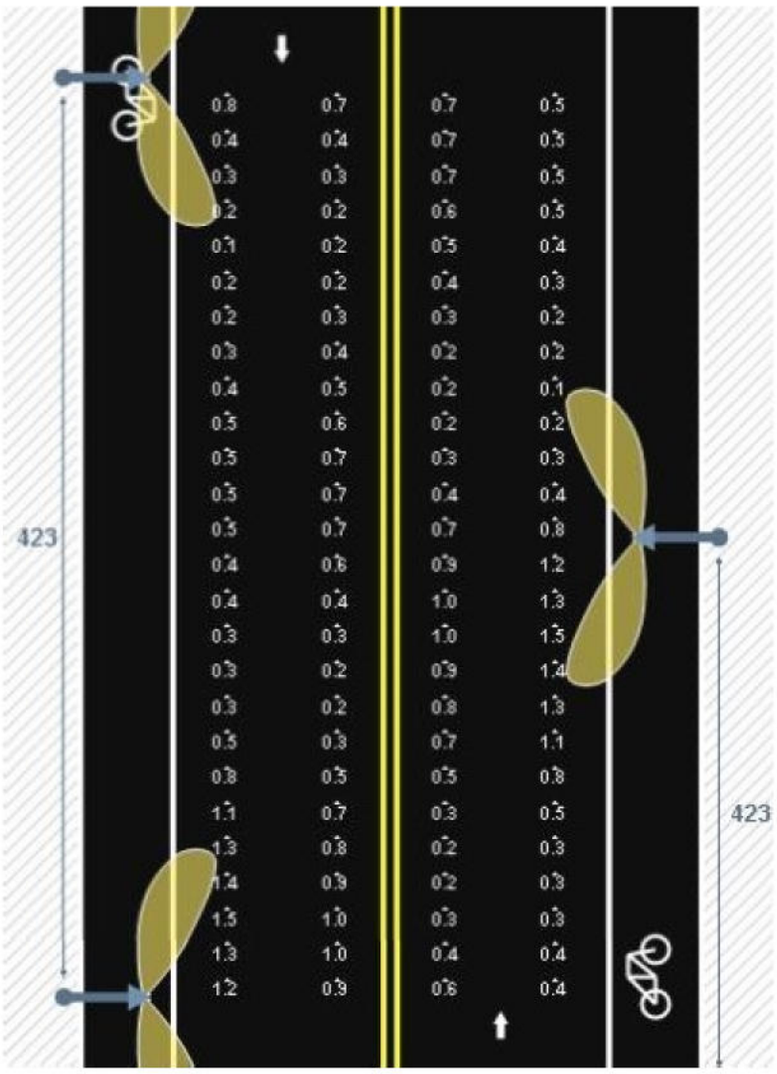
### Right Side - Philips Lumec: RFM-72W32LED4K-G2-R3M

| | | | |
|---|---|---|---|
| Cycle Spacing: | 422.65 ft | Configuration: | Single |
| Setback: | 6 ft | Arm Length: | 4 ft |
| Orientation: | 270 | Tilt: | 0 |
| Mounting Height: | 25 ft | Lamp Lumens: | 8780 |
| Staggered: | True | Wattage: | 73 |
| Light Loss Factor: | 0.9 | Lamp Count: | 1 |

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## Visual - Roadway Tool

www.Visual-3D.com




**Luminance**

### Calculation Results

| **Luminance** | Left | Right | |
|---|---|---|---|
| Average: | 0.6 | 0.6 | cd/m² |
| Max: | 1.5 | 1.5 | cd/m² |
| Min | 0.2 | 0.2 | cd/m² |
| Ave/Min: | 3.7 | 3.7 | |
| Max/Min: | 9.7 | 9.7 | |
| Lv Ratio: | 0.4 | 0.4 | |
| STV: | 4.9 | 4.9 | |

| **Illuminance** | Left | Right | |
|---|---|---|---|
| Average: | 0.7 | 0.7 | fc |
| Max: | 2.9 | 2.9 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 6.2 | 6.2 | |
| Max/Min: | 24.2 | 24.2 | |

| **Sidewalk** | Left | Right | |
|---|---|---|---|
| Average: | -- | -- | fc |
| Min | -- | -- | fc |
| Ave/Min: | -- | -- | |
| Ev Min: | -- | -- | fc |

| **Bikelane** | | | |
|---|---|---|---|
| Average: | 0.7 | 0.7 | fc |
| Min | 0.1 | 0.1 | fc |
| Ave/Min: | 6.2 | 5.5 | |
| Ev Min: | 0 | 0 | fc |

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# Appendix E
## SAMPLE LIGHTING PLANS

A. The sample lighting plans are attached.

## ONE-LINE DIAGRAM SYMBOLS

- INCOMING LINE
- POWER CIRCUIT BREAKER
- OCB — OIL CIRCUIT BREAKER
- CIRCUIT BREAKER
- DRAW-OUT CIRCUIT BREAKER
- LOAD BREAK INTERRUPTING SWITCH
- SINGLE THROW DISCONNECTING SWITCH
- DOUBLE THROW DISCONNECTING SWITCH
- FUSE
- DISCONNECTING FUSE
- SWITCH AND FUSE
- RESISTOR
- RESISTOR
- CURRENT TRANSFORMER
- POTENTIAL TRANSFORMER
- LA — LIGHTNING ARRESTER
- TRANSFORMER
- CAPACITOR
- M — MOTOR
- G — GENERATOR
- RELAY (PILOT RELAY NEC)
- STRESS CONE
- FUSE CUTOUT
- INDICATING CIRCUIT
- A — AMMETER
- AS — AMMETER SWITCH
- DM — DEMAND METER
- PF — POWER FACTOR METER
- V — VOLTMETER
- VS — VOLTMETER SWITCH
- W — WATTMETER
- WH — WATTHOUR METER
- TD — WATTHOUR METER WITH DEMAND REGISTER
- MM — MULTI-FUNCTION METER
- M — METER
- TVSS — TRANSIENT VOLTAGE SURGE SUPPRESSER
- K — KEY INTERLOCK
- AUTOMATIC TRANSFER SWITCH (A.T.S)

## PANELBOARD NAMING CONVENTION

TYPICAL UNLESS INDICATED OTHERWISE

LP#1 — EQUIPMENT TYPE; VOLTAGE; EQUIPMENT NUMBER

EQUIPMENT TYPE:
- SE = SERVICE ENTRANCE SWITCHBOARD
- LP = LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARD
- PP = POWER PANELBOARD
- L = LIGHTING CONTROL PANEL

VOLTAGE:
- A = 120/240 1Φ
- B = 208Y/120 3Φ
- C = 240/120 3Φ
- D = 480Y/277 3Φ

## LIGHTING SYMBOLS

AE — EXTERIOR TYPE; EMERGENCY BALLAST; CIRCUIT NUMBER

FLUORESCENT FIXTURE; SWITCH DESIGNATION; MOUNTING HEIGHT

MOUNTING HEIGHT:
- CEILING RECESSED MOUNTED
- CEILING SURFACE MOUNTED
- PENDANT MOUNTED AT X" A.F.F.
- WALL MOUNTED @ X'-X" A.F.F.

- WALL MOUNT FIXTURE
- FLUORESCENT OR INCANDESCENT RECESSED DOWNLIGHT
- FLUORESCENT OR INCANDESCENT RECESSED WALLWASHER
- WALL MOUNTED UNIT (RED EXAMPLE = CEILING MOUNTED)
- EXIT LIGHT — INDICATES ARROW DIRECTION (IF ANY); FACE(S) ON WHICH LETTERING APPEARS
- REMOTE/BATTERY PACK LIGHT
- TRACK LIGHTING
- COVE LIGHT
- MISCELLANEOUS FIXTURES

## POWER SYMBOLS

- WP — WEATHERPROOF
- 12 GFI — DUPLEX RECEPTACLE - 18"AFF; CIRCUIT NUMBER; GROUND FAULT TYPE
- PEDESTAL MOUNTED FLOOR BOX
- DOUBLE DUPLEX RECEPTACLE - 18"AFF
- EMERGENCY POWER DUPLEX RECEPTACLE - 18"AFF
- CEILING MOUNTED RECEPTACLE DROP
- FLOOR MOUNTED RECEPTACLE OUTLET
- PSA — PLUG STRIP - LETTER DESIGNATES TYPE - 18"AFF
- HOME RUN SURFACE MOUNT
- HOME RUN UNDER-GROUND OR IN-SLAB
- CEILING MOUNTED RECEPTACLE
- WELDING RECEPTACLE - 18"AFF
- SPECIAL PURPOSE RECEPTACLE - 18"AFF

## POWER SYMBOLS (CONT)

- ISOLATED GROUND
- TVSS — DUPLEX RECEPTACLE - 18"AFF; CIRCUIT NUMBER; TRANSIENT VOLTAGE SURGE SUPPRESSION
- SPECIAL RECEPTACLE - 18"AFF
- SPECIAL OUTLET MOUNTING @ X'-X" AFF, OR AS NOTED ON DRAWINGS.
- REMOTE CONNECTION FOR CD/TAPE PLAYER
- MICROPHONE RECEPTACLE WITH VOLUME CONTROL
- SINGLE POLE SWITCH - 48"AFF; SWITCH DESIGNATION
- DOUBLE POLE SWITCH - 48"AFF
- THREE WAY SWITCH - 48"AFF
- FOUR WAY SWITCH - 48"AFF
- DIMMER SWITCH - 48"AFF
- KEY OPERATED SWITCH - 48"AFF
- SWITCH AND PILOT LIGHT - 48"AFF
- MANUAL MOTOR STARTER
- OCCUPANCY SENSOR (WALL MOUNTED) - 48"AFF
- OCCUPANCY SENSOR (CEILING MOUNTED)
- RECEPTACLE PANEL
- LIGHTING PANEL - 54"AFF
- DISTRIBUTION PANEL - 54"AFF
- DISCONNECT SWITCH - 54"AFF
- FUSED DISCONNECT SWITCH - 54"AFF
- WALL MOUNTED CIRCUIT BREAKER - 54"AFF
- COMBINATION STARTER/DISCONNECT - 54"AFF
- MOTOR 3 PHASE
- MOTOR 1 PHASE
- M — METER SOCKET

## TELEPHONE AND INTERCOM SYMBOLS

- TELEPHONE OUTLET - 18"AFF
- W — WALL MOUNTED TELEPHONE OUTLET - 54"AFF
- FLOOR MOUNTED TELEPHONE OUTLET
- D — DATA COMMUNICATIONS OUTLET - 18"AFF
- VOICE/DATA OUTLET - 18"AFF
- POWER/DATA COMMUNICATIONS CEILING POKE-THRU
- D — FLOOR MOUNTED DATA COMMUNICATIONS OUTLET
- TC — TELEPHONE TERMINAL CABINET
- IDS — INTERCOM DOOR STATION - WALL MOUNTED 54"AFF
- IMS — INTERCOM MASTER STATION WALL OR DESK MOUNTED
- IHS — INTERCOM HANDSET STATION WITH HANDSET AND SPEAKER/AMPLIFIER 54"AFF
- IS — INTERCOM SPEAKER

## FIRE ALARM SYMBOLS

- MANUAL PULL STATION - 48"AFF
- F / WP — FIRE ALARM HORN/STROBE - 80"AFF; (WP=WEATHERPROOF); (WG=WIRE GUARD)
- FIRE ALARM STROBE - 80"AFF
- FS — FLOW SWITCH
- TS — TAMPER SWITCH
- P — SMOKE DETECTOR - PHOTOELECTRIC
- I — SMOKE DETECTOR - IONIZATION
- D — DUCT SMOKE DETECTOR
- ER — SMOKE DETECTOR - ELEVATOR RECALL
- HEAT DETECTOR
- H — DOOR HOLDER
- H — FIRE ALARM PANEL
- FIRE ALARM BELL
- F — FIREMANS TELEPHONE

## SECURITY SYMBOLS

- GB — GLASS MOUNTED GLASS BREAK DETECTOR
- GB — GLASS BREAK DETECTOR SENSING DIRECTION
- MD — MOTION DETECTOR SENSING DIRECTION
- PB — PANIC BUTTON
- KP — KEYPAD TYPE ARMING STATION - 48"AFF
- ET — EMERGENCY TELEPHONE
- DC — DOOR CONTACT
- EL — ELECTRIC LOCK
- ES — ELECTRIC STRIKE
- R — REQUEST TO EXIT (REX) MOTION SENSOR
- CR — CARD READER - 48"AFF
- CCTV CAMERA - FIXED MOUNT
- CCTV CAMERA - PAN/TILT/ZOOM
- DGP — DATA GATHERING PANEL BURGLAR ALARM
- ACP — ACCESS CONTROL PANEL

## CONTROL/MISC SYMBOLS

- WALL MOUNTED JUNCTION BOX
- CEILING MOUNTED JUNCTION BOX
- SOLENOID
- LEVEL SWITCH
- EMERGENCY STOP SWITCH
- LS — LIMIT SWITCH
- FS — FLOW SWITCH
- P — PRESSURE SWITCH
- T — TEMPERATURE SWITCH
- S — SPEED SWITCH
- FLOOD SWITCH
- LEVEL TRANSDUCER
- D — DAMPER
- SURGE SUPPRESSOR
- PUSHBUTTON STATION
- PUSHBUTTON WITH ILLUMINATED STOP
- SHEAR PIN SWITCH
- SELECTOR SWITCH WITH INDICATING LIGHT
- BELL
- BUZZER
- HORN
- DOOR HOLDER
- PLUG

## CONTROL/KEY NOTES SYMBOLS

- KEYNOTE
- KEYNOTE
- KEYNOTE
- KEYNOTE
- KEYNOTE
- KEYNOTE

## CONTROL SCHEMATIC SYMBOLS

- NORMALLY CLOSED PUSHBUTTON
- NORMALLY OPEN PUSHBUTTON
- TWO-POSITION SELECTOR SWITCH
- TWO-POSITION SELECTOR SWITCH
- NORMALLY CLOSED LIMIT SWITCH - HELD OPEN
- NORMALLY OPEN LIMIT SWITCH

## CONTROL SCHEMATIC SYM. (CONT)

- NORMALLY OPEN LIMIT SWITCH - HELD CLOSED
- NORMALLY CLOSED LIMIT SWITCH
- OPEN SWITCH WITH TIME DELAY CLOSING
- CLOSED SWITCH WITH TIME DELAY OPENING
- OPEN SWITCH WITH TIME DELAY OPENING
- CLOSED SWITCH WITH TIME DELAY CLOSING
- FLOW SWITCH (CLOSES ON INCREASE IN FLOW)
- FLOW SWITCH (OPENS ON INCREASE IN FLOW)
- LEVEL SWITCH (CLOSES ON RISING LEVEL)
- LEVEL SWITCH (OPENS ON RISING LEVEL)
- PRESSURE SWITCH (CLOSES ON RISING PRESSURE)
- PRESSURE SWITCH (OPENS ON RISING PRESSURE)
- TEMPERATURE SWITCH (CLOSES ON RISING TEMP.)
- TEMPERATURE SWITCH (OPENS ON RISING TEMP.)
- NORMALLY OPEN CONTACTS
- NORMALLY CLOSED CONTACTS
- INDICATING LIGHT
  - A - AMBER
  - B - BLUE
  - C - CLEAR
  - G - GREEN
  - N - NEON
  - OP - OPAL
  - OR - ORANGE
  - P - PURPLE
- PUSH TO TEST INDICATING LIGHT
- CONTROL SYSTEM OUTPUT
- SOLENOID
- MANUAL STARTER
- CURRENT TRANSFORMER
- TDR — TIMING RELAY
- CR OR R — RELAY
- M — OLS — MOTOR STARTER COIL AND OVERLOAD CONTACTS
- GROUND
- CONTROL CIRCUIT TRANSFORMER
- OVERLOAD


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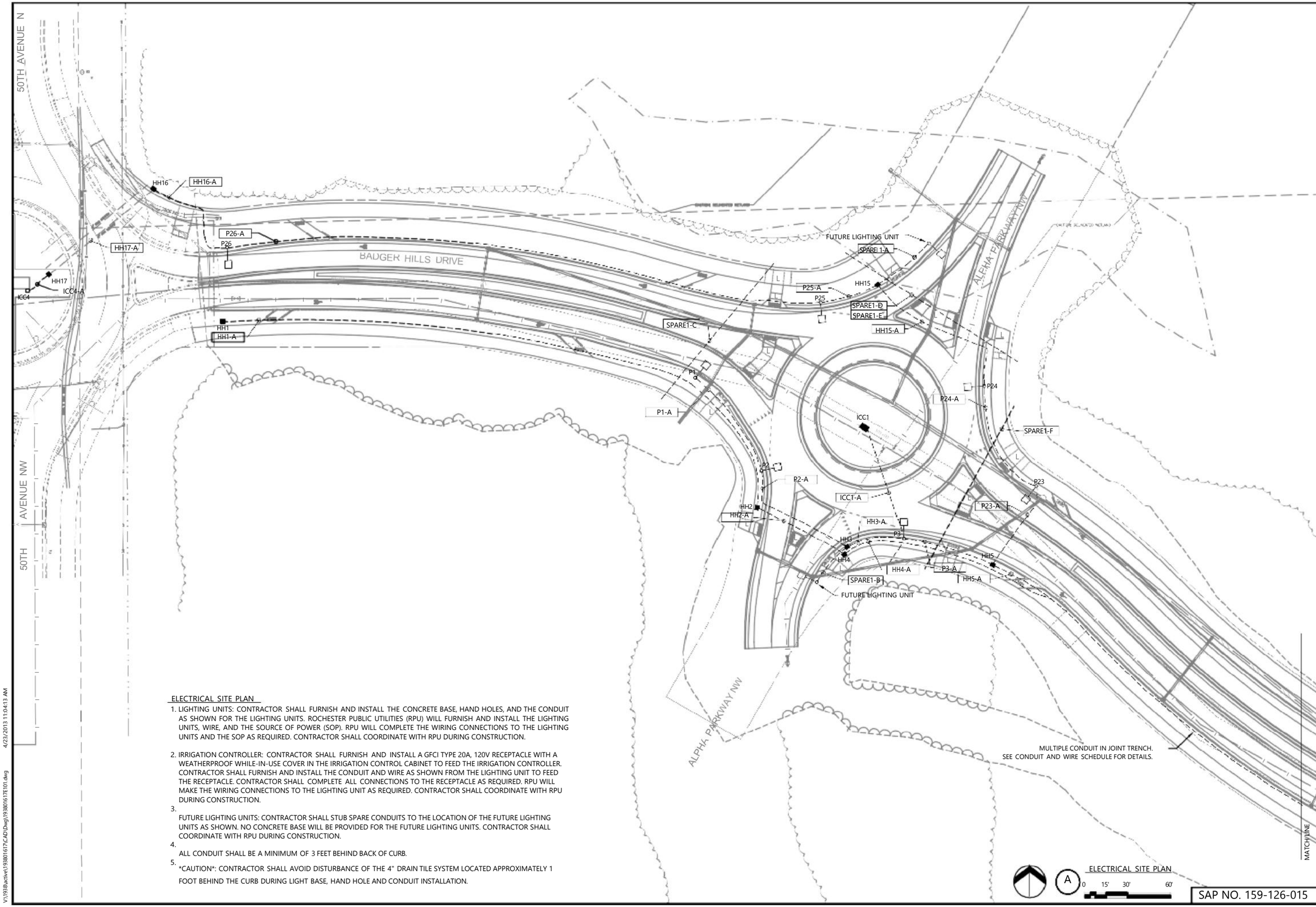
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ELECTRICAL SITE PLAN

1. LIGHTING UNITS: CONTRACTOR SHALL FURNISH AND INSTALL THE CONCRETE BASE, HAND HOLES, AND THE CONDUIT AS SHOWN FOR THE LIGHTING UNITS. ROCHESTER PUBLIC UTILITIES (RPU) WILL FURNISH AND INSTALL THE LIGHTING UNITS, WIRE, AND THE SOURCE OF POWER (SOP). RPU WILL COMPLETE THE WIRING CONNECTIONS TO THE LIGHTING UNITS AND THE SOP AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.
2. IRRIGATION CONTROLLER: CONTRACTOR SHALL FURNISH AND INSTALL A GFCI TYPE 20A, 120V RECEPTACLE WITH A WEATHERPROOF WHILE-IN-USE COVER IN THE IRRIGATION CONTROL CABINET TO FEED THE IRRIGATION CONTROLLER. CONTRACTOR SHALL FURNISH AND INSTALL THE CONDUIT AND WIRE AS SHOWN FROM THE LIGHTING UNIT TO FEED THE RECEPTACLE. CONTRACTOR SHALL COMPLETE ALL CONNECTIONS TO THE RECEPTACLE AS REQUIRED. RPU WILL MAKE THE WIRING CONNECTIONS TO THE LIGHTING UNIT AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.
3. FUTURE LIGHTING UNITS: CONTRACTOR SHALL STUB SPARE CONDUITS TO THE LOCATION OF THE FUTURE LIGHTING UNITS AS SHOWN. NO CONCRETE BASE WILL BE PROVIDED FOR THE FUTURE LIGHTING UNITS. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.
4. ALL CONDUIT SHALL BE A MINIMUM OF 3 FEET BEHIND BACK OF CURB.
5. *CAUTION*: CONTRACTOR SHALL AVOID DISTURBANCE OF THE 4" DRAIN TILE SYSTEM LOCATED APPROXIMATELY 1 FOOT BEHIND THE CURB DURING LIGHT BASE, HAND HOLE AND CONDUIT INSTALLATION.

ELECTRICAL SITE PLAN

A

0 15' 30' 60'

SAP NO. 159-126-015

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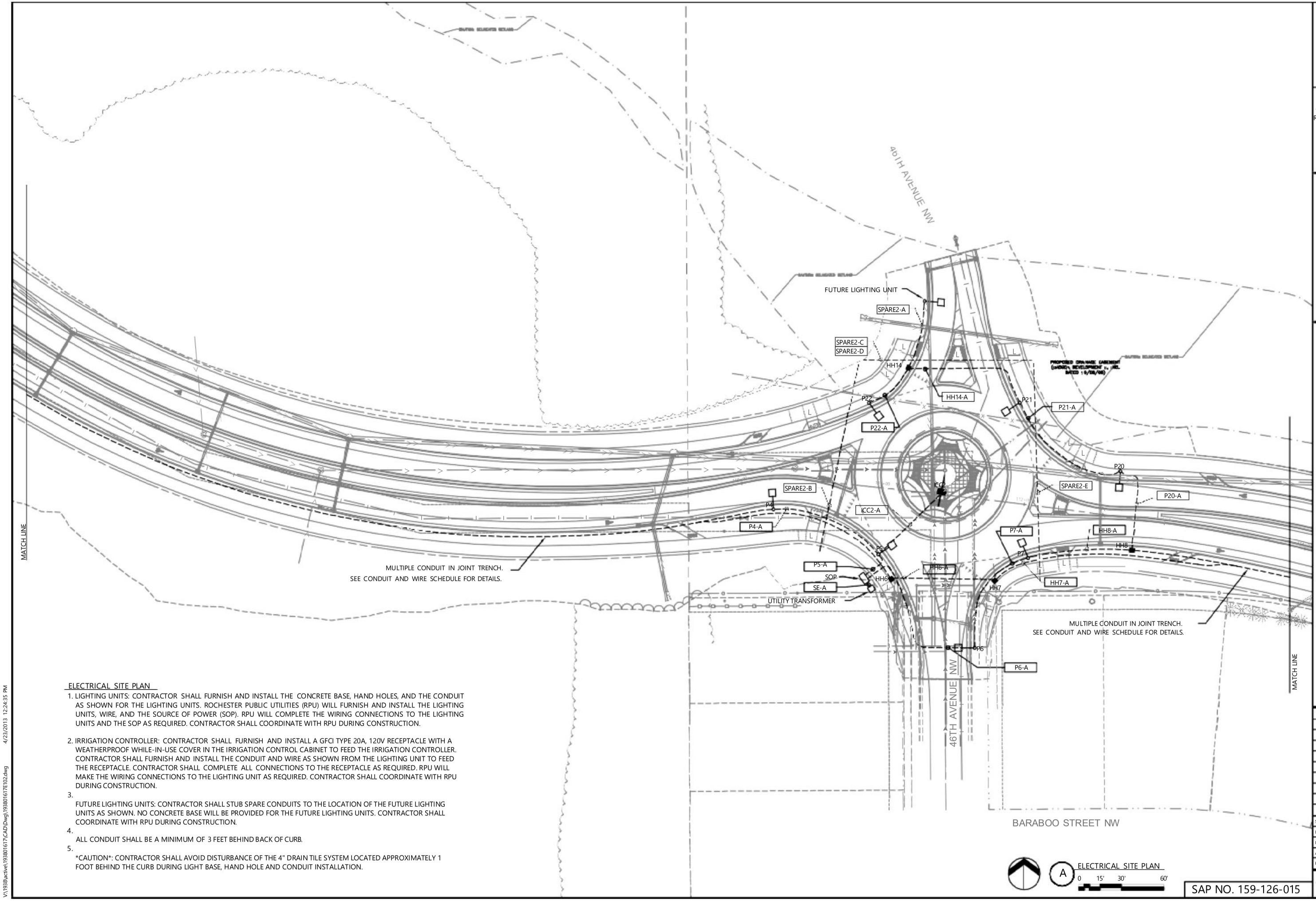
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ELECTRICAL SITE PLAN

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ELECTRICAL SITE PLAN

1. LIGHTING UNITS: CONTRACTOR SHALL FURNISH AND INSTALL THE CONCRETE BASE, HAND HOLES, AND THE CONDUIT AS SHOWN FOR THE LIGHTING UNITS. ROCHESTER PUBLIC UTILITIES (RPU) WILL FURNISH AND INSTALL THE LIGHTING UNITS, WIRE, AND THE SOURCE OF POWER (SOP). RPU WILL COMPLETE THE WIRING CONNECTIONS TO THE LIGHTING UNITS AND THE SOP AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.

2. IRRIGATION CONTROLLER: CONTRACTOR SHALL FURNISH AND INSTALL A GFCI TYPE 20A, 120V RECEPTACLE WITH A WEATHERPROOF WHILE-IN-USE COVER IN THE IRRIGATION CONTROL CABINET TO FEED THE IRRIGATION CONTROLLER. CONTRACTOR SHALL FURNISH AND INSTALL THE CONDUIT AND WIRE AS SHOWN FROM THE LIGHTING UNIT TO FEED THE RECEPTACLE. CONTRACTOR SHALL COMPLETE ALL CONNECTIONS TO THE RECEPTACLE AS REQUIRED. RPU WILL MAKE THE WIRING CONNECTIONS TO THE LIGHTING UNIT AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.

3. FUTURE LIGHTING UNITS: CONTRACTOR SHALL STUB SPARE CONDUITS TO THE LOCATION OF THE FUTURE LIGHTING UNITS AS SHOWN. NO CONCRETE BASE WILL BE PROVIDED FOR THE FUTURE LIGHTING UNITS. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.

4. ALL CONDUIT SHALL BE A MINIMUM OF 3 FEET BEHIND BACK OF CURB.

5. *CAUTION*: CONTRACTOR SHALL AVOID DISTURBANCE OF THE 4" DRAIN TILE SYSTEM LOCATED APPROXIMATELY 1 FOOT BEHIND THE CURB DURING LIGHT BASE, HAND HOLE AND CONDUIT INSTALLATION.

A ELECTRICAL SITE PLAN
0 15' 30' 60'

SAP NO. 159-126-015

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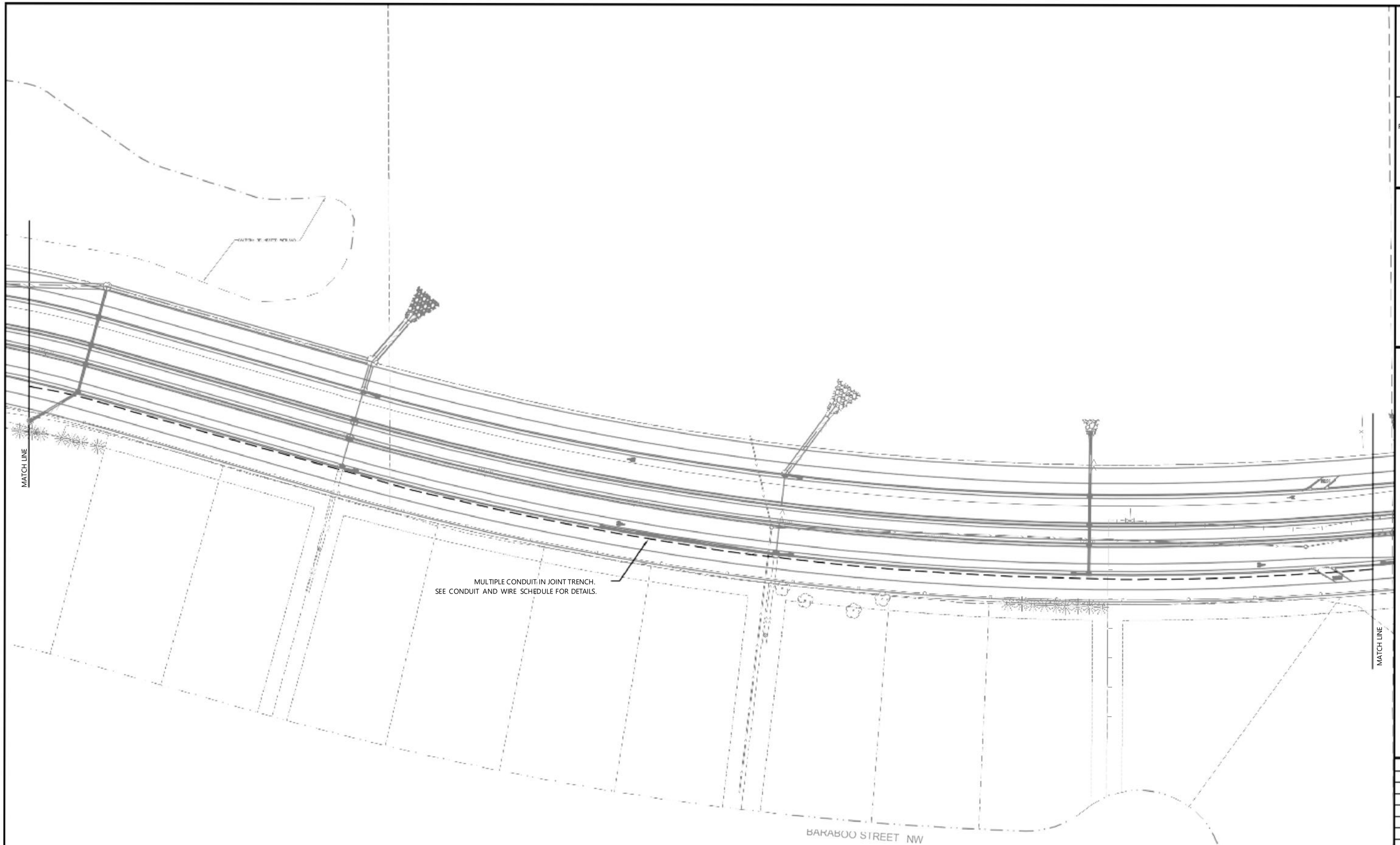
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BADGER HILLS DRIVE / 41ST STREET NW
ELECTRICAL SITE PLAN

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ELECTRICAL SITE PLAN

1. LIGHTING UNITS: CONTRACTOR SHALL FURNISH AND INSTALL THE CONCRETE BASE, HAND HOLES, AND THE CONDUIT AS SHOWN FOR THE LIGHTING UNITS. ROCHESTER PUBLIC UTILITIES (RPU) WILL FURNISH AND INSTALL THE LIGHTING UNITS, WIRE, AND THE SOURCE OF POWER (SOP). RPU WILL COMPLETE THE WIRING CONNECTIONS TO THE LIGHTING UNITS AND THE SOP AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.

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A ELECTRICAL SITE PLAN
0 15' 30' 60'

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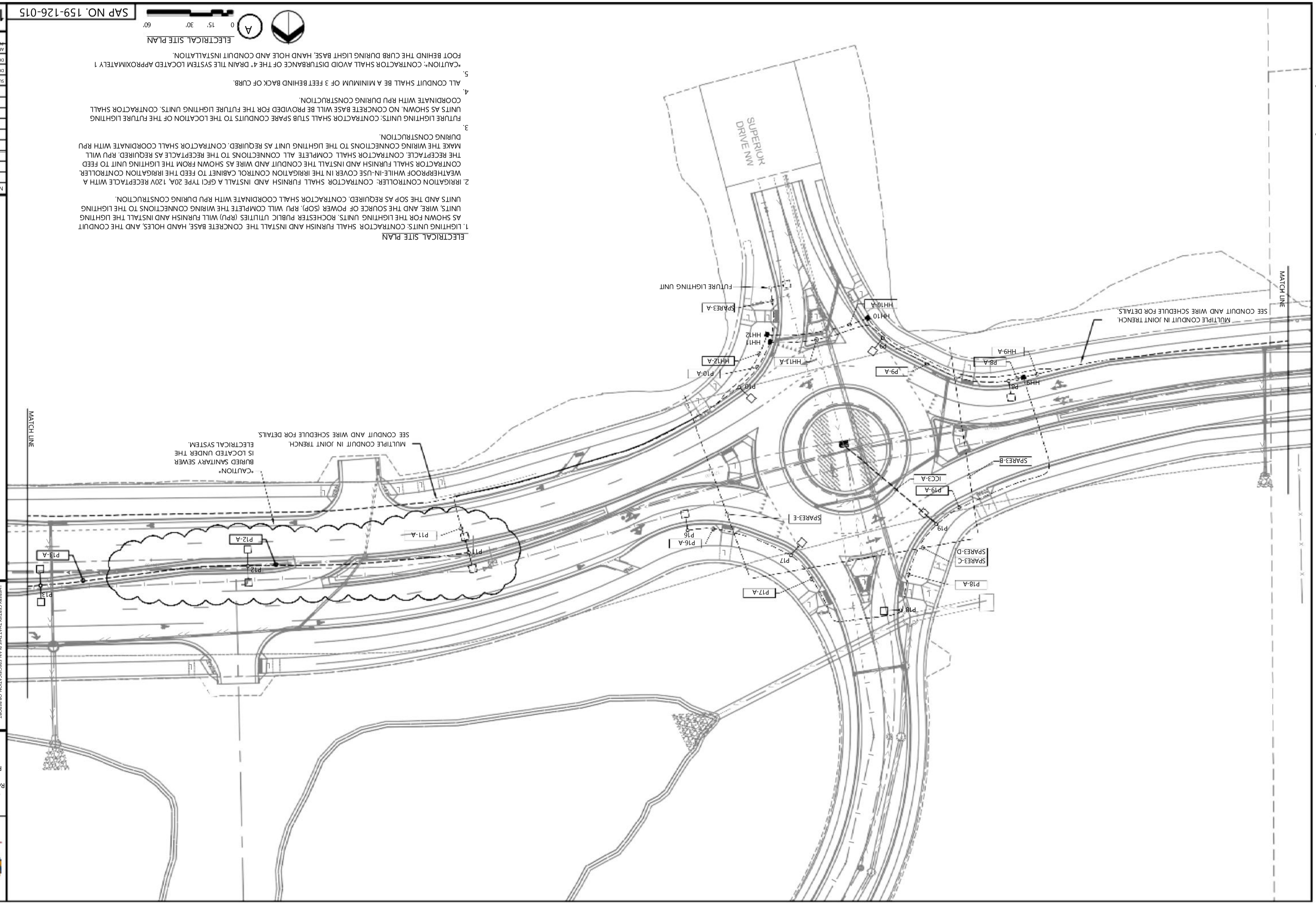
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# CITY OF ROCHESTER, MINNESOTA

## BADGER HILLS DRIVE / 41ST STREET NW

## ELECTRICAL SITE PLAN




### ELECTRICAL SITE PLAN

1. LIGHTING UNITS: CONTRACTOR SHALL FURNISH AND INSTALL THE CONCRETE BASE, HAND HOLES, AND THE CONDUIT AS SHOWN FOR THE LIGHTING UNITS. ROCHESTER PUBLIC UTILITIES (RPU) WILL FURNISH AND INSTALL THE LIGHTING UNITS, WIRE, AND THE SOURCE OF POWER (SOP). RPU WILL COMPLETE THE WIRING CONNECTIONS TO THE LIGHTING UNITS AND THE SOP AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.
2. IRRIGATION CONTROLLER: CONTRACTOR SHALL FURNISH AND INSTALL A GFCI TYPE 20A, 120V RECEPTACLE WITH A WEATHERPROOF WHILE-IN-USE COVER IN THE IRRIGATION CONTROL CABINET TO FEED THE IRRIGATION CONTROLLER. CONTRACTOR SHALL FURNISH AND INSTALL THE CONDUIT AND WIRE AS SHOWN FROM THE LIGHTING UNIT TO FEED THE RECEPTACLE. CONTRACTOR SHALL COMPLETE ALL CONNECTIONS TO THE RECEPTACLE AS REQUIRED. RPU WILL MAKE THE WIRING CONNECTIONS TO THE LIGHTING UNIT AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.
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5. "CAUTION": CONTRACTOR SHALL AVOID DISTURBANCE OF THE 4" DRAIN TILE SYSTEM LOCATED APPROXIMATELY 1 FOOT BEHIND THE CURB DURING LIGHT BASE, HAND HOLE AND CONDUIT INSTALLATION.

### ELECTRICAL SITE PLAN

A
0 15' 30' 60'

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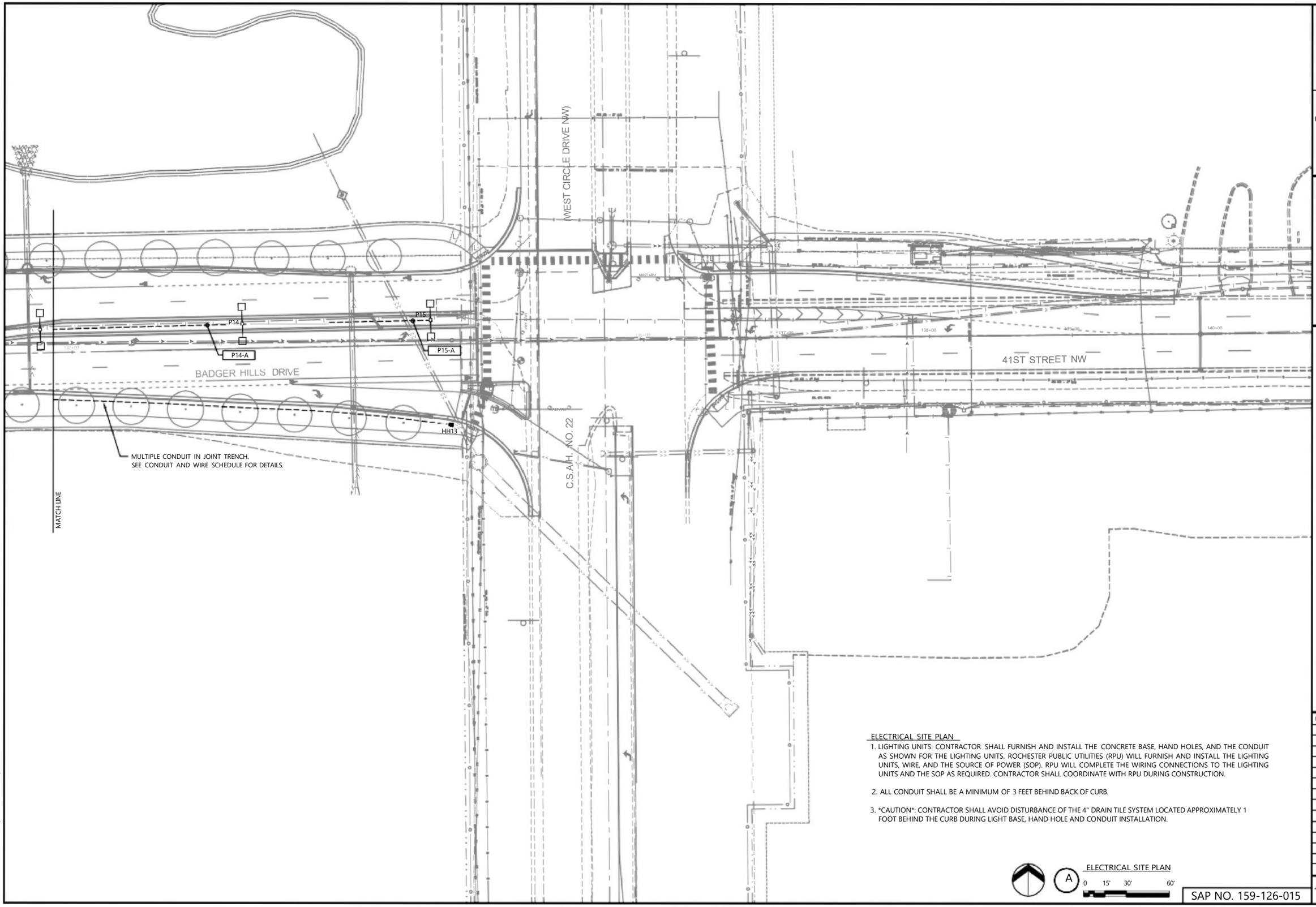
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PRINT NAME: AARON R. MUELLER

SIGNATURE:

DATE: 4/22/2013 LIC. NO. 48184




ELECTRICAL SITE PLAN

1. LIGHTING UNITS: CONTRACTOR SHALL FURNISH AND INSTALL THE CONCRETE BASE, HAND HOLES, AND THE CONDUIT AS SHOWN FOR THE LIGHTING UNITS. ROCHESTER PUBLIC UTILITIES (RPU) WILL FURNISH AND INSTALL THE LIGHTING UNITS, WIRE, AND THE SOURCE OF POWER (SOP). RPU WILL COMPLETE THE WIRING CONNECTIONS TO THE LIGHTING UNITS AND THE SOP AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.
2. ALL CONDUIT SHALL BE A MINIMUM OF 3 FEET BEHIND BACK OF CURB.
3. *CAUTION*: CONTRACTOR SHALL AVOID DISTURBANCE OF THE 4" DRAIN TILE SYSTEM LOCATED APPROXIMATELY 1 FOOT BEHIND THE CURB DURING LIGHT BASE, HAND HOLE AND CONDUIT INSTALLATION.

A ELECTRICAL SITE PLAN
0 15' 30' 60'

SAP NO. 159-126-015

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PRINT NAME: AARON R. MUELLER
SIGNATURE:
DATE: 4/22/2013
LIC. NO. 48184

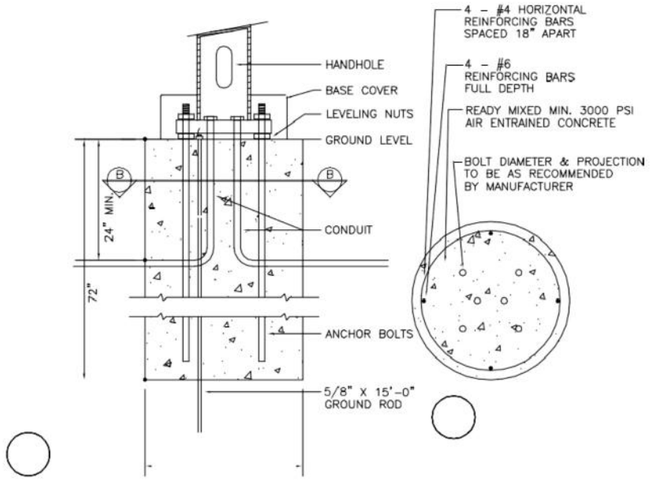
# CITY OF ROCHESTER, MINNESOTA
## BADGER HILLS DRIVE / 41ST STREET NW
## ELECTRICAL SITE PLAN

| NO | REVISION | DATE |
|---|---|---|
| | BID SET | |

SURVEY CAB
DRAWN MTF
DESIGNED MTF
APPROVED ARM
PROJ. NO. 193801617

SHEET NUMBER
1860F330

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CONCRETE BASE DETAIL
LIGHT BASE, DESIGN E

A NOT TO SCALE

SECTION

B NOT TO SCALE

24" MIN.

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PRINT NAME: AARON R. MUELLER
SIGNATURE:
DATE: 4/22/2013 LIC. NO. 46126

CITY OF ROCHESTER, MINNESOTA
BADGER HILLS DRIVE / 41ST STREET NW
ELECTRICAL DETAILS SHEET

| NO. | REVISION | DATE |
|---|---|---|
| | BID SET | |

| | |
|---|---|
| SURVEY | LAB |
| DRAWN | ARM |
| DESIGNED | ARM |
| APPROVED | ARM |
| PROJ. NO. | 193801617 |

SHEET NUMBER
187 OF 330

SAP NO. 159-126-015

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| CONDUIT AND WIRE SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| CONDUIT NAME | CONDUIT SIZE | WIRE COUNT | WIRE SIZE | DEVICE NAME | CONDUIT TO | MINIMUM DEPTH (FT) |
| | | | | | | |
| HH1-A | 2" HDPE | 1 | NYLON PULLCORD | HANDHOLE #1 | HANDHOLE #2 | 3 |
| HH2-A | 2" HDPE | 1 | NYLON PULLCORD | HANDHOLE #2 | HANDHOLE #4 | 3 |
| HH3-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #3 | LIGHTING UNIT P3 | 2 |
| HH4-A | 2" HDPE | 1 | NYLON PULLCORD | HANDHOLE #4 | HANDHOLE #6 | 3 |
| HH5-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #5 | LIGHTING UNIT P4 | 2 |
| HH6-A | 2" HDPE | 1 | NYLON PULLCORD | HANDHOLE #6 | HANDHOLE #7 | 3 |
| HH7-A | 2" HDPE | 1 | NYLON PULLCORD | HANDHOLE #7 | HANDHOLE #10 | 3 |
| HH8-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #8 | LIGHTING UNIT P7 | 2 |
| HH9-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #9 | HANDHOLE #8 | 2 |
| HH10-A | 2" HDPE | 1 | NYLON PULLCORD | HANDHOLE #10 | HANDHOLE #12 | 3 |
| HH11-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #11 | LIGHTING UNIT P9 | 2 |
| HH12-A | 2" HDPE | 1 | NYLON PULLCORD | HANDHOLE #12 | HANDHOLE #13 | 3 |
| HH14-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #14 | LIGHTING UNIT P21 | 2 |
| HH15-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #15 | LIGHTING UNIT P24 | 2 |
| HH16-A | 2" | 2,1 | 8,8G | HANDHOLE #16 | LIGHTING UNIT P26 | 2 |
| HH17-A | EXISTING 6" | 2,1 | 8,8G | HANDHOLE #17 | HANDHOLE #16 | NA |
| | | | | | | |
| ICC1-A | 2" | 2,1 | 8,8G | IRRIGATION CONTROL CABINET #1 RECEPTACLE | LIGHTING UNIT P3 | 2 |
| ICC2-A | 2" | 2,1 | 8,8G | IRRIGATION CONTROL CABINET #2 RECEPTACLE | LIGHTING UNIT P5 | 2 |
| ICC3-A | 2" | 2,1 | 8,8G | IRRIGATION CONTROL CABINET #3 RECEPTACLE | LIGHTING UNIT P19 | 2 |
| ICC4-A | 2" | 2,1 | 8,8G | IRRIGATION CONTROL CABINET #4 RECEPTACLE | HANDHOLE #17 | 2 |
| | | | | | | |
| P1-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P1 | LIGHTING UNIT P2 | 2 |
| P2-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P2 | HANDHOLE #3 | 2 |
| P3-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P3 | HANDHOLE #5 | 2 |
| P4-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P4 | LIGHTING UNIT P5 | 2 |
| P5-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P5 | SERVICE CABINET | 2 |
| P6-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P6 | SERVICE CABINET | 2 |
| P7-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P7 | LIGHTING UNIT P6 | 2 |
| P8-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P8 | HANDHOLE #9 | 2 |
| P9-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P9 | LIGHTING UNIT P8 | 2 |
| P10-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P10 | HANDHOLE #11 | 2 |
| P11-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P11 | LIGHTING UNIT P10 | 2 |
| P12-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P12 | LIGHTING UNIT P11 | 2 |
| P13-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P13 | LIGHTING UNIT P12 | 2 |
| P14-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P14 | LIGHTING UNIT P13 | 2 |
| P15-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P15 | LIGHTING UNIT P14 | 2 |
| P16-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P16 | LIGHTING UNIT P17 | 2 |
| P17-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P17 | LIGHTING UNIT P18 | 2 |
| P18-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P18 | LIGHTING UNIT P19 | 2 |
| P19-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P19 | HANDHOLE #9 | 2 |
| P20-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P20 | HANDHOLE #8 | 2 |
| P21-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P21 | LIGHTING UNIT P20 | 2 |
| P22-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P22 | HANDHOLE #14 | 2 |
| P23-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P23 | HANDHOLE #5 | 2 |
| P24-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P24 | LIGHTING UNIT P23 | 2 |
| P25-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P25 | HANDHOLE #15 | 2 |
| P26-A | 2" | 1 | NYLON PULLCORD | LIGHTING UNIT P26 | LIGHTING UNIT P25 | 2 |
| | | | | | | |
| SE-A | 2" | 1 | NYLON PULLCORD | SERVICE CABINET | UTILITY TRANSFORMER | 2 |
| | | | | | | |
| SPARE1-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #15 | STUBBED OUT AS SHOWN TO FUTURE LIGHTING UNIT | 2 |
| SPARE1-B | 2" | 1 | NYLON PULLCORD | HANDHOLE #3 | STUBBED OUT AS SHOWN TO FUTURE LIGHTING UNIT | 2 |
| SPARE1-C | 4" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE1-D | 5" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE1-E | 5" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE1-F | 4" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE2-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #14 | STUBBED OUT AS SHOWN TO FUTURE LIGHTING UNIT | 2 |
| SPARE2-B | 4" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE2-C | 5" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE2-D | 5" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE2-E | 4" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE3-A | 2" | 1 | NYLON PULLCORD | HANDHOLE #11 | STUBBED OUT AS SHOWN TO FUTURE LIGHTING UNIT | 2 |
| SPARE3-B | 4" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE3-C | 5" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE3-D | 5" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |
| SPARE3-E | 4" | 1 | NYLON PULLCORD | STUBBED OUT AS SHOWN | STUBBED OUT AS SHOWN | SEE ROCHESTER STANDARD PLATE NO. 4-03 |

| HANDHOLE SCEHDULE | | |
|---|---|---|
| TAG | DIMENSIONS WXLXD (INCHES) | LOGO |
| HH1 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH2 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH3 | 24X36X30 | LIGHTING |
| HH4 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH5 | 24X36X30 | LIGHTING |
| HH6 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH7 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH8 | 24X36X30 | LIGHTING |
| HH9 | 24X36X30 | LIGHTING |
| HH10 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH11 | 24X36X30 | LIGHTING |
| HH12 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH13 | 24X36X30 | CITY OF ROCHESTER FIBER |
| HH14 | 24X36X30 | LIGHTING |
| HH15 | 24X36X30 | LIGHTING |

| POLE SCHEDULE | | |
|---|---|---|
| TAG | LIGHTING UNIT, TYPE SPECIAL 1 | LIGHTING UNIT, TYPE SPECIAL 2 |
| P1 | X | |
| P2 | X | |
| P3 | X | |
| P4 | X | |
| P5 | X | |
| P6 | X | |
| P7 | X | |
| P8 | X | |
| P9 | X | |
| P10 | X | |
| P11 | | X |
| P12 | | X |
| P13 | | X |
| P14 | | X |
| P15 | | X |
| P16 | X | |
| P17 | X | |
| P18 | X | |
| P19 | X | |
| P20 | X | |
| P21 | X | |
| P22 | X | |
| P23 | X | |
| P24 | X | |
| P25 | X | |
| P26 | X | |

ELECTRICAL SITE PLAN

1. LIGHTING UNITS: CONTRACTOR SHALL FURNISH AND INSTALL THE CONCRETE BASE, HAND HOLES, AND THE CONDUIT AS SHOWN FOR THE LIGHTING UNITS. ROCHESTER PUBLIC UTILITIES (RPU) WILL FURNISH AND INSTALL THE LIGHTING UNITS, WIRE, AND THE SOURCE OF POWER (SOP). RPU WILL COMPLETE THE WIRING CONNECTIONS TO THE LIGHTING UNITS AND THE SOP AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.

2. IRRIGATION CONTROLLER: CONTRACTOR SHALL FURNISH AND INSTALL A GFCI TYPE 20A, 120V RECEPTACLE WITH A WEATHERPROOF WHILE-IN-USE COVER IN THE IRRIGATION CONTROL CABINET TO FEED THE IRRIGATION CONTROLLER. CONTRACTOR SHALL FURNISH AND INSTALL THE CONDUIT AND WIRE AS SHOWN FROM THE LIGHTING UNIT TO FEED THE RECEPTACLE. CONTRACTOR SHALL COMPLETE ALL CONNECTIONS TO THE RECEPTACLE AS REQUIRED. RPU WILL MAKE THE WIRING CONNECTIONS TO THE LIGHTING UNIT AS REQUIRED. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.

3. FUTURE LIGHTING UNITS: CONTRACTOR SHALL STUB SPARE CONDUITS TO THE LOCATION OF THE FUTURE LIGHTING UNITS AS SHOWN. NO CONCRETE BASE WILL BE PROVIDED FOR THE FUTURE LIGHTING UNITS. CONTRACTOR SHALL COORDINATE WITH RPU DURING CONSTRUCTION.

4. ALL CONDUIT SHALL BE A MINIMUM OF 3 FEET BEHIND BACK OF CURB.

5. *CAUTION*: CONTRACTOR SHALL AVOID DISTURBANCE OF THE 4" DRAIN TILE SYSTEM LOCATED APPROXIMATELY 1 FOOT BEHIND THE CURB DURING LIGHT BASE, HAND HOLE AND CONDUIT INSTALLATION.

6. CONTRACTOR SHALL NOTE THAT THE IRRIGATION CABINET, CONDUIT, WIRE, RECEPTICAL, AND ELECTRICAL CONNECTIONS ARE PART OF THE IRRIGATION SYSTEM (2506.601) BID ITEM AND ARE NOT PART OF THE ELECTRICAL BID ITEM.

SAP NO. 159-126-015


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PRINT NAME: AARON R. MUELLER
SIGNATURE:
DATE: 4/22/2013 LIC. NO. 46184

CITY OF ROCHESTER, MINNESOTA
BADGER HILLS DRIVE / 41ST STREET NW
ELECTRICAL LINE DIAGRAMS AND SCHEDULES

| NO. | REVISION | DATE |
|---|---|---|
| | BID SET | |

| | |
|---|---|
| SURVEY | CAE |
| DRAWN | MTF |
| DESIGNED | MTF |
| APPROVED | ARM |
| PROJ. NO. | 193801617 |

SHEET NUMBER
1880F330

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# Appendix F
## SAMPLE SPECIAL PROVISIONS

A. The sample special provisions are attached.

**INDEX TO SPECIAL PROVISIONS**

**DIVISION SL**

SL-1 (2104) REMOVING MISCELLANEOUS STRUCTURES..... SL-1

SL-2 (2545) ELECTRIC LIGHTING SYSTEM.....SL-2

I hereby certify that the Special Provisions for lighting construction (Division SL) contained in this proposal were prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

_____

Name, P.E.

License #_____ Date: January 28, 2019

**DIVISION SL**
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**Remove Lighting Unit ..... 2-SL**

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**As Built Plans ..... 3-SL**

**SL-2.2 MATERIALS ..... 3-SL**

**Shop Drawings ..... 3-SL**
**Conduit ..... 3-SL**
**Light Foundation, Design E-Modified ..... 4-SL**
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**Light Standard Installation ..... 5-SL**
**Wiring in Light Standard Concrete Foundations ..... 6-SL**

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**Price and Payment Procedures ..... 6-SL**

# DIVISION SL

## SL-1 (2104) REMOVING MISCELLANEOUS STRUCTURES

### SL-1.1 DESCRIPTION

This work consists of removing or salvaging miscellaneous structures in accordance with the provisions of MnDOT 2104 and the following:

### SL-1.2 MATERIALS

None

### SL-1.3 CONSTRUCTION REQUIREMENTS

**A. Remove Light Foundation**

Item 2104.509 (Remove Light Foundation) consists of removing the in place light foundations as indicated in the Plan. Backfill all holes remaining from the removal of the light foundation in accordance with MnDOT 2545.3C.

**B. Remove Direct Buried Lighting Cable in Conduit**

Item 2104.501 (Remove Direct Buried Lighting Cable) consists of removing cables as shown on the drawings and as directed by the Engineer. Removed cables are the property of the Contractor.

**C. Remove Lighting Unit**

Item 2104.509 (Remove Lighting Unit) consists of removing the lighting units as indicated in the Plan.

Disconnect all circuit wiring to the removed lighting units from any lighting units remaining in place. Removed lighting units are the property of the contractor. Dispose of in accordance with 2104.3C.

## SL-2 (2545) ELECTRIC LIGHTING SYSTEM

This work consists of providing labor, equipment, and materials for construction of a lighting system in accordance with the applicable provisions of MnDOT 2471, MnDOT 2545, current edition of the National Electrical Code, Plans, and the following:

### SL-2.1 GENERAL

#### A. As Built Plans

The Contractor shall furnish "as built Plans" that contain any changes in the following:

Cable location
Conduit locations
Light pole locations
Feedpoint locations
Handhole location

Any discrepancy or additions between the final plan and how the lighting system was actually built must be indicated on the "as built plan".

The "as built Plans" shall be in a form that is satisfactory to the Engineer. The Contractor furnished "as built Plans" shall be considered incidental work.

### SL-2.2 MATERIALS

#### A. Shop Drawings

The contractor shall provide shop drawings for all materials.

#### B. Conduit

The Contractor shall furnish and install non-metallic conduit (N.M.C.) at the locations indicated in the Plans. The size of the conduit shall be as indicated in the Plan. All conduits shall be in accordance with the following:

Non-Metallic Conduit:

Shall be in accordance with MnDOT 3803, except as follows:
Rigid Nonmetallic conduit and fittings
- EPC-40-PVC.
- Sunlight resistant.
- NEMA TC2.
- NFPA 70, Article 352.
- UL Listed.
- Manufacturer: Carlon, CertainTeed, or equal.

High Density Polyethylene conduit (HDPE)
- Meets requirements of NFPA70.

Thermoplastic polymer material.
Smooth interior and smooth exterior wall.
UL listed.
NEMA –TC-7.
Manufacturer: Carlon or equal.

**C. Light Foundation, Design E-Modified**

Provide and install a Concrete Light Foundation, Design E-Modified, in accordance with MnDOT 2545.3F with modifications as shown in the concrete base detail located on the Drawings, at the locations indicated on the Drawings.

**D. Luminaire Wire Holder**

The Contractor shall furnish and install a wire holder that supports the luminaire cable/conductors within the end of the lurninaire slipfitter near the connection point of the luminaire. MnDOT approved Wire Holders are listed on the MnDOT Approved/Qualified Products Lists WEB site for Lighting:

http://www.dot.state.mn.us/products/index.html

**E. Lighting Unit Type Special PA**

Light Emitting Diode (LED) Luminaire for Roadway/Street Lighting Applications for Non-Residential Applications.

Lighting unit shall be as specified in the City of Rochester Roadway Design Manual.

The pole shall be as specified in the City of Rochester Roadway Design Manual.

All pole installations shall be capable of withstanding the forces produced by 90-mph winds with a 1.3-gust factor and the total number of luminaires and additional equipment required per pole including but not limited to luminaires, banners, receptacles, signs as shown on the drawings.

**F. Lighting Unit Type Special PB**

Light Emitting Diode (LED) Luminaire for Roadway/Street Lighting Applications for Residential Applications.

Lighting unit shall be as specified in the City of Rochester Roadway Design Manual.

The pole shall be as specified in the City of Rochester Roadway Design Manual.

All pole installations shall be capable of withstanding the forces produced by 90-mph winds with a 1.3-gust factor and the total number of luminaires and additional equipment required per pole including but not limited to luminaires, banners, receptacles, signs as shown on the drawings.

**G. Luminaire Type Special A**

LED Luminaire for Roadway / Street Lighting Underpass Applications.

Luminaire shall be as specified in the City of Rochester Roadway Design Manual.

All pole installations shall be capable of withstanding the forces produced by 90-mph winds with a 1.3-gust factor and the total number of luminaires and additional equipment required per pole including but not limited to luminaires, banners, receptacles, signs as shown on the drawings.

## SL-2.3 CONSTRUCTION REQUIREMENTS

**A. Light Foundation Installation Requirements**

Install Light Foundations where shown on the Drawings and in accordance with details as shown on the Drawings.

**B. Conduit Installation**

Conduit shall be installed in accordance with MnDOT 2565.30, except as follows:

Continuous Type HDPE Non-Metallic Conduit:

Except for under existing pavements, underground Continuous Type HDPE Conduit shall be placed by trenching, stitching, plowing, or other method approved by the Engineer.

Under existing pavements, Continuous Type HDPE Non-Metallic Conduit shall be placed as specified in 2565.3D2b.

Rigid Non-Metallic Conduit Joints:

The Contractor shall install appropriate sized long line couplings when installed under existing roadway surfaces

The applied PVC joint cement shall be allowed to set-up for six (6) hours before pulling the conduit through a directional bored channel.

**C. Light Standard Installation**

The Contractor shall install light standards in accordance with MnDOT 2545.3H and as follows:

1. The Contractor shall use only shims for leveling when installing aluminum light standards on light standard foundations.

    a. Assemble the lighting unit in accordance with the manufacturer's requirements.

b. Make certain that the holddown and connecting washers are installed in their proper locations.

2. The Contractor shall use only leveling nuts when installing stainless steel light standards on light standard foundations.

3. Where leveling nuts are used, the leveling and top nuts shall both be securely tightened against the light standard base plate. Where shims are used the top nuts shall be securely tightened against the light standard base plate. The leveling nuts and top nuts shall be tightened as follows:

The threads of the nuts shall be lubricated with a brush on anti-seize lubricant and then the nuts shall be torqued to minimum 125 ft-lbs. required for 1-inch diameter anchorages.

The threads of the nuts shall be lubricated with a brush on anti-seize lubricant and then the nuts shall be torqued to minimum 240 ft-lbs. required for 1-inch diameter anchorages.

**D. Wiring in Light Standard Concrete Foundations**

The Contractor shall install conduits in light standard concrete foundations in accordance with the provisions of MnDOT 2545.3G. Approximately 2 feet of slack cable shall be left in each light standard base.

## SL-2.4 MEASUREMENT AND PAYMENT PROCEDURES

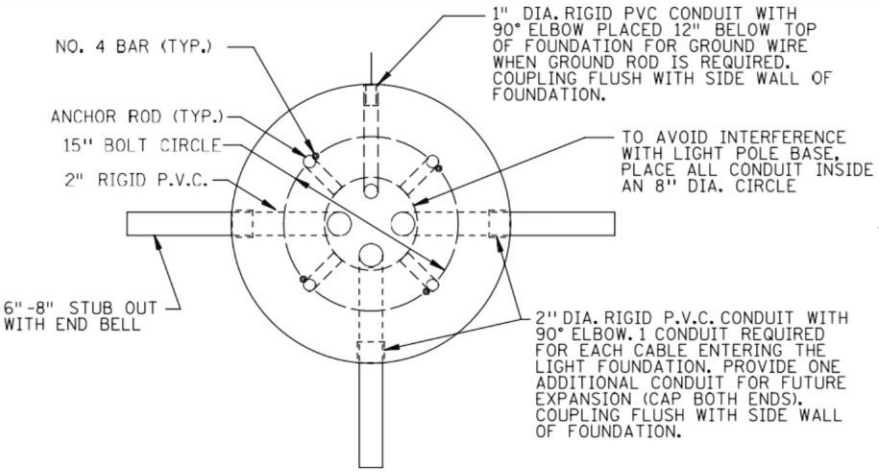
**A. Price and Payment Procedures**

1. Measurement will be based upon the units as listed below for items provided, removed, abandoned, or salvaged complete as specified. No measurement will be made of any removals that are not required. The actual quantity removed multiplied by the appropriate Bid Unit Price will be compensation in full for all Work and costs of the following Bid Items:
   a. Remove Light Foundation: Per Each
   b. Remove Direct Buried Lighting Cable in Conduit: Per Linear Foot
   c. Remove Lighting Unit: Per Each
   d. 1.5" Non-metallic Conduit: Per Linear Foot
   e. Underground Wire 1 Cond No 6: Per Linear Foot
   f. Underground Wire 1 Cond No 8: Per Linear Foot
   g. Light Foundation Design E-Modified: Per Each
   h. Lighting Unit Type Special: Per Each
   i. Service Cabinet Connections: Per Each
   j. Spare poles: Per Each
2. All other Work and costs of this Section shall be incidental to the Project and included in the Total Base Bid.

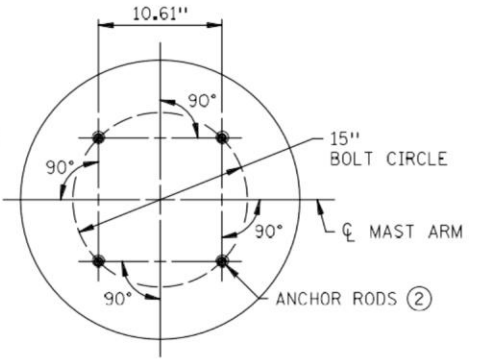
# Appendix G
## STANDARD PLATES

A. The standard plates are as follows and attached.

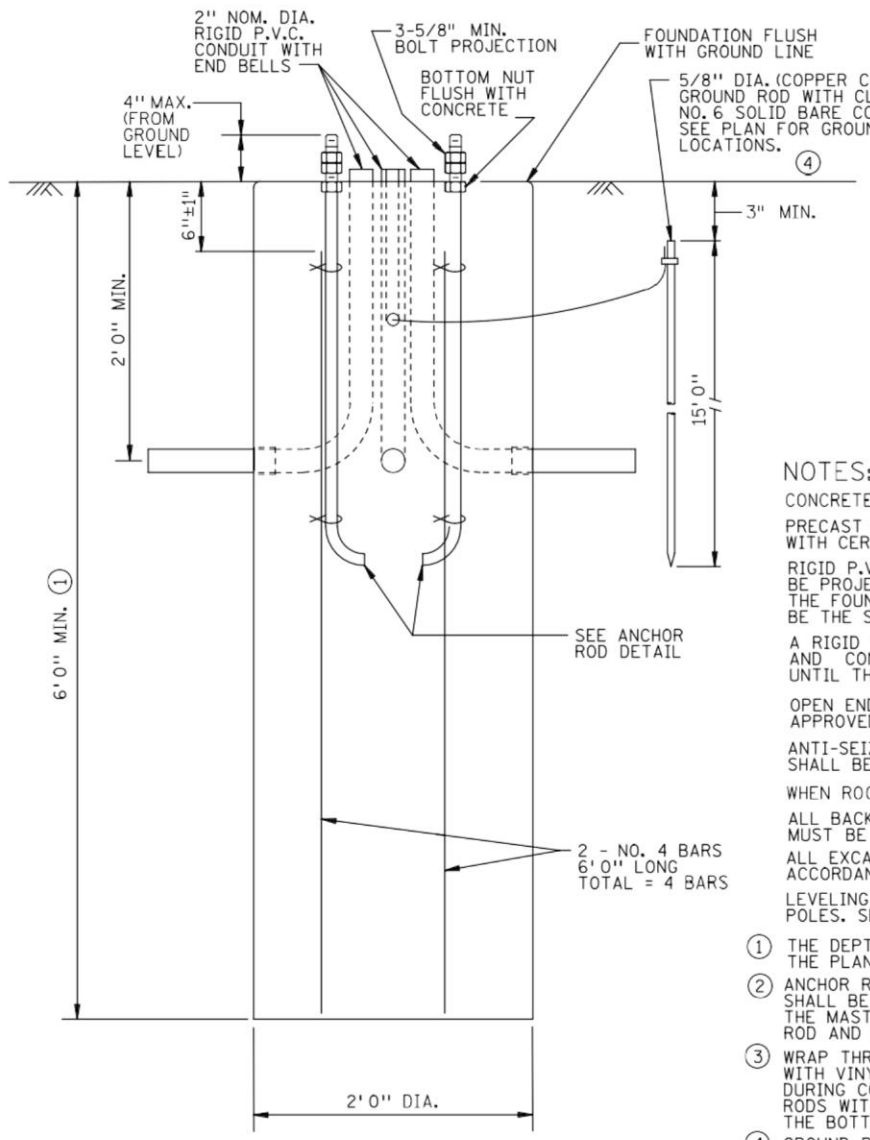
1. MnDOT STANDARD PLATE 8127E – LIGHT FOUNDATION DESIGN E – CAST IN PLACE
2. MnDOT STANDARD PLATE 8127E – LIGHT FOUNDATION DESIGN E – PRECAST
3. MnDOT STANDARD PLATE 8106D – EQUIPMENT PAD B – CAST IN PLACE
4. MnDOT STANDARD PLATE 8106D – EQUIPMENT PAD B – PRECAST



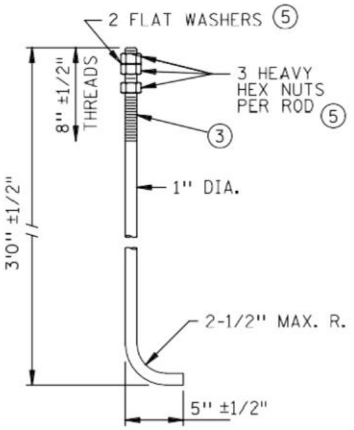

PLAN




ANCHOR ROD PLACEMENT




ELEVATION
PRECAST FOUNDATION




ANCHOR ROD DETAIL
4 REQUIRED (2)

## NOTES:

CONCRETE SHALL BE MIX NO. 3G52.

PRECAST FOUNDATION FACILITY MUST BE IN COMPLIANCE WITH CERTIFIED PLANT REQUIREMENT OF SPEC. 3238.

RIGID P.V.C. CONDUIT PER SPEC. 3803 WITH END BELLS SHALL BE PROJECTED A MINIMUM 1/4" TO MAXIMUM 1" ABOVE THE FOUNDATION BEFORE MORTAR IS PLACED AND SHALL BE THE SIZE AND NUMBER SHOWN IN THE PLAN.

A RIGID TEMPLATE SHALL BE PROVIDED FOR ANCHOR ROD AND CONDUIT PLACEMENT AND SHALL BE LEFT IN PLACE UNTIL THE CONCRETE HAS SET.

OPEN ENDS OF CONDUITS SHALL BE SEALED WITH AN APPROVED SEALING COMPOUND.

ANTI-SEIZE COMPOUND THAT MEETS MIL-PRF-907E SPEC. SHALL BE APPLIED WITH A BRUSH TO ALL THREADS.

WHEN ROCK IS ENCOUNTERED, SEE PLAN DETAILS.

ALL BACKFILLING AND EXCAVATION AROUND FOUNDATION MUST BE IN ACCORDANCE WITH 2451 AND 2545.3.

ALL EXCAVATIONS MUST BE PROPERLY COMPACTED IN ACCORDANCE WITH 2451.

LEVELING SHIMS SHALL BE USED WHEN PLACING ALUMINUM POLES. SEE STANDARD PLATE 8129.

(1) THE DEPTH OF THE FOUNDATION MAY VARY IN THE PLANS OR SPECIAL PROVISIONS.

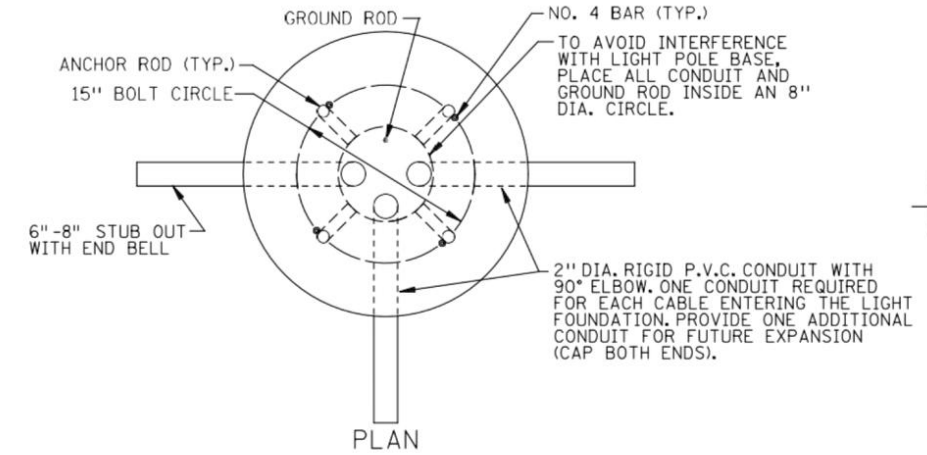
(2) ANCHOR RODS, NUTS, AND WASHERS PER SPEC. 3385, TYPE B, SHALL BE PLACED AT RIGHT ANGLES TO THE DIRECTION OF THE MAST ARM. GALVANIZE THE TOP 1 FT. OF THE ANCHOR ROD AND NUTS PER SPEC. 3392.

(3) WRAP THREADS OF ANCHOR RODS ABOVE THE BOTTOM NUT WITH VINYL ELECTRICAL TAPE TO AVOID CONTAMINATION DURING CONCRETE POURING. WRAP THREADS OF ANCHOR RODS WITH 3 LAYERS OF VINYL ELECTRICAL TAPE 2" BELOW THE BOTTOM NUTS.

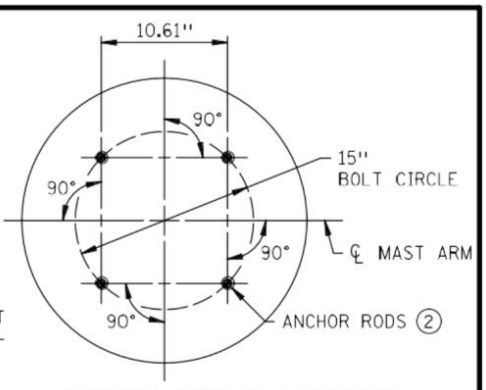
(4) GROUND ROD MUST BE ADDED 3" TO 6" DEEP BELOW GROUND LINE AND WITHIN 1' OF FOUNDATION.

(5) USE 1 HOLDDOWN WASHER AND 2 HEAVY HEX NUTS PER ROD FOR ALUMINUM POLE INSTALLATION.

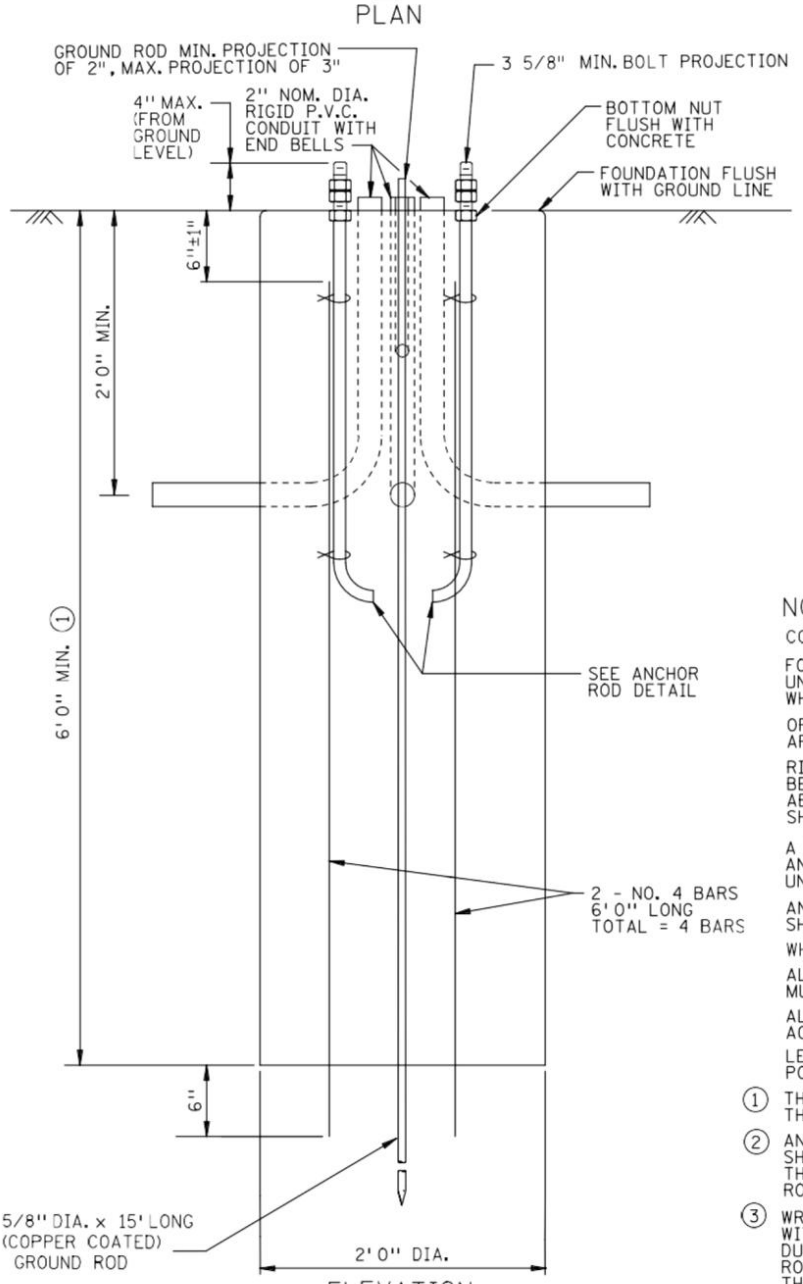
| APPROVED JULY 15, 2015<br>STATE DESIGN ENGINEER | STATE OF MINNESOTA<br>DEPARTMENT OF TRANSPORTATION<br>LIGHT FOUNDATION - DESIGN E<br>PRECAST<br>40 FT. POLE OR LESS | SPECIFICATION REFERENCE<br>2545 | STANDARD PLATE NO.<br>8127E<br>1 OF 2 |
|---|---|---|---|



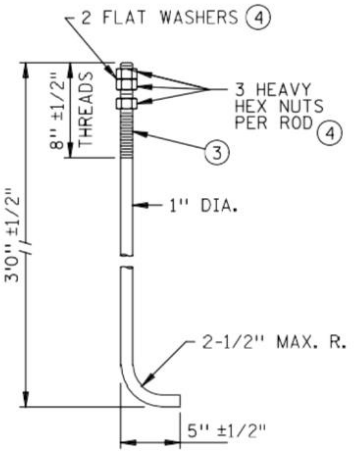

PLAN




ANCHOR ROD PLACEMENT




ELEVATION
CAST-IN-PLACE FOUNDATION




ANCHOR ROD DETAIL
4 REQUIRED (2)

## NOTES:

CONCRETE SHALL BE MIX NO. 3G52.

FOUNDATIONS MAY BE CONSTRUCTED IN AUGERED HOLES UNLESS THE NATURAL SOILS WILL NOT STAND OPEN, IN WHICH CASE FORMING WILL BE REQUIRED.

OPEN ENDS OF CONDUITS SHALL BE SEALED WITH AN APPROVED SEALING COMPOUND.

RIGID P.V.C. CONDUIT PER SPEC. 3803 WITH END BELLS SHALL BE PROJECTED A MINIMUM 1/4" TO MAXIMUM 1" ABOVE THE FOUNDATION BEFORE MORTAR IS PLACED AND SHALL BE THE SIZE AND NUMBER SHOWN IN THE PLAN.

A RIGID TEMPLATE SHALL BE PROVIDED FOR ANCHOR ROD AND CONDUIT PLACEMENT AND SHALL BE LEFT IN PLACE UNTIL THE CONCRETE HAS SET.

ANTI-SEIZE COMPOUND THAT MEETS MIL-PRF-907E SPEC. SHALL BE APPLIED WITH A BRUSH TO ALL THREADS.

WHEN ROCK IS ENCOUNTERED, SEE PLAN DETAILS.

ALL BACKFILLING AND EXCAVATION AROUND FOUNDATION MUST BE IN ACCORDANCE WITH 2451 AND 2545.3.

ALL EXCAVATIONS MUST BE PROPERLY COMPACTED IN ACCORDANCE WITH 2451.

LEVELING SHIMS SHALL BE USED WHEN PLACING ALUMINUM POLES. SEE STANDARD PLATE 8129.

(1) THE DEPTH OF THE FOUNDATION MAY VARY IN THE PLANS OR SPECIAL PROVISIONS.

(2) ANCHOR RODS, NUTS, AND WASHERS PER SPEC. 3385, TYPE B, SHALL BE PLACED AT RIGHT ANGLES TO THE DIRECTION OF THE MAST ARM. GALVANIZE THE TOP 1 FT. OF THE ANCHOR ROD AND NUTS PER SPEC. 3392.

(3) WRAP THREADS OF ANCHOR RODS ABOVE THE BOTTOM NUT WITH VINYL ELECTRICAL TAPE TO AVOID CONTAMINATION DURING CONCRETE POURING. WRAP THREADS OF ANCHOR RODS WITH 3 LAYERS OF VINYL ELECTRICAL TAPE 2" BELOW THE BOTTOM NUTS.

(4) USE 1 HOLDDOWN WASHER AND 2 HEAVY HEX NUTS PER ROD FOR ALUMINUM POLE INSTALLATION.

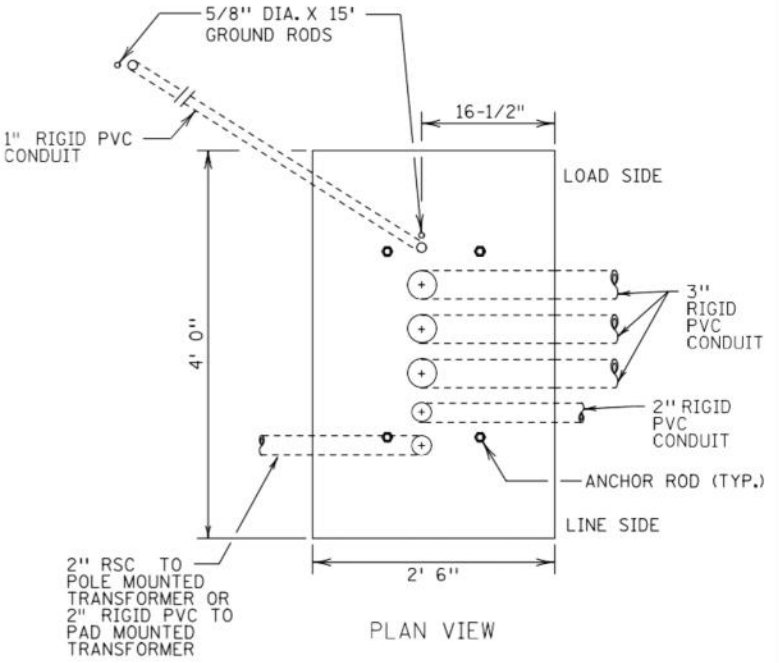
APPROVED JULY 15, 2015

STATE DESIGN ENGINEER

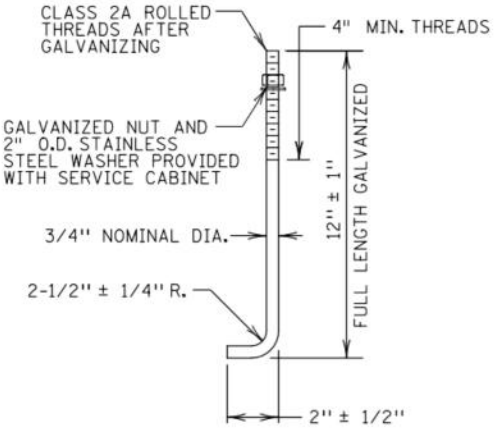
STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

# LIGHT FOUNDATION - DESIGN E
# CAST IN-PLACE
40 FT. POLE OR LESS

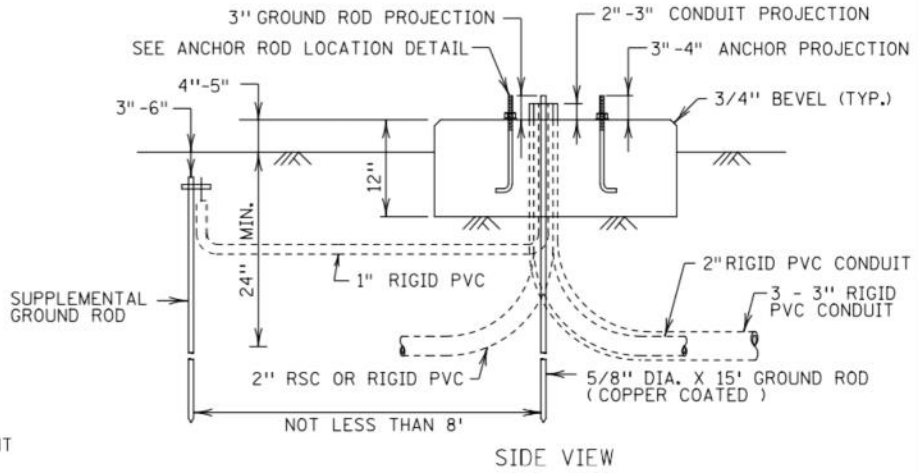
| SPECIFICATION REFERENCE | STANDARD PLATE NO. |
|---|---|
| 2545 | 8127E |
| | 2 OF 2 |




PLAN VIEW

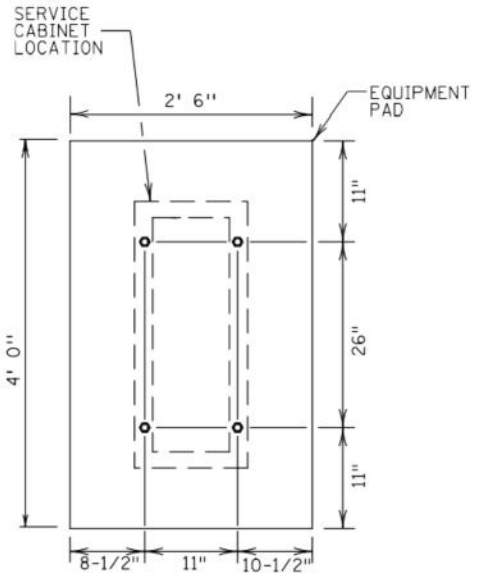



ANCHOR ROD DETAIL
(SPEC. 3385 TYPE A)




SIDE VIEW

CAST-IN-PLACE EQUIPMENT PAD B




ANCHOR ROD LOCATION DETAIL

## NOTES:

CONTRACTOR SHALL HAVE THE OPTION OF PRECAST OR CAST-IN-PLACE EQUIPMENT PAD.

CONCRETE SHALL BE MIX 3F52.

TOP OF PAD SHALL HAVE A BRUSH TOP FINISH.

PLACE THREE (3) 3 IN. RIGID PVC CONDUIT WITH 90° ELBOWS ON THE LOAD SIDE OF THE EQUIPMENT PAD.

PLACE ONE (1) 2 IN. RIGID PVC CONDUIT WITH 90°ELBOW ON THE LOAD SIDE OF THE EQUIPMENT PAD FOR FUTURE USE ONLY. USE PVC CONDUIT CAPS OR PLUGS TO SEAL THE OPEN ENDS OF THE CONDUIT

END BELL FITTINGS ON CONDUIT ENDS SHALL BE INCLUDED PER SPEC. 2565.3D.

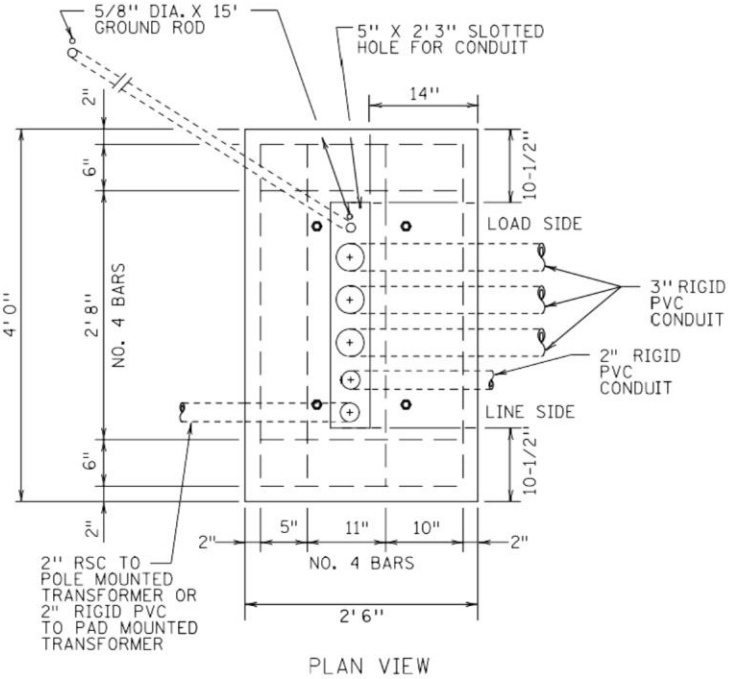
PLACE FOUR (4) GALVANIZED "L" SHAPED CONCRETE EMBEDDED TYPE ANCHOR RODS AS SHOWN IN THE ANCHOR ROD DETAIL. PLACE ANCHOR RODS AS SHOWN ON THE ANCHOR ROD LOCATION DETAIL. USE A RIGID STEEL TEMPLATE TO HOLD ANCHOR RODS IN PLACE UNTIL CONCRETE HAS CURED.

PLACE A 5/8" DIA. X 15' GROUND ROD ELECTRODE IN THE LOAD SIDE OF THE EQUIPMENT PAD AND PROJECT 3" +/- 1/4". PLACE A SUPPLEMENTAL 5/8" DIA. X 15' GROUND ROD ELECTRODE OUTSIDE OF THE EQUIPMENT PAD WITH THE TOP OF THE ELECTRODE BURIED 3" TO 6" BELOW THE GROUND LINE (7" TO 8" IF LOCATED UNDER BITUMINOUS OR CONCRETE SURFACES) AND NOT LESS THEN 8' FROM THE GROUND ROD ELECTRODE IN THE PAD.

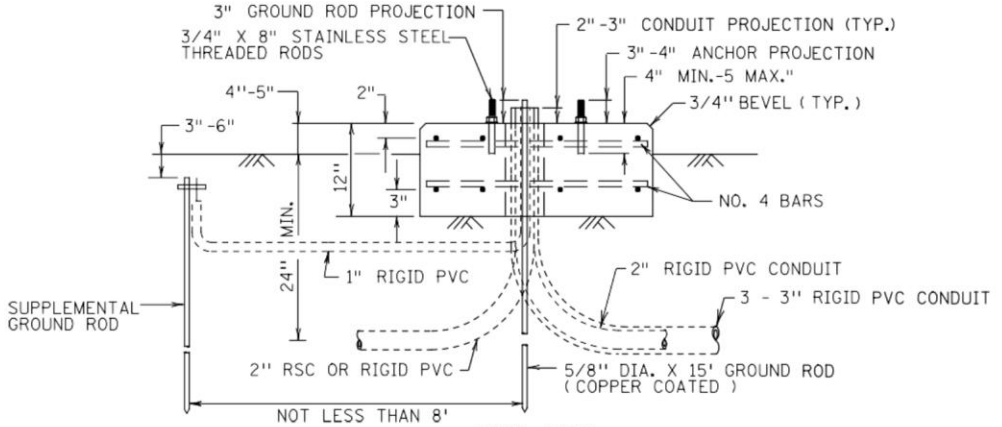
APPLY DE-OX COMPOUND TO THE GROUNDING CONNECTIONS AFTER FINAL ASSEMBLY.

APPLY ANTI -SEIZE COMPOUND THAT MEETS MIL-PRF-907E SPEC. WITH A BRUSH TO ALL ANCHOR ROD THREADS.

| | | | |
|---|---|---|---|
| APPROVED JULY 15, 2015<br>STATE DESIGN ENGINEER | STATE OF MINNESOTA<br>DEPARTMENT OF TRANSPORTATION<br>EQUIPMENT PAD B | SPECIFICATION REFERENCE<br>2461, 2545<br>2550, 2565 | STANDARD PLATE NO.<br>8106D<br>1 OF 3 |




PLAN VIEW




SIDE VIEW

PRECAST EQUIPMENT PAD B

## NOTES:

CONTRACTOR SHALL HAVE THE OPTION OF PRECAST OR CAST-IN-PLACE EQUIPMENT PAD.

CONCRETE SHALL BE MIX 3F52.

TOP OF PAD SHALL HAVE A BRUSH TOP FINISH.

SEE ANCHOR ROD LOCATION DETAIL ON SHEET 1 OF 3 FOR BOLT LOCATION.

PLACE THREE (3) 3 IN. RIGID PVC CONDUIT WITH 90° ELBOWS ON THE LOAD SIDE OF THE EQUIPMENT PAD.

PLACE ONE (1) 2 IN. RIGID PVC CONDUIT WITH 90°ELBOW ON THE LOAD SIDE OF THE EQUIPMENT PAD FOR FUTURE USE ONLY. USE PVC CONDUIT CAPS OR PLUGS TO SEAL THE OPEN ENDS OF THE CONDUIT

END BELL FITTINGS ON CONDUIT ENDS SHALL BE INCLUDED PER SPEC. 2565.3D.

FILL AREA AROUND RIGID PVC CONDUIT AND GROUND ROD AS APPROVED BY THE ENGINEER.

PLACE A 5/8" DIA. X 15' GROUND ROD ELECTRODE IN THE LOAD SIDE OF THE EQUIPMENT PAD AND PROJECT 3" +/- 1/4". PLACE A SUPPLEMENTAL 5/8" DIA. X 15' GROUND ROD ELECTRODE OUTSIDE OF THE EQUIPMENT PAD WITH THE TOP OF THE ELECTRODE BURIED 3" TO 6" BELOW THE GROUND LINE (7" TO 8" IF UNDER BITUMINOUS OR CONCRETE SURFACES) AND NOT LESS THAN 8' FROM THE GROUND ROD ELECTRODE IN THE PAD

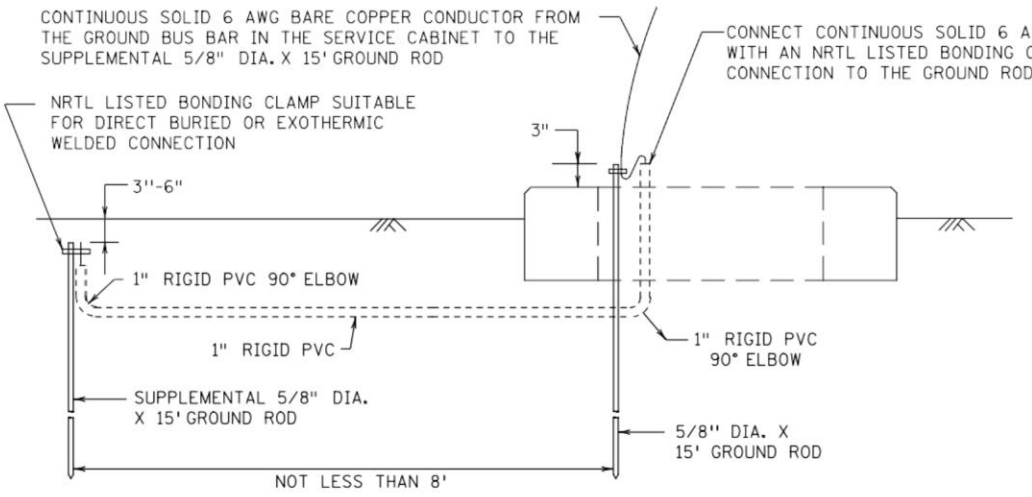
APPLY DE-OX COMPOUND TO THE GROUNDING CONNECTIONS AFTER FINAL ASSEMBLY.

REINFORCEMENT SHALL BE NO. 4. BAR. EACH PAD SHALL CONTAIN: EIGHT (8) 3'-8" LENGTH BARS AND EIGHT (8) 2'-2" LENGTH BARS AS SHOWN.

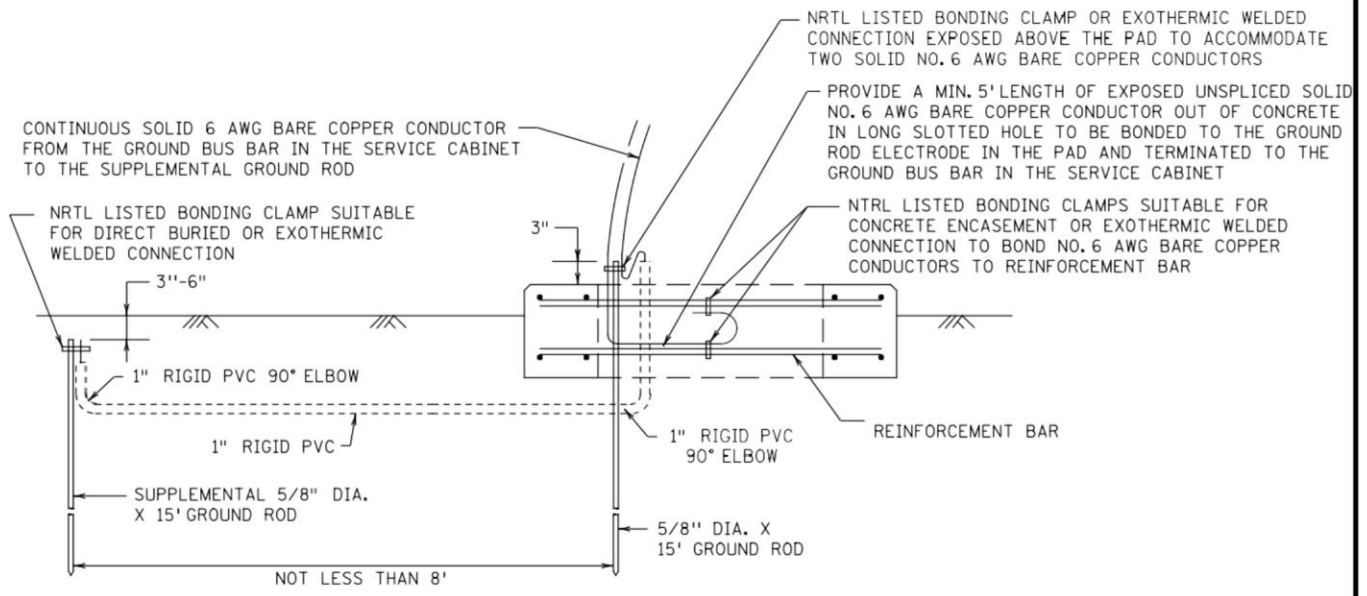
ANCHOR RODS SHALL BE CHAMFERED AND SHALL BE IN ACCORDANCE WITH 3385.2D. RODS SHALL BE ANCHORED USING AN EPOXY ADHESIVE INTO 7/8" DIA. DRILLED HOLE 4" - 5" IN DEPTH PER MANUFACTURE'S INSTRUCTIONS. MECHANICAL ANCHOR BOLTS OR CONCRETE WEDGE ANCHORS SHALL NOT BE USED. USE AN APPROVED EPOXY ADHESIVE FOR APS PUSH BUTTON BASE ADHESIVE ANCHOR SYSTEMS FROM MnDOT's APPROVED/QUALIFIED PRODUCTS LIST. PLACE ANCHORS AS SHOWN ON THE ANCHOR ROD LOCATION DETAIL. USE NUT AND WASHER PROVIDED WITH THE SERVICE CABINET.

APPLY ANTI-SEIZE COMPOUND THAT MEETS MIL-PRF-907E SPEC. WITH A BRUSH TO ALL ANCHOR ROD THREADS.

| APPROVED JULY 15, 2015<br>STATE DESIGN ENGINEER | STATE OF MINNESOTA<br>DEPARTMENT OF TRANSPORTATION<br>EQUIPMENT PAD B | SPECIFICATION REFERENCE<br>2461, 2545<br>2550, 2565 | STANDARD PLATE NO.<br>8106D<br>2 OF 3 |
|---|---|---|---|




GROUNDING ELECTRODE SYSTEM
FOR CAST-IN-PLACE PAD




GROUNDING ELECTRODE SYSTEM
FOR PRECAST PAD

NOTES:

APPLY DE-OX COMPOUND TO THE GROUNDING CONNECTIONS AFTER FINAL ASSEMBLY.

| | | | |
|---|---|---|---|
| APPROVED JULY 15, 2015<br>STATE DESIGN ENGINEER | STATE OF MINNESOTA<br>DEPARTMENT OF TRANSPORTATION<br>EQUIPMENT PAD B | SPECIFICATION REFERENCE<br>2461, 2545<br>2550, 2565 | STANDARD PLATE NO.<br>8106D<br>3 OF 3 |

# Appendix H
## APPROVED PRODUCTS SPECIFICATION SHEETS

A. The approved products specifications sheets are attached.

PHILIPS
LUMEC

# Roadway

## RoadFocus

RFM: 72, 108 and 160W



Project:

Location:

Cat.No:

Type:

Lamps: Qty:

Notes:

The Philips Lumec RoadFocus LED Cobra Head luminaires feature a sleek design that provides seamless replacement of existing HID luminaires. RoadFocus is available in three sizes, offers multiple lumen packages, and a complete array of optical distributions, making it an outstanding solution for all types of roadway applications.

## Ordering guide

**example:** RFM-72W32LED4K-T-R2S-UNIV-DMG-AST-FAWS-RCD-SP2-PHXL-GY3

| Luminaire | LED Module | Optical System | Voltage | Driver and Dimming | Wattage Switch | Twist-Lock Receptacle | Surge Protection | Luminaire Options | Finish |
|---|---|---|---|---|---|---|---|---|---|
| **RFM** | | | | | | | | | |
| RoadFocus Medium | *4000K:*<br>**72W32LED4K-T**<br>**108W32LED4K-T**[2,4]<br>**108W48LED4K-T**<br>**160W48LED4K-T**[2,4]<br>*3000K:*<br>**72W32LED3K-T**<br>**108W32LED3K-T** [2,4]<br>**108W48LED3K-T**<br>**160W48LED3K-T** [2,4] | **R2S**<br>Type II Short<br>**R2M**<br>Type II Medium<br>**R3S**<br>Type III Short<br>**R3M**<br>Type III Medium<br>**4**<br>Type IV<br>**5**<br>Type V | **UNIV**<br>120-277VAC<br>**HVU**<br>347-480VAC | *Standard:*<br>**DMG**[1,6]<br>Dimmable driver 0-10V<br>*Optional:*<br>**Dynadimmer**<br>Economy Profile<br>**CDMGE25**[2,4,5,6]<br>**CDMGE50**[2,4,5,6]<br>**CDMGE75**[2,4,5,6]<br>Median Profile<br>**CDMGM25**[2,4,5,6]<br>**CDMGM50**[2,4,5,6]<br>**CDMGM75**[2,4,5,6]<br>Safety Profile<br>**CDMGS25**[2,4,5,6]<br>**CDMGS50**[2,4,5,6]<br>**CDMGS75**[2,4,5,6]<br>**DALI**[2,4,5,6]<br>Digitally Adressable Lighting Interface<br>**DMG-AST***[2,4]<br>Adjustable Startup Time<br>**DMG-CLO***[2,4,5]<br>Constant Light Output<br>**DMG-OTL***[2,4]<br>Over The Life<br>**Includes 0-10v dimming* | None (leave blank)<br>**FAWS**[5]<br>Field Adjustable Wattage Selector (optional) | *Standard:*<br>**RCD**[1,3,7]<br>Receptacle for twist-lock photocell or shorting cap, 5-pin (standard)<br>*Optional:*<br>**RCD7**[3,7]<br>Receptacle for twist-lock photocell or shorting cap, 7-pin (optional) | None (leave blank)<br>**SP2**[8]<br>20kV / 20kA Surge Protector (optional) | **HS**<br>House side shield, 1 per 16 LED light engine<br>**PH8**[3]<br>Twist-lock Photoelectric Cell, UNIV (120-277VAC)<br>**PH8/347**[3]<br>Twist-lock Photoelectric Cell, HVU (347VAC)<br>**PH8/480**[3]<br>Twist-lock Photoelectric Cell, HVU (480VAC)<br>**PHXL**[3]<br>Twist-lock Photoelectric Cell, extended life, UNIV (120-277VAC)<br>**PH9**[3]<br>Shorting cap<br>**API**<br>Factory installed NEMA label | **BK**<br>Black finish<br>**BR**<br>Bronze finish<br>**GY3**<br>Gray finish<br>**WH**<br>White finish |

1. Please note these integrated features come standard with RoadFocus luminaires.
2. Denotes programmable driver option. Not available with HVU (347-480volt). Not available with 1050 mA versions (108W32LED, 160W48LED).
3. Use of photoelectric cell or shorting cap is required to ensure proper illumination.
4. Not available with HVU (347-480volt).
5. FAWS not available with CDMG options, DALI or CLO.
6. Dimming choices: Select either DMG or one of the CDMG options or DALI.
7. When RDC7 option is selected you will get 7-pin instead of standard RCD 5-pin.
8. When SP2 option is selected you will get SP2 instead of standard SP1.

# RFM RoadFocus

## Medium, LED Cobrahead: 72, 108, and 160W

### Accessories (must be ordered as separate line items - quickly and easily installed in the field)

**CPC or CPCD**[1]
CityTouch Connector Node.

1. Contact the factory for additional support when connected lighting or additional services are desired.

### LED Wattage and Lumen Values

LED = Philips Lumileds LUXEON T, CRI = 70, CCT = 4000K (+/- 350K), System (LED + driver) rated life = 100,000 hrs[1]

| LED Module | Typical Delivered Lumens | Typical System Wattage (W)[2] | LED Current (mA) | Typical System Current (A) @ 120V | 208V | 240V | 277V | 347V | 480V | Efficacy (Lm/W) | BUG Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **72W32LED4K-T-R2S** | 8,330 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 114 | B2-U0-G1 |
| **72W32LED4K-T-R2M** | 8,140 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 112 | B2-U0-G2 |
| **72W32LED4K-T-R3S** | 8,085 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 111 | B1-U0-G2 |
| **72W32LED4K-T-R3M** | 8,178 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 112 | B2-U0-G2 |
| **72W32LED4K-T-4** | 7,142 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 98 | B1 U0 G2 |
| **72W32LED4K-T-5** | 7,496 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 103 | B3-U0-G2 |
| **108W32LED4K-T-R2S** | 11,169 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | N/A | | 103 | B2-U0-G2 |
| **108W32LED4K-T-R2M** | 10,914 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 101 | B2-U0-G2 |
| **108W32LED4K-T-R3S** | 10,841 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 100 | B1-U0-G2 |
| **108W32LED4K-T-R3M** | 10,965 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 102 | B2-U0-G2 |
| **108W32LED4K-T-4** | 10,320 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 96 | B2-U0-G2 |
| **108W32LED4K-T-5** | 10,050 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 93 | B3-U0-G2 |
| **108W48LED4K-T-R2S** | 12,507 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 118 | B3-U0-G2 |
| **108W48LED4K-T-R2M** | 12,222 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 115 | B2-U0-G2 |
| **108W48LED4K-T-R3S** | 12,140 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 115 | B2-U0-G2 |
| **108W48LED4K-T-R3M** | 12,279 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 116 | B2-U0-G2 |
| **108W48LED4K-T-4** | 10,724 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2 U0 G2 |
| **108W48LED4K-T-5** | 11,255 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 107 | B4-U0-G2 |
| **160W48LED4K-T-R2S** | 16,778 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | N/A | | 104 | B3-U0-G2 |
| **160W48LED4K-T-R2M** | 16,396 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 102 | B3-U0-G3 |
| **160W48LED4K-T-R3S** | 16,285 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 101 | B2-U0-G3 |
| **160W48LED4K-T-R3M** | 16,472 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 102 | B3-U0-G3 |
| **160W48LED4K-T-4** | 14,386 | 161 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 89 | B2-U0-G3 |
| **160W48LED4K-T-5** | 15,098 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 94 | B4-U0-G2 |

1. $L_{70}$ >100,000 hrs (at ambient temperature = 25˚C).
2. System wattage or total luminaire wattage includes the LED module and the LED driver.

*Note: Due to rapid and continuous advances in LED technology, LED luminaire data is subject to change without notice and at the discretion of Philips.*

# RFM RoadFocus

## Medium, LED Cobrahead: 72, 108, and 160W

### LED Wattage and Lumen Values

LED = Philips Lumileds LUXEON T, CRI = 70, CCT = 3000K (+/- 350K), System (LED + driver) rated life = 100,000 hrs[1]

| LED Module | Typical Delivered Lumens | Typical System Wattage (W)[2] | LED Current (mA) | Typical System Current (A) @ 120V | 208V | 240V | 277V | 347V | 480V | Efficacy (Lm/W) | BUG Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 72W32LED3K-T-R2S | 7,398 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 101 | B2-U0-G1 |
| 72W32LED3K-T-R2M | 7,181 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 98 | B2-U0-G2 |
| 72W32LED3K-T-R3S | 7,168 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 98 | B1-U0-G2 |
| 72W32LED3K-T-R3M | 7,042 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 96 | B2-U0-G2 |
| 72W32LED3K-T-4 | 7,223 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 99 | B1-U0-G2 |
| 72W32LED3K-T-5 | 7,231 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 99 | B3-U0-G2 |
| 108W32LED3K-T-R2S | 10,064 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | N/A | | 93 | B2-U0-G2 |
| 108W32LED3K-T-R2M | 9,769 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 90 | B2-U0-G2 |
| 108W32LED3K-T-R3S | 9,751 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 90 | B1-U0-G2 |
| 108W32LED3K-T-R3M | 9,581 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 89 | B2-U0-G2 |
| 108W32LED3K-T-4 | 9,826 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 91 | B2-U0-G2 |
| 108W32LED3K-T-5 | 9,837 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 91 | B4-U0-G2 |
| 108W48LED3K-T-R2S | 11,116 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 105 | B2-U0-G2 |
| 108W48LED3K-T-R2M | 10,790 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2-U0-G2 |
| 108W48LED3K-T-R3S | 10,770 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2-U0-G2 |
| 108W48LED3K-T-R3M | 10,581 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 100 | B2-U0-G2 |
| 108W48LED3K-T-4 | 10,853 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2-U0-G2 |
| 108W48LED3K-T-5 | 10,865 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 103 | B4-U0-G2 |
| 160W48LED3K-T-R2S | 14,706 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | N/A | | 91 | B3-U0-G2 |
| 160W48LED3K-T-R2M | 14,275 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B3-U0-G3 |
| 160W48LED3K-T-R3S | 14,249 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B2-U0-G2 |
| 160W48LED3K-T-R3M | 13,999 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 87 | B3-U0-G2 |
| 160W48LED3K-T-4 | 14,358 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B2-U0-G3 |
| 160W48LED3K-T-5 | 14,374 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B4-U0-G2 |

1. $L_{70}$ >100,000 hrs (at ambient temperature = 25˚C).
2. System wattage or total luminaire wattage includes the LED module and the LED driver.

*Note: Due to rapid and continuous advances in LED technology, LED luminaire data is subject to change without notice and at the discretion of Philips.*

### Field Adjustable Wattage (FAWS) Multiplier Chart

**72W32LED4K-T or 108W48LED4K-T (700 mA)**
**72W32LED3K-T or 108W48LED3K-T (700 mA)**

| FAWS Position | Typical Delivered Lumens Multiplier | Typical System wattage and typical current |
|---|---|---|
| 1 | 0.37 | 0.29 |
| 2 | 0.55 | 0.50 |
| 3 | 0.62 | 0.58 |
| 4 | 0.71 | 0.69 |
| 5 | 0.77 | 0.75 |
| 6 | 0.81 | 0.81 |
| 7 | 0.84 | 0.87 |
| 8 | 0.94 | 0.91 |
| 9 | 0.98 | 0.96 |
| 10 | 1.00 | 1.00 |

**108W32LED4K-T OR 160W48LED4K-T (1050mA)**
**108W32LED3K-T OR 160W48LED3K-T (1050mA)**

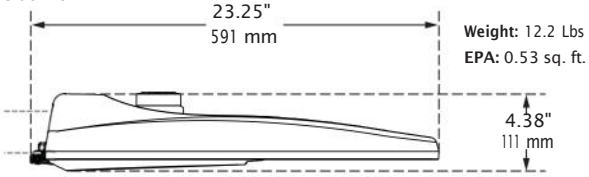
| FAWS Position | Typical Delivered Lumens Multiplier | Typical System wattage and typical current |
|---|---|---|
| 1 | 0.33 | 0.27 |
| 2 | 0.56 | 0.48 |
| 3 | 0.64 | 0.57 |
| 4 | 0.71 | 0.65 |
| 5 | 0.79 | 0.74 |
| 6 | 0.84 | 0.79 |
| 7 | 0.89 | 0.85 |
| 8 | 0.92 | 0.90 |
| 9 | 0.96 | 0.95 |
| 10 | 1.00 | 1.00 |

# RFM RoadFocus

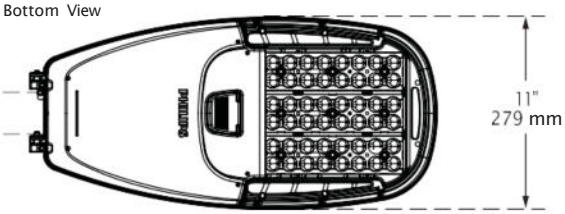
## Medium, LED Cobrahead: 72, 108, and 160W

## Dimensions

Side View




Bottom View




## Predicted Lumen Depreciation Data

Predicted performance derived from LED manufacturer's data and engineering design estimates, based on IESNA LM-80 methodology. Actual experience may vary due to field application conditions.$L_{70}$ is the predicted time when LED performance depreciates to 70% of initial lumen output. Calculated per IESNA TM21-11. Published $L_{70}$ hours limited to 6 times actual LED test hours

| Ambient Temperature °C | Driver mA | Calculated $L_{70}$ Hours | $L_{70}$ per TM-21 | Lumen Maintenance % at 60,000 hrs |
|---|---|---|---|---|
| 25°C | up to 1050 mA | >100,000 hours | >60,000 hours | >96% |

## Specifications

### Housing

Made of a low copper die cast Aluminum alloy (A360), 0.100" (2.5mm) minimum thickness. Fits on a 1.66" (42mm) O.D. (1.25" NPS), 1.9" (48mm) O.D. (1.5" NPS) or 2 3/8" (60mm) O.D. (2" NPS) by 5 1/2" (140mm) minimum long tenon. Comes with a zinc plated clamp fixed by 2 zinc plated hexagonal bolts 3/8 16 UNC for ease of installation. Provides an easy step adjustment of +/- 5° tilt in 2.5° increments. Includes integral bubble level standard (always included). A quick release, tool less entry, single latch, hinged, removable door opens downward to provide access to electronic components and to a terminal block. Door is secured to prevent accidental dropping or disengagement. A clearance of 13" (330mm) at the rear is required in order to remove the door. Complete with a bird guard protecting against birds and similar intruders and an ANSI label to identify wattage and source (both included in box).

### Light Engine

Composed of 4 main components: LED Module / Optical System / Heat Sink / Driver.

Electrical components are RoHS compliant, IP66 sealed light engine equipped with Philips Lumileds LUXEON T LEDs.LEDs tested by ISO 17025-2005 accredited lab in accordance with IESNA LM-80 guidelines in compliance with EPA ENERGY STAR, extrapolations in accordance with IESNA TM-21. Metal core board ensures greater heat transfer and longer lifespan.

**LED Module:** LED type Philips Lumileds LUXEON T. Composed of high-performance white LEDs. Color temperature as per ANSI/NEMA bin Neutral White, 3000 Kelvin nominal (3045K +/- 175K) or 4000 Kelvin nominal (3985K +/- 275K), CRI 70 Min. 75 Typical.

**Optical System:** Composed of high performance UV stabilized optical grade polymer refractor lenses to achieve desired distribution optimized to get maximum spacing, target lumens and a superior lighting uniformity. System is rated IP66. Performance shall be tested per LM-63, LM-79 and TM-15 (IESNA) certifying its photometric performance. 0% uplight and U0 per IESNA TM-15.

**Heat Sink:** Built in the housing, designed to ensure high efficacy and superior cooling by natural vertical convection air flow pattern always close to LEDs and driver optimising their efficiency and life. Product does not use any cooling device with moving parts (only passive cooling). Wide openings enable natural cleaning and removal of dirt and debris. Entire luminaire is rated for operation in ambient temperature of -40°C / -40°F up to +40°C / +104°F.

**Driver:** High power factor of 90% min. Electronic driver, operating range 50/60 Hz. Auto adjusting universal voltage input from 120 to 277 or 347 to 480 VAC rated for both application line to line or line to neutral, Class I, THD of 20% max.

**DMG:** Dimming compatible 0-10 volts.
The current supplying the LEDs will be reduced by the driver if the driver experiences internal overheating as a protection to the LEDs and the electrical components. Output is protected from short circuits, voltage overload and current overload. Automatic recovery after correction. Standard built in driver surge protection of 2.5kV (min).

### Integrated Features

**DMG**: Dimmable driver 0-10V.

**RCD***: Receptacle with 5 pins enabling dimming, can be used with a twist lock Starsense or photoelectric cell or a shorting cap.

**SP1:** Surge protection device tested in accordance with ANSI/IEEE C62.45 per ANSI/IEEE C62.41.2 Scenario I Category C High Exposure 10kV/10kA waveforms for Line-Ground, Line-Neutral and Neutral-Ground, and in accordance with DOE MSSLC Model Specification for LED Roadway Luminaires Appendix D Electrical Immunity High test level 10kV/10kA.

*Please note that these integrated features always come with RoadFocus luminaire.*

** Use of photoelectric cell or shorting cap is required to ensure proper illumination.*

# RFM RoadFocus

## Medium, LED Cobrahead: 72, 108, and 160W

### Specifications (continued)

#### Driver and Luminaire Options

**AST*:** Pre-set driver for progressive start-up of the LED module(s) to optimize energy management and enhance visual comfort at start-up.

**CLO*:** Pre-set driver to manage the lumen depreciation by adjusting the power given to the LEDs offering the same lighting intensity during the entire lifespan of the LED module.

**DALI*:** Pre-set driver compatible with the DALI control system.

**OTL*:** Pre-set driver to signal end of life of the LED module(s) for better fixture management.

**CDMG*:** Dynadimmer standard dimming functionalities including pre-programmed scenarios to suit many applications and needs from safety to maximum energy savings.

**Safety Mode:**
CDMGS25: 4 hours, 25% power dimming
CDMGS50: 4 hours 50% power dimming
CDMGS75: 4 hours 75% power dimming

**Median Mode:**
CDMGM25: 6 hours 25% power dimming
CDMGM50: 6 hours 50% power dimming
CDMGM75: 6 hours 75% power dimming

**Economy Mode:**
CDMGE25: 8 hours 25% power dimming
CDMGE50: 8 hours 50% power dimming
CDMGE75: 8 hours 75% power dimming

** Not available with HVU (347-480V)*

**FAWS:** Field Adjustable Wattage Selector, pre-set to the highest position, can be easily switched in the field to the required position. This reduces total luminaire wattage consumption and reduces the light level – see the FAWS multiplier chart for more details.

*Note: It is not recommended to use FAWS with other dimming or controls; if you do, set the switch to position 10 (maximum output) to enable the other dimming or controls. Switching FAWS to any position other than 10 will disable the other dimming or controls.*

**SP2:** 20kV / 20kA surge protection device that provides extra protection beyond the SP1 10kV/10kA level.

**RCD7*:** Receptacle with 7 pins enabling dimming and additional functionality (to be determined), can be used with a twist lock Starsense node or photoelectric cell or a shorting cap.

*Please note: Additional hardware will be required to utilize the additional 2 pins on this receptacle.*

**HS:** House side shield, 1 per 16 LED light engine.

**PH8*:** Twist-lock Photoelectric Cell, UNIV (120-277VAC).

**PH8/347*:** Twist-lock Photoelectric Cell, HVU (347VAC).

**PH8/480*:** Twist-lock Photoelectric Cell, HVU (480VAC).

**PHXL*:** Twist-lock Photoelectric Cell, extended life, UNIV (120-277VAC).

**PH9*:** Shorting cap.

**API:** Factory Installed NEMA label, ANSI C136.15 compliant

** Use of photoelectric cell or shorting cap is required to ensure proper illumination.*

#### Luminaire Useful Life

Refer to IES files for energy consumption and delivered lumens for each option. Based on ISTMT in situ thermal testing in accordance with UL1598 and UL8750, Philips System Reliability Tool, Philips Advance data and Philips Lumileds LM-80/TM-21 data, expected to reach 100,000 + hours (72W32LED and 108W48LED at 700mA) or 94,500 hours (108W32LED and 160W48LED at 1050mA) with >L70 lumen maintenance @ 25˚C. Luminaire Useful Life accounts for LED lumen maintenance AND all of these additional factors including: LED life, driver life, PCB substrate, solder joints, on/off cycles, burning hours and corrosion.

#### Wiring

The connection of the luminaire is done using a terminal block connector 600V, 85A for use with #2 14 AWG. wires from the primary circuit, located inside the housing. Due to the inrush current that occurs with electronic drivers, recommend using a 10Amp time-delay fuse to avoid unwanted fuse blowing (false tripping) that can occur with normal or fast acting fuses.

#### Hardware

All exposed screws shall be complete with Ceramic primer seal to reduce seizing of the parts, also offers a high resistance to corrosion. All seals and sealing devices are made and/or lined with EPDM and/or silicone and/or rubber.

#### Finish

Color in accordance with the AAMA 2603 standard. Application of polyester powder coat paint (4 mils/100 microns) with ± 1 mils/24 microns of tolerance. The Thermosetting resins provides a discoloration resistant finish in accordance with the ASTM D2244 standard, as well as luster retention in keeping with the ASTM D523 standard and humidity proof in accordance with the ASTM D2247 standard.

The surface treatment achieves a minimum of 3000 hours for salt spray resistant finish in accordance with testing performed and per ASTM B117 standard.

#### LED products manufacturing standard

The electronic components sensitive to electrostatic discharge (ESD) such as light emitting diodes (LEDs) are assembled in compliance with IEC61340-5-1 and ANSI/ESD S20.20 standards so as to eliminate ESD events that could decrease the useful life of the product.

#### Vibration Resistance

The RFM meets the ANSI C136.31, American National Standard for Roadway Luminaire Vibration specifications for Bridge/overpass applications. (Tested for 3G over 100,000 cycles by independent lab)

#### Certifications and Compliance

cULus Listed for Canada and USA. Luminaire meets DOE and MSSLC Model Specification for LED Roadway Luminaires. RoadFocus LED Cobrahead luminaires are DesignLights Consortium qualified. Luminaire complies with or exceeds the following ANSI C136 standards: .2, .3, .10, .14, .15, .22, .25, .31, .37, .41.

#### Limited Warranty

10-year limited warranty.
See philips.com/warranties for details and restrictions.

#### Brackets/Arms

For brackets / arms available with this luminaire, see Lumec 3D for details.

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philips.com/luminaires



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# Autobahn Series ATBM
## Roadway

Consistent with LEED® goals & Green Globes™ criteria for light pollution reduction

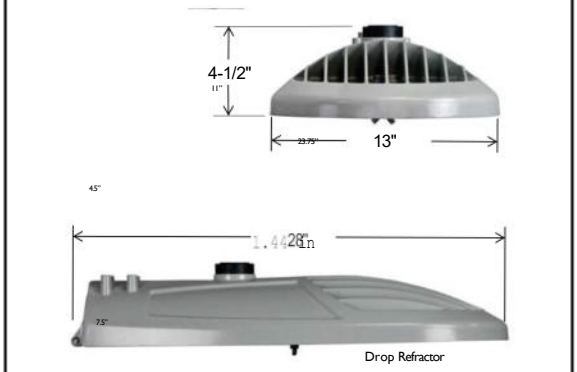
**PRODUCT OVERVIEW**



## Applications:

Residential streets
Parking lots
High speed roadways

**DIMENSIONS**




Effective Projected Area (EPA)
The EPA for the ATBM is 0.3 sq. ft.,
Approx. Wt. = 21 lbs. (9.5 kg)

### STANDARDS

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

Color temperatures of ≤ 3000K must be specified for International Dark-Sky Association certification.

Rated for -40°C to 40°C ambient
CSA Certified to U.S. and Canadian standards
Complies with ANSI: C136.2, C136.10, C136.14, C136.31, C136.15, C136.37

## Features:

### OPTICAL

Same Light: Performance is comparable to 150W – 250W HPS

White Light: Correlated color temperature - 4000K, 70 CRI minimum, 3000K, 70 CRI minimum or optional 5000K, 70 CRI minimum.

IP66 rated borosilicate glass optics ensure longevity and minimize dirt depreciation. Unique IP66 rated LED light engines provide 0% uplight and restrict backlight to within sidewalk depth, providing optimal application coverage and optimal pole spacing.

Available distributions are Type II, III, IV, & V roadway distributions.

### ELECTRICAL

Expected Life: LED light engines are rated >100,000 hours at 25°C, L70.
Electronic driver has an expected life of 100,000 hours at a 25°C ambient.

Lower Energy: Saves an expected 40-60% over comparable HID luminaires.

Robust Surge Protection: Three different surge protection options provide a minimum of ANSI C136.2 10kV/5kA protection. 20kV/10kA surge protection is also available.

### MECHANICAL

Includes standard AEL lineman-friendly features such as tool-less entry, 3 station terminal block and quick disconnects. Bubble level located inside the electrical compartment for easy leveling at installation.

Rugged die-cast aluminum housing and door are polyester powder-coated for durability and corrosion resistance. Rigorous five-stage pre-treating and painting process yields a finish that achieves a scribe creepage rating of 8 (per ASTM D1654) after over 5000 hours exposure to salt fog chamber (operated per ASTM B117).

Mast arm mount is adjustable for arms from 1-1/4" to 2" (1-5/8" to 2-3/8" O.D.) diameter.
The 2 – bolt and optional 4 bolt clamping mechanism provide 3G vibration rating per ANSI C136.

The Wildlife shield is cast into the housing (not a separate piece).

### CONTROLS

NEMA 3 pin photocontrol receptacle is standard, with the Acuity designed ANSI standard 5 pin and 7 pin receptacles optionally available.

Premium solid state locking-style photocontrol – PCSS (10 year rated life) Extreme long life solid state locking-style photocontrol – PCL1 (20 year rated life).

Extreme long life solid state locking-style photocontrol with on demand remote on/off control - PCCC (15 year rated life).

Optional onboard Adjustable Output module allows the light output and input wattage to be modified to meet site specific requirements, and also can allow a single fixture to be flexibly applied in many different applications.

# **Autobahn** Series ATBM
## Roadway

## ORDERING INFORMATION

**Example:** ATBM A MVOLT R2

| Series | Performance Packages | Voltage | Optics | Mounting |
|---|---|---|---|---|
| **ATBM** Autobahn LED Roadway | **A** 7,000 lumens<br>**B** 8,000 lumens<br>**C** 9,000 lumens<br>**D** 11,600 lumens<br>**E** 13,400 lumens<br>**F** 15,700 lumens<br>**G** 16,600 lumens<br>**H** 17,400 lumens | **MVOLT** Multi-volt, 120-277V<br>**347** 347V<br>**480** 480V | **R2** Roadway Type II<br>**R3** Roadway Type III<br>**R4** Roadway Type IV<br>**R5** Roadway Type V | **(Blank)** 2 Bolt Mounting<br>**4B** 4 Bolt Mounting |

### Options

Color Temperature (CCT)
- **(Blank)** 4000K CCT, 70 CRI Min.
- **3K** 3000K CCT, 70 CRI Min.
- **5K** 5000K CCT, 70 CRI Min.

Paint
- **(Blank)** Gray
- **BK** Black
- **BZ** Bronze
- **DDB** Dark Bronze
- **GI** Graphite
- **WH** White

Surge Protection
- **(Blank)** Acuity SPD
- **20** 20kV/10KA SPD[8]
- **MP** MOV Pack[1]
- **IL** SPD with Indicator Light[1]

Miscellaneous Options
- **HSS** House Side Shield
- **NL** NEMA Label Indicating Wattage
- **XL** Not CSA Certified – No Terminal Block Cover

Control Options
- **(Blank)** 3 Pin NEMA Photocontrol Receptacle
- **P5** 5 Pin Photocontrol Receptacle (dimmable driver included)[2]
- **P7** 7 Pin Photocontrol Receptacle (dimmable driver included)[2]
- **NR** No Photocontrol Receptacle[3]
- **AO** Field Adjustable Output[4]
- **DM** 0-10V Dimmable Driver[5]
- **PCSS** Solid-State Lighting Photocontrol[6]
- **PCLL** Solid-State Long Life Photocontrol
- **PCCC** Solid-State Long Life Photocontrol with remote control on/off[7]
- **SH** Shorting Cap

Packages
- **(Blank)** Standard Pack
- **JP** Job Pack (36/pallet)

Accessories
- **ATBMHSS** House Side Shield
- **ATBMLTS** Light Trespass Shield
- **RKATBMMVOLTSPD** ATBM Acuity SPD Replacement Kit MVOLT
- **RKATBMHVSPD** ATBM Acuity SPD Replacement Kit 347/480V
- **RKATBMMVOLTMP** ATBM MOV Pack Replacement Kit
- **RKATBMMVOLTIL** ATBM IL SPD Replaement Kit

**Notes:**
1. Not available with G and H performance packages.
2. Dimmable Driver included. Not available with DM or NR.
3. Not available with P5, P7.
4. Not available with DM.
5. Controls by others. Not available with AO.
6. MVOLT only.
7. Not available with PCSS or PCLL.
8. Not available with G & H packages at 347/480 volts.

American Electric Lighting
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www.americanelectriclighting.com
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**Warranty** Five-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx
Actual performance may differ as a result of end-user environment and application.
Specifications subject to change without notice.

***Please contact your sales representative for the latest product information.***

## PERFORMANCE PACKAGE

| Performance Package | Distribution | 4000 K CCT | | | LLD @ 25°C | | |
|---|---|---|---|---|---|---|---|
| | | Lumens | Input Watts | LPW | 50K Hours | 75K Hours | 100K Hours |
| A | R2 | 7,114 | 60 | 118 | 89 | 84 | 80 |
| | R3 | 7,024 | | 117 | | | |
| | R4 | 6,958 | | 116 | | | |
| | R5 | 7,469 | | 124 | | | |
| B | R2 | 8,090 | 70 | 115 | 89 | 84 | 80 |
| | R3 | 8,016 | | 114 | | | |
| | R4 | 7,924 | | 113 | | | |
| | R5 | 8528 | | 121 | | | |
| C | R2 | 9031 | 81 | 112 | 89 | 84 | 80 |
| | R3 | 8,942 | | 111 | | | |
| | R4 | 8,827 | | 110 | | | |
| | R5 | 9,517 | | 118 | | | |
| D | R2 | 11,769 | 95 | 124 | 90 | 87 | 84 |
| | R3 | 11,690 | | 123 | | | |
| | R4 | 11,534 | | 121 | | | |
| | R5 | 12,388 | | 130 | | | |
| E | R2 | 13,601 | 115 | 118 | 90 | 87 | 84 |
| | R3 | 13,416 | | 117 | | | |
| | R4 | 13,323 | | 116 | | | |
| | R5 | 14,263 | | 124 | | | |
| F | R2 | 15,932 | 133 | 120 | 90 | 86 | 83 |
| | R3 | 15,741 | | 118 | | | |
| | R4 | 15,476 | | 116 | | | |
| | R5 | 16,691 | | 125 | | | |
| G | R2 | 17,102 | 150 | 114 | 90 | 86 | 83 |
| | R3 | 16,974 | | 113 | | | |
| | R4 | 16,635 | | 111 | | | |
| | R5 | 17,938 | | 119 | | | |
| H | R2 | 18,085 | 164 | 111 | 90 | 86 | 83 |
| | R3 | 17,929 | | 110 | | | |
| | R4 | 17,439 | | 107 | | | |
| | R5 | 18,966 | | 116 | | | |

**Note:** Information shown above is based on 4000K nominal system data. Individual fixture performance may vary. Specifications subject to change without notice.

American Electric Lighting
AEL Headquarters, 3825 Columbus Road, Granville, OH 43023
www.americanelectriclighting.com
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**Warranty** Five-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx
Actual performance may differ as a result of end-user environment and application.
Specifications subject to change without notice.

***Please contact your sales representative for the latest product information.***

# Streetworks

## DESCRIPTION

The Verdeon LED roadway luminaire combines optical performance, energy efficiency, and outstanding versatility to meet the requirements of any roadway application. Advanced optical technology delivers unparalleled uniformity, scalability, and budget-beating operating costs for municipal streets and highways. UL/cUL listed for wet locations with an optional IP66 enclosure rating available.

| | | |
|---|---|---|
| Catalog # | | Type |
| Project | | |
| Comments | | Date |
| Prepared by | | |

## SPECIFICATION FEATURES

### Construction
Heavy-duty die-cast aluminum housing and door. Tool-less entry, hinged removable door for easy maintenance. 3G vibration rated.

### Optics
Optics are precisely designed to shape the distribution maximizing efficiency and fixture spacing. Offered standard in 4000K (+/-275K) CCT and 70 CRI. Optional 5700K CCT, 5000K CCTand 3000K CCT are available.

### Electrical
120-277V 50/60Hz, 347V 60Hz or 480V 60Hz operation. 10kV/10kA common- and differential- mode surge protection available.Thermal management transfers heat away from the LED source for optimal efficiency, light output and lumen maintenance. Operates in ambient temperatures from -40˚C to 40˚C. 50˚C HA (high ambient) option available. Standard three-position tunnel type terminal block. LED modules are IP66 rated.

### Mounting
Two-bolt/one-bracket slipfitter with cast-in pipe stop and 2.5˚ leveling steps. Four-bolt/two-clamp mounting option. Fixed-in-place bird guard seals around 1-1/4" to 2" (1-5/8" to 2-3/8" O.D.) mounting arms. Optional 15" pole mount arm available with round pole adapter and mounting hardware included.

### Finish
Housing and cast parts finished in five-stage super TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Consult your lighting representative at Eaton for a complete selection of standard colors.

### Warranty
Five-year warranty.



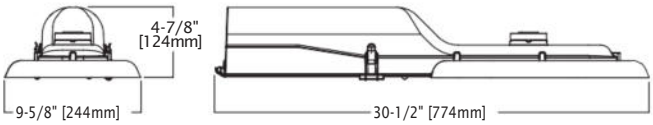
**VERD** VERDEON

**LED**

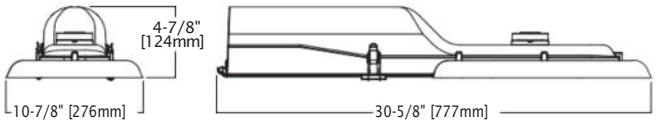
**ROADWAY LUMINAIRE**

## DIMENSIONS

**VERD**

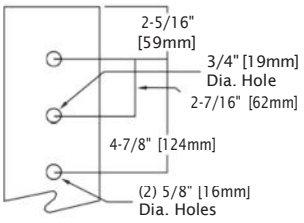



**VERD-G**



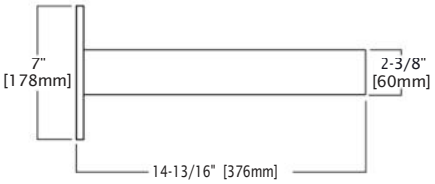

## ARM DRILLING

**TYPE "M"**




## OPTIONAL ARM

**15" Straight Arm**




## CERTIFICATION DATA
UL and cUL Wet Location Listed
IP66-Rated Optics
3G Vibration Rated
ISO 9001
DesignLights Consortium® Qualified*

## ENERGY DATA
**Electronic LED Driver**
0.9 Power Factor
<20% Total Harmonic Distortion
120-277V/50 and 60Hz, 347V 60Hz, 480V 60Hz
-40˚C Minimum Temperature Rating
+40˚C Ambient Temperature Rating

## EPA
**Effective Projected Area** (Sq. Ft.): 0.5

## SHIPPING DATA
**Approximate Net Weight:**
20 lbs. (9.1 kgs.)

*www.designlights.org

## POWER AND LUMENS

| Light Engine | | A016 | A018 | A01 | A028 | A02 | G-A028 | G-A02 |
|---|---|---|---|---|---|---|---|---|
| Power (Watts) | | 36 | 51 | 64 | 72 | 92 | 103 | 143 |
| Current (a) @ 120V | | 0.32 | 0.45 | 0.57 | 0.64 | 0.81 | 0.91 | 1.26 |
| Current (a) @ 277V | | 0.15 | 0.20 | 0.25 | 0.29 | 0.64 | 0.40 | 0.53 |
| Power (Watts) | | 44 | 59 | -- | 83 | 100 | 113 | 154 |
| Current (a) @ 347V | | 0.13 | 0.17 | -- | 0.24 | 0.28 | 0.33 | 0.45 |
| Current (a) @ 480V | | 0.09 | 0.13 | -- | 0.17 | 0.21 | 0.24 | 0.33 |
| **Optics** | | | | | | | | |
| **Type II** | Lumens | 3,855 | 4,936 | 5,839 | 7,858 | 9,294 | 12,064 | 15,332 |
| | BUG Rating | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | B3-U0-G3 |
| **Type III** | Lumens | 3,775 | 4,833 | 5,716 | 7,693 | 9,099 | 11,946 | 15,182 |
| | BUG Rating | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 |
| **Type IV** | Lumens | 3,785 | 4,846 | 5,732 | 7,714 | 9,123 | 11,944 | 15,180 |
| | BUG Rating | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | B1-U0-G3 | B2-U0-G3 | B2-U0-G3 | B2-U0-G4 |
| **Type V** | Lumens | 3,864 | 4,948 | 5,852 | 7,876 | 9,315 | 12,137 | 15,425 |
| | BUG Rating | B3-U0-G2 | B3-U0-G2 | B3-U0-G2 | B3-U0-G3 | B4-U0-G3 | B4-U0-G3 | B4-U0-G3 |

**NOTE:** Lumen output for AP Grey fixture color, 120-277V.

## LUMEN MAINTENANCE

| Ambient Temperature | TM-21 Lumen Maintenance (50,000 hours) | Theoretical L70 (Hours) |
|---|---|---|
| **A01*** | | |
| 25˚C | >88% | >127,000 |
| 40˚C | >82% | >87,000 |
| **A018, A016, A02, & A028** | | |
| **Ambient Temperature** | **TM-21 Lumen Maintenance (50,000 hours)** | **Theoretical L70 (Hours)** |
| 25˚C | >92% | >200,000 |
| 40˚C | >90% | >145,000 |
| **G-A02 & G-A028** | | |
| **Ambient Temperature** | **TM-21 Lumen Maintenance (60,000 hours)** | **Theoretical L70 (Hours)** |
| 25˚C | >91% | >250,000 |
| 40˚C | >90% | >200,000 |

* A01 Not available in 347V or 480V.

## LUMEN MULTIPLIER

| Ambient Temperature | Lumen Multiplier |
|---|---|
| 0˚C | 1.02 |
| 10˚C | 1.01 |
| 25˚C | 1.00 |
| 40˚C | 0.99 |
| 50˚C | 0.97 |

## ORDERING INFORMATION

**Sample Number**: VERD-A018-D-U-T2-4N7-AP

| Product Family [1, 2] | Light Engine [3] | Driver [5] | Voltage | Distribution |
|---|---|---|---|---|
| **VERD**=Verdeon | **A01**=1 LED, Full Output [4]<br>**A018**=1 LED, Approximately 80% Output<br>**A016**=1 LED, Approximately 60% Output<br>**A02**=2 LEDs, Full Output<br>**A028**=2 LEDs, Approximately 80% Output<br>**G-A02**=High Lumen, 2 LEDs, Full Output<br>**G-A028**=High Lumen, 2 LEDs, Approximately 80% Output | **E**=Non-Dimming<br>**D**=Dimming (0-10V) [6] | **U**=Universal (120-277V)<br>**8**=480V [7, 8]<br>**9**=347V [7] | **T2**=Type II<br>**T3**=Type III<br>**T4**=Type IV<br>**T5**=Type V |

| **Options** (Add as Suffix) | **Color** | **Accessories** (Order Separately) |
|---|---|---|
| **7030**=70 CRI / 3000K CCT [9]<br>**7060**=70 CRI / 5700K CCT [9]<br>**4**=NEMA Twistlock Photocontrol Receptacle<br>**4N7**=NEMA 7-PIN Twistlock Photocontrol Receptacle [10]<br>**10K**=10kV UL 1449 Surge Protective Device<br>**10MSP**=10kV MOV Surge Protective Device<br>**IP66**=IP66 Rated Housing<br>**HA**=50˚C High Ambient Temperature<br>**MS/DIM-L08**=Motion Sensor for Dimming Operation, Maximum 8' Mounting Height [10, 11, 12]<br>**MS/DIM-L20**=Motion Sensor for Dimming Operation, Maximum 9' - 20' Mounting Height [10, 11, 12]<br>**MS/DIM-L40**=Motion Sensor for Dimming Operation, Maximum 21' - 40' Mounting Height [10, 11, 12]<br>**LWR-LN**=Factory Installed LumaWatt RF Dimming Control System (Mounting Height 16' and Up) [13, 14]<br>**LWR-LW**=Factory Installed LumaWatt RF Dimming Control System (Mounting Height below 16') [13, 14]<br>**K**=Level Indicator<br>**4B**=Four-bolt, Two-clamp Mounting<br>**A15**=Arm Included (15" Straight Arm) [15] | **AP**=Grey (Standard)<br>**BZ**=Bronze<br>**BK**=Black<br>**DP**=Dark Platinum<br>**GM**=Graphite Metallic<br>**WH**=White | **OA1223**=10kV UL 1449 Surge Module Replacement<br>**OA/RA1013**=Photocontrol Shorting Cap<br>**OA/RA1014**=NEMA Photocontrol - 120V<br>**OA/RA1016**=NEMA Photocontrol - Multi-Tap<br>**OA/RA1027**=NEMA Photocontrol - 480V<br>**OA/RA1201**=NEMA Photocontrol - 347V<br>**FSIR-100**=Wireless Configuration Tool for Motion Sensor [16]<br>**HS-VERD**=Verdeon House Side Shield<br>**VGS-F/B**=Vertical Glare Shield, Front/Back<br>**VGS-SIDE**=Vertical Glare Shield, Side |

**NOTES:**

1. Customer is responsible for engineering analysis to confirm pole and fixture compatiblity for all applications. Refer to our white paper WP513001EN for additional support information.
2. DesignLights Consortium® Qualified. Refer to www.designlights.org qualified products list under family models for details.
3. Standard 4000K CCT and 70 CRI.
4. Not available in 347V or 480V.
5. Consult factory for driver surge protection values.
6. Dimming leads will be capped except when 4N7 or motion sensor option is specified.
7. Not available with A01 light engine.
8. Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems).
9. Extended lead times apply. Use dedicated IES files for 3000K and 5700K when performing layouts. These files are published on the VERD Verdeon luminaire product page on the website.
10. Must specify dimming driver.
11. Not available with 4B option. Sensor mounted externally. Consult factory for more information.
12. The FSIR-100 accessory is required to adjust parameters.
13. LumaWatt wireless sensors are factory installed and require network components RF-EM-1, RF-GW-1 and RF-ROUT-1 in appropriate quantities. See website for LumaWatt application information.
14. LumaWatt wireless system is not available with photocontrol receptacle (not required).
15. Round pole adapter and mounting hardware included. "M" drill pattern.
16. This tool enables adjustment of parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Eaton for more information.

Powering Business Worldwide

**Eaton**
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.eaton.com/lighting

Specifications and dimensions subject to change without notice.




# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2







current
powered by GE

# GE Evolve™
## LED Roadway Lighting
ERL1-ERLH-ERL2



The **Evolve** LED Roadway Luminaire is optimized for customers requiring a LED solution for local, collector and major roadways. GE's unique reflective optics are designed to optimize application efficiency and minimize glare. The modern design incorporates the heat sink directly into the unit for heat transfer to prolong LED life. This reliable unit has a 100,000 hour design life, significantly reducing maintenance needs and expense over the life of the fixture. This efficient solution lowers energy consumption compared to a traditional HID fixture for additional operating cost savings.

## Features:

- Optimized roadway photometric distributions
- **Evolve**™ light engine consisting of reflective technology designed to optimize application efficiency and minimize glare
- 70 CRI at 2700K, 3000K and 4000K typical.
- –40°C to 50°C UL Ambient Typical.
- ULOR = 0 (zero uplight)
- Designed & Assembled in USA

## Applications:

- Local Roadways
- Collector Roadways
- Major Roadway/Streets

Compatible with **LightGrid**™ Outdoor Wireless Control System





To learn more about **GE Evolve LED Roadway Lighting**, go to: **www.currentbyge.com**

# GE Evolve™
## LED Roadway Lighting
ERL1-ERLH-ERL2



Project name _____
Date _____
Type _____

# Typical Specifications: ERL1-ERLH-ERL2

## LED & Optical

- **Output Range:** 1900 – 30000 lm
- **Photometric Options:** Type II Narrow, Type II Wide, Type III, Type IV
- **System Efficacy:** 100 - 145 LPW
- **CCT:** 2700K, 3000K, 4000K; High brightness LEDs @ 70 CRI

## Lumen Maintenance Tables

Projected Lxx per IES TM-21 at 25°C for reference:

| ERL1 LUMEN OUTPUT CODES | LXX)10K)@HOURS 25,000 HR | 50,000 HR | 100,000 HR |
|---|---|---|---|
| 02,03,04,05,06 | L96 | L95 | L91 |
| 07,08,09 | L95 | L91 | L84 |
| 10 | L89 | L80 | L64 |

| ERLH LUMEN OUTPUT CODES | LXX)10K)@HOURS 25,000 HR | 50,000 HR | 100,000 HR |
|---|---|---|---|
| 10, 11 | L97 | L96 | L94 |
| 13, 14 | L95 | L93 | L88 |
| 15, 16 | L94 | L91 | L85 |

| ERL2 LUMEN OUTPUT CODES | LXX)10K)@HOURS 25,000 HR | 50,000 HR | 100,000 HR |
|---|---|---|---|
| 16, 18, 19, 21, 23 | L96 | L94 | L91 |
| 25, 27, 28 | L95 | L93 | L88 |
| 30 | L95 | L93 | L87 |

**Note:** Projected Lxx based on LM80 (10,000 hour testing). DOE Lighting Facts Verification Testing Tolerances apply to initial luminous flux and lumen maintenance measurements.

## Electrical

- **Input Voltage:** 120-277 volt and 347-480 volt
- **Input Frequency:** 50/60Hz
- **Power Factor )PF)*:** >90%
- **Total Harmonic Distortion )THD)*:** <20%

**Power factor and THD tolerance exceptions: ERL1 "02" Lumen output: PF and THD within tolerances above only at 120 volt. ERL1 "03" Lumen output: @120 volt PF~0.89; @ 480 volt THD~26% ERL1 "04" Lumen output: @480 volt THD~22%*

## Ratings

- **Surge Protection:** per ANSI C136.2-2015:
  **)Driver Internal):**
  - 6kV/3kA "Basic: (120 Strikes)" - Standard on ERL1 (02-06)
  - 10kV/5kA "Enhanced: (40 Strikes)" - Standard on ERL1 (07 - 10), ERLH, ERL2

  **)Additional Separate Secondary SPD)**
  - 10kV/5kA "Enhanced: (40 Strikes) - Option "R"
  - 20kV/10kA "Elevated" (40 Strikes) - Option "T"
- **Safety:** UL/cUL Listed. UL 1598 listed, suitable for wet locations
- **Environmental:** Compliant with the materials restrictions of RoHS
- **EMI:** Title 47 CFR Part 15 Class A
- **Vibration:** 3G per ANSI C136.31-2010
- LM-79 testing in accordance with IESNA Standards
- Std. Optical enclosure rated per ANSI C136.25-2009:
  — ERL1/ERLH/ERL2 = IP65, Optional: IP66
- **Operating Temperature:**

| PRODUCT ID | LUMEN OUTPUT | AMBIENT READING |
|---|---|---|
| ERL1 | 02-10 | -40°C to 50°C |
| ERLH | 10-11, 13 | -40°C to 50°C |
| ERLH | 14-16 | -40°C to 45°C |
| ERL2 | 16-28 | -40°C to 50°C |
| ERL2 | 30 | -40°C to 45°C |

Delayed start may be experienced < -35°C

## Construction & Finish

- **Housing:**
  — Die Cast Enclosure
  — Casting-integral heat sink for maximum heat transfer
- **Lensing:** Impact resistant tempered glass, standard
- **Paint:** Corrosion resistant polyester powder painted, minimum 2.0 mil. thickness.
  — Standard Colors: Dark Bronze, Black, & Gray
  — RAL & custom colors available
  — Optional coastal finish available.
- **Weight:** 12.4lbs (5.6kg) – 24lbs (10.9kg)

## Warranty

- **System Warranty:** 5 Year Standard, 10 Year Optional

## Controls

- **Dimming:**
  — Standard: 0-10V; Optional: DALI (120-277V Only)
- **Sensors:**
  — Photo electric sensors (PE) available.
- LightGrid™ compatible

## Mounting

- Slipfitter with +/- 5 degree of adjustment for leveling.
- Integral die cast mounting pipe stop.
- Adjustable for 1.25 in. or 2 in. mounting pipe.

## Suggested HID Replacement Lumen Levels

- ~4,000–5,000 lumens to replace 100W HPS Cobra-head
- ~7,000–8,800 lumens to replace 150W HPS Cobra-head
- ~8,500–11,500 lumens to replace 200W HPS Cobra-head
- ~11,500–14,000 lumens to replace 250W HPS Cobra-head
- ~21,000–30,000 lumens to replace 400W HPS Cobra-head

**Note:** Actual replacement lumens may vary based upon mounting height, pole spacing, design criteria, etc.

| CONVERSION FROM PREVIOUS GENERATION OPTICS TO CURRENT GENERATION OPTICS** PREVIOUS | DESCRIPTION | CURRENT | DESCRIPTION |
|---|---|---|---|
| A1, B1 | Extra Narrow/Narrow Asymmetric | A3 | Type II Narrow |
| C1, E1 | Asymmetric Short/Medium | B3 | Type II Wide |
| D1, G1 | Asymmetric Forward/Extra Wide | C3 | Type III |
| F1 | Asymmetric Wide | D3 | Type IV |
| | | E3 | Type II Enhanced Back Light |

**The information above is designed to provide a guideline to select the correct luminaire for a roadway application. The best and most accurate way to ensure the proper design is do a lighting layout Utilizing AGI.

# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2



Project name ______________

Date ______________

Type ______________

**E R L 1**

_ _ _ _   _   _ _   _ _   _ _   _   _ _ _ _   _ _ _

| PROD. ID | VOLTAGE | LUMEN OUTPUT | DISTRIBUTION* | CCT | CONTROLS | COLOR | OPTIONS |
|---|---|---|---|---|---|---|---|
| **E** = Evolve<br>**R** = Roadway<br>**L** = Local<br>**1** = Single Module | **0** = 120-277V*<br>**1** = 120<br>**2** = 208<br>**3** = 240<br>**4** = 277<br>**5** = 480<br>**D** = 347<br>**H** = 347-480*<br>*Not available with Fusing. Must choose a discrete voltage with F option. | **02***<br>**03**<<br>**04**<<br>**05**<<br>**06**<br>**07**<br>**08**<br>**09**<br>**10**<br>See Table<br>*120V only, not compatible with 0-10V dimming.<br>< See Note Under Controls Column | **A3** = Type II Narrow<br>**B3** = Type II Wide<br>**C3** = Type III<br>**D3** = Type IV<br>**E3** = Type II Enhanced Back Light<br>See Table<br>*Nominal IES Type classing subject to typical variation, individual units may differ. | **27** = 2700K<br>**30** = 3000K<br>**40** = 4000K<br>Select 2700K or 3000K CCT for IDA approved units. | **A** = ANSI C136.41 7-pin<br>**D** = ANSI C136.41 7-pin with Shorting Cap<br>**E** = ANSI C136.41 7-pin with non-Dimming PE Control.*<br>*PE Control Only available for 120-277V or 480V Discrete. Not available for 347-480V or 347V Discrete.<br>< If dimming the 03 - 05 lumen out put using a control supplied from a source other than GE call<br>1-888-694-3533, then select Option 2 at the prompt for assistance.<br>**NOTE:** Dimming controls wired for 0-10V standard unless DALI option "U" requested. | **GRAY** = Gray<br>**BLCK** = Black<br>**DKBZ** = Dark Bronze | **A** = 4 Bolt Slipfitter †<br>**F** = Fusing<br>**G** = Internal Bubble Level<br>**I** = IP66 Optical<br>**L** = Tool-Less Entry<br>**R** = Secondary 10kV/5kA SPD<br>**T** = Secondary 20kV/10kA SPD<br>**U** = DALI Programmable +^<br>**V1** = Variable Output via Field Adjustable Module<br>**X** = Single Package #<br>**Y** = Coastal Finish *<br>**XXX** = Special Options<br>† Contact manufacturer for Lead-Time.<br># "X" option provides single pack box per fixture. Std Packaging = 20 units per Magna pak container.<br>* Recommended for installations within 750 ft. from the coast. Contact Factory for Lead-Time.<br>+ Compatible with LightGrid 2.0 nodes.<br>^ Not available in 347V, 480V or 347-480V for Lumen Output Levels 07, 08, 09, and 10. |

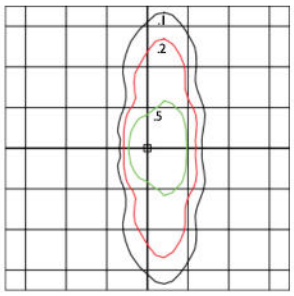
| LUMEN OUTPUT | DISTRIBUTION | TYPICAL INITIAL LUMENS 4000K | 3000K | 2700K | TYPICAL SYSTEM WATTAGE 120-277V | 347-480V | BUG RATING 4000K | 3000K | 2700K | IES FILE NUMBER 4000K 120-277V | 4000K 347-480V | 3000K 120-277V | 3000K 347-480V | 2700K 120-277V | 2700K 347-480V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02 | A3 | 2000 | 1900 | 1900 | 14 | N/A | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02A340_-120V.IES | N/A | ERL1_02A330_-120V.IES | N/A | ERL1_02A327_-120V.IES | N/A |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02B340_-120V.IES | N/A | ERL1_02B330_-120V.IES | N/A | ERL1_02B327_-120V.IES | N/A |
| | C3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02C340_-120V.IES | N/A | ERL1_02C330_-120V.IES | N/A | ERL1_02C327_-120V.IES | N/A |
| | D3 | | | | | | B0-U0-G1 | B0-U0-G1 | B0-U0-G1 | ERL1_02D340_-120V.IES | N/A | ERL1_02D330_-120V.IES | N/A | ERL1_02D327_-120V.IES | N/A |
| | E3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02E340_-120V.IES | N/A | ERL1_02E330_-120V.IES | N/A | ERL1_02E327_-120V.IES | N/A |
| 03 | A3 | 3000 | 2900 | 2800 | 22 | 26 | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03A340_-120-277V.IES | ERL1_03A340_-347-480V.IES | ERL1_03A330_-120-277V.IES | ERL1_03A330_-347-480V.IES | ERL1_03A327_-120-277V.IES | ERL1_03A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03B340_-120-277V.IES | ERL1_03B340_-347-480V.IES | ERL1_03B330_-120-277V.IES | ERL1_03B330_-347-480V.IES | ERL1_03B327_-120-277V.IES | ERL1_03B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03C340_-120-277V.IES | ERL1_03C340_-347-480V.IES | ERL1_03C330_-120-277V.IES | ERL1_03C330_-347-480V.IES | ERL1_03C327_-120-277V.IES | ERL1_03C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03D340_-120-277V.IES | ERL1_03D340_-347-480V.IES | ERL1_03D330_-120-277V.IES | ERL1_03D330_-347-480V.IES | ERL1_03D327_-120-277V.IES | ERL1_03D327--347-480V.IES |
| | E3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03E340_-120-277V.IES | ERL1_03E340_-347-480V.IES | ERL1_03E330_-120-277V.IES | ERL1_03E330_-347-480V.IES | ERL1_03E327_-120-277V.IES | ERL1_03E327_-347-480V.IES |
| 04 | A3 | 4000 | 3900 | 3800 | 31 | 34 | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04A340_-120-277V.IES | ERL1_04A340_-347-480V.IES | ERL1_04A330_-120-277V.IES | ERL1_04A330_-347-480V.IES | ERL1_04A327_-120-277V.IES | ERL1_04A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04B340_-120-277V.IES | ERL1_04B340_-347-480V.IES | ERL1_04B330_-120-277V.IES | ERL1_04B330_-347-480V.IES | ERL1_04B327_-120-277V.IES | ERL1_04B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04C340_-120-277V.IES | ERL1_04C340_-347-480V.IES | ERL1_04C330_-120-277V.IES | ERL1_04C330_-347-480V.IES | ERL1_04C327_-120-277V.IES | ERL1_04C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04D340_-120-277V.IES | ERL1_04D340_-347-480V.IES | ERL1_04D330_-120-277V.IES | ERL1_04D330_-347-480V.IES | ERL1_04D327_-120-277V.IES | ERL1_04D327_-347-480V.IES |
| | E3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04E340_-120-277V.IES | ERL1_04E340_-347-480V.IES | ERL1_04E330_-120-277V.IES | ERL1_04E330_-347-480V.IES | ERL1_04E327_-120-277V.IES | ERL1_04E327_-347-480V.IES |
| 05 | A3 | 5000 | 4900 | 4700 | 39 | 43 | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_05A340_-120-277V.IES | ERL1_05A340_-347-480V.IES | ERL1_05A330_-120-277V.IES | ERL1_05A330_-347-480V.IES | ERL1_05A327_-120-277V.IES | ERL1_05A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_05B340_-120-277V.IES | ERL1_05B340_-347-480V.IES | ERL1_05B330_-120-277V.IES | ERL1_05B330_-347-480V.IES | ERL1_05B327_-120-277V.IES | ERL1_05B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_05C340_-120-277V.IES | ERL1_05C340_-347-480V.IES | ERL1_05C330_-120-277V.IES | ERL1_05C330_-347-480V.IES | ERL1_05C327_-120-277V.IES | ERL1_05C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_05D340_-120-277V.IES | ERL1_05D340_-347-480V.IES | ERL1_05D330_-120-277V.IES | ERL1_05D330_-347-480V.IES | ERL1_05D327_-120-277V.IES | ERL1_05D327_-347-480V.IES |
| | E3 | | | | | | B2-U0-G2 | B1-U0-G1 | B1-U0-G1 | ERL1_05E340_-120-277V.IES | ERL1_05E340_-347-480V.IES | ERL1_05E330_-120-277V.IES | ERL1_05E330_-347-480V.IES | ERL1_05E327_-120-277V.IES | ERL1_05E327_-347-480V.IES |
| 06 | A3 | 6000 | 5800 | 5700 | 47 | 52 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_06A340_-120-277V.IES | ERL1_06A340_-347-480V.IES | ERL1_06A330_-120-277V.IES | ERL1_06A330_-347-480V.IES | ERL1_06A327_-120-277V.IES | ERL1_06A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_06B340_-120-277V.IES | ERL1_06B340_-347-480V.IES | ERL1_06B330_-120-277V.IES | ERL1_06B330_-347-480V.IES | ERL1_06B327_-120-277V.IES | ERL1_06B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_06C340_-120-277V.IES | ERL1_06C340_-347-480V.IES | ERL1_06C330_-120-277V.IES | ERL1_06C330_-347-480V.IES | ERL1_06C327_-120-277V.IES | ERL1_06C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_06D340_-120-277V.IES | ERL1_06D340_-347-480V.IES | ERL1_06D330_-120-277V.IES | ERL1_06D330_-347-480V.IES | ERL1_06D327_-120-277V.IES | ERL1_06D327_-347-480V.IES |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_06E340_-120-277V.IES | ERL1_06E340_-347-480V.IES | ERL1_06E330_-120-277V.IES | ERL1_06E330_-347-480V.IES | ERL1_06E327_-120-277V.IES | ERL1_06E327_-347-480V.IES |
| 07 | A3 | 7000 | 6800 | 6600 | 58 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_07A340__.IES | | ERL1_07A330__.IES | | ERL1_07A327__.IES | |
| | B3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_07B340__.IES | | ERL1_07B330__.IES | | ERL1_07B327__.IES | |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_07C340__.IES | | ERL1_07C330__.IES | | ERL1_07C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_07D340__.IES | | ERL1_07D330__.IES | | ERL1_07D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_07E340__.IES | | ERL1_07E330__.IES | | ERL1_07E327__.IES | |
| 08 | A3 | 8000 | 7800 | 7600 | 71 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_08A340__.IES | | ERL1_08A330__.IES | | ERL1_08A327__.IES | |
| | B3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_08B340__.IES | | ERL1_08B330__.IES | | ERL1_08B327__.IES | |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_08C340__.IES | | ERL1_08C330__.IES | | ERL1_08C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_08D340__.IES | | ERL1_08D330__.IES | | ERL1_08D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_08E340__.IES | | ERL1_08E330__.IES | | ERL1_08E327__.IES | |
| 09 | A3 | 9000 | 8800 | 8500 | 84 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_09A340__.IES | | ERL1_09A330__.IES | | ERL1_09A327__.IES | |
| | B3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_09B340__.IES | | ERL1_09B330__.IES | | ERL1_09B327__.IES | |
| | C3 | | | | | | B2-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_09C340__.IES | | ERL1_09C330__.IES | | ERL1_09C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_09D340__.IES | | ERL1_09D330__.IES | | ERL1_09D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_09E340__.IES | | ERL1_09E330__.IES | | ERL1_09E327__.IES | |
| 10 | A3 | 9800 | 9600 | 9250 | 97 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10A340__.IES | | ERL1_10A330__.IES | | ERL1_10A327__.IES | |
| | B3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10B340__.IES | | ERL1_10B330__.IES | | ERL1_10B327__.IES | |
| | C3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10C340__.IES | | ERL1_10C330__.IES | | ERL1_10C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_10D340__.IES | | ERL1_10D330__.IES | | ERL1_10D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10E340__.IES | | ERL1_10E330__.IES | | ERL1_10E327__.IES | |

# Photometrics:

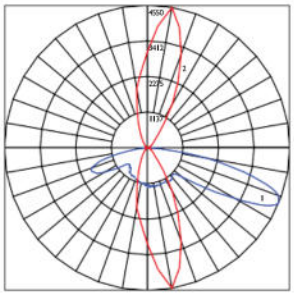
## Evolve™ LED Streetlight )ERL1)

### ERL1
Type II Narrow
(05A340)

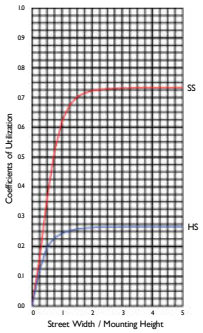
5,000 Lumens
4000K
ERL1_05A340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

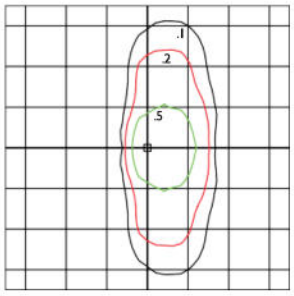


– Vertical plane through horizontal angle of Max. Cd at 80°
– Horizontal cone through vertical angle of Max. Cd at 67°

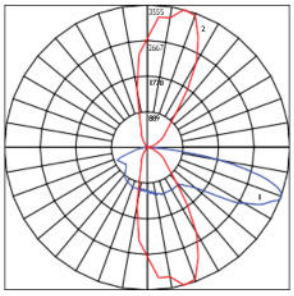



### ERL1
Type II Wide
(05B340)

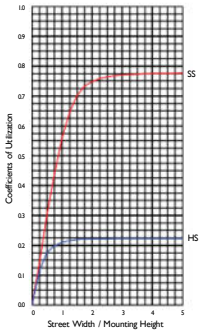
5,000 Lumens
4000K
ERL1_05B340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

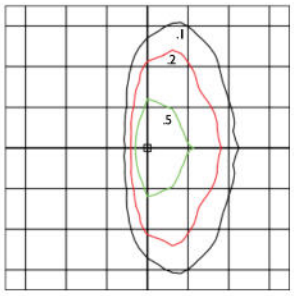


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 69°

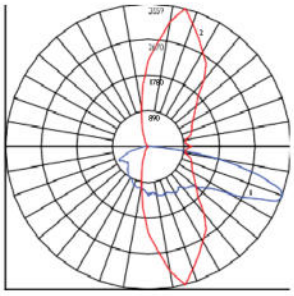



### ERL1
Type III
((05C340)

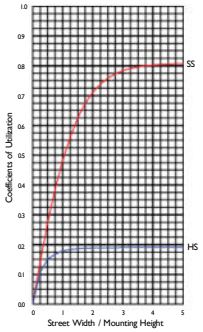
5,000 Lumens
4000K
ERL1_05C340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

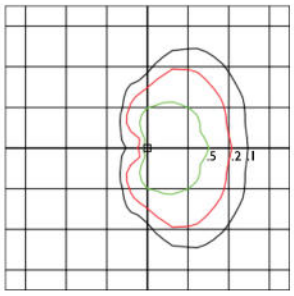


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 70°

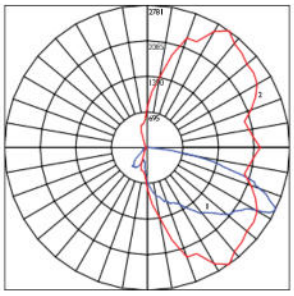



### ERL1
Type IV
(05D340)

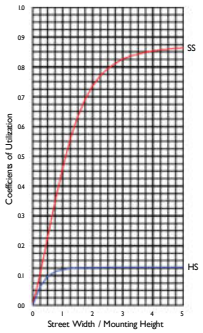
5,000 Lumens
4000K
ERL1_(05D340)___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

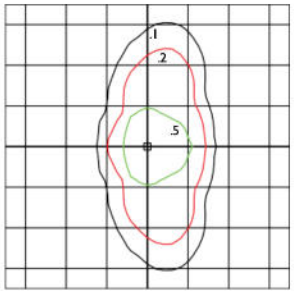


– Vertical plane through horizontal angle of Max. Cd at 55°
– Horizontal cone through vertical angle of Max. Cd at 64°

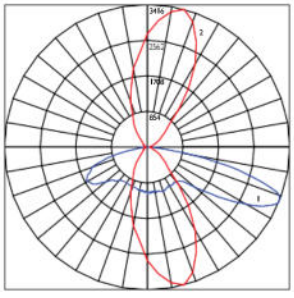



### ERL1
Type II Enhanced Back Light
(05E340)

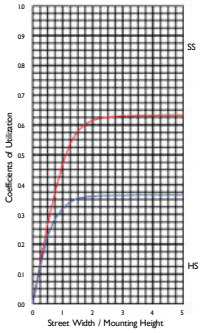
5,000 Lumens
4000K
ERL1_(05E340)___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade



– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 67°



# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2



Project name ______________

Date ______________

Type ______________

**E R L H**
_ _ _ _   _   _ _   _ _   _ _   _   _ _ _ _   _ _ _

| PROD. ID | VOLTAGE | LUMEN OUTPUT | DISTRIBUTION* | CCT | CONTROLS | COLOR | OPTIONS |
|---|---|---|---|---|---|---|---|
| **E** = Evolve<br>**R** = Roadway<br>**L** = Local<br>**H** = High Output | **0** = 120-277V*<br>**1** = 120<br>**2** = 208<br>**3** = 240<br>**4** = 277<br>**5** = 480<br>**D** = 347<br>**H** = 347-480*<br><br>*Not available with Fusing. Must choose a discrete voltage with F option. | **10**<br>**11**<br>**13**<br>**14**<br>**15**<br>**16**<br><br>See Table | **A3** = Type II Narrow<br>**B3** = Type II Wide<br>**C3** = Type III<br>**D3** = Type IV<br>**E3** = Type II Enhanced Back Light<br><br>See Table<br><br>*Nominal IES Type classing subject to typical variation, individual units may differ. | **30** = 3000K<br>**40** = 4000K<br><br>Select 3000K CCT for IDA approved units. | **A** = ANSI C136.41 7-pin<br>**D** = ANSI C136.41 7-pin with Shorting Cap<br>**E** = ANSI C136.41 7-pin with non-Dimming PE Control.*<br><br>*PE Control Only available for 120-277V or 480V Discrete. Not available for 347-480V or 347V Discrete.<br><br>**NOTE:** Dimming controls wired for 0-10V standard unless DALI option "U" requested. | **GRAY** = Gray<br>**BLCK** = Black<br>**DKBZ** = Dark Bronze | **A** = 4 Bolt Slipfitter †<br>**F** = Fusing<br>**G** = Internal Bubble Level<br>**I** = IP66 Optical<br>**L** = Tool-Less Entry<br>**R** = Secondary 10kV/5kA SPD<br>**T** = Secondary 20kV/10kA SPD<br>**U** = DALI Programmable +^<br>**V1** = Variable Output via Field Adjustable Module<br>**X** = Single Package #<br>**Y** = Coastal Finish *<br>**XXX** = Special Options<br><br>† Contact manufacturer for Lead-Time.<br><br># "X" option provides single pack box per fixture. Std Packaging = 20 units per Magna pak container.<br><br>* Recommended for installations within 750 ft. from the coast. Contact Factory for Lead-Time.<br><br>+ Compatible with LightGrid 2.0 nodes.<br><br>^ Not available in 347V, 480V or 347-480V. |

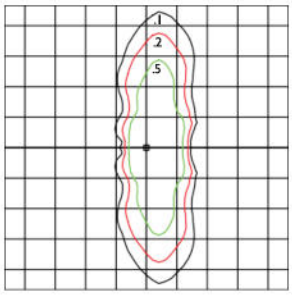
| LUMEN OUTPUT | DISTRIBUTION | TYPICAL INITIAL LUMENS 4000K | TYPICAL INITIAL LUMENS 3000K | TYPICAL SYSTEM WATTAGE 120-277V | TYPICAL SYSTEM WATTAGE 347-480V | BUG RATING 4000K | BUG RATING 3000K | IES FILE NUMBER 4000K | IES FILE NUMBER 3000K |
|---|---|---|---|---|---|---|---|---|---|
| 10 | A3 | 10000 | 9600 | 82 | 82 | B2-U0-G2 | B2-U0-G2 | ERLH_10A340__.IES | ERLH_10A330__.IES |
| | B3 | | | | | B2-U0-G2 | B2-U0-G2 | ERLH_10B340__.IES | ERLH_10B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G2 | ERLH_10C340__.IES | ERLH_10C330__.IES |
| | D3 | | | | | B1-U0-G3 | B1-U0-G2 | ERLH_10D340__.IES | ERLH_10D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_10E340__.IES | ERLH_10E330__.IES |
| 11 | A3 | 11500 | 11000 | 98 | 98 | B3-U0-G3 | B2-U0-G2 | ERLH_11A340__.IES | ERLH_11A330__.IES |
| | B3 | | | | | B3-U0-G3 | B2-U0-G2 | ERLH_11B340__.IES | ERLH_11B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_11C340__.IES | ERLH_11C330__.IES |
| | D3 | | | | | B1-U0-G3 | B1-U0-G2 | ERLH_11D340__.IES | ERLH_11D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_11E340__.IES | ERLH_11E330__.IES |
| 13 | A3 | 13000 | 12500 | 111 | 111 | B3-U0-G3 | B3-U0-G3 | ERLH_13A340__.IES | ERLH_13A330__.IES |
| | B3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_13B340__.IES | ERLH_13B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_13C340__.IES | ERLH_13C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_13D340__.IES | ERLH_13D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_13E340__.IES | ERLH_13E330__.IES |
| 14 | A3 | 14000 | 13400 | 122 | 122 | B3-U0-G3 | B3-U0-G3 | ERLH_14A340__.IES | ERLH_14A330__.IES |
| | B3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_14B340__.IES | ERLH_14B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_14C340__.IES | ERLH_14C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_14D340__.IES | ERLH_14D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_14E340__.IES | ERLH_14E330__.IES |
| 15 | A3 | 15000 | 14400 | 136 | 136 | B3-U0-G3 | B3-U0-G3 | ERLH_15A340__.IES | ERLH_15A330__.IES |
| | B3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_15B340__.IES | ERLH_15B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_15C340__.IES | ERLH_15C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_15D340__.IES | ERLH_15D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_15E340__.IES | ERLH_15E330__.IES |
| 16 | A3 | 16000 | 15300 | 149 | 149 | B3-U0-G3 | B3-U0-G3 | ERLH_16A340__.IES | ERLH_16A330__.IES |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_16B340__.IES | ERLH_16B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_16C340__.IES | ERLH_16C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_16D340__.IES | ERLH_16D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_16E340__.IES | ERLH_16E330__.IES |

# Photometrics:

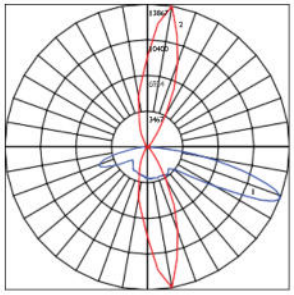
## Evolve™ LED Streetlight )ERLH)

### ERLH
Type II Narrow
(13A340)

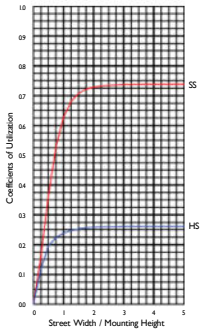
13,000 Lumens
4000K
ERLH_13A340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

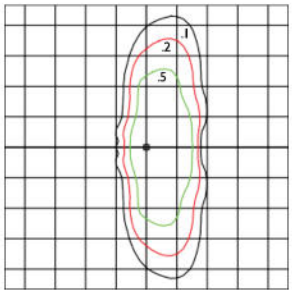


– Vertical plane through horizontal angle of Max. Cd at 80°
– Horizontal cone through vertical angle of Max. Cd at 69°

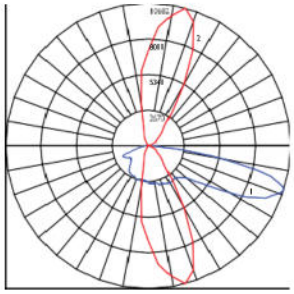



### ERLH
Type II Wide
(13B340)

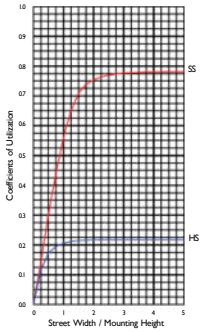
13,000 Lumens
4000K
ERLH_13B340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

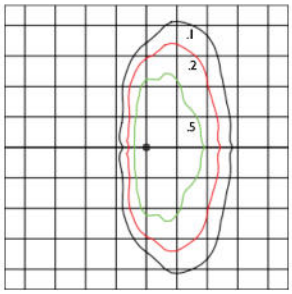


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 72°

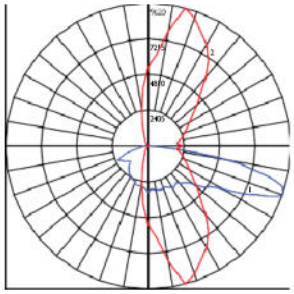



### ERLH
Type III
(13C340)

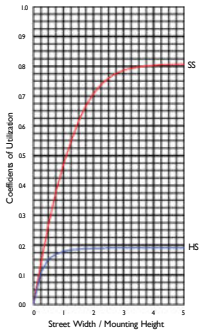
13,000 Lumens
4000K
ERLH_13C340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

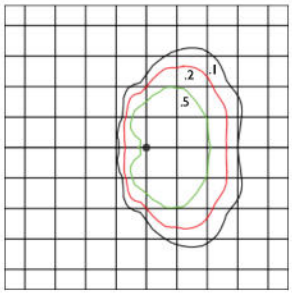


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 71°

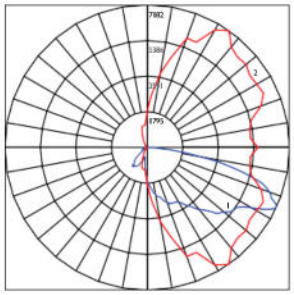



### ERLH
Type IV
13D340

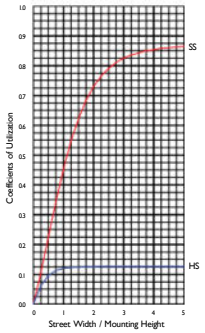
13,000 Lumens
4000K
ERLH_13D340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

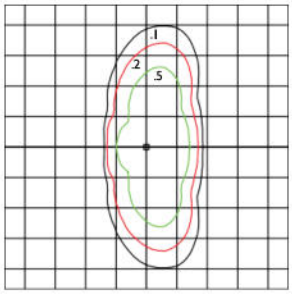


– Vertical plane through horizontal angle of Max. Cd at 55°
– Horizontal cone through vertical angle of Max. Cd at 65°

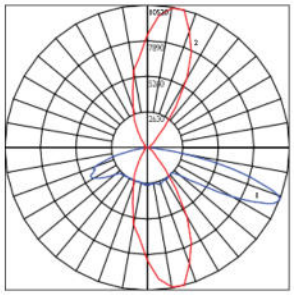



### ERLH
Type II Enhanced Back Light
13E340

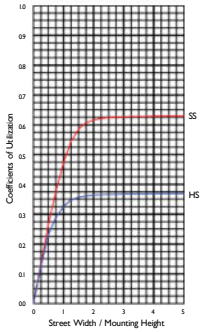
13,000 Lumens
4000K
ERLH_13E340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade



– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 69°



# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2



Project name ______________

Date ______________

Type ______________

**E R L 2**

_ _ _ _  _  _ _  _ _  _ _  _  _ _ _ _  _ _ _

| PROD. ID | VOLTAGE | LUMEN OUTPUT | DISTRIBUTION* | CCT | CONTROLS | COLOR | OPTIONS |
|---|---|---|---|---|---|---|---|
| **E** = Evolve<br>**R** = Roadway<br>**L** = Local<br>**2** = Double Module | **0** = 120-277V*<br>**1** = 120<br>**2** = 208<br>**3** = 240<br>**4** = 277<br>**5** = 480<br>**D** = 347<br>**H** = 347-480*<br>*Not available with Fusing. Must choose a discrete voltage with F option. | **16**<br>**18**<br>**19**<br>**21**<br>**23**<br>**25**<br>**27**<br>**28**<br>**30**<br>See Table | **A3** = Type II Narrow<br>**B3** = Type II Wide<br>**C3** = Type III<br>**D3** = Type IV<br>**E3** = Type II Enhanced Back Light<br>See Table<br>*Nominal IES Type classing subject to typical variation, individual units may differ. | **30** = 3000K<br>**40** = 4000K<br>**50** = 5000K*<br>Select 3000K CCT for IDA approved units.<br>*50 = 5200K for ERL2 lumen outputs 25, 27, 28, and 30. | **A** = ANSI C136.41 7-pin<br>**D** = ANSI C136.41 7-pin with Shorting Cap<br>**E** = ANSI C136.41 7-pin with non-Dimming PE Control.*<br>*PE Control Only available for 120-277V or 480V Discrete. Not available for 347-480V or 347V Discrete.<br>**NOTE:** Dimming controls wired for 0-10V standard unless DALI option "U" requested. | **GRAY** = Gray<br>**BLCK** = Black<br>**DKBZ** = Dark Bronze | **A** = 4 Bolt Slipfitter †<br>**F** = Fusing<br>**G** = Internal Bubble Level<br>**I** = IP66 Optical<br>**L** = Tool-Less Entry<br>**R** = Secondary 10kV/5kA SPD<br>**T** = Secondary 20kV/10kA SPD<br>**U** = DALI Programmable ^<br>**V1** = Variable Output via Field Adjustable Module<br>**Y** = Coastal Finish *<br>**XXX** = Special Options<br>† Contact manufacturer for Lead-Time.<br>* Recommended for installations within 750 ft. from the coast. Contact Factory for Lead-Time.<br>+ Compatible with LightGrid 2.0 nodes.<br>^ Not available in 347V, 480V or 347-480V. |

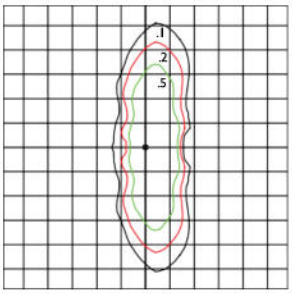
| LUMEN OUTPUT | DISTRIBUTION | TYPICAL INITIAL LUMENS 4000K/ 5000-5200K | TYPICAL INITIAL LUMENS 3000K | TYPICAL SYSTEM WATTAGE 120-277V | TYPICAL SYSTEM WATTAGE 347-480V | BUG RATING 4000K | BUG RATING 3000K | IES FILE NUMBER 4000K 120-277V | IES FILE NUMBER 4000K 347-480V | IES FILE NUMBER 3000K 120-277V | IES FILE NUMBER 3000K 347-480V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | A3 | 16000 | 15300 | 120 | 120 | B3-U0-G3 | B3-U0-G3 | ERL2_16A340___.IES | | ERL2_16A330___.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_16B340___.IES | | ERL2_16B330___.IES | |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_16C340___.IES | | ERL2_16C330___.IES | |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_16D340___.IES | | ERL2_16D330___.IES | |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_16E340___.IES | | ERL2_16E330___.IES | |
| 18 | A3 | 18000 | 17300 | 140 | 140 | B3-U0-G3 | B3-U0-G3 | ERL2_18A340___.IES | | ERL2_18A330___.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_18B340___.IES | | ERL2_18B330___.IES | |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_18C340___.IES | | ERL2_18C330___.IES | |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_18D340___.IES | | ERL2_18D330___.IES | |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_18E340___.IES | | ERL2_18E330___.IES | |
| 19 | A3 | 19000 | 18200 | 149 | 149 | B3-U0-G3 | B3-U0-G3 | ERL2_19A340___.IES | | ERL2_19A330___.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_19B340___.IES | | ERL2_19B330___.IES | |
| | C3 | | | | | B3-U0-G3 | B2-U0-G3 | ERL2_19C340___.IES | | ERL2_19C330___.IES | |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_19D340___.IES | | ERL2_19D330___.IES | |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_19E340___.IES | | ERL2_19E330___.IES | |
| 21 | A3 | 21000 | 20100 | 174 | 177 | B3-U0-G3 | B3-U0-G3 | ERL2_21A340_-120-277V.IES | ERL2_21A340_-347-480V.IES | ERL2_21A330_-120-277V.IES | ERL2_21A330_-347-480V.IES |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_21B340_-120-277V.IES | ERL2_21B340_-347-480V.IES | ERL2_21B330_-120-277V.IES | ERL2_21B330_-347-480V.IES |
| | C3 | | | | | B3-U0-G4 | B3-U0-G3 | ERL2_21C340_-120-277V.IES | ERL2_21C340_-347-480V.IES | ERL2_21C330_-120-277V.IES | ERL2_21C330_-347-480V.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_21D340_-120-277V.IES | ERL2_21D340_-347-480V.IES | ERL2_21D330_-120-277V.IES | ERL2_21D330_-347-480V.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_21E340_-120-277V.IES | ERL2_21E340_-347-480V.IES | ERL2_21E330_-120-277V.IES | ERL2_21E330_-347-480V.IES |
| 23 | A3 | 23000 | 22100 | 194 | 196 | B3-U0-G3 | B3-U0-G3 | ERL2_23A340_-120-277V.IES | ERL2_23A340_-347-480V.IES | ERL2_23A330_-120-277V.IES | ERL2_23A330_-347-480V.IES |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_23B340_-120-277V.IES | ERL2_23B340_-347-480V.IES | ERL2_23B330_-120-277V.IES | ERL2_23B330_-347-480V.IES |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_23C340_-120-277V.IES | ERL2_23C340_-347-480V.IES | ERL2_23C330_-120-277V.IES | ERL2_23C330_-347-480V.IES |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_23D340_-120-277V.IES | ERL2_23D340_-347-480V.IES | ERL2_23D330_-120-277V.IES | ERL2_23D330_-347-480V.IES |
| | E3 | | | | | B4-U0-G4 | B3-U0-G3 | ERL2_23E340_-120-277V.IES | ERL2_23E340_-347-480V.IES | ERL2_23E330_-120-277V.IES | ERL2_23E330_-347-480V.IES |
| 25 | A3 | 25000 | 24000 | 214 | 214 | B3-U0-G3 | B3-U0-G3 | ERL2_25A340___.IES | | ERL2_25A330___.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_25B340___.IES | | ERL2_25B330___.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_25C340___.IES | | ERL2_25C330___.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_25D340___.IES | | ERL2_25D330___.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_25E340___.IES | | ERL2_25E330___.IES | |
| 27 | A3 | 27000 | 25900 | 237 | 237 | B3-U0-G3 | B3-U0-G3 | ERL2_27A340___.IES | | ERL2_27A330___.IES | |
| | B3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_27B340___.IES | | ERL2_27B330___.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_27C340___.IES | | ERL2_27C330___.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_27D340___.IES | | ERL2_27D330___.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_27E340___.IES | | ERL2_27E330___.IES | |
| 28 | A3 | 28000 | 26900 | 251 | 251 | B3-U0-G3 | B3-U0-G3 | ERL2_28A340___.IES | | ERL2_28A330___.IES | |
| | B3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_28B340___.IES | | ERL2_28B330___.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_28C340___.IES | | ERL2_28C330___.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_28D340___.IES | | ERL2_28D330___.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_28E340___.IES | | ERL2_28E330___.IES | |
| 30 | A3 | 30000 | 28800 | 278 | 278 | B4-U0-G4 | B4-U0-G4 | ERL2_30A340___.IES | | ERL2_30A330___.IES | |
| | B3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_30B340___.IES | | ERL2_30B330___.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_30C340___.IES | | ERL2_30C330___.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_30D340___.IES | | ERL2_30D330___.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_30E340___.IES | | ERL2_30E330___.IES | |

# Photometrics:

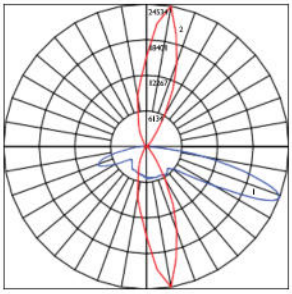
## Evolve™ LED Streetlight )ERL2)

### ERL2
Type II Narrow
(23A340)

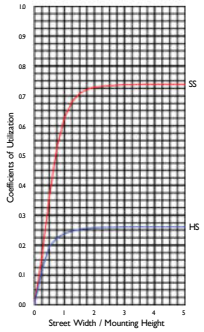
23,000 Lumens
4000K
ERL2_23A340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

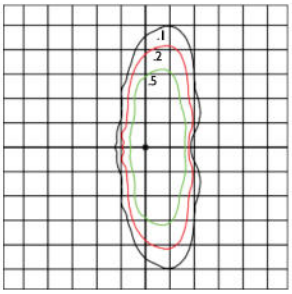


– Vertical plane through horizontal angle of Max. Cd at 80°
– Horizontal cone through vertical angle of Max. Cd at 69°

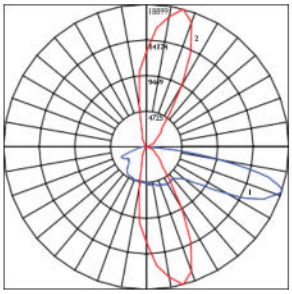



### ERL2
Type II Wide
(23B340)

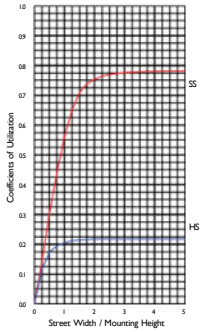
23,000 Lumens
4000K
ERL2_23B340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

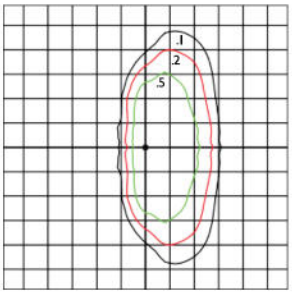


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 72°

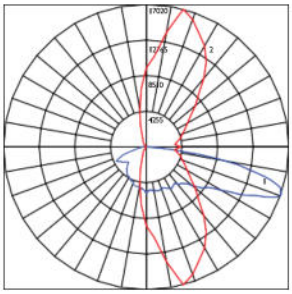



### ERL2
Type III
(23C340)

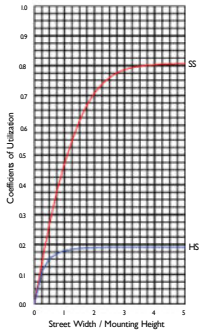
23,000 Lumens
4000K
ERL2_23C340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

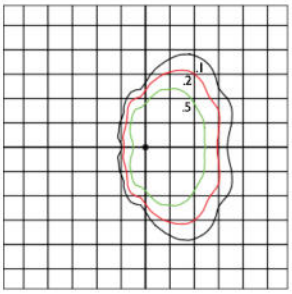


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 71°

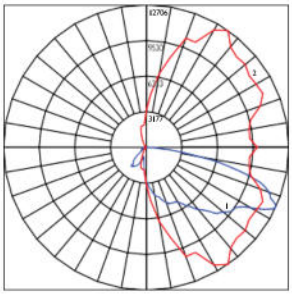



### ERL2
Type IV
(23D340)

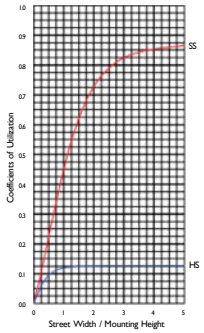
23,000 Lumens
4000K
ERL2_23D340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

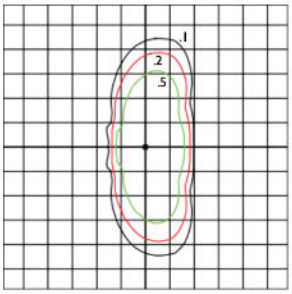


– Vertical plane through horizontal angle of Max. Cd at 55°
– Horizontal cone through vertical angle of Max. Cd at 65°

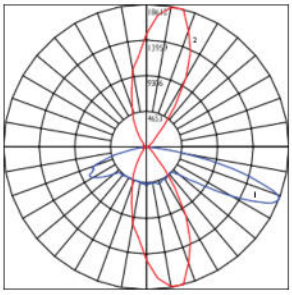



### ERL2
Type II Enhanced Back Light
(23E340)

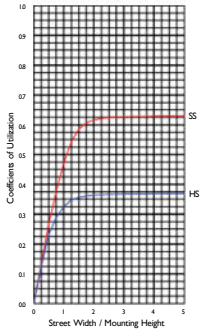
23,000 Lumens
4000K
ERL2_23E340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade



– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 69°



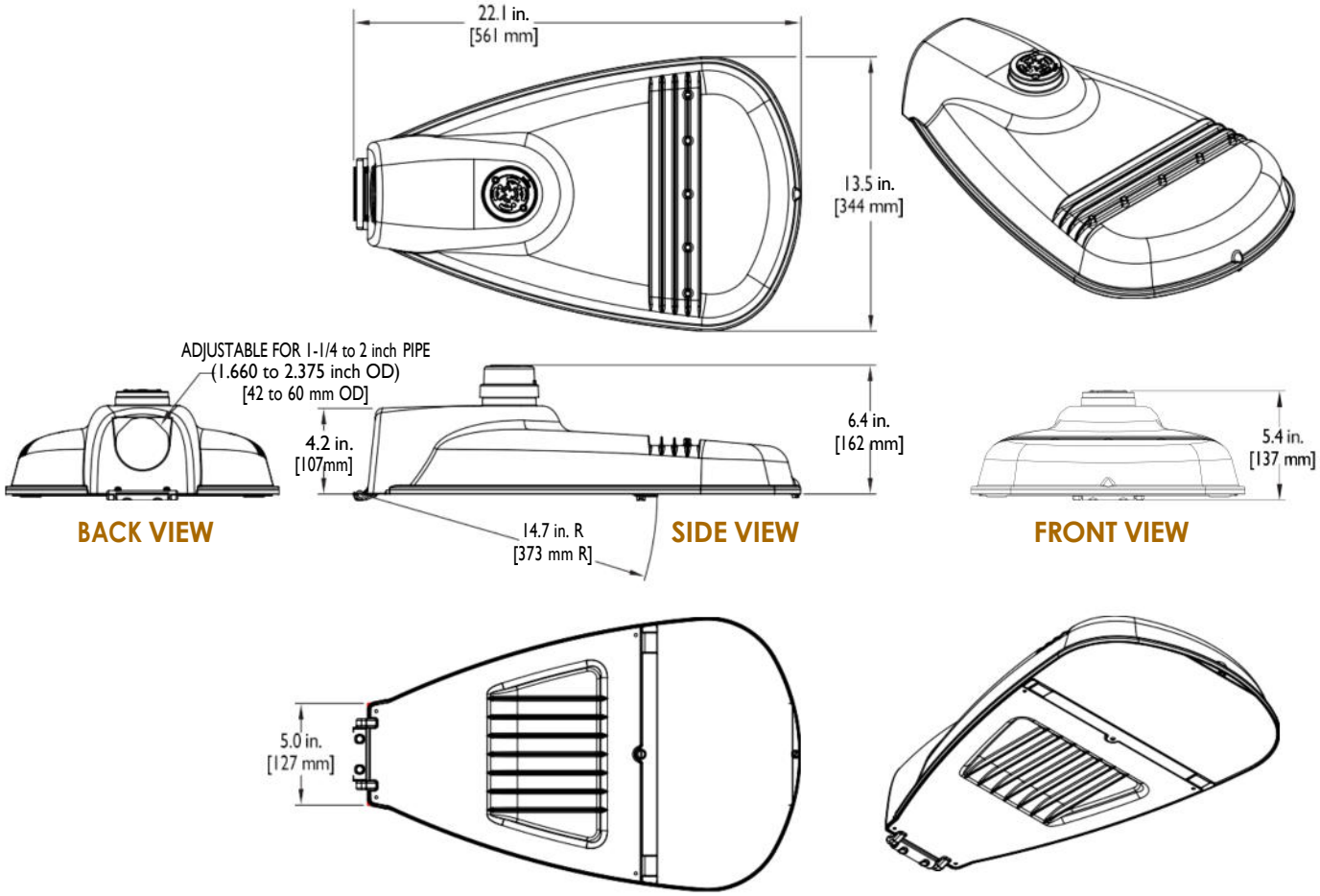
# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2

## Product Dimensions:

**Evolve™ LED Streetlight )ERL1)**




**DATA**

- Approximate net weight: 12.4 lbs (5.6kgs) -15.5 lbs (7.0kgs) with XFMR
- Effective Projected Area (EPA): 0.5 sq ft max (0.046 sq m)

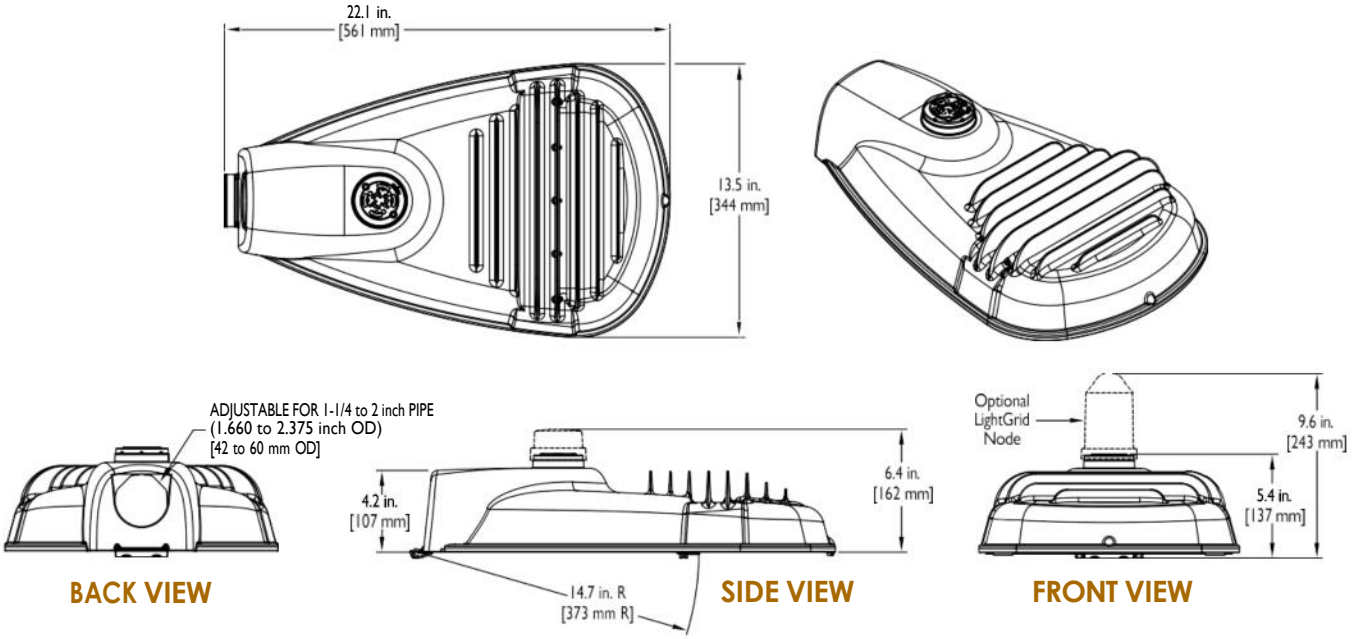
# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2

## Product Dimensions:

**Evolve™ LED Streetlight )ERLH)**




**DATA**

- Approximate net weight: 15.15 lbs (6.9 kgs) - 2 Bolt Slipfitter
- Approximate net weight: 15.85 lbs (7.2 kgs) - 4 Bolt Slipfitter
- Effective Projected Area (EPA): 0.5 sq ft max (0.046 sq m)

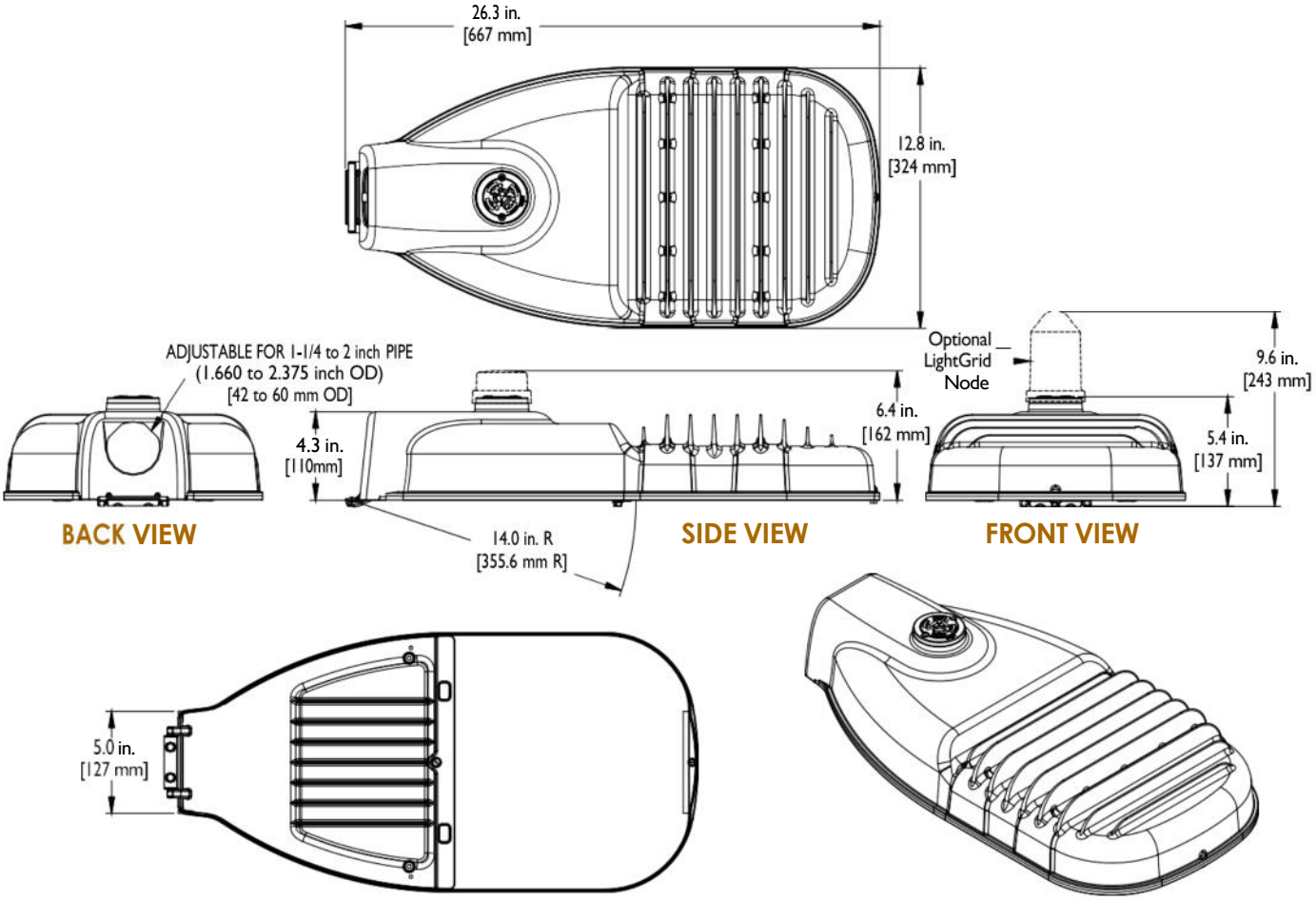
# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2

## Product Dimensions:

**Evolve™ LED Streetlight )ERL2)**




**DATA**

- Approximate net weight: 24.0 lbs (10.9 kgs)
  Contact manufacturer for specific configuration weight.
- Effective Projected Area (EPA): 0.57 sq ft max (0.053 sq m)

current powered by GE

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PHILIPS
LUMEC

# Roadway

## RoadFocus

RFM: 72, 108 and 160W



Project:

Location:

Cat.No:

Type:

Lamps: Qty:

Notes:

The Philips Lumec RoadFocus LED Cobra Head luminaires feature a sleek design that provides seamless replacement of existing HID luminaires. RoadFocus is available in three sizes, offers multiple lumen packages, and a complete array of optical distributions, making it an outstanding solution for all types of roadway applications.

## Ordering guide

**example:** RFM-72W32LED4K-T-R2S-UNIV-DMG-AST-FAWS-RCD-SP2-PHXL-GY3

| Luminaire<br>RFM | LED Module | Optical System | Voltage | Driver and Dimming | Wattage Switch | Twist-Lock Receptacle | Surge Protection | Luminaire Options | Finish |
|---|---|---|---|---|---|---|---|---|---|
| **RFM**<br>RoadFocus<br>Medium | *4000K:*<br>**72W32LED4K-T**<br>**108W32LED4K-T**[2,4]<br>**108W48LED4K-T**<br>**160W48LED4K-T**[2,4]<br>*3000K:*<br>**72W32LED3K-T**<br>**108W32LED3K-T** [2,4]<br>**108W48LED3K-T**<br>**160W48LED3K-T** [2,4] | **R2S**<br>Type II<br>Short<br>**R2M**<br>Type II<br>Medium<br>**R3S**<br>Type III<br>Short<br>**R3M**<br>Type III<br>Medium<br>**4**<br>Type IV<br>**5**<br>Type V | **UNIV**<br>120-277VAC<br>**HVU**<br>347-480VAC | *Standard:*<br>**DMG**[1,6]<br>Dimmable driver 0-10V<br>*Optional:*<br>**Dynadimmer**<br>Economy Profile<br>**CDMGE25**[2,4,5,6]<br>**CDMGE50**[2,4,5,6]<br>**CDMGE75**[2,4,5,6]<br>Median Profile<br>**CDMGM25**[2,4,5,6]<br>**CDMGM50**[2,4,5,6]<br>**CDMGM75**[2,4,5,6]<br>Safety Profile<br>**CDMGS25**[2,4,5,6]<br>**CDMGS50**[2,4,5,6]<br>**CDMGS75**[2,4,5,6]<br>**DALI**[2,4,5,6]<br>Digitally Adressable Lighting Interface<br>**DMG-AST***[2,4]<br>Adjustable Startup Time<br>**DMG-CLO***[2,4,5]<br>Constant Light Output<br>**DMG-OTL***[2,4]<br>Over The Life<br>**Includes 0-10v dimming* | None<br>(leave blank)<br>**FAWS**[5]<br>Field Adjustable Wattage Selector (optional) | *Standard:*<br>**RCD**[1,3,7]<br>Receptacle for twist-lock photocell or shorting cap, 5-pin (standard)<br>*Optional:*<br>**RCD7**[3,7]<br>Receptacle for twist-lock photocell or shorting cap, 7-pin (optional) | None<br>(leave blank)<br>**SP2**[8]<br>20kV / 20kA Surge Protector (optional) | **HS**<br>House side shield, 1 per 16 LED light engine<br>**PH8**[3]<br>Twist-lock Photoelectric Cell, UNIV (120-277VAC)<br>**PH8/347**[3]<br>Twist-lock Photoelectric Cell, HVU (347VAC)<br>**PH8/480**[3]<br>Twist-lock Photoelectric Cell, HVU (480VAC)<br>**PHXL**[3]<br>Twist-lock Photoelectric Cell, extended life, UNIV (120-277VAC)<br>**PH9**[3]<br>Shorting cap<br>**API**<br>Factory installed NEMA label | **BK**<br>Black finish<br>**BR**<br>Bronze finish<br>**GY3**<br>Gray finish<br>**WH**<br>White finish |

1. Please note these integrated features come standard with RoadFocus luminaires.
2. Denotes programmable driver option. Not available with HVU (347-480volt). Not available with 1050 mA versions (108W32LED, 160W48LED).
3. Use of photoelectric cell or shorting cap is required to ensure proper illumination.
4. Not available with HVU (347-480volt).
5. FAWS not available with CDMG options, DALI or CLO.
6. Dimming choices: Select either DMG or one of the CDMG options or DALI.
7. When RDC7 option is selected you will get 7-pin instead of standard RCD 5-pin.
8. When SP2 option is selected you will get SP2 instead of standard SP1.

# RFM RoadFocus

## Medium, LED Cobrahead: 72, 108, and 160W

### Accessories (must be ordered as separate line items - quickly and easily installed in the field)

**CPC or CPCD**[1]
CityTouch Connector Node.

1. Contact the factory for additional support when connected lighting or additional services are desired.

### LED Wattage and Lumen Values

LED = Philips Lumileds LUXEON T, CRI = 70, CCT = 4000K (+/- 350K), System (LED + driver) rated life = 100,000 hrs[1]

| LED Module | Typical Delivered Lumens | Typical System Wattage (W)[2] | LED Current (mA) | Typical System Current (A) @ 120V | 208V | 240V | 277V | 347V | 480V | Efficacy (Lm/W) | BUG Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **72W32LED4K-T-R2S** | 8,330 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 114 | B2-U0-G1 |
| **72W32LED4K-T-R2M** | 8,140 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 112 | B2-U0-G2 |
| **72W32LED4K-T-R3S** | 8,085 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 111 | B1-U0-G2 |
| **72W32LED4K-T-R3M** | 8,178 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 112 | B2-U0-G2 |
| **72W32LED4K-T-4** | 7,142 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 98 | B1 U0 G2 |
| **72W32LED4K-T-5** | 7,496 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 103 | B3-U0-G2 |
| **108W32LED4K-T-R2S** | 11,169 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | N/A | | 103 | B2-U0-G2 |
| **108W32LED4K-T-R2M** | 10,914 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 101 | B2-U0-G2 |
| **108W32LED4K-T-R3S** | 10,841 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 100 | B1-U0-G2 |
| **108W32LED4K-T-R3M** | 10,965 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 102 | B2-U0-G2 |
| **108W32LED4K-T-4** | 10,320 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 96 | B2-U0-G2 |
| **108W32LED4K-T-5** | 10,050 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 93 | B3-U0-G2 |
| **108W48LED4K-T-R2S** | 12,507 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 118 | B3-U0-G2 |
| **108W48LED4K-T-R2M** | 12,222 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 115 | B2-U0-G2 |
| **108W48LED4K-T-R3S** | 12,140 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 115 | B2-U0-G2 |
| **108W48LED4K-T-R3M** | 12,279 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 116 | B2-U0-G2 |
| **108W48LED4K-T-4** | 10,724 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2 U0 G2 |
| **108W48LED4K-T-5** | 11,255 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 107 | B4-U0-G2 |
| **160W48LED4K-T-R2S** | 16,778 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | N/A | | 104 | B3-U0-G2 |
| **160W48LED4K-T-R2M** | 16,396 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 102 | B3-U0-G3 |
| **160W48LED4K-T-R3S** | 16,285 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 101 | B2-U0-G3 |
| **160W48LED4K-T-R3M** | 16,472 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 102 | B3-U0-G3 |
| **160W48LED4K-T-4** | 14,386 | 161 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 89 | B2-U0-G3 |
| **160W48LED4K-T-5** | 15,098 | 161 | 1050 | 1.34 | 0.76 | 0.66 | 0.58 | | | 94 | B4-U0-G2 |

1. $L_{70}$ >100,000 hrs (at ambient temperature = 25˚C).
2. System wattage or total luminaire wattage includes the LED module and the LED driver.

*Note: Due to rapid and continuous advances in LED technology, LED luminaire data is subject to change without notice and at the discretion of Philips.*

# RFM RoadFocus

## Medium, LED Cobrahead: 72, 108, and 160W

### LED Wattage and Lumen Values

LED = Philips Lumileds LUXEON T, CRI = 70, CCT = 3000K (+/- 350K), System (LED + driver) rated life = 100,000 hrs[1]

| LED Module | Typical Delivered Lumens | Typical System Wattage (W)[2] | LED Current (mA) | Typical System Current (A) @ 120V | 208V | 240V | 277V | 347V | 480V | Efficacy (Lm/W) | BUG Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 72W32LED3K-T-R2S | 7,398 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 101 | B2-U0-G1 |
| 72W32LED3K-T-R2M | 7,181 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 98 | B2-U0-G2 |
| 72W32LED3K-T-R3S | 7,168 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 98 | B1-U0-G2 |
| 72W32LED3K-T-R3M | 7,042 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 96 | B2-U0-G2 |
| 72W32LED3K-T-4 | 7,223 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 99 | B1-U0-G2 |
| 72W32LED3K-T-5 | 7,231 | 73 | 700 | 0.62 | 0.36 | 0.31 | 0.28 | 0.21 | 0.15 | 99 | B3-U0-G2 |
| 108W32LED3K-T-R2S | 10,064 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | N/A | | 93 | B2-U0-G2 |
| 108W32LED3K-T-R2M | 9,769 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 90 | B2-U0-G2 |
| 108W32LED3K-T-R3S | 9,751 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 90 | B1-U0-G2 |
| 108W32LED3K-T-R3M | 9,581 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 89 | B2-U0-G2 |
| 108W32LED3K-T-4 | 9,826 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 91 | B2-U0-G2 |
| 108W32LED3K-T-5 | 9,837 | 108 | 1050 | 0.91 | 0.53 | 0.47 | 0.41 | | | 91 | B4-U0-G2 |
| 108W48LED3K-T-R2S | 11,116 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 105 | B2-U0-G2 |
| 108W48LED3K-T-R2M | 10,790 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2-U0-G2 |
| 108W48LED3K-T-R3S | 10,770 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2-U0-G2 |
| 108W48LED3K-T-R3M | 10,581 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 100 | B2-U0-G2 |
| 108W48LED3K-T-4 | 10,853 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 102 | B2-U0-G2 |
| 108W48LED3K-T-5 | 10,865 | 106 | 700 | 0.93 | 0.53 | 0.46 | 0.40 | 0.32 | 0.23 | 103 | B4-U0-G2 |
| 160W48LED3K-T-R2S | 14,706 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | N/A | | 91 | B3-U0-G2 |
| 160W48LED3K-T-R2M | 14,275 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B3-U0-G3 |
| 160W48LED3K-T-R3S | 14,249 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B2-U0-G2 |
| 160W48LED3K-T-R3M | 13,999 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 87 | B3-U0-G2 |
| 160W48LED3K-T-4 | 14,358 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B2-U0-G3 |
| 160W48LED3K-T-5 | 14,374 | 161 | 1050 | 1.33 | 0.76 | 0.67 | 0.58 | | | 89 | B4-U0-G2 |

1. $L_{70}$ >100,000 hrs (at ambient temperature = 25˚C).
2. System wattage or total luminaire wattage includes the LED module and the LED driver.

*Note: Due to rapid and continuous advances in LED technology, LED luminaire data is subject to change without notice and at the discretion of Philips.*

### Field Adjustable Wattage (FAWS) Multiplier Chart

**72W32LED4K-T or 108W48LED4K-T (700 mA)**
**72W32LED3K-T or 108W48LED3K-T (700 mA)**

| FAWS Position | Typical Delivered Lumens Multiplier | Typical System wattage and typical current |
|---|---|---|
| 1 | 0.37 | 0.29 |
| 2 | 0.55 | 0.50 |
| 3 | 0.62 | 0.58 |
| 4 | 0.71 | 0.69 |
| 5 | 0.77 | 0.75 |
| 6 | 0.81 | 0.81 |
| 7 | 0.84 | 0.87 |
| 8 | 0.94 | 0.91 |
| 9 | 0.98 | 0.96 |
| 10 | 1.00 | 1.00 |

**108W32LED4K-T OR 160W48LED4K-T (1050mA)**
**108W32LED3K-T OR 160W48LED3K-T (1050mA)**

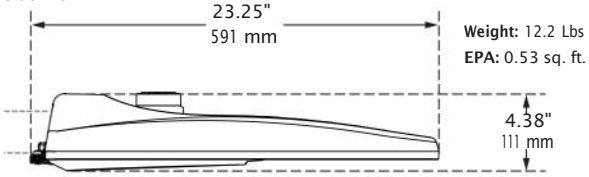
| FAWS Position | Typical Delivered Lumens Multiplier | Typical System wattage and typical current |
|---|---|---|
| 1 | 0.33 | 0.27 |
| 2 | 0.56 | 0.48 |
| 3 | 0.64 | 0.57 |
| 4 | 0.71 | 0.65 |
| 5 | 0.79 | 0.74 |
| 6 | 0.84 | 0.79 |
| 7 | 0.89 | 0.85 |
| 8 | 0.92 | 0.90 |
| 9 | 0.96 | 0.95 |
| 10 | 1.00 | 1.00 |

# RFM RoadFocus

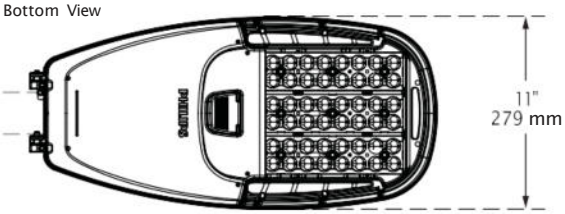
## Medium, LED Cobrahead: 72, 108, and 160W

## Dimensions

Side View




Bottom View




## Predicted Lumen Depreciation Data

Predicted performance derived from LED manufacturer's data and engineering design estimates, based on IESNA LM-80 methodology. Actual experience may vary due to field application conditions.$L_{70}$ is the predicted time when LED performance depreciates to 70% of initial lumen output. Calculated per IESNA TM21-11. Published $L_{70}$ hours limited to 6 times actual LED test hours

| Ambient Temperature °C | Driver mA | Calculated $L_{70}$ Hours | $L_{70}$ per TM-21 | Lumen Maintenance % at 60,000 hrs |
|---|---|---|---|---|
| 25°C | up to 1050 mA | >100,000 hours | >60,000 hours | >96% |

## Specifications

### Housing

Made of a low copper die cast Aluminum alloy (A360), 0.100" (2.5mm) minimum thickness. Fits on a 1.66" (42mm) O.D. (1.25" NPS), 1.9" (48mm) O.D. (1.5" NPS) or 2 3/8" (60mm) O.D. (2" NPS) by 5 1/2" (140mm) minimum long tenon. Comes with a zinc plated clamp fixed by 2 zinc plated hexagonal bolts 3/8 16 UNC for ease of installation. Provides an easy step adjustment of +/- 5° tilt in 2.5° increments. Includes integral bubble level standard (always included). A quick release, tool less entry, single latch, hinged, removable door opens downward to provide access to electronic components and to a terminal block. Door is secured to prevent accidental dropping or disengagement. A clearance of 13" (330mm) at the rear is required in order to remove the door. Complete with a bird guard protecting against birds and similar intruders and an ANSI label to identify wattage and source (both included in box).

### Light Engine

Composed of 4 main components: LED Module / Optical System / Heat Sink / Driver.

Electrical components are RoHS compliant, IP66 sealed light engine equipped with Philips Lumileds LUXEON T LEDs.LEDs tested by ISO 17025-2005 accredited lab in accordance with IESNA LM-80 guidelines in compliance with EPA ENERGY STAR, extrapolations in accordance with IESNA TM-21. Metal core board ensures greater heat transfer and longer lifespan.

**LED Module:** LED type Philips Lumileds LUXEON T. Composed of high-performance white LEDs. Color temperature as per ANSI/NEMA bin Neutral White, 3000 Kelvin nominal (3045K +/- 175K) or 4000 Kelvin nominal (3985K +/- 275K), CRI 70 Min. 75 Typical.

**Optical System:** Composed of high performance UV stabilized optical grade polymer refractor lenses to achieve desired distribution optimized to get maximum spacing, target lumens and a superior lighting uniformity. System is rated IP66. Performance shall be tested per LM-63, LM-79 and TM-15 (IESNA) certifying its photometric performance. 0% uplight and U0 per IESNA TM-15.

**Heat Sink:** Built in the housing, designed to ensure high efficacy and superior cooling by natural vertical convection air flow pattern always close to LEDs and driver optimising their efficiency and life. Product does not use any cooling device with moving parts (only passive cooling). Wide openings enable natural cleaning and removal of dirt and debris. Entire luminaire is rated for operation in ambient temperature of -40°C / -40°F up to +40°C / +104°F.

**Driver:** High power factor of 90% min. Electronic driver, operating range 50/60 Hz. Auto adjusting universal voltage input from 120 to 277 or 347 to 480 VAC rated for both application line to line or line to neutral, Class I, THD of 20% max.

**DMG:** Dimming compatible 0-10 volts.
The current supplying the LEDs will be reduced by the driver if the driver experiences internal overheating as a protection to the LEDs and the electrical components. Output is protected from short circuits, voltage overload and current overload. Automatic recovery after correction. Standard built in driver surge protection of 2.5kV (min).

### Integrated Features

**DMG**: Dimmable driver 0-10V.

**RCD***: Receptacle with 5 pins enabling dimming, can be used with a twist lock Starsense or photoelectric cell or a shorting cap.

**SP1:** Surge protection device tested in accordance with ANSI/IEEE C62.45 per ANSI/IEEE C62.41.2 Scenario I Category C High Exposure 10kV/10kA waveforms for Line-Ground, Line-Neutral and Neutral-Ground, and in accordance with DOE MSSLC Model Specification for LED Roadway Luminaires Appendix D Electrical Immunity High test level 10kV/10kA.

*Please note that these integrated features always come with RoadFocus luminaire.*

** Use of photoelectric cell or shorting cap is required to ensure proper illumination.*

# RFM RoadFocus

## Medium, LED Cobrahead: 72, 108, and 160W

### Specifications (continued)

#### Driver and Luminaire Options

**AST*:** Pre-set driver for progressive start-up of the LED module(s) to optimize energy management and enhance visual comfort at start-up.

**CLO*:** Pre-set driver to manage the lumen depreciation by adjusting the power given to the LEDs offering the same lighting intensity during the entire lifespan of the LED module.

**DALI*:** Pre-set driver compatible with the DALI control system.

**OTL*:** Pre-set driver to signal end of life of the LED module(s) for better fixture management.

**CDMG*:** Dynadimmer standard dimming functionalities including pre-programmed scenarios to suit many applications and needs from safety to maximum energy savings.

**Safety Mode:**
CDMGS25: 4 hours, 25% power dimming
CDMGS50: 4 hours 50% power dimming
CDMGS75: 4 hours 75% power dimming

**Median Mode:**
CDMGM25: 6 hours 25% power dimming
CDMGM50: 6 hours 50% power dimming
CDMGM75: 6 hours 75% power dimming

**Economy Mode:**
CDMGE25: 8 hours 25% power dimming
CDMGE50: 8 hours 50% power dimming
CDMGE75: 8 hours 75% power dimming

** Not available with HVU (347-480V)*

**FAWS:** Field Adjustable Wattage Selector, pre-set to the highest position, can be easily switched in the field to the required position. This reduces total luminaire wattage consumption and reduces the light level – see the FAWS multiplier chart for more details.

*Note: It is not recommended to use FAWS with other dimming or controls; if you do, set the switch to position 10 (maximum output) to enable the other dimming or controls. Switching FAWS to any position other than 10 will disable the other dimming or controls.*

**SP2:** 20kV / 20kA surge protection device that provides extra protection beyond the SP1 10kV/10kA level.

**RCD7*:** Receptacle with 7 pins enabling dimming and additional functionality (to be determined), can be used with a twist lock Starsense node or photoelectric cell or a shorting cap.

*Please note: Additional hardware will be required to utilize the additional 2 pins on this receptacle.*

**HS:** House side shield, 1 per 16 LED light engine.

**PH8*:** Twist-lock Photoelectric Cell, UNIV (120-277VAC).

**PH8/347*:** Twist-lock Photoelectric Cell, HVU (347VAC).

**PH8/480*:** Twist-lock Photoelectric Cell, HVU (480VAC).

**PHXL*:** Twist-lock Photoelectric Cell, extended life, UNIV (120-277VAC).

**PH9*:** Shorting cap.

**API:** Factory Installed NEMA label, ANSI C136.15 compliant

** Use of photoelectric cell or shorting cap is required to ensure proper illumination.*

#### Luminaire Useful Life

Refer to IES files for energy consumption and delivered lumens for each option. Based on ISTMT in situ thermal testing in accordance with UL1598 and UL8750, Philips System Reliability Tool, Philips Advance data and Philips Lumileds LM-80/TM-21 data, expected to reach 100,000 + hours (72W32LED and 108W48LED at 700mA) or 94,500 hours (108W32LED and 160W48LED at 1050mA) with >L70 lumen maintenance @ 25˚C. Luminaire Useful Life accounts for LED lumen maintenance AND all of these additional factors including: LED life, driver life, PCB substrate, solder joints, on/off cycles, burning hours and corrosion.

#### Wiring

The connection of the luminaire is done using a terminal block connector 600V, 85A for use with #2 14 AWG. wires from the primary circuit, located inside the housing. Due to the inrush current that occurs with electronic drivers, recommend using a 10Amp time-delay fuse to avoid unwanted fuse blowing (false tripping) that can occur with normal or fast acting fuses.

#### Hardware

All exposed screws shall be complete with Ceramic primer seal to reduce seizing of the parts, also offers a high resistance to corrosion. All seals and sealing devices are made and/or lined with EPDM and/or silicone and/or rubber.

#### Finish

Color in accordance with the AAMA 2603 standard. Application of polyester powder coat paint (4 mils/100 microns) with ± 1 mils/24 microns of tolerance. The Thermosetting resins provides a discoloration resistant finish in accordance with the ASTM D2244 standard, as well as luster retention in keeping with the ASTM D523 standard and humidity proof in accordance with the ASTM D2247 standard.

The surface treatment achieves a minimum of 3000 hours for salt spray resistant finish in accordance with testing performed and per ASTM B117 standard.

#### LED products manufacturing standard

The electronic components sensitive to electrostatic discharge (ESD) such as light emitting diodes (LEDs) are assembled in compliance with IEC61340-5-1 and ANSI/ESD S20.20 standards so as to eliminate ESD events that could decrease the useful life of the product.

#### Vibration Resistance

The RFM meets the ANSI C136.31, American National Standard for Roadway Luminaire Vibration specifications for Bridge/overpass applications. (Tested for 3G over 100,000 cycles by independent lab)

#### Certifications and Compliance

cULus Listed for Canada and USA. Luminaire meets DOE and MSSLC Model Specification for LED Roadway Luminaires. RoadFocus LED Cobrahead luminaires are DesignLights Consortium qualified. Luminaire complies with or exceeds the following ANSI C136 standards: .2, .3, .10, .14, .15, .22, .25, .31, .37, .41.

#### Limited Warranty

10-year limited warranty.
See philips.com/warranties for details and restrictions.

#### Brackets/Arms

For brackets / arms available with this luminaire, see Lumec 3D for details.

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philips.com/luminaires



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281 Hillmount Rd, Markham, ON, Canada L6C 2S3
Tel. 800-668-9008

# Autobahn Series ATBM
## Roadway

Consistent with LEED® goals & Green Globes™ criteria for light pollution reduction

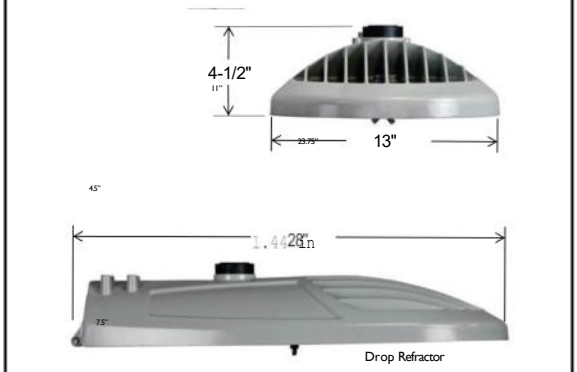
**PRODUCT OVERVIEW**



## Applications:

Residential streets
Parking lots
High speed roadways

**DIMENSIONS**




Effective Projected Area (EPA)
The EPA for the ATBM is 0.3 sq. ft.,
Approx. Wt. = 21 lbs. (9.5 kg)

### STANDARDS

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

Color temperatures of ≤ 3000K must be specified for International Dark-Sky Association certification.

Rated for -40°C to 40°C ambient
CSA Certified to U.S. and Canadian standards
Complies with ANSI: C136.2, C136.10, C136.14, C136.31, C136.15, C136.37

## Features:

### OPTICAL

Same Light: Performance is comparable to 150W – 250W HPS

White Light: Correlated color temperature - 4000K, 70 CRI minimum, 3000K, 70 CRI minimum or optional 5000K, 70 CRI minimum.

IP66 rated borosilicate glass optics ensure longevity and minimize dirt depreciation. Unique IP66 rated LED light engines provide 0% uplight and restrict backlight to within sidewalk depth, providing optimal application coverage and optimal pole spacing.

Available distributions are Type II, III, IV, & V roadway distributions.

### ELECTRICAL

Expected Life: LED light engines are rated >100,000 hours at 25°C, L70.
Electronic driver has an expected life of 100,000 hours at a 25°C ambient.

Lower Energy: Saves an expected 40-60% over comparable HID luminaires.

Robust Surge Protection: Three different surge protection options provide a minimum of ANSI C136.2 10kV/5kA protection. 20kV/10kA surge protection is also available.

### MECHANICAL

Includes standard AEL lineman-friendly features such as tool-less entry, 3 station terminal block and quick disconnects. Bubble level located inside the electrical compartment for easy leveling at installation.

Rugged die-cast aluminum housing and door are polyester powder-coated for durability and corrosion resistance. Rigorous five-stage pre-treating and painting process yields a finish that achieves a scribe creepage rating of 8 (per ASTM D1654) after over 5000 hours exposure to salt fog chamber (operated per ASTM B117).

Mast arm mount is adjustable for arms from 1-1/4" to 2" (1-5/8" to 2-3/8" O.D.) diameter.
The 2 – bolt and optional 4 bolt clamping mechanism provide 3G vibration rating per ANSI C136.

The Wildlife shield is cast into the housing (not a separate piece).

### CONTROLS

NEMA 3 pin photocontrol receptacle is standard, with the Acuity designed ANSI standard 5 pin and 7 pin receptacles optionally available.

Premium solid state locking-style photocontrol – PCSS (10 year rated life) Extreme long life solid state locking-style photocontrol – PCL1 (20 year rated life).

Extreme long life solid state locking-style photocontrol with on demand remote on/off control - PCCC (15 year rated life).

Optional onboard Adjustable Output module allows the light output and input wattage to be modified to meet site specific requirements, and also can allow a single fixture to be flexibly applied in many different applications.

# **Autobahn** Series ATBM
## Roadway

## ORDERING INFORMATION

**Example:** ATBM A MVOLT R2

| Series | Performance Packages | Voltage | Optics | Mounting |
|---|---|---|---|---|
| **ATBM** Autobahn LED Roadway | **A** 7,000 lumens<br>**B** 8,000 lumens<br>**C** 9,000 lumens<br>**D** 11,600 lumens<br>**E** 13,400 lumens<br>**F** 15,700 lumens<br>**G** 16,600 lumens<br>**H** 17,400 lumens | **MVOLT** Multi-volt, 120-277V<br>**347** 347V<br>**480** 480V | **R2** Roadway Type II<br>**R3** Roadway Type III<br>**R4** Roadway Type IV<br>**R5** Roadway Type V | **(Blank)** 2 Bolt Mounting<br>**4B** 4 Bolt Mounting |

### Options

Color Temperature (CCT)
- **(Blank)** 4000K CCT, 70 CRI Min.
- **3K** 3000K CCT, 70 CRI Min.
- **5K** 5000K CCT, 70 CRI Min.

Paint
- **(Blank)** Gray
- **BK** Black
- **BZ** Bronze
- **DDB** Dark Bronze
- **GI** Graphite
- **WH** White

Surge Protection
- **(Blank)** Acuity SPD
- **20** 20kV/10KA SPD[8]
- **MP** MOV Pack[1]
- **IL** SPD with Indicator Light[1]

Miscellaneous Options
- **HSS** House Side Shield
- **NL** NEMA Label Indicating Wattage
- **XL** Not CSA Certified – No Terminal Block Cover

Control Options
- **(Blank)** 3 Pin NEMA Photocontrol Receptacle
- **P5** 5 Pin Photocontrol Receptacle (dimmable driver included)[2]
- **P7** 7 Pin Photocontrol Receptacle (dimmable driver included)[2]
- **NR** No Photocontrol Receptacle[3]
- **AO** Field Adjustable Output[4]
- **DM** 0-10V Dimmable Driver[5]
- **PCSS** Solid-State Lighting Photocontrol[6]
- **PCLL** Solid-State Long Life Photocontrol
- **PCCC** Solid-State Long Life Photocontrol with remote control on/off[7]
- **SH** Shorting Cap

Packages
- **(Blank)** Standard Pack
- **JP** Job Pack (36/pallet)

Accessories
- **ATBMHSS** House Side Shield
- **ATBMLTS** Light Trespass Shield
- **RKATBMMVOLTSPD** ATBM Acuity SPD Replacement Kit MVOLT
- **RKATBMHVSPD** ATBM Acuity SPD Replacement Kit 347/480V
- **RKATBMMVOLTMP** ATBM MOV Pack Replacement Kit
- **RKATBMMVOLTIL** ATBM IL SPD Replaement Kit

**Notes:**
1. Not available with G and H performance packages.
2. Dimmable Driver included. Not available with DM or NR.
3. Not available with P5, P7.
4. Not available with DM.
5. Controls by others. Not available with AO.
6. MVOLT only.
7. Not available with PCSS or PCLL.
8. Not available with G & H packages at 347/480 volts.

American Electric Lighting
AEL Headquarters, 3825 Columbus Road, Granville, OH 43023
www.americanelectriclighting.com
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**Warranty** Five-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx
Actual performance may differ as a result of end-user environment and application.
Specifications subject to change without notice.

***Please contact your sales representative for the latest product information.***

## PERFORMANCE PACKAGE

| Performance Package | Distribution | 4000 K CCT | | | LLD @ 25°C | | |
|---|---|---|---|---|---|---|---|
| | | Lumens | Input Watts | LPW | 50K Hours | 75K Hours | 100K Hours |
| A | R2 | 7,114 | 60 | 118 | 89 | 84 | 80 |
| | R3 | 7,024 | | 117 | | | |
| | R4 | 6,958 | | 116 | | | |
| | R5 | 7,469 | | 124 | | | |
| B | R2 | 8,090 | 70 | 115 | 89 | 84 | 80 |
| | R3 | 8,016 | | 114 | | | |
| | R4 | 7,924 | | 113 | | | |
| | R5 | 8528 | | 121 | | | |
| C | R2 | 9031 | 81 | 112 | 89 | 84 | 80 |
| | R3 | 8,942 | | 111 | | | |
| | R4 | 8,827 | | 110 | | | |
| | R5 | 9,517 | | 118 | | | |
| D | R2 | 11,769 | 95 | 124 | 90 | 87 | 84 |
| | R3 | 11,690 | | 123 | | | |
| | R4 | 11,534 | | 121 | | | |
| | R5 | 12,388 | | 130 | | | |
| E | R2 | 13,601 | 115 | 118 | 90 | 87 | 84 |
| | R3 | 13,416 | | 117 | | | |
| | R4 | 13,323 | | 116 | | | |
| | R5 | 14,263 | | 124 | | | |
| F | R2 | 15,932 | 133 | 120 | 90 | 86 | 83 |
| | R3 | 15,741 | | 118 | | | |
| | R4 | 15,476 | | 116 | | | |
| | R5 | 16,691 | | 125 | | | |
| G | R2 | 17,102 | 150 | 114 | 90 | 86 | 83 |
| | R3 | 16,974 | | 113 | | | |
| | R4 | 16,635 | | 111 | | | |
| | R5 | 17,938 | | 119 | | | |
| H | R2 | 18,085 | 164 | 111 | 90 | 86 | 83 |
| | R3 | 17,929 | | 110 | | | |
| | R4 | 17,439 | | 107 | | | |
| | R5 | 18,966 | | 116 | | | |

**Note:** Information shown above is based on 4000K nominal system data. Individual fixture performance may vary. Specifications subject to change without notice.

American Electric Lighting
AEL Headquarters, 3825 Columbus Road, Granville, OH 43023
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# Streetworks

## DESCRIPTION

The Verdeon LED roadway luminaire combines optical performance, energy efficiency, and outstanding versatility to meet the requirements of any roadway application. Advanced optical technology delivers unparalleled uniformity, scalability, and budget-beating operating costs for municipal streets and highways. UL/cUL listed for wet locations with an optional IP66 enclosure rating available.

| | | |
|---|---|---|
| Catalog # | | Type |
| Project | | |
| Comments | | Date |
| Prepared by | | |

## SPECIFICATION FEATURES

### Construction
Heavy-duty die-cast aluminum housing and door. Tool-less entry, hinged removable door for easy maintenance. 3G vibration rated.

### Optics
Optics are precisely designed to shape the distribution maximizing efficiency and fixture spacing. Offered standard in 4000K (+/-275K) CCT and 70 CRI. Optional 5700K CCT, 5000K CCTand 3000K CCT are available.

### Electrical
120-277V 50/60Hz, 347V 60Hz or 480V 60Hz operation. 10kV/10kA common- and differential- mode surge protection available.Thermal management transfers heat away from the LED source for optimal efficiency, light output and lumen maintenance. Operates in ambient temperatures from -40˚C to 40˚C. 50˚C HA (high ambient) option available. Standard three-position tunnel type terminal block. LED modules are IP66 rated.

### Mounting
Two-bolt/one-bracket slipfitter with cast-in pipe stop and 2.5˚ leveling steps. Four-bolt/two-clamp mounting option. Fixed-in-place bird guard seals around 1-1/4" to 2" (1-5/8" to 2-3/8" O.D.) mounting arms. Optional 15" pole mount arm available with round pole adapter and mounting hardware included.

### Finish
Housing and cast parts finished in five-stage super TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Consult your lighting representative at Eaton for a complete selection of standard colors.

### Warranty
Five-year warranty.



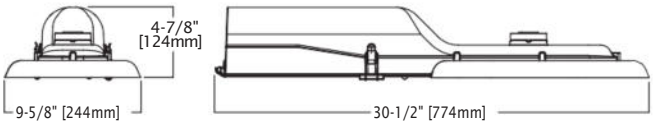
**VERD** VERDEON

**LED**

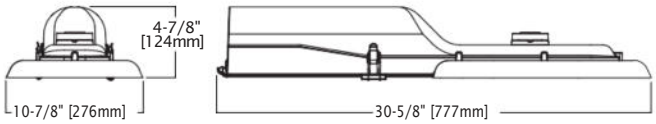
**ROADWAY LUMINAIRE**

## DIMENSIONS

**VERD**

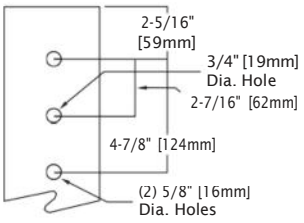



**VERD-G**



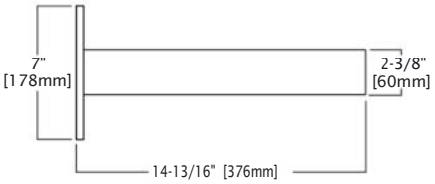

## ARM DRILLING

**TYPE "M"**




## OPTIONAL ARM

**15" Straight Arm**




## CERTIFICATION DATA
UL and cUL Wet Location Listed
IP66-Rated Optics
3G Vibration Rated
ISO 9001
DesignLights Consortium® Qualified*

## ENERGY DATA
**Electronic LED Driver**
0.9 Power Factor
<20% Total Harmonic Distortion
120-277V/50 and 60Hz, 347V 60Hz, 480V 60Hz
-40˚C Minimum Temperature Rating
+40˚C Ambient Temperature Rating

## EPA
**Effective Projected Area** (Sq. Ft.): 0.5

## SHIPPING DATA
**Approximate Net Weight:**
20 lbs. (9.1 kgs.)

*www.designlights.org

## POWER AND LUMENS

| Light Engine | | A016 | A018 | A01 | A028 | A02 | G-A028 | G-A02 |
|---|---|---|---|---|---|---|---|---|
| Power (Watts) | | 36 | 51 | 64 | 72 | 92 | 103 | 143 |
| Current (a) @ 120V | | 0.32 | 0.45 | 0.57 | 0.64 | 0.81 | 0.91 | 1.26 |
| Current (a) @ 277V | | 0.15 | 0.20 | 0.25 | 0.29 | 0.64 | 0.40 | 0.53 |
| Power (Watts) | | 44 | 59 | -- | 83 | 100 | 113 | 154 |
| Current (a) @ 347V | | 0.13 | 0.17 | -- | 0.24 | 0.28 | 0.33 | 0.45 |
| Current (a) @ 480V | | 0.09 | 0.13 | -- | 0.17 | 0.21 | 0.24 | 0.33 |
| **Optics** | | | | | | | | |
| **Type II** | Lumens | 3,855 | 4,936 | 5,839 | 7,858 | 9,294 | 12,064 | 15,332 |
| | BUG Rating | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | B3-U0-G3 |
| **Type III** | Lumens | 3,775 | 4,833 | 5,716 | 7,693 | 9,099 | 11,946 | 15,182 |
| | BUG Rating | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 |
| **Type IV** | Lumens | 3,785 | 4,846 | 5,732 | 7,714 | 9,123 | 11,944 | 15,180 |
| | BUG Rating | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | B1-U0-G3 | B2-U0-G3 | B2-U0-G3 | B2-U0-G4 |
| **Type V** | Lumens | 3,864 | 4,948 | 5,852 | 7,876 | 9,315 | 12,137 | 15,425 |
| | BUG Rating | B3-U0-G2 | B3-U0-G2 | B3-U0-G2 | B3-U0-G3 | B4-U0-G3 | B4-U0-G3 | B4-U0-G3 |

**NOTE:** Lumen output for AP Grey fixture color, 120-277V.

## LUMEN MAINTENANCE

| Ambient Temperature | TM-21 Lumen Maintenance (50,000 hours) | Theoretical L70 (Hours) |
|---|---|---|
| **A01*** | | |
| 25˚C | >88% | >127,000 |
| 40˚C | >82% | >87,000 |
| **A018, A016, A02, & A028** | | |
| **Ambient Temperature** | **TM-21 Lumen Maintenance (50,000 hours)** | **Theoretical L70 (Hours)** |
| 25˚C | >92% | >200,000 |
| 40˚C | >90% | >145,000 |
| **G-A02 & G-A028** | | |
| **Ambient Temperature** | **TM-21 Lumen Maintenance (60,000 hours)** | **Theoretical L70 (Hours)** |
| 25˚C | >91% | >250,000 |
| 40˚C | >90% | >200,000 |

* A01 Not available in 347V or 480V.

## LUMEN MULTIPLIER

| Ambient Temperature | Lumen Multiplier |
|---|---|
| 0˚C | 1.02 |
| 10˚C | 1.01 |
| 25˚C | 1.00 |
| 40˚C | 0.99 |
| 50˚C | 0.97 |

## ORDERING INFORMATION

**Sample Number**: VERD-A018-D-U-T2-4N7-AP

| Product Family [1, 2] | Light Engine [3] | Driver [5] | Voltage | Distribution |
|---|---|---|---|---|
| **VERD**=Verdeon | **A01**=1 LED, Full Output [4]<br>**A018**=1 LED, Approximately 80% Output<br>**A016**=1 LED, Approximately 60% Output<br>**A02**=2 LEDs, Full Output<br>**A028**=2 LEDs, Approximately 80% Output<br>**G-A02**=High Lumen, 2 LEDs, Full Output<br>**G-A028**=High Lumen, 2 LEDs, Approximately 80% Output | **E**=Non-Dimming<br>**D**=Dimming (0-10V) [6] | **U**=Universal (120-277V)<br>**8**=480V [7, 8]<br>**9**=347V [7] | **T2**=Type II<br>**T3**=Type III<br>**T4**=Type IV<br>**T5**=Type V |

| **Options** (Add as Suffix) | **Color** | **Accessories** (Order Separately) |
|---|---|---|
| **7030**=70 CRI / 3000K CCT [9]<br>**7060**=70 CRI / 5700K CCT [9]<br>**4**=NEMA Twistlock Photocontrol Receptacle<br>**4N7**=NEMA 7-PIN Twistlock Photocontrol Receptacle [10]<br>**10K**=10kV UL 1449 Surge Protective Device<br>**10MSP**=10kV MOV Surge Protective Device<br>**IP66**=IP66 Rated Housing<br>**HA**=50˚C High Ambient Temperature<br>**MS/DIM-L08**=Motion Sensor for Dimming Operation, Maximum 8' Mounting Height [10, 11, 12]<br>**MS/DIM-L20**=Motion Sensor for Dimming Operation, Maximum 9' - 20' Mounting Height [10, 11, 12]<br>**MS/DIM-L40**=Motion Sensor for Dimming Operation, Maximum 21' - 40' Mounting Height [10, 11, 12]<br>**LWR-LN**=Factory Installed LumaWatt RF Dimming Control System (Mounting Height 16' and Up) [13, 14]<br>**LWR-LW**=Factory Installed LumaWatt RF Dimming Control System (Mounting Height below 16') [13, 14]<br>**K**=Level Indicator<br>**4B**=Four-bolt, Two-clamp Mounting<br>**A15**=Arm Included (15" Straight Arm) [15] | **AP**=Grey (Standard)<br>**BZ**=Bronze<br>**BK**=Black<br>**DP**=Dark Platinum<br>**GM**=Graphite Metallic<br>**WH**=White | **OA1223**=10kV UL 1449 Surge Module Replacement<br>**OA/RA1013**=Photocontrol Shorting Cap<br>**OA/RA1014**=NEMA Photocontrol - 120V<br>**OA/RA1016**=NEMA Photocontrol - Multi-Tap<br>**OA/RA1027**=NEMA Photocontrol - 480V<br>**OA/RA1201**=NEMA Photocontrol - 347V<br>**FSIR-100**=Wireless Configuration Tool for Motion Sensor [16]<br>**HS-VERD**=Verdeon House Side Shield<br>**VGS-F/B**=Vertical Glare Shield, Front/Back<br>**VGS-SIDE**=Vertical Glare Shield, Side |

**NOTES:**

1. Customer is responsible for engineering analysis to confirm pole and fixture compatiblity for all applications. Refer to our white paper WP513001EN for additional support information.
2. DesignLights Consortium® Qualified. Refer to www.designlights.org qualified products list under family models for details.
3. Standard 4000K CCT and 70 CRI.
4. Not available in 347V or 480V.
5. Consult factory for driver surge protection values.
6. Dimming leads will be capped except when 4N7 or motion sensor option is specified.
7. Not available with A01 light engine.
8. Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems).
9. Extended lead times apply. Use dedicated IES files for 3000K and 5700K when performing layouts. These files are published on the VERD Verdeon luminaire product page on the website.
10. Must specify dimming driver.
11. Not available with 4B option. Sensor mounted externally. Consult factory for more information.
12. The FSIR-100 accessory is required to adjust parameters.
13. LumaWatt wireless sensors are factory installed and require network components RF-EM-1, RF-GW-1 and RF-ROUT-1 in appropriate quantities. See website for LumaWatt application information.
14. LumaWatt wireless system is not available with photocontrol receptacle (not required).
15. Round pole adapter and mounting hardware included. "M" drill pattern.
16. This tool enables adjustment of parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Eaton for more information.

Powering Business Worldwide

**Eaton**
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.eaton.com/lighting

Specifications and dimensions subject to change without notice.




# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2







current
powered by GE

# GE Evolve™
## LED Roadway Lighting
ERL1-ERLH-ERL2



The **Evolve** LED Roadway Luminaire is optimized for customers requiring a LED solution for local, collector and major roadways. GE's unique reflective optics are designed to optimize application efficiency and minimize glare. The modern design incorporates the heat sink directly into the unit for heat transfer to prolong LED life. This reliable unit has a 100,000 hour design life, significantly reducing maintenance needs and expense over the life of the fixture. This efficient solution lowers energy consumption compared to a traditional HID fixture for additional operating cost savings.

## Features:

- Optimized roadway photometric distributions
- **Evolve**™ light engine consisting of reflective technology designed to optimize application efficiency and minimize glare
- 70 CRI at 2700K, 3000K and 4000K typical.
- –40°C to 50°C UL Ambient Typical.
- ULOR = 0 (zero uplight)
- Designed & Assembled in USA

## Applications:

- Local Roadways
- Collector Roadways
- Major Roadway/Streets

Compatible with **LightGrid**™ Outdoor Wireless Control System





To learn more about **GE Evolve LED Roadway Lighting**, go to: **www.currentbyge.com**

# GE Evolve™
## LED Roadway Lighting
ERL1-ERLH-ERL2



Project name _____
Date _____
Type _____

# Typical Specifications: ERL1-ERLH-ERL2

## LED & Optical

- **Output Range:** 1900 – 30000 lm
- **Photometric Options:** Type II Narrow, Type II Wide, Type III, Type IV
- **System Efficacy:** 100 - 145 LPW
- **CCT:** 2700K, 3000K, 4000K; High brightness LEDs @ 70 CRI

## Lumen Maintenance Tables

Projected Lxx per IES TM-21 at 25°C for reference:

| ERL1 LUMEN OUTPUT CODES | LXX)10K)@HOURS 25,000 HR | 50,000 HR | 100,000 HR |
|---|---|---|---|
| 02,03,04,05,06 | L96 | L95 | L91 |
| 07,08,09 | L95 | L91 | L84 |
| 10 | L89 | L80 | L64 |

| ERLH LUMEN OUTPUT CODES | LXX)10K)@HOURS 25,000 HR | 50,000 HR | 100,000 HR |
|---|---|---|---|
| 10, 11 | L97 | L96 | L94 |
| 13, 14 | L95 | L93 | L88 |
| 15, 16 | L94 | L91 | L85 |

| ERL2 LUMEN OUTPUT CODES | LXX)10K)@HOURS 25,000 HR | 50,000 HR | 100,000 HR |
|---|---|---|---|
| 16, 18, 19, 21, 23 | L96 | L94 | L91 |
| 25, 27, 28 | L95 | L93 | L88 |
| 30 | L95 | L93 | L87 |

**Note:** Projected Lxx based on LM80 (10,000 hour testing). DOE Lighting Facts Verification Testing Tolerances apply to initial luminous flux and lumen maintenance measurements.

## Electrical

- **Input Voltage:** 120-277 volt and 347-480 volt
- **Input Frequency:** 50/60Hz
- **Power Factor )PF)*:** >90%
- **Total Harmonic Distortion )THD)*:** <20%

**Power factor and THD tolerance exceptions: ERL1 "02" Lumen output: PF and THD within tolerances above only at 120 volt. ERL1 "03" Lumen output: @120 volt PF~0.89; @ 480 volt THD~26% ERL1 "04" Lumen output: @480 volt THD~22%*

## Ratings

- **Surge Protection:** per ANSI C136.2-2015:
  **)Driver Internal):**
  - 6kV/3kA "Basic: (120 Strikes)" - Standard on ERL1 (02-06)
  - 10kV/5kA "Enhanced: (40 Strikes)" - Standard on ERL1 (07 - 10), ERLH, ERL2

  **)Additional Separate Secondary SPD)**
  - 10kV/5kA "Enhanced: (40 Strikes) - Option "R"
  - 20kV/10kA "Elevated" (40 Strikes) - Option "T"
- **Safety:** UL/cUL Listed. UL 1598 listed, suitable for wet locations
- **Environmental:** Compliant with the materials restrictions of RoHS
- **EMI:** Title 47 CFR Part 15 Class A
- **Vibration:** 3G per ANSI C136.31-2010
- LM-79 testing in accordance with IESNA Standards
- Std. Optical enclosure rated per ANSI C136.25-2009:
  — ERL1/ERLH/ERL2 = IP65, Optional: IP66
- **Operating Temperature:**

| PRODUCT ID | LUMEN OUTPUT | AMBIENT READING |
|---|---|---|
| ERL1 | 02-10 | -40°C to 50°C |
| ERLH | 10-11, 13 | -40°C to 50°C |
| ERLH | 14-16 | -40°C to 45°C |
| ERL2 | 16-28 | -40°C to 50°C |
| ERL2 | 30 | -40°C to 45°C |

Delayed start may be experienced < -35°C

## Construction & Finish

- **Housing:**
  — Die Cast Enclosure
  — Casting-integral heat sink for maximum heat transfer
- **Lensing:** Impact resistant tempered glass, standard
- **Paint:** Corrosion resistant polyester powder painted, minimum 2.0 mil. thickness.
  — Standard Colors: Dark Bronze, Black, & Gray
  — RAL & custom colors available
  — Optional coastal finish available.
- **Weight:** 12.4lbs (5.6kg) – 24lbs (10.9kg)

## Warranty

- **System Warranty:** 5 Year Standard, 10 Year Optional

## Controls

- **Dimming:**
  — Standard: 0-10V; Optional: DALI (120-277V Only)
- **Sensors:**
  — Photo electric sensors (PE) available.
- LightGrid™ compatible

## Mounting

- Slipfitter with +/- 5 degree of adjustment for leveling.
- Integral die cast mounting pipe stop.
- Adjustable for 1.25 in. or 2 in. mounting pipe.

## Suggested HID Replacement Lumen Levels

- ~4,000–5,000 lumens to replace 100W HPS Cobra-head
- ~7,000–8,800 lumens to replace 150W HPS Cobra-head
- ~8,500–11,500 lumens to replace 200W HPS Cobra-head
- ~11,500–14,000 lumens to replace 250W HPS Cobra-head
- ~21,000–30,000 lumens to replace 400W HPS Cobra-head

**Note:** Actual replacement lumens may vary based upon mounting height, pole spacing, design criteria, etc.

| CONVERSION FROM PREVIOUS GENERATION OPTICS TO CURRENT GENERATION OPTICS** PREVIOUS | DESCRIPTION | CURRENT | DESCRIPTION |
|---|---|---|---|
| A1, B1 | Extra Narrow/Narrow Asymmetric | A3 | Type II Narrow |
| C1, E1 | Asymmetric Short/Medium | B3 | Type II Wide |
| D1, G1 | Asymmetric Forward/Extra Wide | C3 | Type III |
| F1 | Asymmetric Wide | D3 | Type IV |
| | | E3 | Type II Enhanced Back Light |

**The information above is designed to provide a guideline to select the correct luminaire for a roadway application. The best and most accurate way to ensure the proper design is do a lighting layout Utilizing AGI.

# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2



Project name ______________

Date ______________

Type ______________

**E R L 1**

_ _ _ _   _   _ _   _ _   _ _   _   _ _ _ _   _ _ _

| PROD. ID | VOLTAGE | LUMEN OUTPUT | DISTRIBUTION* | CCT | CONTROLS | COLOR | OPTIONS |
|---|---|---|---|---|---|---|---|
| E = Evolve<br>R = Roadway<br>L = Local<br>1 = Single Module | 0 = 120-277V*<br>1 = 120<br>2 = 208<br>3 = 240<br>4 = 277<br>5 = 480<br>D = 347<br>H = 347-480*<br>*Not available with Fusing. Must choose a discrete voltage with F option. | 02*<br>03<<br>04<<br>05<<br>06<br>07<br>08<br>09<br>10<br>See Table<br>*120V only, not compatible with 0-10V dimming.<br>< See Note Under Controls Column | A3 = Type II Narrow<br>B3 = Type II Wide<br>C3 = Type III<br>D3 = Type IV<br>E3 = Type II Enhanced Back Light<br>See Table<br>*Nominal IES Type classing subject to typical variation, individual units may differ. | 27 = 2700K<br>30 = 3000K<br>40 = 4000K<br>Select 2700K or 3000K CCT for IDA approved units. | A = ANSI C136.41 7-pin<br>D = ANSI C136.41 7-pin with Shorting Cap<br>E = ANSI C136.41 7-pin with non-Dimming PE Control.*<br>*PE Control Only available for 120-277V or 480V Discrete. Not available for 347-480V or 347V Discrete.<br>< If dimming the 03 - 05 lumen output using a control supplied from a source other than GE call 1-888-694-3533, then select Option 2 at the prompt for assistance.<br>**NOTE:** Dimming controls wired for 0-10V standard unless DALI option "U" requested. | GRAY = Gray<br>BLCK = Black<br>DKBZ = Dark Bronze | A = 4 Bolt Slipfitter †<br>F = Fusing<br>G = Internal Bubble Level<br>I = IP66 Optical<br>L = Tool-Less Entry<br>R = Secondary 10kV/5kA SPD<br>T = Secondary 20kV/10kA SPD<br>U = DALI Programmable +^<br>V1 = Variable Output via Field Adjustable Module<br>X = Single Package #<br>Y = Coastal Finish *<br>XXX = Special Options<br>† Contact manufacturer for Lead-Time.<br># "X" option provides single pack box per fixture. Std Packaging = 20 units per Magna pak container.<br>* Recommended for installations within 750 ft. from the coast. Contact Factory for Lead-Time.<br>+ Compatible with LightGrid 2.0 nodes.<br>^ Not available in 347V, 480V or 347-480V for Lumen Output Levels 07, 08, 09, and 10. |

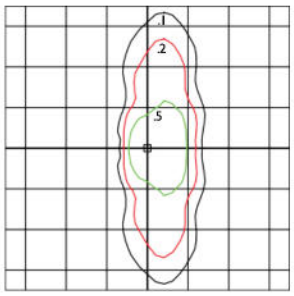
| LUMEN OUTPUT | DISTRIBUTION | TYPICAL INITIAL LUMENS 4000K | 3000K | 2700K | TYPICAL SYSTEM WATTAGE 120-277V | 347-480V | BUG RATING 4000K | 3000K | 2700K | IES FILE NUMBER 4000K 120-277V | 4000K 347-480V | 3000K 120-277V | 3000K 347-480V | 2700K 120-277V | 2700K 347-480V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02 | A3 | 2000 | 1900 | 1900 | 14 | N/A | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02A340_-120V.IES | N/A | ERL1_02A330_-120V.IES | N/A | ERL1_02A327_-120V.IES | N/A |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02B340_-120V.IES | N/A | ERL1_02B330_-120V.IES | N/A | ERL1_02B327_-120V.IES | N/A |
| | C3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02C340_-120V.IES | N/A | ERL1_02C330_-120V.IES | N/A | ERL1_02C327_-120V.IES | N/A |
| | D3 | | | | | | B0-U0-G1 | B0-U0-G1 | B0-U0-G1 | ERL1_02D340_-120V.IES | N/A | ERL1_02D330_-120V.IES | N/A | ERL1_02D327_-120V.IES | N/A |
| | E3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_02E340_-120V.IES | N/A | ERL1_02E330_-120V.IES | N/A | ERL1_02E327_-120V.IES | N/A |
| 03 | A3 | 3000 | 2900 | 2800 | 22 | 26 | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03A340_-120-277V.IES | ERL1_03A340_-347-480V.IES | ERL1_03A330_-120-277V.IES | ERL1_03A330_-347-480V.IES | ERL1_03A327_-120-277V.IES | ERL1_03A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03B340_-120-277V.IES | ERL1_03B340_-347-480V.IES | ERL1_03B330_-120-277V.IES | ERL1_03B330_-347-480V.IES | ERL1_03B327_-120-277V.IES | ERL1_03B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03C340_-120-277V.IES | ERL1_03C340_-347-480V.IES | ERL1_03C330_-120-277V.IES | ERL1_03C330_-347-480V.IES | ERL1_03C327_-120-277V.IES | ERL1_03C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03D340_-120-277V.IES | ERL1_03D340_-347-480V.IES | ERL1_03D330_-120-277V.IES | ERL1_03D330_-347-480V.IES | ERL1_03D327_-120-277V.IES | ERL1_03D327--347-480V.IES |
| | E3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_03E340_-120-277V.IES | ERL1_03E340_-347-480V.IES | ERL1_03E330_-120-277V.IES | ERL1_03E330_-347-480V.IES | ERL1_03E327_-120-277V.IES | ERL1_03E327_-347-480V.IES |
| 04 | A3 | 4000 | 3900 | 3800 | 31 | 34 | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04A340_-120-277V.IES | ERL1_04A340_-347-480V.IES | ERL1_04A330_-120-277V.IES | ERL1_04A330_-347-480V.IES | ERL1_04A327_-120-277V.IES | ERL1_04A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04B340_-120-277V.IES | ERL1_04B340_-347-480V.IES | ERL1_04B330_-120-277V.IES | ERL1_04B330_-347-480V.IES | ERL1_04B327_-120-277V.IES | ERL1_04B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04C340_-120-277V.IES | ERL1_04C340_-347-480V.IES | ERL1_04C330_-120-277V.IES | ERL1_04C330_-347-480V.IES | ERL1_04C327_-120-277V.IES | ERL1_04C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04D340_-120-277V.IES | ERL1_04D340_-347-480V.IES | ERL1_04D330_-120-277V.IES | ERL1_04D330_-347-480V.IES | ERL1_04D327_-120-277V.IES | ERL1_04D327_-347-480V.IES |
| | E3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_04E340_-120-277V.IES | ERL1_04E340_-347-480V.IES | ERL1_04E330_-120-277V.IES | ERL1_04E330_-347-480V.IES | ERL1_04E327_-120-277V.IES | ERL1_04E327_-347-480V.IES |
| 05 | A3 | 5000 | 4900 | 4700 | 39 | 43 | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_05A340_-120-277V.IES | ERL1_05A340_-347-480V.IES | ERL1_05A330_-120-277V.IES | ERL1_05A330_-347-480V.IES | ERL1_05A327_-120-277V.IES | ERL1_05A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_05B340_-120-277V.IES | ERL1_05B340_-347-480V.IES | ERL1_05B330_-120-277V.IES | ERL1_05B330_-347-480V.IES | ERL1_05B327_-120-277V.IES | ERL1_05B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_05C340_-120-277V.IES | ERL1_05C340_-347-480V.IES | ERL1_05C330_-120-277V.IES | ERL1_05C330_-347-480V.IES | ERL1_05C327_-120-277V.IES | ERL1_05C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G1 | B1-U0-G1 | B1-U0-G1 | ERL1_05D340_-120-277V.IES | ERL1_05D340_-347-480V.IES | ERL1_05D330_-120-277V.IES | ERL1_05D330_-347-480V.IES | ERL1_05D327_-120-277V.IES | ERL1_05D327_-347-480V.IES |
| | E3 | | | | | | B2-U0-G2 | B1-U0-G1 | B1-U0-G1 | ERL1_05E340_-120-277V.IES | ERL1_05E340_-347-480V.IES | ERL1_05E330_-120-277V.IES | ERL1_05E330_-347-480V.IES | ERL1_05E327_-120-277V.IES | ERL1_05E327_-347-480V.IES |
| 06 | A3 | 6000 | 5800 | 5700 | 47 | 52 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_06A340_-120-277V.IES | ERL1_06A340_-347-480V.IES | ERL1_06A330_-120-277V.IES | ERL1_06A330_-347-480V.IES | ERL1_06A327_-120-277V.IES | ERL1_06A327_-347-480V.IES |
| | B3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_06B340_-120-277V.IES | ERL1_06B340_-347-480V.IES | ERL1_06B330_-120-277V.IES | ERL1_06B330_-347-480V.IES | ERL1_06B327_-120-277V.IES | ERL1_06B327_-347-480V.IES |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_06C340_-120-277V.IES | ERL1_06C340_-347-480V.IES | ERL1_06C330_-120-277V.IES | ERL1_06C330_-347-480V.IES | ERL1_06C327_-120-277V.IES | ERL1_06C327_-347-480V.IES |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_06D340_-120-277V.IES | ERL1_06D340_-347-480V.IES | ERL1_06D330_-120-277V.IES | ERL1_06D330_-347-480V.IES | ERL1_06D327_-120-277V.IES | ERL1_06D327_-347-480V.IES |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_06E340_-120-277V.IES | ERL1_06E340_-347-480V.IES | ERL1_06E330_-120-277V.IES | ERL1_06E330_-347-480V.IES | ERL1_06E327_-120-277V.IES | ERL1_06E327_-347-480V.IES |
| 07 | A3 | 7000 | 6800 | 6600 | 58 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_07A340__.IES | | ERL1_07A330__.IES | | ERL1_07A327__.IES | |
| | B3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_07B340__.IES | | ERL1_07B330__.IES | | ERL1_07B327__.IES | |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_07C340__.IES | | ERL1_07C330__.IES | | ERL1_07C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_07D340__.IES | | ERL1_07D330__.IES | | ERL1_07D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_07E340__.IES | | ERL1_07E330__.IES | | ERL1_07E327__.IES | |
| 08 | A3 | 8000 | 7800 | 7600 | 71 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_08A340__.IES | | ERL1_08A330__.IES | | ERL1_08A327__.IES | |
| | B3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_08B340__.IES | | ERL1_08B330__.IES | | ERL1_08B327__.IES | |
| | C3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_08C340__.IES | | ERL1_08C330__.IES | | ERL1_08C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_08D340__.IES | | ERL1_08D330__.IES | | ERL1_08D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_08E340__.IES | | ERL1_08E330__.IES | | ERL1_08E327__.IES | |
| 09 | A3 | 9000 | 8800 | 8500 | 84 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_09A340__.IES | | ERL1_09A330__.IES | | ERL1_09A327__.IES | |
| | B3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_09B340__.IES | | ERL1_09B330__.IES | | ERL1_09B327__.IES | |
| | C3 | | | | | | B2-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_09C340__.IES | | ERL1_09C330__.IES | | ERL1_09C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_09D340__.IES | | ERL1_09D330__.IES | | ERL1_09D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_09E340__.IES | | ERL1_09E330__.IES | | ERL1_09E327__.IES | |
| 10 | A3 | 9800 | 9600 | 9250 | 97 | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10A340__.IES | | ERL1_10A330__.IES | | ERL1_10A327__.IES | |
| | B3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10B340__.IES | | ERL1_10B330__.IES | | ERL1_10B327__.IES | |
| | C3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10C340__.IES | | ERL1_10C330__.IES | | ERL1_10C327__.IES | |
| | D3 | | | | | | B1-U0-G2 | B1-U0-G2 | B1-U0-G2 | ERL1_10D340__.IES | | ERL1_10D330__.IES | | ERL1_10D327__.IES | |
| | E3 | | | | | | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 | ERL1_10E340__.IES | | ERL1_10E330__.IES | | ERL1_10E327__.IES | |

# Photometrics:

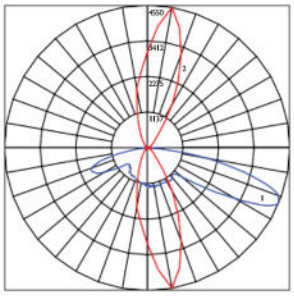
## Evolve™ LED Streetlight )ERL1)

### ERL1
Type II Narrow
(05A340)

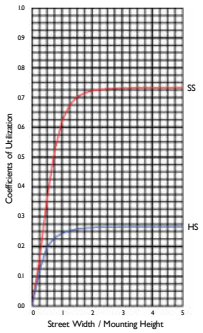
5,000 Lumens
4000K
ERL1_05A340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

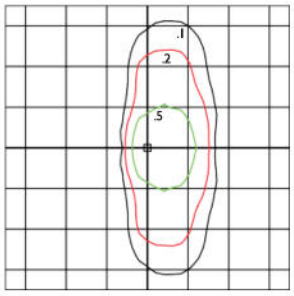


– Vertical plane through horizontal angle of Max. Cd at 80°
– Horizontal cone through vertical angle of Max. Cd at 67°

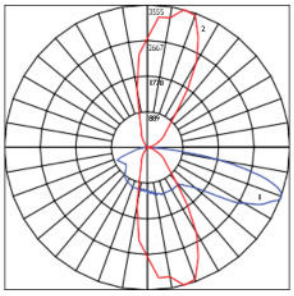



### ERL1
Type II Wide
(05B340)

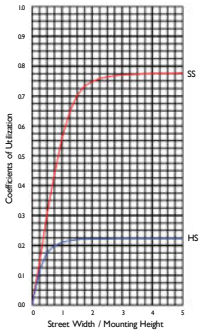
5,000 Lumens
4000K
ERL1_05B340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

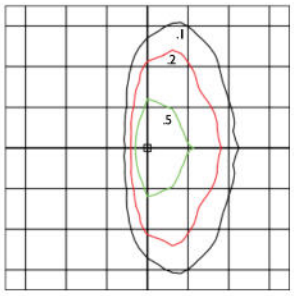


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 69°

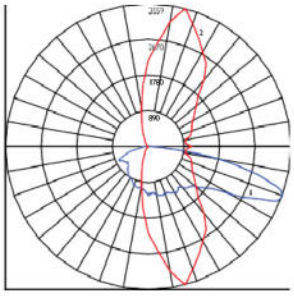



### ERL1
Type III
((05C340)

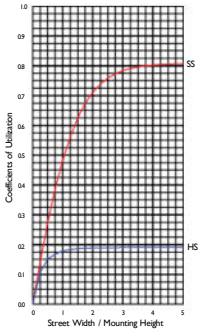
5,000 Lumens
4000K
ERL1_05C340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

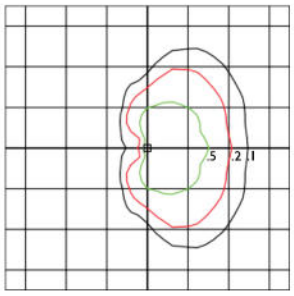


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 70°

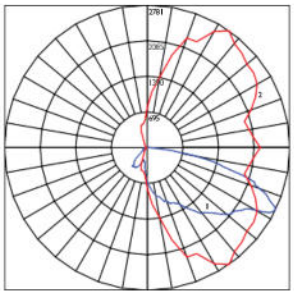



### ERL1
Type IV
(05D340)

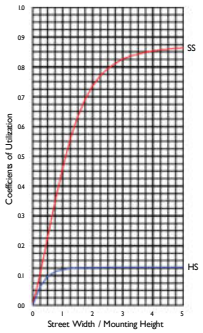
5,000 Lumens
4000K
ERL1_(05D340)___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

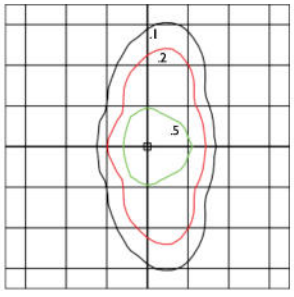


– Vertical plane through horizontal angle of Max. Cd at 55°
– Horizontal cone through vertical angle of Max. Cd at 64°

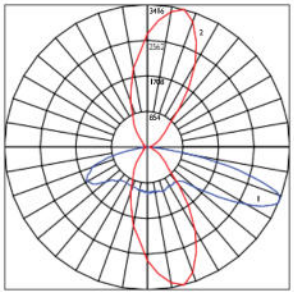



### ERL1
Type II Enhanced Back Light
(05E340)

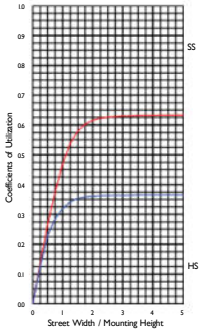
5,000 Lumens
4000K
ERL1_(05E340)___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade



– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 67°



# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2



Project name ______________

Date ______________

Type ______________

**E R L H**

_ _ _ _   _   _ _   _ _   _ _   _   _ _ _ _   _ _ _

| PROD. ID | VOLTAGE | LUMEN OUTPUT | DISTRIBUTION* | CCT | CONTROLS | COLOR | OPTIONS |
|---|---|---|---|---|---|---|---|
| **E** = Evolve<br>**R** = Roadway<br>**L** = Local<br>**H** = High Output | **0** = 120-277V*<br>**1** = 120<br>**2** = 208<br>**3** = 240<br>**4** = 277<br>**5** = 480<br>**D** = 347<br>**H** = 347-480*<br><br>*Not available with Fusing. Must choose a discrete voltage with F option. | **10**<br>**11**<br>**13**<br>**14**<br>**15**<br>**16**<br><br>See Table | **A3** = Type II Narrow<br>**B3** = Type II Wide<br>**C3** = Type III<br>**D3** = Type IV<br>**E3** = Type II Enhanced Back Light<br><br>See Table<br><br>*Nominal IES Type classing subject to typical variation, individual units may differ. | **30** = 3000K<br>**40** = 4000K<br><br>Select 3000K CCT for IDA approved units. | **A** = ANSI C136.41 7-pin<br>**D** = ANSI C136.41 7-pin with Shorting Cap<br>**E** = ANSI C136.41 7-pin with non-Dimming PE Control.*<br><br>*PE Control Only available for 120-277V or 480V Discrete. Not available for 347-480V or 347V Discrete.<br><br>**NOTE:** Dimming controls wired for 0-10V standard unless DALI option "U" requested. | **GRAY** = Gray<br>**BLCK** = Black<br>**DKBZ** = Dark Bronze | **A** = 4 Bolt Slipfitter †<br>**F** = Fusing<br>**G** = Internal Bubble Level<br>**I** = IP66 Optical<br>**L** = Tool-Less Entry<br>**R** = Secondary 10kV/5kA SPD<br>**T** = Secondary 20kV/10kA SPD<br>**U** = DALI Programmable +^<br>**V1** = Variable Output via Field Adjustable Module<br>**X** = Single Package #<br>**Y** = Coastal Finish *<br>**XXX** = Special Options<br><br>† Contact manufacturer for Lead-Time.<br><br># "X" option provides single pack box per fixture. Std Packaging = 20 units per Magna pak container.<br><br>* Recommended for installations within 750 ft. from the coast. Contact Factory for Lead-Time.<br><br>+ Compatible with LightGrid 2.0 nodes.<br><br>^ Not available in 347V, 480V or 347-480V. |

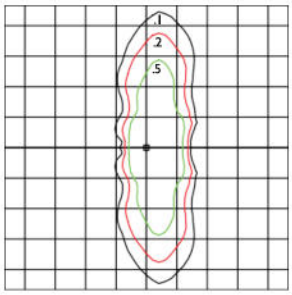
| LUMEN OUTPUT | DISTRIBUTION | TYPICAL INITIAL LUMENS 4000K | TYPICAL INITIAL LUMENS 3000K | TYPICAL SYSTEM WATTAGE 120-277V | TYPICAL SYSTEM WATTAGE 347-480V | BUG RATING 4000K | BUG RATING 3000K | IES FILE NUMBER 4000K | IES FILE NUMBER 3000K |
|---|---|---|---|---|---|---|---|---|---|
| 10 | A3 | 10000 | 9600 | 82 | 82 | B2-U0-G2 | B2-U0-G2 | ERLH_10A340__.IES | ERLH_10A330__.IES |
| | B3 | | | | | B2-U0-G2 | B2-U0-G2 | ERLH_10B340__.IES | ERLH_10B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G2 | ERLH_10C340__.IES | ERLH_10C330__.IES |
| | D3 | | | | | B1-U0-G3 | B1-U0-G2 | ERLH_10D340__.IES | ERLH_10D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_10E340__.IES | ERLH_10E330__.IES |
| 11 | A3 | 11500 | 11000 | 98 | 98 | B3-U0-G3 | B2-U0-G2 | ERLH_11A340__.IES | ERLH_11A330__.IES |
| | B3 | | | | | B3-U0-G3 | B2-U0-G2 | ERLH_11B340__.IES | ERLH_11B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_11C340__.IES | ERLH_11C330__.IES |
| | D3 | | | | | B1-U0-G3 | B1-U0-G2 | ERLH_11D340__.IES | ERLH_11D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_11E340__.IES | ERLH_11E330__.IES |
| 13 | A3 | 13000 | 12500 | 111 | 111 | B3-U0-G3 | B3-U0-G3 | ERLH_13A340__.IES | ERLH_13A330__.IES |
| | B3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_13B340__.IES | ERLH_13B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_13C340__.IES | ERLH_13C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_13D340__.IES | ERLH_13D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_13E340__.IES | ERLH_13E330__.IES |
| 14 | A3 | 14000 | 13400 | 122 | 122 | B3-U0-G3 | B3-U0-G3 | ERLH_14A340__.IES | ERLH_14A330__.IES |
| | B3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_14B340__.IES | ERLH_14B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_14C340__.IES | ERLH_14C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_14D340__.IES | ERLH_14D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_14E340__.IES | ERLH_14E330__.IES |
| 15 | A3 | 15000 | 14400 | 136 | 136 | B3-U0-G3 | B3-U0-G3 | ERLH_15A340__.IES | ERLH_15A330__.IES |
| | B3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_15B340__.IES | ERLH_15B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_15C340__.IES | ERLH_15C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_15D340__.IES | ERLH_15D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_15E340__.IES | ERLH_15E330__.IES |
| 16 | A3 | 16000 | 15300 | 149 | 149 | B3-U0-G3 | B3-U0-G3 | ERLH_16A340__.IES | ERLH_16A330__.IES |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_16B340__.IES | ERLH_16B330__.IES |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_16C340__.IES | ERLH_16C330__.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERLH_16D340__.IES | ERLH_16D330__.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERLH_16E340__.IES | ERLH_16E330__.IES |

# Photometrics:

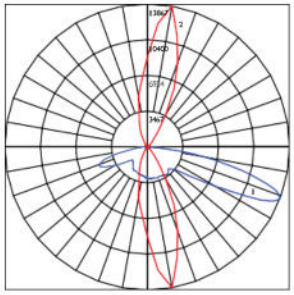
## Evolve™ LED Streetlight )ERLH)

### ERLH
Type II Narrow
(13A340)

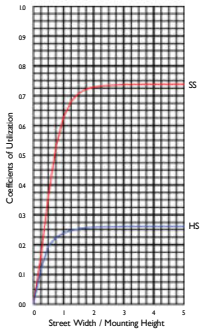
13,000 Lumens
4000K
ERLH_13A340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

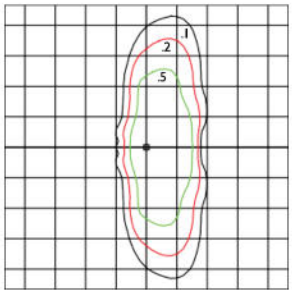


– Vertical plane through horizontal angle of Max. Cd at 80°
– Horizontal cone through vertical angle of Max. Cd at 69°

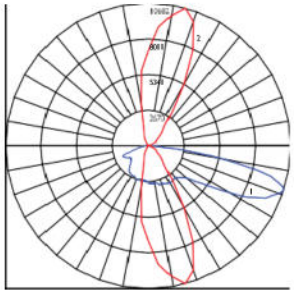



### ERLH
Type II Wide
(13B340)

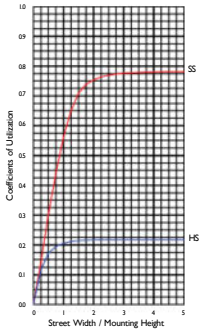
13,000 Lumens
4000K
ERLH_13B340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

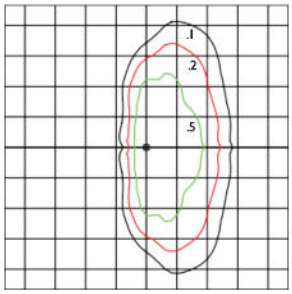


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 72°

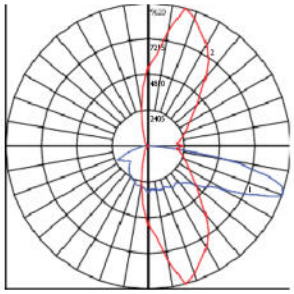



### ERLH
Type III
(13C340)

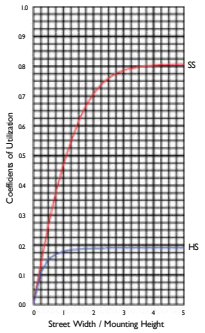
13,000 Lumens
4000K
ERLH_13C340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

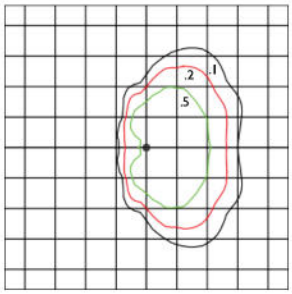


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 71°

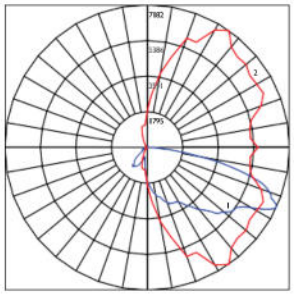



### ERLH
Type IV
13D340

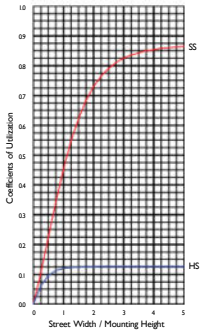
13,000 Lumens
4000K
ERLH_13D340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

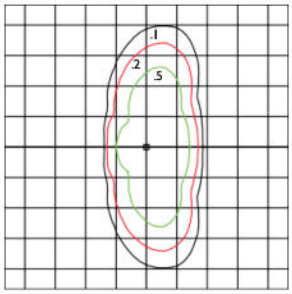


– Vertical plane through horizontal angle of Max. Cd at 55°
– Horizontal cone through vertical angle of Max. Cd at 65°

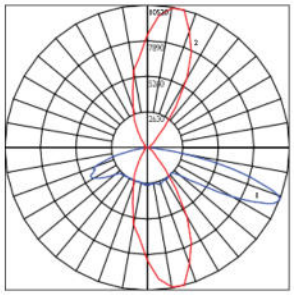



### ERLH
Type II Enhanced Back Light
13E340

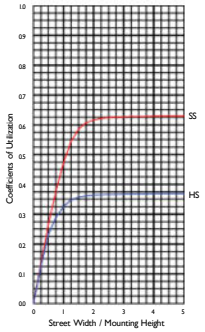
13,000 Lumens
4000K
ERLH_13E340___.IES




Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade



– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 69°



# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2



Project name ______________

Date ______________

Type ______________

**E R L 2**

_ _ _ _   _   _ _   _ _   _ _   _   _ _ _ _   _ _ _

| PROD. ID | VOLTAGE | LUMEN OUTPUT | DISTRIBUTION* | CCT | CONTROLS | COLOR | OPTIONS |
|---|---|---|---|---|---|---|---|
| **E** = Evolve<br>**R** = Roadway<br>**L** = Local<br>**2** = Double Module | **0** = 120-277V*<br>**1** = 120<br>**2** = 208<br>**3** = 240<br>**4** = 277<br>**5** = 480<br>**D** = 347<br>**H** = 347-480*<br>*Not available with Fusing. Must choose a discrete voltage with F option. | **16**<br>**18**<br>**19**<br>**21**<br>**23**<br>**25**<br>**27**<br>**28**<br>**30**<br>See Table | **A3** = Type II Narrow<br>**B3** = Type II Wide<br>**C3** = Type III<br>**D3** = Type IV<br>**E3** = Type II Enhanced Back Light<br>See Table<br>*Nominal IES Type classing subject to typical variation, individual units may differ. | **30** = 3000K<br>**40** = 4000K<br>**50** = 5000K*<br>Select 3000K CCT for IDA approved units.<br>*50 = 5200K for ERL2 lumen outputs 25, 27, 28, and 30. | **A** = ANSI C136.41 7-pin<br>**D** = ANSI C136.41 7-pin with Shorting Cap<br>**E** = ANSI C136.41 7-pin with non-Dimming PE Control.*<br>*PE Control Only available for 120-277V or 480V Discrete. Not available for 347-480V or 347V Discrete.<br>**NOTE:** Dimming controls wired for 0-10V standard unless DALI option "U" requested. | **GRAY** = Gray<br>**BLCK** = Black<br>**DKBZ** = Dark Bronze | **A** = 4 Bolt Slipfitter †<br>**F** = Fusing<br>**G** = Internal Bubble Level<br>**I** = IP66 Optical<br>**L** = Tool-Less Entry<br>**R** = Secondary 10kV/5kA SPD<br>**T** = Secondary 20kV/10kA SPD<br>**U** = DALI Programmable ^<br>**V1** = Variable Output via Field Adjustable Module<br>**Y** = Coastal Finish *<br>**XXX** = Special Options<br>† Contact manufacturer for Lead-Time.<br>* Recommended for installations within 750 ft. from the coast. Contact Factory for Lead-Time.<br>+ Compatible with LightGrid 2.0 nodes.<br>^ Not available in 347V, 480V or 347-480V. |

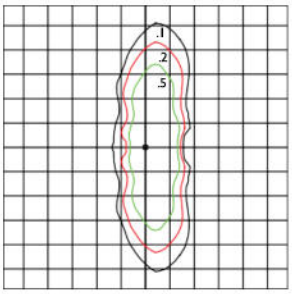
| LUMEN OUTPUT | DISTRIBUTION | TYPICAL INITIAL LUMENS 4000K/5000-5200K | TYPICAL INITIAL LUMENS 3000K | TYPICAL SYSTEM WATTAGE 120-277V | TYPICAL SYSTEM WATTAGE 347-480V | BUG RATING 4000K | BUG RATING 3000K | IES FILE NUMBER 4000K 120-277V | IES FILE NUMBER 4000K 347-480V | IES FILE NUMBER 3000K 120-277V | IES FILE NUMBER 3000K 347-480V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | A3 | 16000 | 15300 | 120 | 120 | B3-U0-G3 | B3-U0-G3 | ERL2_16A340__.IES | | ERL2_16A330__.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_16B340__.IES | | ERL2_16B330__.IES | |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_16C340__.IES | | ERL2_16C330__.IES | |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_16D340__.IES | | ERL2_16D330__.IES | |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_16E340__.IES | | ERL2_16E330__.IES | |
| 18 | A3 | 18000 | 17300 | 140 | 140 | B3-U0-G3 | B3-U0-G3 | ERL2_18A340__.IES | | ERL2_18A330__.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_18B340__.IES | | ERL2_18B330__.IES | |
| | C3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_18C340__.IES | | ERL2_18C330__.IES | |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_18D340__.IES | | ERL2_18D330__.IES | |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_18E340__.IES | | ERL2_18E330__.IES | |
| 19 | A3 | 19000 | 18200 | 149 | 149 | B3-U0-G3 | B3-U0-G3 | ERL2_19A340__.IES | | ERL2_19A330__.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_19B340__.IES | | ERL2_19B330__.IES | |
| | C3 | | | | | B3-U0-G3 | B2-U0-G3 | ERL2_19C340__.IES | | ERL2_19C330__.IES | |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_19D340__.IES | | ERL2_19D330__.IES | |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_19E340__.IES | | ERL2_19E330__.IES | |
| 21 | A3 | 21000 | 20100 | 174 | 177 | B3-U0-G3 | B3-U0-G3 | ERL2_21A340_-120-277V.IES | ERL2_21A340_-347-480V.IES | ERL2_21A330_-120-277V.IES | ERL2_21A330_-347-480V.IES |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_21B340_-120-277V.IES | ERL2_21B340_-347-480V.IES | ERL2_21B330_-120-277V.IES | ERL2_21B330_-347-480V.IES |
| | C3 | | | | | B3-U0-G4 | B3-U0-G3 | ERL2_21C340_-120-277V.IES | ERL2_21C340_-347-480V.IES | ERL2_21C330_-120-277V.IES | ERL2_21C330_-347-480V.IES |
| | D3 | | | | | B2-U0-G3 | B2-U0-G3 | ERL2_21D340_-120-277V.IES | ERL2_21D340_-347-480V.IES | ERL2_21D330_-120-277V.IES | ERL2_21D330_-347-480V.IES |
| | E3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_21E340_-120-277V.IES | ERL2_21E340_-347-480V.IES | ERL2_21E330_-120-277V.IES | ERL2_21E330_-347-480V.IES |
| 23 | A3 | 23000 | 22100 | 194 | 196 | B3-U0-G3 | B3-U0-G3 | ERL2_23A340_-120-277V.IES | ERL2_23A340_-347-480V.IES | ERL2_23A330_-120-277V.IES | ERL2_23A330_-347-480V.IES |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_23B340_-120-277V.IES | ERL2_23B340_-347-480V.IES | ERL2_23B330_-120-277V.IES | ERL2_23B330_-347-480V.IES |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_23C340_-120-277V.IES | ERL2_23C340_-347-480V.IES | ERL2_23C330_-120-277V.IES | ERL2_23C330_-347-480V.IES |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_23D340_-120-277V.IES | ERL2_23D340_-347-480V.IES | ERL2_23D330_-120-277V.IES | ERL2_23D330_-347-480V.IES |
| | E3 | | | | | B4-U0-G4 | B3-U0-G3 | ERL2_23E340_-120-277V.IES | ERL2_23E340_-347-480V.IES | ERL2_23E330_-120-277V.IES | ERL2_23E330_-347-480V.IES |
| 25 | A3 | 25000 | 24000 | 214 | 214 | B3-U0-G3 | B3-U0-G3 | ERL2_25A340__.IES | | ERL2_25A330__.IES | |
| | B3 | | | | | B3-U0-G3 | B3-U0-G3 | ERL2_25B340__.IES | | ERL2_25B330__.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_25C340__.IES | | ERL2_25C330__.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_25D340__.IES | | ERL2_25D330__.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_25E340__.IES | | ERL2_25E330__.IES | |
| 27 | A3 | 27000 | 25900 | 237 | 237 | B3-U0-G3 | B3-U0-G3 | ERL2_27A340__.IES | | ERL2_27A330__.IES | |
| | B3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_27B340__.IES | | ERL2_27B330__.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_27C340__.IES | | ERL2_27C330__.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_27D340__.IES | | ERL2_27D330__.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_27E340__.IES | | ERL2_27E330__.IES | |
| 28 | A3 | 28000 | 26900 | 251 | 251 | B3-U0-G3 | B3-U0-G3 | ERL2_28A340__.IES | | ERL2_28A330__.IES | |
| | B3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_28B340__.IES | | ERL2_28B330__.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_28C340__.IES | | ERL2_28C330__.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_28D340__.IES | | ERL2_28D330__.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_28E340__.IES | | ERL2_28E330__.IES | |
| 30 | A3 | 30000 | 28800 | 278 | 278 | B4-U0-G4 | B4-U0-G4 | ERL2_30A340__.IES | | ERL2_30A330__.IES | |
| | B3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_30B340__.IES | | ERL2_30B330__.IES | |
| | C3 | | | | | B3-U0-G4 | B3-U0-G4 | ERL2_30C340__.IES | | ERL2_30C330__.IES | |
| | D3 | | | | | B2-U0-G4 | B2-U0-G4 | ERL2_30D340__.IES | | ERL2_30D330__.IES | |
| | E3 | | | | | B4-U0-G4 | B4-U0-G4 | ERL2_30E340__.IES | | ERL2_30E330__.IES | |

# Photometrics:

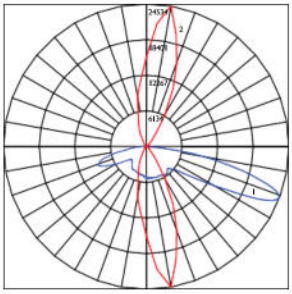
## Evolve™ LED Streetlight )ERL2)

### ERL2
Type II Narrow
(23A340)

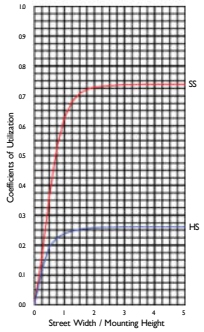
23,000 Lumens
4000K
ERL2_23A340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

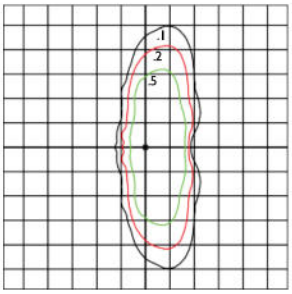


– Vertical plane through horizontal angle of Max. Cd at 80°
– Horizontal cone through vertical angle of Max. Cd at 69°

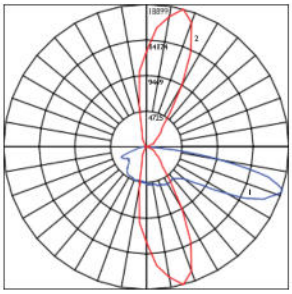



### ERL2
Type II Wide
(23B340)

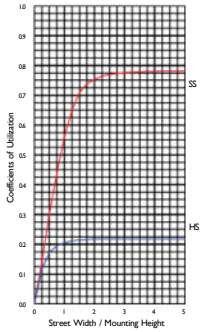
23,000 Lumens
4000K
ERL2_23B340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

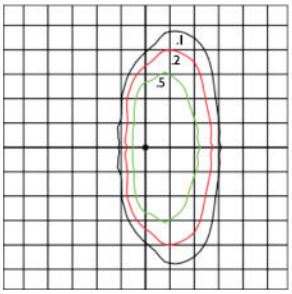


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 72°

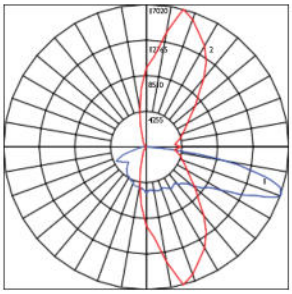



### ERL2
Type III
(23C340)

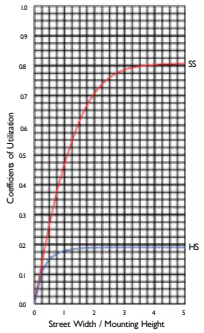
23,000 Lumens
4000K
ERL2_23C340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

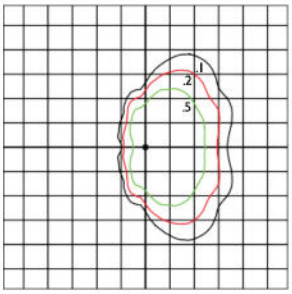


– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 71°

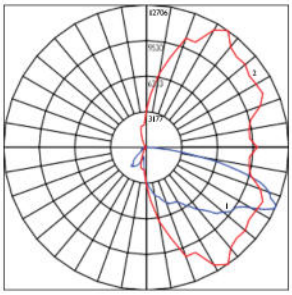



### ERL2
Type IV
(23D340)

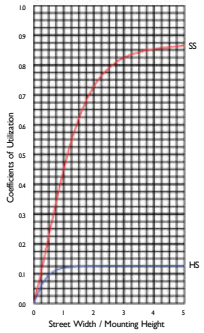
23,000 Lumens
4000K
ERL2_23D340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade

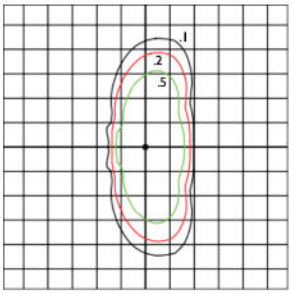


– Vertical plane through horizontal angle of Max. Cd at 55°
– Horizontal cone through vertical angle of Max. Cd at 65°

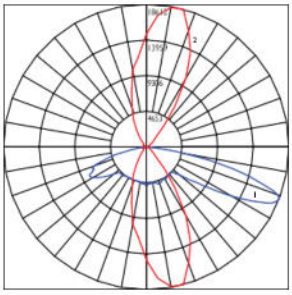



### ERL2
Type II Enhanced Back Light
(23E340)

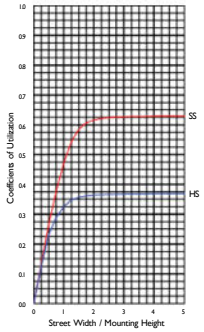
23,000 Lumens
4000K
ERL2_23E340___.IES



Grid Distance in Units of Mounting Height at 30'
Initial Footcandle Values at Grade



– Vertical plane through horizontal angle of Max. Cd at 75°
– Horizontal cone through vertical angle of Max. Cd at 69°



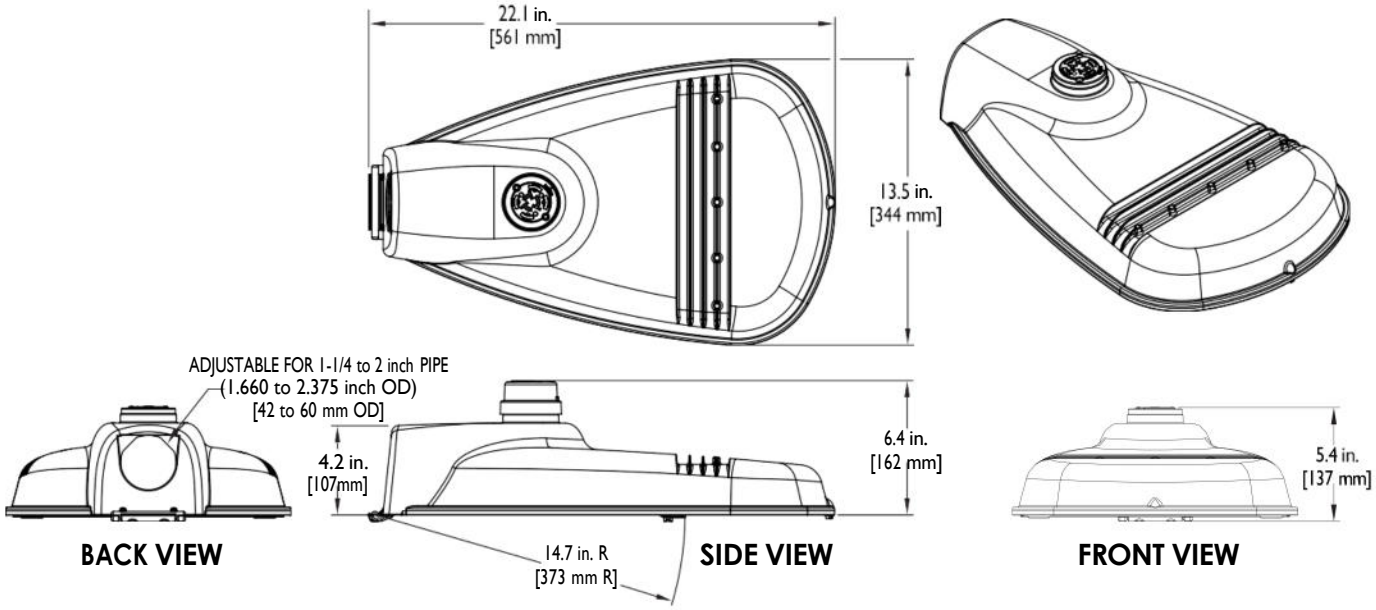
# GE Evolve™

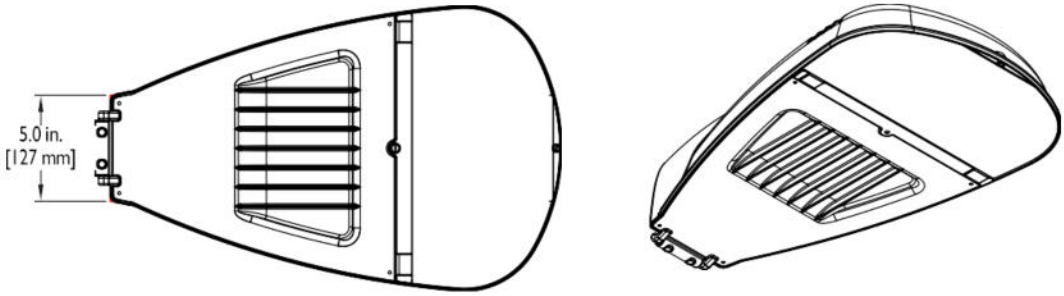
## LED Roadway Lighting

ERL1-ERLH-ERL2

## Product Dimensions:

**Evolve™ LED Streetlight )ERL1)**




**DATA**

- Approximate net weight: 12.4 lbs (5.6kgs) -15.5 lbs (7.0kgs) with XFMR
- Effective Projected Area (EPA): 0.5 sq ft max (0.046 sq m)

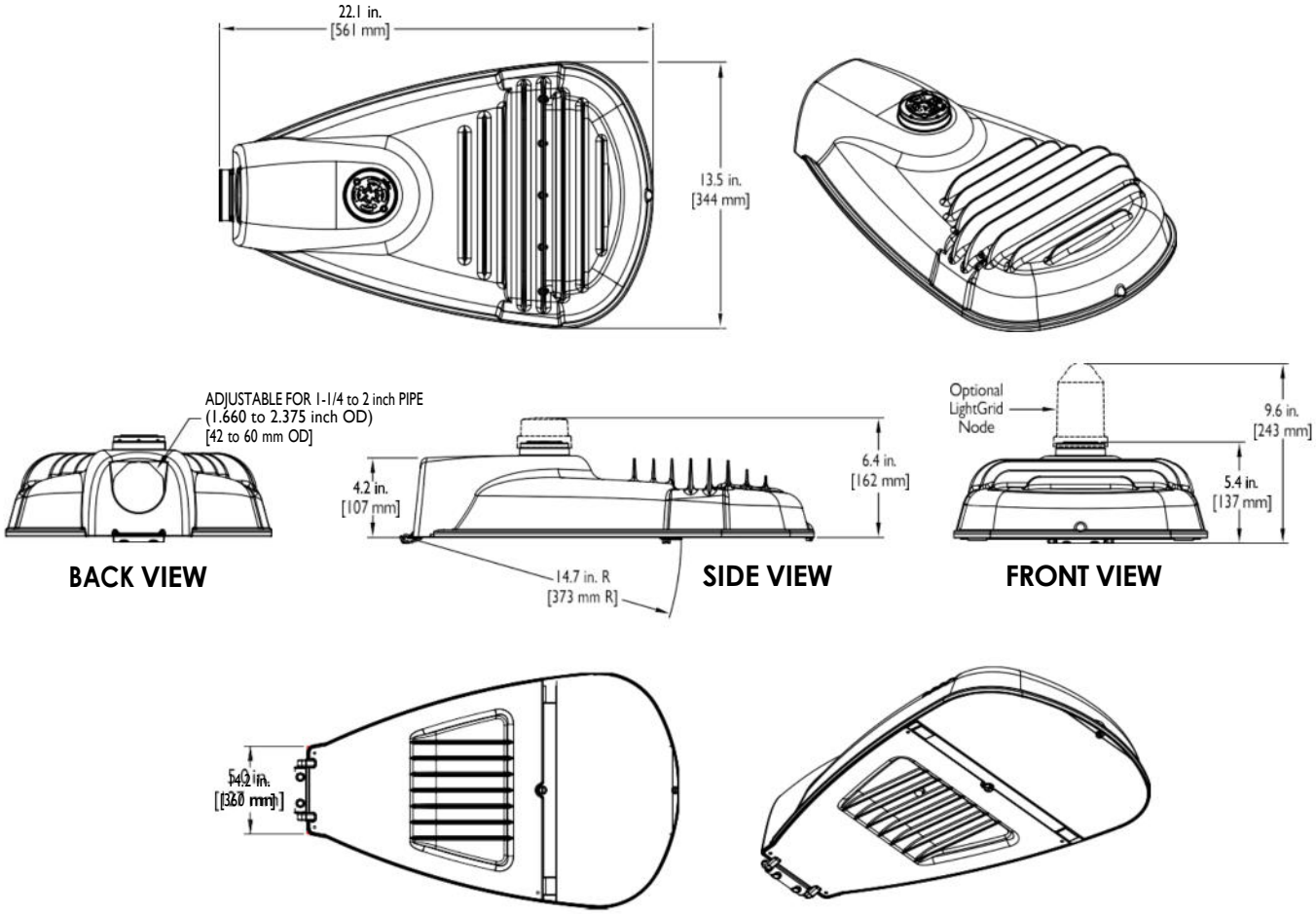
# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2

## Product Dimensions:

**Evolve™ LED Streetlight )ERLH)**




**DATA**

- Approximate net weight: 15.15 lbs (6.9 kgs) - 2 Bolt Slipfitter
- Approximate net weight: 15.85 lbs (7.2 kgs) - 4 Bolt Slipfitter
- Effective Projected Area (EPA): 0.5 sq ft max (0.046 sq m)

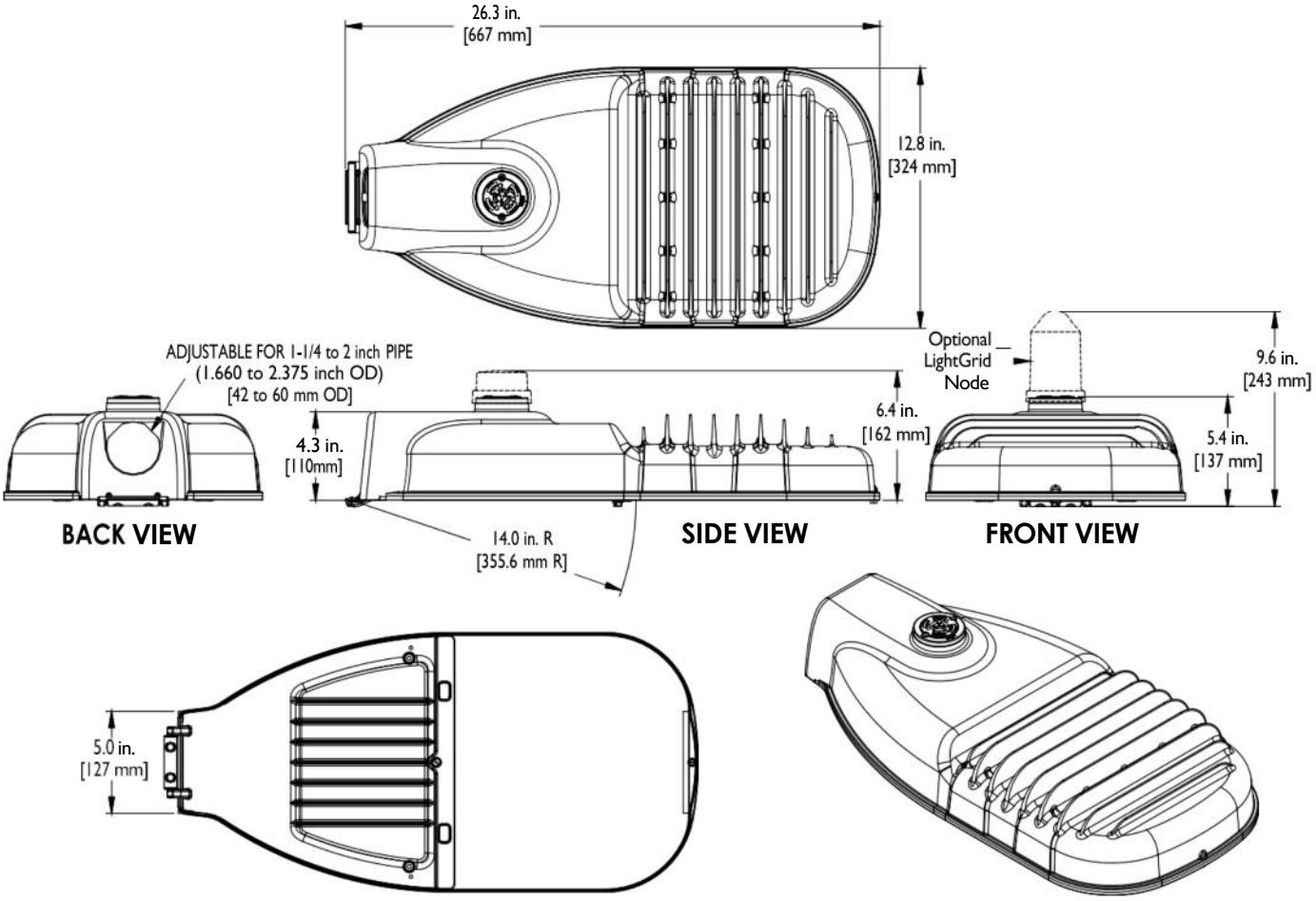
# GE Evolve™

## LED Roadway Lighting

ERL1-ERLH-ERL2

## Product Dimensions:

**Evolve™ LED Streetlight )ERL2)**

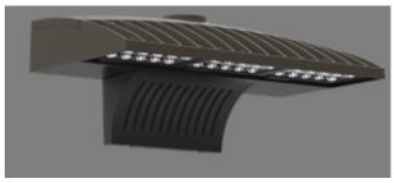



**DATA**

- Approximate net weight: 24.0 lbs (10.9 kgs)
  Contact manufacturer for specific configuration weight.
- Effective Projected Area (EPA): 0.57 sq ft max (0.053 sq m)

current powered by GE

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© 2018 GE.



d#series

# D-Series Size 2
## LED Wall Luminaire

Catalog Number

Notes

Type

*Hit the Tab key or mouse over the page to see all interactive elements.*

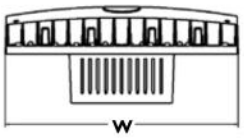
## Specifications

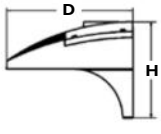
### Luminaire

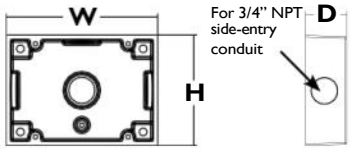
| | | | |
|---|---|---|---|
| **Width:** | 18-1/2" (47.0 cm) | **Weight:** | 21 lbs (9.5 kg) |
| **Depth:** | 10" (25.4 cm) | | |
| **Height:** | 7-5/8" (19.4 cm) | | |

### Back Box (BBW)

| | | | |
|---|---|---|---|
| **Width:** | 5-1/2" (14.0 cm) | **BBW Weight:** | 1 lbs (0.5 kg) |
| **Depth:** | 1-1/2" (3.8 cm) | | |
| **Height:** | 4" (10.2 cm) | | |




A+ Capable options indicated by this color background.

## Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and system-level interoperability.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is A+ Certified when ordered with DTL® controls marked by a shaded background. DTL DLL equipped luminaires meet the A+ specification for luminaire to photocontrol interoperability1
- This luminaire is part of an A+ Certified solution for ROAM® or XPoint™ Wireless control networks, providing out-of-the-box control compatibility with simple commissioning, when ordered with drivers and control options marked by a shaded background[1]

To learn more about A+, visit www.acuitybrands.com/aplus.

1. See ordering tree for details.
2. A+ Certified Solutions for ROAM require the order of one ROAM node per luminaire. Sold Separately: Link to Roam; Link to DTL DLL

## Ordering Information

**EXAMPLE: DSXW2 LED 30C 700 40K T3M MVOLT DDBTXD**

**DSXW2 LED**

| Series | LEDs | Drive Current | Color temperature | Distribution | Voltage | Mounting | Control Options |
|---|---|---|---|---|---|---|---|
| DSXW2 LED | 20C 20 LEDs (two engines)<br>30C 30 LEDs (three engines) | 350 350 mA<br>530 530 mA<br>700 700 mA<br>1000 1000 mA[1] (1 A) | 30K 3000 K<br>40K 4000 K<br>50K 5000 K<br>AMBPC Amber phosphor converted[2] | T2S Type II Short<br>T2M Type II Medium<br>T3S Type III Short<br>T3M Type III Medium<br>T4M Type IV Medium<br>TFTM Forward Throw Medium<br>ASYDF Asymmetric diffuse | MVOLT[3]<br>120[4]<br>208[4]<br>240[4]<br>277[4]<br>347[4,5]<br>480[4,5] | **Shipped included**<br>(blank) Surface mounting bracket<br><br>**Shipped separately[6]**<br>BBW Surface-mounted back box (for conduit entry) | **Shipped installed**<br>PE Photoelectric cell, button type[7]<br>PER NEMA twist-lock receptacle only (control ordered separate)[8]<br>PER5 Five-wire receptacle only (control ordered separate)[8,9]<br>PER7 Seven-wire receptacle only (control ordered separate)[8,9]<br>DMG 0-10v dimming wires pulled outside fixture (for use with an external control, ordered separately)<br>PIR 180° motion/ambient light sensor,<15' mtg ht[10,11]<br>PIRH 180° motion/ambient light sensor, 15-30' mtg ht[10,11]<br>PIR1FC3V Motion/ambient sensor, 8-15' mounting height, ambient sensor enabled at 1fc[11,12]<br>PIRH1FC3V Motion/ambient sensor, 15-30' mounting height, ambient sensor enabled at 1fc[11,12] |

### Other Options

**Shipped installed**

- SF Single fuse (120, 277, 347V)[3]
- DF Double fuse (208, 240, 480V)[3]
- HS House-side shield[4]
- SPD Separate surge protection[13]

**Shipped separately**[13]

- BSW Bird-deterrent spikes
- WG Wire guard
- VG Vandal guard

### Finish *(required)*

| | | | | | |
|---|---|---|---|---|---|
| DDBXD | Dark bronze | DSSXD | Sandstone | DWHGXD | Textured white |
| DBLXD | Black | DDBTXD | Textured dark bronze | DSSTXD | Textured sandstone |
| DNAXD | Natural aluminum | DBLBXD | Textured black | | |
| DWHXD | White | DNATXD | Textured natural aluminum | | |



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## Ordering Information

### Accessories

*Ordered and shipped separately.*

| | |
|---|---|
| DLL127F 1.5 JU | Photocell - SSL twist-lock (120-277V) [14] |
| DLL347F 1.5 CUL JU | Photocell - SSL twist-lock (347V) [14] |
| DLL480F 1.5 CUL JU | Photocell - SSL twist-lock (480V) [14] |
| DSHORT SBK U | Shorting cap (Included when ordering PER, PER5 or PER7) [14] |
| DSXWHS U | House-side shield (one per light engine) |
| DSXWBSW U | Bird-deterrent spikes |
| DSXW2WG U | Wire guard accessory |
| DSXW2VG U | Vandal guard accessory |
| DSXW2BBW DDBXD U | Back box accessory (specify finish) |

*For more control options, visit DTL and ROAM online.*

**NOTES**

1 1000mA is not available with AMBPC.
2 AMBPC is not available with 1000mA.
3 MVOLT driver operates on any line voltage from 120-277V (50/60 Hz).
4 Single fuse (SF) requires 120, 277 or 347 voltage option. Double fuse (DF) requires 208, 240 or 480 voltage option.
5 Available with 30 LED/700mA options only (DSXW2 LED 30C 700). DMG option not available.
6 Also available as a separate accessory; see Accessories information.
7 Photocontrol (PE) requires 120, 208, 240, 277 or 347 voltage option. Not available with motion/ambient light sensors (PIR or PIRH).
8 Photocell ordered and shipped as a separate line item from Acuity Brands Controls. See accessories. Shorting Cap included.
9 If ROAM® node required, it must be ordered and shipped as a separate line item from Acuity Brands Controls. Shorting Cap included.
10 Reference Motion Sensor table on page 3.
11 Reference PER Table on page 3 for functionality.
12 PIR and PIR1FC3V specify the SensorSwitch SBGR-10-ODP control; PIRH and PIRH1FC3V specify the SensorSwitch SBGR-6-ODP control; see Motion Sensor Guide for details. Dimming driver standard. Not available with PER5 or PER7. Separate on/off required.
13 See the electrical section on page 2 for more details.
14 Requires luminaire to be specified with PER option. Ordered and shipped as a separate line item. See PER Table.

## Performance Data

### Lumen Output

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown, within the tolerances allowed by Lighting Facts. Contact factory for performance data on any configurations not shown here.

| LEDs | Drive Current (mA) | System Watts | Dist. Type | 30K | | | | | 40K | | | | | 50K | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Lumens | B | U | G | LPW | Lumens | B | U | G | LPW | Lumens | B | U | G | LPW |
| 20C (20 LEDs) | 350 mA | 25W | T2S | 2,783 | 1 | 0 | 1 | 111 | 2,989 | 1 | 0 | 1 | 120 | 3,008 | 1 | 0 | 1 | 120 |
| | | | T2M | 2,709 | 1 | 0 | 1 | 108 | 2,908 | 1 | 0 | 1 | 116 | 2,926 | 1 | 0 | 1 | 117 |
| | | | T3S | 2,748 | 1 | 0 | 1 | 110 | 2,951 | 1 | 0 | 1 | 118 | 2,969 | 1 | 0 | 1 | 119 |
| | | | T3M | 2,793 | 1 | 0 | 1 | 112 | 2,999 | 1 | 0 | 1 | 120 | 3,018 | 1 | 0 | 1 | 121 |
| | | | T4M | 2,756 | 1 | 0 | 1 | 110 | 2,959 | 1 | 0 | 1 | 118 | 2,977 | 1 | 0 | 1 | 119 |
| | | | TFTM | 2,753 | 1 | 0 | 1 | 110 | 2,956 | 1 | 0 | 1 | 118 | 2,975 | 1 | 0 | 1 | 119 |
| | 530 mA | 36W | T2S | 4,030 | 1 | 0 | 1 | 112 | 4,327 | 1 | 0 | 1 | 120 | 4,354 | 1 | 0 | 1 | 121 |
| | | | T2M | 3,920 | 1 | 0 | 1 | 109 | 4,210 | 1 | 0 | 1 | 117 | 4,236 | 1 | 0 | 1 | 118 |
| | | | T3S | 3,978 | 1 | 0 | 1 | 111 | 4,272 | 1 | 0 | 1 | 119 | 4,299 | 1 | 0 | 1 | 119 |
| | | | T3M | 4,044 | 1 | 0 | 2 | 112 | 4,343 | 1 | 0 | 2 | 121 | 4,370 | 1 | 0 | 2 | 121 |
| | | | T4M | 3,990 | 1 | 0 | 1 | 111 | 4,284 | 1 | 0 | 1 | 119 | 4,310 | 1 | 0 | 1 | 120 |
| | | | TFTM | 3,987 | 1 | 0 | 1 | 111 | 4,281 | 1 | 0 | 1 | 119 | 4,308 | 1 | 0 | 1 | 120 |
| | 700 mA | 47W | T2S | 5,130 | 1 | 0 | 1 | 109 | 5,509 | 1 | 0 | 1 | 117 | 5,544 | 1 | 0 | 1 | 118 |
| | | | T2M | 4,991 | 1 | 0 | 2 | 106 | 5,360 | 1 | 0 | 2 | 114 | 5,393 | 1 | 0 | 2 | 115 |
| | | | T3S | 5,066 | 1 | 0 | 1 | 108 | 5,440 | 1 | 0 | 1 | 116 | 5,474 | 1 | 0 | 1 | 116 |
| | | | T3M | 5,148 | 1 | 0 | 2 | 110 | 5,529 | 1 | 0 | 2 | 118 | 5,563 | 1 | 0 | 2 | 118 |
| | | | T4M | 5,080 | 1 | 0 | 2 | 108 | 5,455 | 1 | 0 | 2 | 116 | 5,488 | 1 | 0 | 2 | 117 |
| | | | TFTM | 5,075 | 1 | 0 | 2 | 108 | 5,450 | 1 | 0 | 2 | 116 | 5,484 | 1 | 0 | 2 | 117 |
| | 1000 mA | 73W | T2S | 7,147 | 2 | 0 | 2 | 98 | 7,675 | 2 | 0 | 2 | 105 | | | | | |
| | | | T2M | 6,954 | 2 | 0 | 2 | 95 | 7,467 | 2 | 0 | 2 | 102 | | | | | |
| | | | T3S | 7,057 | 1 | 0 | 2 | 97 | 7,579 | 1 | 0 | 2 | 104 | | | | | |
| | | | T3M | 7,172 | 2 | 0 | 3 | 98 | 7,702 | 2 | 0 | 3 | 106 | | | | | |
| | | | T4M | 7,076 | 1 | 0 | 2 | 97 | 7,599 | 1 | 0 | 2 | 104 | | | | | |
| | | | TFTM | 7,071 | 1 | 0 | 2 | 97 | 7,594 | 1 | 0 | 2 | 104 | | | | | |
| 30C (30 LEDs) | 350 mA | 36W | T2S | 4,160 | 1 | 0 | 1 | 116 | 4,467 | 1 | 0 | 1 | 124 | 4,494 | 1 | 0 | 1 | 125 |
| | | | T2M | 4,048 | 1 | 0 | 1 | 112 | 4,346 | 1 | 0 | 2 | 121 | 4,373 | 1 | 0 | 2 | 121 |
| | | | T3S | 4,108 | 1 | 0 | 1 | 114 | 4,411 | 1 | 0 | 1 | 123 | 4,438 | 1 | 0 | 1 | 123 |
| | | | T3M | 4,174 | 1 | 0 | 2 | 116 | 4,483 | 1 | 0 | 2 | 125 | 4,510 | 1 | 0 | 2 | 125 |
| | | | T4M | 4,119 | 1 | 0 | 1 | 114 | 4,423 | 1 | 0 | 2 | 123 | 4,450 | 1 | 0 | 2 | 124 |
| | | | TFTM | 4,115 | 1 | 0 | 1 | 114 | 4,419 | 1 | 0 | 1 | 123 | 4,446 | 1 | 0 | 1 | 124 |
| | 530 mA | 54W | T2S | 6,001 | 1 | 0 | 1 | 111 | 6,444 | 1 | 0 | 1 | 119 | 6,484 | 1 | 0 | 1 | 120 |
| | | | T2M | 5,838 | 1 | 0 | 2 | 108 | 6,270 | 2 | 0 | 2 | 116 | 6,308 | 2 | 0 | 2 | 117 |
| | | | T3S | 5,926 | 1 | 0 | 2 | 110 | 6,364 | 1 | 0 | 2 | 118 | 6,403 | 1 | 0 | 2 | 119 |
| | | | T3M | 6,023 | 1 | 0 | 2 | 112 | 6,467 | 1 | 0 | 2 | 120 | 6,507 | 1 | 0 | 2 | 121 |
| | | | T4M | 5,942 | 1 | 0 | 2 | 110 | 6,380 | 1 | 0 | 2 | 118 | 6,420 | 1 | 0 | 2 | 119 |
| | | | TFTM | 5,937 | 1 | 0 | 2 | 110 | 6,376 | 1 | 0 | 2 | 118 | 6,415 | 1 | 0 | 2 | 119 |
| | 700 mA | 71W | T2S | 7,403 | 2 | 0 | 2 | 104 | 8,170 | 2 | 0 | 2 | 115 | 8,221 | 2 | 0 | 2 | 116 |
| | | | T2M | 7,609 | 2 | 0 | 2 | 107 | 7,949 | 2 | 0 | 2 | 112 | 7,998 | 2 | 0 | 2 | 113 |
| | | | T3S | 7,513 | 1 | 0 | 2 | 106 | 8,068 | 1 | 0 | 2 | 114 | 8,118 | 1 | 0 | 2 | 114 |
| | | | T3M | 7,635 | 2 | 0 | 3 | 108 | 8,199 | 2 | 0 | 3 | 115 | 8,250 | 2 | 0 | 3 | 116 |
| | | | T4M | 7,534 | 1 | 0 | 2 | 106 | 8,089 | 1 | 0 | 2 | 114 | 8,140 | 1 | 0 | 2 | 115 |
| | | | TFTM | 7,527 | 1 | 0 | 2 | 106 | 8,082 | 2 | 0 | 2 | 114 | 8,134 | 2 | 0 | 2 | 115 |
| | 1000 mA | 109W | T2S | 10,468 | 2 | 0 | 2 | 96 | 11,241 | 2 | 0 | 2 | 103 | | | | | |
| | | | T2M | 10,184 | 2 | 0 | 3 | 93 | 10,936 | 2 | 0 | 3 | 100 | | | | | |
| | | | T3S | 10,335 | 2 | 0 | 2 | 95 | 11,099 | 2 | 0 | 2 | 102 | | | | | |
| | | | T3M | 10,505 | 2 | 0 | 3 | 96 | 11,280 | 2 | 0 | 3 | 103 | | | | | |
| | | | T4M | 10,365 | 2 | 0 | 2 | 95 | 11,129 | 2 | 0 | 2 | 102 | | | | | |
| | | | TFTM | 10,356 | 2 | 0 | 2 | 95 | 11,121 | 2 | 0 | 3 | 102 | | | | | |

**Note:**
Available with phosphor-converted amber LED's (nomenclature AMBPC). These LED's produce light with 97+% >530 nm.
Output can be calculated by applying a 0.7 factor to 4000 K lumen values and photometric files.


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# Performance Data

## Lumen Ambient Temperature (LAT) Multipliers

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

| Ambient | | Lumen Multiplier |
|---|---|---|
| 0°C | 32°F | 1.02 |
| 10°C | 50°F | 1.01 |
| 20°C | 68°F | 1.00 |
| **25°C** | **77°F** | **1.00** |
| 30°C | 86°F | 1.00 |
| 40°C | 104°F | 0.98 |

## Electrical Load

| | | | Current (A) | | | | | |
|---|---|---|---|---|---|---|---|---|
| LEDs | Drive Current (mA) | System Watts | 120V | 208V | 240V | 277V | 347V | 480V |
| 20C | 350 | 25 W | 0.23 | 0.13 | 0.12 | 0.10 | - | - |
| | 530 | 36 W | 0.33 | 0.19 | 0.17 | 0.14 | - | - |
| | 700 | 47 W | 0.44 | 0.25 | 0.22 | 0.19 | - | - |
| | 1000 | 74 W | 0.68 | 0.39 | 0.34 | 0.29 | - | - |
| 30C | 350 | 36 W | 0.33 | 0.19 | 0.17 | 0.14 | - | - |
| | 530 | 54 W | 0.50 | 0.29 | 0.25 | 0.22 | - | - |
| | 700 | 71 W | 0.66 | 0.38 | 0.33 | 0.28 | 0.23 | 0.16 |
| | 1000 | 109 W | 1.01 | 0.58 | 0.50 | 0.44 | - | - |

## Projected LED Lumen Maintenance

Data references the extrapolated performance projections for the **DSXW2 LED 30C 1000** platform in a **25°C ambient**, based on 10,000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

| Operating Hours | 0 | 25,000 | 50,000 | 100,000 |
|---|---|---|---|---|
| Lumen Maintenance Factor | 1.0 | 0.95 | 0.92 | 0.87 |

## Motion Sensor Default Settings

| Option | Dimmed State | High Level (when triggered) | Photocell Operation | Dwell Time | Ramp-up Time | Ramp-down Time |
|---|---|---|---|---|---|---|
| *PIR or PIRH | 3V (37%) Output | 10V (100%) Output | Enabled @ 5FC | 5 min | 3 sec | 5 min |
| PIR1FC3V or PIRH1FC3V | 3V (37%) Output | 10V (100%) Output | Enabled @ 1FC | 5 min | 3 sec | 5 min |

*for use with Inline Dusk to Dawn or timer

## PER Table

| Control | PER (3 wire) | PER5 (5 wire) | | PER7 (7 wire) | | |
|---|---|---|---|---|---|---|
| | | | Wire 4/Wire5 | | Wire 4/Wire5 | Wire 6/Wire7 |
| Photocontrol Only (On/Off) | ✓ | ⚠ | Wired to dimming leads on driver | ⚠ | Wired to dimming leads on driver | Wires Capped inside fixture |
| ROAM | ⊘ | ✓ | Wired to dimming leads on driver | ⚠ | Wired to dimming leads on driver | Wires Capped inside fixture |
| ROAM with Motion | ⊘ | ⚠ | Wired to dimming leads on driver | ⚠ | Wired to dimming leads on driver | Wires Capped inside fixture |
| Futureproof* | ⊘ | ⚠ | Wired to dimming leads on driver | ✓ | Wired to dimming leads on driver | Wires Capped inside fixture |
| Futureproof* with Motion | ⊘ | ⚠ | Wired to dimming leads on driver | ✓ | Wired to dimming leads on driver | Wires Capped inside fixture |

✓ Recommended

⊘ Will not work

⚠ Alternate

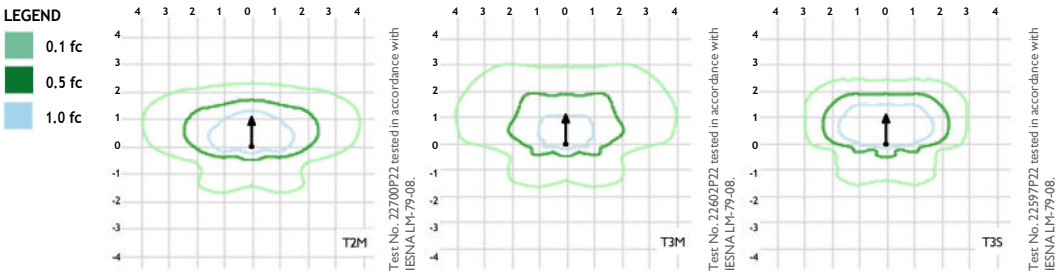
*Futureproof means: Ability to change controls in the future.


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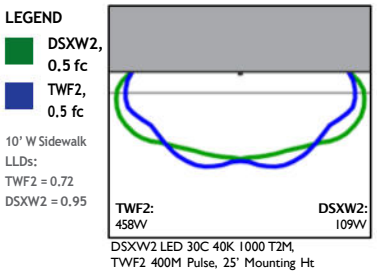
## Photometric Diagrams

To see complete photometric reports or download .ies files for this product, visit Lithonia Lighting's D-Series Wall Size 2 homepage.

Isofootcandle plots for the DSXW2 LED 30C 1000 40K. Distances are in units of mounting height (25').




Distribution overlay comparison to 400W metal halide.




DSXW2 LED 30C 40K 1000 T2M,
TWF2 400M Pulse, 25' Mounting Ht

## FEATURES & SPECIFICATIONS

### INTENDED USE

The energy savings, long life and easy-to-install design of the D-Series Wall Size 2 make it the smart choice for building-mounted doorway and pathway illumination for nearly any facility.

### CONSTRUCTION

Two-piece die-cast aluminum housing has integral heat sink fins to optimize thermal management through conductive and convective cooling. Modular design allows for ease of maintenance. The LED driver is mounted to the door to thermally isolate it from the light engines for low operating temperature and long life. Housing is completely sealed against moisture and environmental contaminants (IP65).

### FINISH

Exterior parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering. A tightly controlled multi-stage process ensures a minimum 3 mils thickness for a finish that can withstand extreme climate changes without cracking or peeling. Available in textured and non-textured finishes.

### OPTICS

Precision-molded proprietary acrylic lenses provide multiple photometric distributions tailored specifically to building mounted applications. Light engines are available in 3000 K (70 min. CRI), 4000 K (70 min. CRI) or 5000 K (70 min. CRI) configurations.

### ELECTRICAL

Light engine(s) consist of 10 high-efficacy LEDs mounted to a metal-core circuit board to maximize heat dissipation and promote long life (L87/100,000 hrs at 25°C). Class 1 electronic drivers have a power factor >90%, THD <20%, and a minimum 2.5KV surge rating. When ordering the SPD option, a separate surge protection device is installed within the luminaire which meets a minimum Category C Low (per ANSI/IEEE C62.41.2).

### INSTALLATION

Included universal mounting bracket attaches securely to any 4" round or square outlet box for quick and easy installation. Luminaire has a slotted gasket wireway and attaches to the mounting bracket via corrosion-resistant screws.

### LISTINGS

CSA certified to U.S. and Canadian standards. Rated for -40°C minimum ambient.

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org to confirm which versions are qualified.

### WARRANTY

Five-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

**Note:** Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.


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# Streetworks

## DESCRIPTION

The XNV2 LED roadway luminaire combines optical performance, energy efficiency, and outstanding versatility to meet the requirements of any roadway application. Patented AccuLED Optics™ technology delivers unparalleled uniformity and budget-beating operating costs for municipal streets and highways. UL/cUL listed for wet locations. IP66 enclosure rating available.

| | | |
|---|---|---|
| Catalog # | | Type |
| Project | | |
| Comments | | Date |
| Prepared by | | |

## SPECIFICATION FEATURES

### Construction
Heavy-duty cast aluminum housing and door. Tool-less entry, hinged removable door for easy maintenance. 3G vibration rated. Light square is IP66 rated.

### Optics
Patented, high-efficiency injection-molded AccuLED Optics™ system. Optics are precisely designed to shape the distribution, maximizing efficiency and uniformity while optimizing application spacing. Offered standard in 4000K (+/-275K) CCT and 70 CRI.

### Electrical
120-277V 50/60Hz, 347V 60Hz or 480V 60Hz operation. 480V is compatible for use with 480V Wye systems only. Standard with 0-10V dimming driver. 10kV / 10kA common- and differential-mode surge protection standard. Thermal management transfers heat rapidly away from the LED source for optimal efficiency and light output. Ambient operating temperature from -40˚C to 40˚C. Standard three-position tunnel type compression terminal block. 90% lumen maintenance expected at 60,000 hours. Standard 1A drive current.

### Mounting
Two-bolt/one-bracket slipfitter with cast-in pipe stop and 2.5˚ leveling steps. Fixed-in-place bird guard seals around 1-1/4" to 2" (1-5/8" to 2-3/8" O.D.) mounting arms.

### Finish
Housing and cast parts finished in 5-stage super durable TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Consult your lighting representative at Eaton for a complete selection of standard colors.

### Warranty
Five-year warranty.



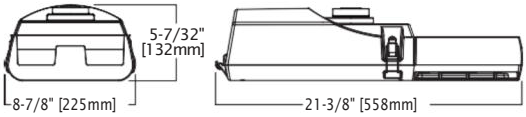
# XNV2

**2 Light Squares**

**LED**

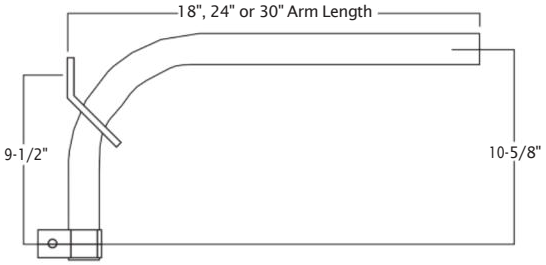
**ROADWAY LUMINAIRE**

## DIMENSIONS



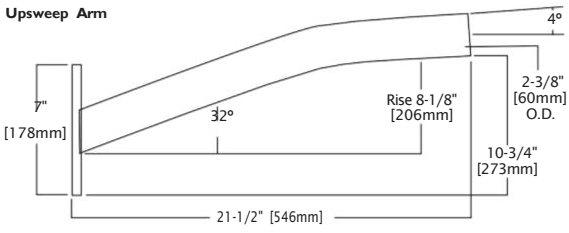

## OPTIONAL WOOD POLE PIPE ARM

**18", 24" or 30" Pipe Arm**



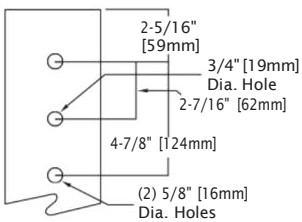

## OPTIONAL MOUNTING ARM

**Upsweep Arm**




## ARM DRILLING

**TYPE "M"**




## CERTIFICATION DATA

ISO 9001
IP66 Light Square
3G Vibration Rated
DesignLights Consortium™ Qualified*
10kV/10kA, UL 1449 Surge Protection
UL and cUL Wet Location Listed

## ENERGY DATA

**Electronic LED Driver**
0.9 Power Factor
<20% Total Harmonic Distortion
120-277V/50 and 60 Hz, 347V/60 Hz, 480V/60 Hz
-40˚C Minimum Temperature Rating
+40˚C Ambient Temperature Rating

## EPA

**Effective Projected Area (Sq. Ft.):** 1.0

## SHIPPING DATA

**Approximate Net Weight:**
22 lbs. (10.0 kgs.)

Powering Business Worldwide

*www.designlights.org

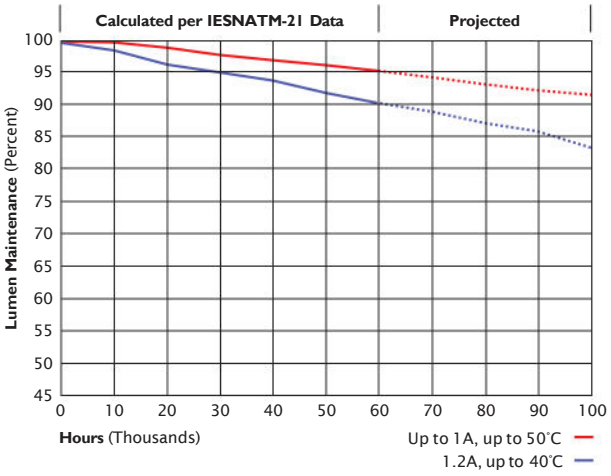
## POWER AND LUMENS

| Number of LED Squares | | 2 | 2 | 2 | 2 |
|---|---|---|---|---|---|
| LED Drive Current | | 1.2A | 1A | 800mA | 600mA |
| Luminaire Wattage (Nominal) | | 128 | 111 | 85 | 66 |
| Input Current @ 120V (A) | | 1.16 | 1.02 | 0.77 | 0.58 |
| Input Current @ 277V (A) | | 0.48 | 0.42 | 0.36 | 0.28 |
| Optics | | | | | |
| T2R | 4000K/5000K Lumens | 13,863 | 12,637 | 10,210 | 8,326 |
| | 3000K Lumens | 12,272 | 11,186 | 9,038 | 7,370 |
| | BUG Rating | B2-U0-G2 | B2-U0-G2 | B1-U0-G2 | B1-U0-G2 |
| T3R | 4000K/5000K Lumens | 13,454 | 12,265 | 9,909 | 8,081 |
| | 3000K Lumens | 11,909 | 10,857 | 8,771 | 7,153 |
| | BUG Rating | B2-U0-G2 | B2-U0-G2 | B1-U0-G2 | B1-U0-G2 |
| T4FT | 4000K/5000K Lumens | 13,333 | 12,154 | 9,820 | 8,008 |
| | 3000K Lumens | 11,802 | 10,759 | 8,693 | 7,089 |
| | BUG Rating | B2-U0-G3 | B2-U0-G2 | B1-U0-G2 | B3-U0-G1 |
| T4W | 4000K/5000K Lumens | 13,072 | 11,916 | 9,628 | 7,851 |
| | 3000K Lumens | 11,571 | 10,548 | 8,523 | 6,950 |
| | BUG Rating | B2-U0-G3 | B2-U0-G2 | B2-U0-G2 | B2-U0-G2 |
| 5NQ | 4000K/5000K Lumens | 13,600 | 12,397 | 10,016 | 8,168 |
| | 3000K Lumens | 12,039 | 10,974 | 8,866 | 7,230 |
| | BUG Rating | B3-U0-G2 | B3-U0-G2 | B3-U0-G1 | B3-U0-G1 |
| 5MQ | 4000K/5000K Lumens | 14,088 | 12,842 | 10,376 | 8,462 |
| | 3000K Lumens | 12,471 | 11,368 | 9,185 | 7,491 |
| | BUG Rating | B4-U0-G2 | B4-U0-G2 | B3-U0-G2 | B3-U0-G2 |
| 5WQ | 4000K/5000K Lumens | 13,762 | 12,545 | 10,136 | 8,266 |
| | 3000K Lumens | 12,182 | 11,105 | 8,972 | 7,317 |
| | BUG Rating | B4-U0-G2 | B4-U0-G2 | B4-U0-G2 | B3-U0-G2 |
| SL2 | 4000K/5000K Lumens | 12,968 | 11,822 | 9,552 | 7,789 |
| | 3000K Lumens | 11,479 | 10,465 | 8,455 | 6,895 |
| | BUG Rating | B2-U0-G3 | B2-U0-G3 | B2-U0-G2 | B1-U0-G2 |
| SL3 | 4000K/5000K Lumens | 13,212 | 12,043 | 9,731 | 7,935 |
| | 3000K Lumens | 11,695 | 10,660 | 8,614 | 7,024 |
| | BUG Rating | B2-U0-G3 | B2-U0-G3 | B1-U0-G2 | B1-U0-G2 |
| SL4 | 4000K/5000K Lumens | 12,620 | 11,504 | 9,294 | 7,579 |
| | 3000K Lumens | 11,171 | 10,183 | 8,227 | 6,709 |
| | BUG Rating | B1-U0-G3 | B1-U0-G3 | B1-U0-G3 | B1-U0-G3 |

* Nominal lumen data for 70 CRI. BUG rating for 4000K/5000K. Refer to IES files for 3000K BUG rating.

## LUMEN MAINTENANCE

| Drive Current | Ambient Temperature | TM-21 Lumen Maintenance (60,000 hours) | Projected L70 (Hours) |
|---|---|---|---|
| Up to 1A | Up to 40°C | > 95% | 416,000 |
| 1.2A | Up to 40°C | > 90% | 205,000 |




## LUMEN MULTIPLIER

| Ambient Temperature | Lumen Multiplier |
|---|---|
| 10°C | 1.02 |
| 15°C | 1.01 |
| 25°C | 1 |
| 40°C | 0.99 |

Eaton
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.eaton.com/lighting

Specifications and dimensions subject to change without notice.

## ORDERING INFORMATION

**Sample Number**: XNV2-AF-02-E-U-2-10K-4-AP

| Product Family [1,2,3] | Light Engine | Number of Light Squares | Driver | Voltage | Distribution | Surge Protection |
|---|---|---|---|---|---|---|
| **XNV2**=XNV2 | **AF**=Version AF | **02**=2 | **D**=Dimming (0-10V) | **U**=Universal (120-277V)<br>**8**=480V [4]<br>**9**=347V | **T2R**=Type II Roadway<br>**T3R**=Type III Roadway<br>**T4FT**=Type IV ForwardThrow<br>**T4W**=Type IV Wide<br>**5NQ**=Type V Narrow<br>**5MQ**=Type V Square Medium<br>**5WQ**=Type V Square Wide<br>**SL2**=Type II with Spill Control<br>**SL3**=Type III with Spill Control<br>**SL4**=Type IV with Spill Control | **10K**=Cooper 10kV Surge Module (Standard)<br>**X**=Driver Surge Protection Only [5] |

| Options (Add as Suffix) | Color | Accessories (Order Separately) |
|---|---|---|
| **7030**=70 CRI / 3000K CCT [6]<br>**8030**=80 CRI / 3000K CCT [6]<br>**7050**=70 CRI / 5000K CCT [6]<br>**600**=Drive Current Factory Set to Nominal 600mA<br>**800**=Drive Current Factory Set to Nominal 800mA<br>**1200**=Drive Current Factory Set to Nominal 1200mA [7]<br>**4**=NEMA Twistlock Photocontrol Receptacle [8]<br>**4N7**=NEMA 7-PIN Twistlock Photocontrol Receptacle [8]<br>**K**=Level Indicator<br>**IP66**=IP66 Rated<br>**MS/DIM-L08**=Programmable Motion Sensor, Maximum 8' Mounting Height [9]<br>**MS/DIM-L20**= Programmable Motion Sensor, Maximum 20' Mounting Height [9]<br>**MS/DIM-L40**= Programmable Motion Sensor, Maximum 40' Mounting Height [9]<br>**LWR-LW**=LumaWatt Wireless Sensor, Wide Lens for 8' - 16' Mounting Height [10,11]<br>**LWR-LN**=LumaWatt Wireless Sensor, Narrow Lens for 16' - 40' Mounting Height [10,11]<br>**AI**=Site Arm Included [12]<br>**B18**=18" Wood Pole Pipe Arm [13]<br>**B24**=24" Wood Pole Pipe Arm [13]<br>**B30**=30" Wood Pole Pipe Arm [13] | **AP**=Grey (Standard)<br>**BZ**=Bronze<br>**BK**=Black<br>**DP**=Dark Platinum<br>**GM**=Graphite Metallic<br>**WH**=White<br>**A**=Raw Aluminum Unfinished | **OA/RA1016**=NEMA Photocontrol - Multi-Tap<br>**OA/RA1027**=NEMA Photocontrol - 480V<br>**OA/RA1201**=NEMA Photocontrol - 347V<br>**OA/RA1013**=Photocontrol Shorting Cap<br>**OA/RA1014**=NEMA Photocontrol - 120V<br>**OA1223**=10kV Surge Module Replacement<br>**FSIR-100**=Wireless Configuration Tool for Motion Sensor [14]<br>**LS/HSS-XX**=Light Square House Side Shield [15] |

**NOTES:**

1. Customer is responsible for engineering analysis to confirm pole and fixture compatiblity for all applications. Refer to our white paper WP513001EN for additional support information.
2. DesignLights Consortium™ Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details.
3. Standard 4000K CCT and 70 CRI.
4. Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems).
5. Consult factory for driver surge protection values.
6. Consult factory for lead times. Use dedicated IES files.
7. Not available in combination with 347V/480V and sensor options.
8. Not available with any sensor options.
9. Factory installed. Includes integral photocontrol. Use FSIR-100 accessory to adjust factory settings.
10. LumaWatt wireless sensors are factory installed only requiring network components in appropriate quantities. See www.eaton.com/lighting for LumaWatt application information.
11. LumaWatt wireless system is not available with 4 or 4N7 options. Includes integral photocontrol.
12. 22" upsweep arm. Round pole adapter included. See optional mounting arm drawing.
13. 1-1/4" pipe plus hardware for mounting to wood utility pole. See optional wood pole mounting bracket drawing.
14. Hand-held tool that enables adjustment of parameters, including high and low modes, sensitivity, time delay, cutoff, and more. Consult your lighting representative at Eaton for more information. Only available with dimming driver.
15. Replace XX with color.

KIM LIGHTING

# Solitaire **SRS1**

Clear Acrylic Lens / Die-Cast Aluminum Top, PicoEmitter™ LED

12/19/13 • kl_srs1eled_spec.pdf

**Type:**
**Job:**
**Catalog number:**

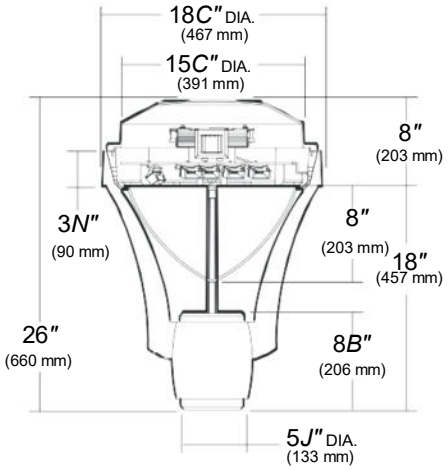
/ / / /

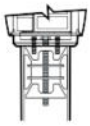
| Mtg. | Fixture | Electrical Module | Finish | Options |
|---|---|---|---|---|
| | See page 2 | See page 3 | | See pages 4 - 6 |

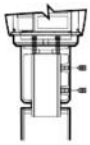
**Approvals:**

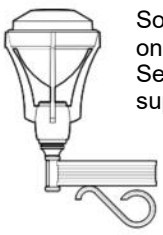
**Date:**
**Page: 1 of 6**

## Specifications




**FM**  4"O.D. extruded aluminum pole

**PT**  Pole with 2" pipe-size tenon (2*C*"O.D. x 4*K*" min. length)

 Solitaire shown on HA32S arm. See p. 5 for other support arm options.

**Top:** Lamp and reflector are accessible by loosening four stainless steel captive screws. Die-Cast, low copper (<0.6% Cu) aluminum alloy.

**Lens:** Clear high-temperature acrylic.

**Reflector Ring:** Die-cast, low copper (<0.6% Cu) aluminum alloy sealed with one-piece silicone gaskets.

**Arms:** Die-cast, low copper (<0.6% Cu) aluminum alloy with sealed wireway channels.

**Mounting Chamber:** Cast, low copper (<0.6% Cu) aluminum alloy with removable cover for access to mounting hardware for head and removal. Sealed with one-piece silicone gaskets. Mounted by one of the following pole attachment means:

**FM** - Flush Mounting by means of an expansion device activated by a single bolt within the splice compartment. Pole must have a plain-cut top. Standard pole size is 4" O.D. (Other pole adapter sizes available; contact Kim representative.)

**PT** - Pole Tenon mounting by means of a cast aluminum adapter containing four recessed *C*" stainless steel allen head set screws. Pole must have a 2" pipe-size tenon (2*C*" O.D. x 4*K*" minimum length). Pole tenon must be field drilled at one set screw location to secure against fixture rotation.

**Electronic Module:** All electrical components are UL and CSA recognized, mounted on a single plate and factory prewired with quick-disconnect plugs. Module includes a driver, LifeShield™ temperature control device and surge protector. Electrical module attaches to housing with key hole slots, accessible by opening the lens frame and removing optical module. Driver is rated for -40°F starting temperature and has a 0-10V dimming interface on the LifeShield device for multi-level illumination options.

**Optical Module:** Precision, replaceable PicoEmitters are positioned to achieve directional control toward desired task. The entire EmitterDeck™ mounting assembly fastens to housing as a one-piece module.

**Finish/Color:** TGIC thermoset polyester powder coat paint, 2.5 mil nominal thickness. Standard colors are Black, Dark Bronze, Light Gray, Stealth Gray™, Platinum Silver, or White. Custom colors are available.

**Listed To:** UL 1598 Standard for Luminaires - UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products and CSA C22.2#250.0 Luminaires.

**Warranty:** Kim Lighting warrants SolitaireLED products sold by Kim Lighting to be free from defects in material and workmanship for (i) a period of five (5) years for metal parts, (ii) a period of ten (10) years for exterior housing paint finish(s), (iii) a period of six (6) years for LED Light Engines (PicoEmitter reflectors) and, (iv) a period of five (5) years for LED power components (LED Driver, LifeShield temperature control device, surge protector), from the date of sale of such goods to the buyer as specified in Kim Lighting shipment documents for each product. This warranty applies only to the use of the Product(s) as intended by Kim Lighting and does not cover any misapplication or misuse of said Product(s), or installation in hazardous or corrosive environments. In no event shall Kim Lighting's total liability for any reason arising hereunder exceed the purchase price paid to Kim Lighting for the product purchased by the buyer hereunder. Contact Kim Lighting for complete warranty language, exceptions, and limitations.

**CAUTION:** Fixtures must be grounded in accordance with national, state, and/or local codes. Failute to do so may result in serious personal injury.

HUBBELL LIGHTING, INC.

**U.S. Patent D444,584**

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# Standard Features

## Mounting



Cat. No.: ☐ **FM** ☐ **PT** ☐ **1SA** ☐ **2SB** ☐ **3SY** ☐ **4SC** ☐ **1W**

**NOTE: FM** Flush Mount for direct mounting to top of pole. 4" O.D. poles only. **PT** Pipe Tenon Mount for poles with 2" pipe (2C" x 4" length). **1SA, 2SB, 3SY** and **4SC** mounting arms are part of the Pole Assembly or Slipfitter Mount. See p. **5** for styles. **1W** Wall Mount arm not included and must be ordered separately. Refer to Kim Lighting's Arms & Poles Selection Guide for EPA information and additional information on arm, tenon and wall mounting.

## Fixture

Cat. No. designates fixture and optic

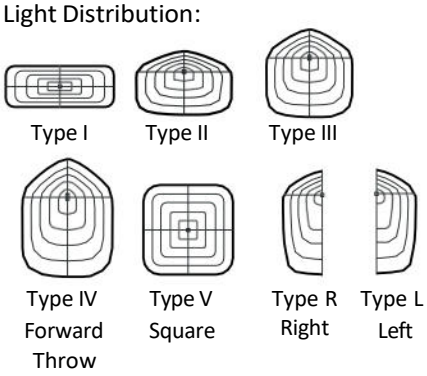
SRS1 x E35

**Housing Size:**
SRS1

**Distribution:**
- ☐ H1 = Type I
- ☐ H2 = Type II
- ☐ H3 = Type III
- ☐ H4 = Type IV
- ☐ H5 = Type V
- ☐ HR = Type R Right
- ☐ HL = Type L Left

E35 = 350mA

Light Distribution:




## Electrical Module

Cat. Nos. for Electrical Modules available:

60L xK x

**Source:**
60L = 60 LED's

**Color Temperature:**
- ☐ 3K = 3000K
- ☐ 4K = 4200K
- ☐ 5K = 5100K
- ☐ 2K = 580nm - Amber

**Voltage:**
- ☐ ~~120 = 120V~~
- ☐ ~~208 = 208V~~
- ☐ 240 = 240V
- ☐ 277 = 277V
- ☐ 347 = 347V[1]
- ☐ 480 = 480V[1]

[1]Due to current unavailability of 347V and 480V drivers, specification of these voltages may feature an integral step-down transformer.

## Finish

TGIC powder coat

| Color: | Black | Dark Bronze | Light Gray | Stealth Gray | Platinum Silver | White | Custom Color[1] |
|---|---|---|---|---|---|---|---|
| Cat. No.: | ☐ **BL** | ☐ **DB** | ☐ **LG** | ☐ **SG** | ☐ **PS** | ☐ **WH** | ☐ **CC** |

[1]Custom colors subject to additional charges, minimum quantities and extended lead times. Consult representative. Custom color description: _____



# Optional Features

**Neighbor Friendly Optic:**
Cat. No. ☐ **NFO**
☐ **No Option**

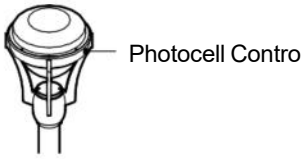
Integrated Neighbor Friendly Optic on each PicoEmitter™ module to completely control unwanted backlight. Most effective with Type III and IV distibutions.




**Photocell Control**
Cat. No. **(See right)**
☐ **No Option**

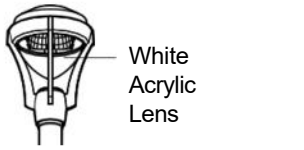
Factory installed photocell inside housing with a fully gasketed sensor on the side wall. For twin arm mount, each fixture has a photocell.

| Cat. No. | Line Volts: | Cat. No. | Line Volts: |
|---|---|---|---|
| ☐ **A-30** | 120V | ☐ **A-33** | 277V |
| ☐ **A-31** | 208V | ☐ **A-35** | 347V |
| ☐ **A-32** | 240V | ☐ **A-34** | 480V |




**White Acrylic Lens**
Cat. No. ☐ **WA**
☐ **No Option**

White high-temperature acrylic.

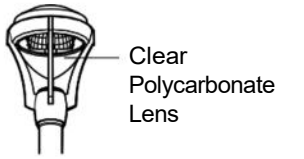



**Polycarbonate Lens**
Cat. No. ☐ **CP**
☐ **WP**
☐ **No Option**

**CP** Clear, injection molded, UV stabilized polycarbonate.

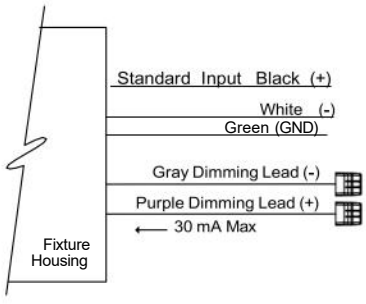
**WP** White, injection molded, UV stabilized polycarbonate. Replaces standard bottom acrylic lens.

**CAUTION:** Use only when vandalism is anticipated to be high. Useful life of lens is limited by UV discoloration from sunlight.




**0-10V Dimming Interface**

Driver has a 0-10V dimming interface with a dimming range of 10-100%. Is compatible with most control systems including Hubbell Building Automation wiHUBB™. Approved dimmers include Lutron Diva AVTV, Lutron Nova NFTV and NTFTV. Note: Not compatible with current sourcing dimmers. Controls compatible via Gray and Purple dimming lead.




**Fusing**
Cat. No. **(See right)**
☐ **No Option**

High temperature fuse holders factory installed inside ballast chamber. Fuse is included.

| Line Volts: | 120V | 208V | 240V | 277V | 347V | 480V |
|---|---|---|---|---|---|---|
| Cat. No.: | ☐ **SF** | ☐ **DF** | ☐ **DF** | ☐ **SF** | ☐ **SF** | ☐ **DF** |

**Poles**

See Kim Lighting's Arms and Poles Selection Guide.

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# Optional Features

**Outdoor Occupancy Sensor**

Cat. No. **(See right)**

☐ **No Option**

### Side Pole Mount

Outdoor Occupancy Sensor with 0-10VDC dimming control mounts directly to the underside of the luminaire. Wide 360° pattern. Available in voltages to match luminaire from 120 through 480VAC. Module color available in Black, Gray, or White (Picked at the factory when luminaire color is chosen, black used for dark colors). Field Adjustable Timeout settings for 5, 10, 15, and 30 minutes (Factory default is 5-minutes). Field adjustable unoccupied dimming level, 20%, 50%, 60%, or 70% (Factory default is 50%). One sensor can support multiple units up to 1500 watts. (Wiring from module to luminaire(s) is by-others). Mounted to a cast pole adapter painted to match pole.

Cat. No.

☐ **SCL-R*/ **/ ***** – Pole Occupancy Sensor up to 16′, UNV (120-347V) or 480V. Specify pole diameter.

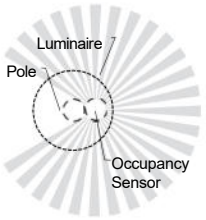
☐ **SCL-S/ **/ ***** – Pole Occupancy Sensor up to 16′, UNV (120-347V) or 480V. Square pole mount.

☐ **SCH-R*/ **/ ***** – Pole Occupancy Sensor up to 30′, UNV (120-347V) or 480V. Specify pole diameter.

☐ **SCH-S/ **/ ***** – Pole Occupancy Sensor up to 30′, UNV (120-347V) or 480V. Square pole mount.

* Pole Diameter, ** Voltage, *** Color

**Ordering Example: SCL-R4/277/BL**

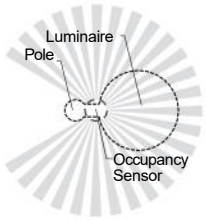



Side Pole Mount
Detection Pattern
Top View for Round Luminaire
Mounted on Post Top

**NOTE:** Occupancy detection is blocked directly behind pole. Install occupancy sensor as far away from pole as possible to maximize detection.



Outdoor
Occupancy Sensor
Side Pole Mount



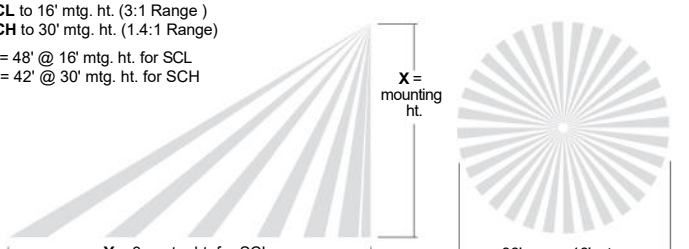

Side Pole Mount
Detection Pattern
Top View for Round Luminaire
Mounted on Arm

**NOTE:** For 360° coverage, install two occupancy sensors 180° apart on pole

### Sensor Lens Coverage and Detection Patterns

**SCL** to 16' mtg. ht. (3:1 Range )
**SCH** to 30' mtg. ht. (1.4:1 Range)

**Y** = 48' @ 16' mtg. ht. for SCL
**Y** = 42' @ 30' mtg. ht. for SCH




Side View

Top View



# Optional Features

## Arms

**Note:** Refer to Kim Lighting's Arms and Poles Specification Guide for EPA information and additional information on arm, tenon and wall mounting. **1W** Wall Mount arm is **not** included and must be ordered separately.

Mounting Orientation
**1SA**
**2SB**
**3SY**
**4SC**

### Side Mount Swept Cast Arm

| ARM | Tenon Mount | Wall Mt |
|---|---|---|
|  |  |  |
| **HA11S** | **HA11S-TM1**<br>**HA11S-TM2**<br>**HA11S-TM3**<br>**HA11S-TM4** | **HA11S-W** |

### Side Pole S-Shaped Up Cast Arm

| ARM | Tenon Mount | Wall Mt |
|---|---|---|
|  |  |  |
| **HA12S** | **HA12S-TM1**<br>**HA12S-TM2**<br>**HA12S-TM3**<br>**HA12S-TM4** | **HA12S-W** |

### Side Pole S-Shaped Down Cast Arm

| ARM | Tenon Mount | Wall Mt |
|---|---|---|
|  |  |  |
| **HA13S** | **HA13S-TM1**<br>**HA13S-TM2**<br>**HA13S-TM3**<br>**HA13S-TM4** | **HA13S-W** |

### Side Pole Ribbon Arm w/ Bottom Scroll

| ARM | Tenon Mount | Wall Mt |
|---|---|---|
|  |  |  |
| **HA32S** | **HA32S-TM1**<br>**HA32S-TM2**<br>**HA32S-TM3**<br>**HA32S-TM4** | **HA32S-W** |

### Side Pole Ribbon Arm w/ Bottom Gusset

| ARM | Tenon Mount | Wall Mt |
|---|---|---|
|  |  |  |
| **HA34S** | **HA34S-TM1**<br>**HA34S-TM2**<br>**HA34S-TM3**<br>**HA34S-TM4** | **HA34S-W** |

### Side Pole Ribbon Arm w/ Bottom Brace

| ARM | Tenon Mount | Wall Mt |
|---|---|---|
|  | | |
| **HA36S** | **HA36S-TM**<br>Consult<br>Factory | **HA36S-W**<br>Consult<br>Factory |

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# Lumen Data

| **Spectroradiometric** | | | |
|---|---|---|---|
| | 3000K Average | 4200K Average | 5100K Average |
| Correlated Color Temp. CCT (K) | 2800K-3175K | 3800K-4600K | 4600K-5600K |
| Color Rendering Index (CRI) | ≤80 | ≤80 | ≤70 |
| Power Factor | >.90 | >.90 | >.90 |

| **Projected Lumen Maintenance** | | |
|---|---|---|
| mA | 100,000 hrs | (Calculated L70) |
| 350 | 94.60% | 778,000 Hrs. |

| **Electrical** Drive Current | | |
|---|---|---|
| Volts - AC | Amps - AC | System Watts |
| 120 | 0.56 | 67 |
| 208 | 0.32 | 67 |
| 240 | 0.28 | 67 |
| 277 | 0.24 | 67 |
| 347 | 0.19 | 67 |
| 480 | 0.14 | 67 |

**B.U.G. Rating** (TM15) in Lumens wher B = Backlight, U = Uplight, G = Glare

| Temperature | TYPE 1 | TYPE 2 | TYPE 3 | TYPE 3 NFO | TYPE 4 | TYPE 4 NFO | TYPE 5 | TYPE L/R |
|---|---|---|---|---|---|---|---|---|
| 3000K | TBD | B1 U2 G1 | B1 U2 G1 | N/A | B1 U2 G1 | B0 U2 G1 | B2 U2 G1 | TBD |
| 4200K | TBD | B2 U2 G2 | B1 U2 G2 | N/A | B1 U2 G2 | B1 U2 G1 | B3 U2 G1 | TBD |
| 5100K | TBD | B2 U2 G2 | B1 U2 G2 | N/A | B1 U2 G2 | B1 U2 G2 | B3 U2 G1 | TBD |

**Absolute Lumens**

| Temperature | TYPE 1 | TYPE 2 | TYPE 3 | TYPE 3 NFO | TYPE 4 | TYPE 4 NFO | TYPE 5 | TYPE L/R |
|---|---|---|---|---|---|---|---|---|
| 3000K | TBD | 3920 | 3905 | N/A | 4101 | 3572 | 3972 | TBD |
| 4200K | TBD | 4982 | 4963 | N/A | 5212 | 4539 | 5048 | TBD |
| 5100K | TBD | 5430 | 5409 | N/A | 5680 | 4947 | 5502 | TBD |

LED performance and lumen output continues to improve at a rapid pace. Log onto www.kimlighting.com to download the most current photometric files from Kim Lighting's IES File Library.
For custom optics and color temperature configurations, contact factory.

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KIM LIGHTING

# SRS1-LED-KIT

Solitaire, PicoEmitter™ LED Upgrade Kit

12/19/13 • kl_srs1eledkit_spec.pdf

**Type:**
**Job:**
**Catalog number:**

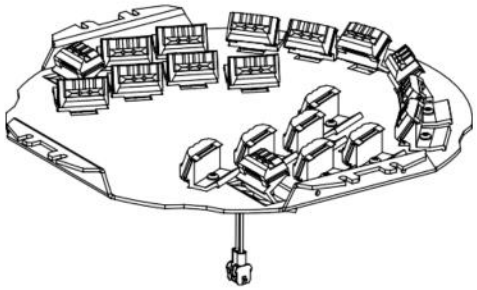
_____ / _____ / _____
LED Kit | Electrical Module | Option

**Approvals:**

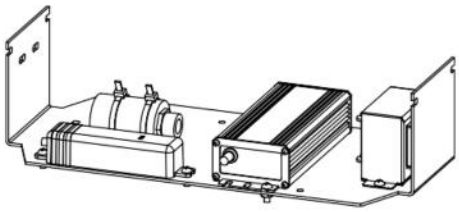
**Date:**


## Specifications

**SRS1-LED-KIT**
60 Light Emitting Diodes
Total Max System Watts = 67W
Maximum Weight = 30 lbs.
when installed in Solitaire LED



LED EmitterDeck®



LED Driver Assembly

**Electronic Module:** All electrical components are UL recognized, mounted on a single plate and factory prewired with quick-disconnect plugs. Module includes a driver, LifeShield® temperature control device and surge protector. The electronic module mounts to the top of the optical module. Driver is rated for -40°F starting temperature and has a 0-10V dimming interface for multi-level illumination options.

**Optical Module:** Precision, replaceable PicoEmitters are positioned to achieve directional control toward desired task. The electronic module and optical module fasten as one piece to the Solitaire housing with six Philips head screws.

**Listed To:** UL 1598 Standard for Luminaires - UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products and CSA C22.2#250.0 Luminaires.

**NOTE:** Existing product conditions are taken as the base point. Participation rules apply. See complete warranty provisions for further details.

**IMPORTANT:** Disable all power to the luminaire before conducting any maintenance or upgrade activity. Failure to do so will create a hazardous working environment.

**CAUTION:** Fixtures must be grounded in accordance with national, state and/or local electrical codes. Failure to do so may result in serious personal injury.

**Suggested Tools:**
- Flathead Screw Driver
- Phillips Screw Driver

HUBBELL
HUBBELL LIGHTING, INC.

KIM LIGHTING RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.



## Standard Features

**Fixture**
Cat. No. designates fixture and distribution

SRS1-LED-KIT — x

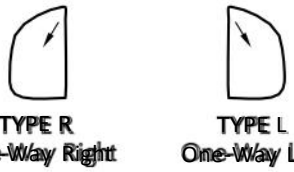
**Upgrade Kit:**
SRS1-LED-KIT

**Distribution:**
- 1 = Type I
- 2 = Type II
- 3 = Type III
- 4 = Type IV
- 5 = Type V

- R = Type R Right
- L = Type L Left

**Light Distribution:**




**Electrical Module**

Cat. Nos. for Electrical Modules available:

60L — x — x

**Source:**
60L = 60 LED's

**Color Temperature:**
- 2K = 580nm - Amber
- 3K = 3000K
- 4K = 4200K
- 5K = 5100K

**Voltage:**
- 120 = 120V
- 208 = 208V
- 240 = 240V
- 277 = 277V
- 347 = 347V[1]
- 480 = 480V[1]

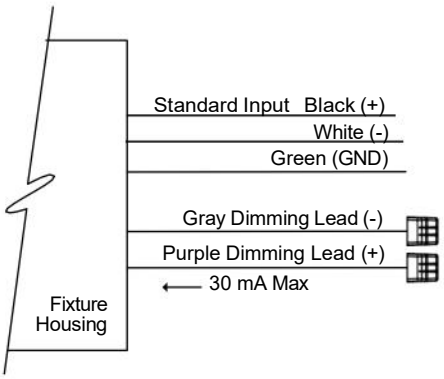
[1]Due to current unavailability of 347V and 480V drivers, specification of these voltages may feature an integral step-down transformer.



## Standard Features

**0-10V Dimming Interface**

Driver has a 0-10V dimming interface with a dimming range of 10-100%. Is compatible with most control systems including Hubbell Building Automation wiHUBB™. Approved dimmers include Lutron Diva AVTV, Lutron Nova NFTV and NTFTV. Note: Not compatible with current sourcing dimmers. Controls compatible via Gray and Purple dimming lead.




## Optional Features

**Neighbor Friendly Optic:**
Cat. No. ❙ **NFO**
❙ **No Option**

Integrated Neighbor Friendly Optic on each PicoEmitter™ module to completely control unwanted backlight. Most effective with Type III and IV distributions.



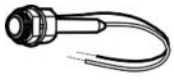




**Fusing**
Cat. No. **(see right)**
❙ **No Option**

High temperature fuse holders factory installed inside the fixture housing. Fuse included.

| Line Volts: | 120V | 208V | 240V | 277V | 347V | 480V |
|---|---|---|---|---|---|---|
| Cat. No.: | ❙ **SF** | ❙ **DF** | ❙ **DF** | ❙ **SF** | ❙ **SF** | ❙ **DF** |



Single Fuse



## Lumen Data

| **Spectroradiometric** | | | |
|---|---|---|---|
| | 3000K Average | 4200K Average | 5100K Average |
| Correlated Color Temp. CCT (K) | 2800K-3175K | 3800K-4600K | 4600K-5600K |
| Color Rendering Index (CRI) | ≤80 | ≤80 | ≤70 |
| Power Factor | >.90 | >.90 | >.90 |

| **Projected Lumen Maintenance** | | |
|---|---|---|
| mA | 100,000 hrs | (Calculated L70) |
| 350 | 94.60% | 778,000 Hrs. |

| **Electrical** Drive Current | | |
|---|---|---|
| Volts - AC | Amps - AC | System Watts |
| 120 | 0.56 | 67 |
| 208 | 0.32 | 67 |
| 240 | 0.28 | 67 |
| 277 | 0.24 | 67 |
| 347 | 0.19 | 67 |
| 480 | 0.14 | 67 |

| **B.U.G. Rating** (TM15) in Lumens wher B = Backlight, U = Uplight, G = Glare | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Temperature | TYPE 1 | TYPE 2 | TYPE 3 | TYPE 3 NFO | TYPE 4 | TYPE 4 NFO | TYPE 5 | TYPE L/R |
| 3000K | TBD | B1 U2 G1 | B1 U2 G1 | N/A | B1 U2 G1 | B0 U2 G1 | B2 U2 G1 | TBD |
| 4200K | TBD | B2 U2 G2 | B1 U2 G2 | N/A | B1 U2 G2 | B1 U2 G1 | B3 U2 G1 | TBD |
| 5100K | TBD | B2 U2 G2 | B1 U2 G2 | N/A | B1 U2 G2 | B1 U2 G2 | B3 U2 G1 | TBD |

| **Absolute Lumens** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Temperature | TYPE 1 | TYPE 2 | TYPE 3 | TYPE 3 NFO | TYPE 4 | TYPE 4 NFO | TYPE 5 | TYPE L/R |
| 3000K | TBD | 3920 | 3905 | N/A | 4101 | 3572 | 3972 | TBD |
| 4200K | TBD | 4982 | 4963 | N/A | 5212 | 4539 | 5048 | TBD |
| 5100K | TBD | 5430 | 5409 | N/A | 5680 | 4947 | 5502 | TBD |

LED performance and lumen output continues to improve at a rapid pace. Log onto www.kimlighting.com to download the most current photometric files from Kim Lighting's IES File Library.
For custom optics and color temperature configurations, contact factory.



# HID To LED Upgrade Kit Warranty

When properly installed and under normal conditions of use, Kim Lighting warrants LED Upgrade Kit products ("Product(s)") sold by Kim Lighting to be free from defects for (i) a period of five (5) years for LED Light Engines (PicoEmitters),(ii) a period of five (5) years for LED power components(LED Driver, LifeShield Device), (iii) a period of six (6) years for LED Light Engines (PicoEmitters) and (iv) for a period of five (5) years for the re-used metal housing components of the existing luminaire from the date of sale of the LED Upgrade Kit to the buyer as specified in Kim Lighting shipment documents for each Product(s). Conditions and limitations of the re-used metal housing component warranty are as follows: 1) Existing luminaire must have been purchased within 10 years prior to the date of sale of the Upgrade Kit, 2) Poles, arms, accessories, and options are excluded, 3) Products installed in harsh or hazardous environments are excluded, 4) Warranty covers defects in material and workmanship in excess of the normal wear and tear to which the luminaire can normally be expected to experience at the judgment of Kim Lighting from the baseline condition of the luminaire at the time of installation and registration of the LED Upgrade Kit, 5) Owner must within 30 days of shipment of the LED Upgrade Kit by Kim Lighting register the project by emailing at least five (5) photo images of at least three (3) upgraded housings to upgrade@kimlighting.com referencing the project name and location, LED Upgrade Kit purchase order number, and approximate purchase date of the existing housing(s). Failure to provide complete registration information within the required 30 days will dissolve the five year housing warranty. 6) Kim Lighting reserves the right to deny the five year metal housing component warranty extension upon review of the submitted product images if the existing/original condition of the product indicates substantially excessive wear and tear beyond normal expectations given the product age. 7) Paint/finish of the fixture housing is excluded from this warranty for fixtures that have been installed for more than ten (10) years prior to the application of and are not included as part of Kim Lighting warranty. The buyer agrees to make all claims regarding defects or deficiencies in the Product(s) at the time of the claim. Valid warranty claims must be made within the warranty period specified herein above, and submitted within thirty (30) days of discovery of the damage or defect. No FIELD labor, repair, DISMANTLE, or installation charges are included with this warranty. Kim Lighting may repair or replace any Product(s) covered by this warranty at its sole discretion and in accordance with its procedure. Any unauthorized return, repair, replacement or modification of the Product(s) shall avoid this warranty. This warranty applies only to the use of the Product(s) as intended by Kim Lighting and does not cover any misapplication or misuse of said Product(s), or installation in hazardous or corrosive environments. In no event shall Kim Lighting's total liability for any reason arising hereunder exceed the purchase price paid to Kim Lighting for the product purchased by the buyer hereunder. Contact Kim Lighting for complete warranty language, exceptions, and limitations.

# Appendix I
## PAPERS ON THE EFFECTS OF LEDS

A. American Medical Association CSAPH Report 2-A-16: Human and Environmental Effects of Light Emitting Diodes (LED) Community Lighting.

B. Sternberg Lighting – Blue Light Issues in a Nutshell

REPORT OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH

CSAPH Report 2-A-16

Subject: Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting

Presented by: Louis J. Kraus, MD, Chair

Referred to: Reference Committee E
(Theodore Zanker, MD, Chair)

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## INTRODUCTION

With the advent of highly efficient and bright light emitting diode (LED) lighting, strong economic arguments exist to overhaul the street lighting of U.S. roadways.[1-3] Valid and compelling reasons driving the conversion from conventional lighting include the inherent energy efficiency and longer lamp life of LED lighting, leading to savings in energy use and reduced operating costs, including taxes and maintenance, as well as lower air pollution burden from reduced reliance on fossil-based carbon fuels.

Not all LED light is optimal, however, when used as street lighting. Improper design of the lighting fixture can result in glare, creating a road hazard condition.[4,5] LED lighting also is available in various color correlated temperatures. Many early designs of white LED lighting generated a color spectrum with excessive blue wavelength. This feature further contributes to disability glare, i.e., visual impairment due to stray light, as blue wavelengths are associated with more scattering in the human eye, and sufficiently intense blue spectrum damages retinas.[6,7] The excessive blue spectrum also is environmentally disruptive for many nocturnal species. Accordingly, significant human and environmental concerns are associated with short wavelength (blue) LED emission. Currently, approximately 10% of existing U.S. street lighting has been converted to solid state LED technology, with efforts underway to accelerate this conversion. The Council is undertaking this report to assist in advising communities on selecting among LED lighting options in order to minimize potentially harmful human health and environmental effects.

## METHODS

English language reports published between 2005 and 2016 were selected from a search of the PubMed and Google Scholar databases using the MeSH terms "light," "lighting methods," "color," "photic stimulation," and "adverse effects," in combination with "circadian rhythm/physiology/radiation effects," "radiation dosage/effects," "sleep/physiology," "ecosystem," "environment," and "environmental monitoring." Additional searches using the text terms "LED" and "community," "street," and "roadway lighting" were conducted. Additional information and perspective were supplied by recognized experts in the field.

## ADVANTGAGES AND DISADVANAGES OF LED STREET LIGHTS

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Action of the AMA House of Delegates 2016 Annual Meeting: Council on Science and Public Health Report 2 Recommendations Adopted and Remainder of Report Filed.

The main reason for converting to LED street lighting is energy efficiency; LED lighting can reduce energy consumption by up to 50% compared with conventional high pressure sodium (HPS) lighting. LED lighting has no warm up requirement with a rapid "turn on and off" at full intensity. In the event of a power outage, LED lights can turn on instantly when power is restored, as opposed to sodium-based lighting requiring prolonged warm up periods. LED lighting also has the inherent capability to be dimmed or tuned, so that during off peak usage times (e.g., 1 to 5 AM), further energy savings can be achieved by reducing illumination levels. LED lighting also has a much longer lifetime (15 to 20 years, or 50,000 hours), reducing maintenance costs by decreasing the frequency of fixture or bulb replacement. That lifespan exceeds that of conventional HPS lighting by 2-4 times. Also, LED lighting has no mercury or lead, and does not release any toxic substances if damaged, unlike mercury or HPS lighting. The light output is very consistent across cold or warm temperature gradients. LED lights also do not require any internal reflectors or glass covers, allowing higher efficiency as well, if designed properly.[8,9]

Despite the benefits of LED lighting, some potential disadvantages are apparent. The initial cost is higher than conventional lighting; several years of energy savings may be required to recoup that initial expense.[10] The spectral characteristics of LED lighting also can be problematic. LED lighting is inherently narrow bandwidth, with "white" being obtained by adding phosphor coating layers to a high energy (such as blue) LED. These phosphor layers can wear with time leading to a higher spectral response than was designed or intended. Manufacturers address this problem with more resistant coatings, blocking filters, or use of lower color temperature LEDs. With proper design, higher spectral responses can be minimized. LED lighting does not tend to abruptly "burn out," rather it dims slowly over many years. An LED fixture generally needs to be replaced after it has dimmed by 30% from initial specifications, usually after about 15 to 20 years.[1,11]

Depending on the design, a large amount blue light is emitted from some LEDs that appear white to the naked eye. The excess blue and green emissions from some LEDs lead to increased light pollution, as these wavelengths scatter more within the eye and have detrimental environmental and glare effects. LED's light emissions are characterized by their correlated color temperature (CCT) index.[12,13] The first generation of LED outdoor lighting and units that are still widely being installed are "4000K" LED units. This nomenclature (Kelvin scale) reflects the equivalent color of a heated metal object to that temperature. The LEDs are cool to the touch and the nomenclature has nothing to do with the operating temperature of the LED itself. By comparison, the CCT associated with daylight light levels is equivalent to 6500K, and high pressure sodium lighting (the current standard) has a CCT of 2100K. Twenty-nine percent of the spectrum of 4000K LED lighting is emitted as blue light, which the human eye perceives as a harsh white color. Due to the point-source nature of LED lighting, studies have shown that this intense blue point source leads to discomfort and disability glare.[14]

More recently engineered LED lighting is now available at 3000K or lower. At 3000K, the human eye still perceives the light as "white," but it is slightly warmer in tone, and has about 21% of its emission in the blue-appearing part of the spectrum. This emission is still very blue for the nighttime environment, but is a significant improvement over the 4000K lighting because it reduces discomfort and disability glare. Because of different coatings, the energy efficiency of 3000K lighting is only 3% less than 4000K, but the light is more pleasing to humans and has less of an impact on wildlife.

*Glare*

Disability glare is defined by the Department of Transportation (DOT) as the following:

> "Disability glare occurs when the introduction of stray light into the eye reduces the ability to resolve spatial detail. It is an objective impairment in visual performance."

Classic models of this type of glare attribute the deleterious effects to intraocular light scatter in the eye. Scattering produces a veiling luminance over the retina, which effectively reduces the contrast of stimulus images formed on the retina. The disabling effect of the veiling luminance has serious implications for nighttime driving visibility.[15]

Although LED lighting is cost efficient and inherently directional, it paradoxically can lead to worse glare than conventional lighting. This glare can be greatly minimized by proper lighting design and engineering. Glare can be magnified by improper color temperature of the LED, such as blue-rich LED lighting. LEDs are very intense point sources that cause vision discomfort when viewed by the human eye, especially by older drivers. This effect is magnified by higher color temperature LEDs, because blue light scatters more within the human eye, leading to increased disability glare.[16]

In addition to disability glare and its impact on drivers, many residents are unhappy with bright LED lights. In many localities where 4000K and higher lighting has been installed, community complaints of glare and a "prison atmosphere" by the high intensity blue-rich lighting are common. Residents in Seattle, WA have demanded shielding, complaining they need heavy drapes to be comfortable in their own homes at night.[17] Residents in Davis, CA demanded and succeeded in getting a complete replacement of the originally installed 4000K LED lights with the 3000K version throughout the town at great expense.[18] In Cambridge, MA, 4000K lighting with dimming controls was installed to mitigate the harsh blue-rich lighting late at night. Even in places with a high level of ambient nighttime lighting, such as Queens in New York City, many complaints were made about the harshness and glare from 4000K lighting.[19] In contrast, 3000K lighting has been much better received by citizens in general.

*Unshielded LED Lighting*

Unshielded LED lighting causes significant discomfort from glare. A French government report published in 2013 stated that due to the point source nature of LED lighting, the luminance level of unshielded LED lighting is sufficiently high to cause visual discomfort regardless of the position, as long as it is in the field of vision. As the emission surfaces of LEDs are highly concentrated point sources, the luminance of each individual source easily exceeds the level of visual discomfort, in some cases by a factor of 1000.[17]

Discomfort and disability glare can decrease visual acuity, decreasing safety and creating a road hazard. Various testing measures have been devised to determine and quantify the level of glare and vision impairment by poorly designed LED lighting.[20] Lighting installations are typically tested by measuring foot-candles per square meter on the ground. This is useful for determining the efficiency and evenness of lighting installations. This method, however, does not take into account the human biological response to the point source. It is well known that unshielded light sources cause pupillary constriction, leading to worse nighttime vision between lighting fixtures and causing a "veil of illuminance" beyond the lighting fixture. This leads to worse vision than if the light never existed at all, defeating the purpose of the lighting fixture. Ideally LED lighting installations should be tested in real life scenarios with effects on visual acuity evaluated in order to ascertain the best designs for public safety.

*Proper Shielding*

With any LED lighting, proper attention should be paid to the design and engineering features. LED lighting is inherently a bright point source and can cause eye fatigue and disability glare if it is allowed to directly shine into human eyes from roadway lighting. This is mitigated by proper design, shielding and installation ensuring that no light shines above 80 degrees from the horizontal. Proper shielding also should be used to prevent light trespass into homes alongside the road, a common cause of citizen complaints. Unlike current HPS street lighting, LEDs have the ability to be controlled electronically and dimmed from a central location. Providing this additional control increases the installation cost, but may be worthwhile because it increases long term energy savings and minimizes detrimental human and environmental lighting effects. In environmentally sensitive or rural areas where wildlife can be especially affected (e.g., near national parks or bio-rich zones where nocturnal animals need such protection), strong consideration should be made for lower emission LEDs (e.g., 3000K or lower lighting with effective shielding). Strong consideration also should be given to the use of filters to block blue wavelengths (as used in Hawaii), or to the use of inherent amber LEDs, such as those deployed in Quebec. Blue light scatters more widely (the reason the daytime sky is "blue"), and unshielded blue-rich lighting that travels along the horizontal plane increases glare and dramatically increases the nighttime sky glow caused by excessive light pollution.

## POTENTIAL HEALTH EFFECTS OF "WHITE" LED STREET LIGHTING

Much has been learned over the past decade about the potential adverse health effects of electric light exposure, particularly at night.[21-25] The core concern is disruption of circadian rhythmicity. With waning ambient light, and in the absence of electric lighting, humans begin the transition to nighttime physiology at about dusk; melatonin blood concentrations rise, body temperature drops, sleepiness grows, and hunger abates, along with several other responses.

A number of controlled laboratory studies have shown delays in the normal transition to nighttime physiology from evening exposure to tablet computer screens, backlit e-readers, and room light typical of residential settings.[26-28] These effects are wavelength and intensity dependent, implicating bright, short wavelength (blue) electric light sources as disrupting transition. These effects are not seen with dimmer, longer wavelength light (as from wood fires or low wattage incandescent bulbs). In human studies, a short-term detriment in sleep quality has been observed after exposure to short wavelength light before bedtime. Although data are still emerging, some evidence supports a long-term increase in the risk for cancer, diabetes, cardiovascular disease and obesity from chronic sleep disruption or shiftwork and associated with exposure to brighter light sources in the evening or night.[25,29]

Electric lights differ in terms of their circadian impact.[30] Understanding the neuroscience of circadian light perception can help optimize the design of electric lighting to minimize circadian disruption and improve visual effectiveness. White LED streetlights are currently being marketed to cities and towns throughout the country in the name of energy efficiency and long term cost savings, but such lights have a spectrum containing a strong spike at the wavelength that most effectively suppresses melatonin during the night. It is estimated that a "white" LED lamp is at least 5 times more powerful in influencing circadian physiology than a high pressure sodium light based on melatonin suppression.[31] Recent large surveys found that brighter residential nighttime lighting is associated with reduced sleep time, dissatisfaction with sleep quality, nighttime awakenings, excessive sleepiness, impaired daytime functioning, and obesity.[29,32] Thus, white LED street lighting patterns also could contribute to the risk of chronic disease in the populations of cities in which they have been installed. Measurements at street level from white LED street lamps are needed to more accurately assess the potential circadian impact of evening/nighttime exposure to these lights.

## ENVIRONMENTAL EFFECTS OF LED LIGHTING

The detrimental effects of inefficient lighting are not limited to humans; 60% of animals are nocturnal and are potentially adversely affected by exposure to nighttime electrical lighting. Many birds navigate by the moon and star reflections at night; excessive nighttime lighting can lead to reflections on glass high rise towers and other objects, leading to confusion, collisions and death.[33] Many insects need a dark environment to procreate, the most obvious example being lightning bugs that cannot "see" each other when light pollution is pronounced. Other environmentally beneficial insects are attracted to blue-rich lighting, circling under them until they are exhausted and die.[34,35] Unshielded lighting on beach areas has led to a massive drop in turtle populations as hatchlings are disoriented by electrical light and sky glow, preventing them from reaching the water safely.[35-37] Excessive outdoor lighting diverts the hatchlings inland to their demise. Even bridge lighting that is "too blue" has been shown to inhibit upstream migration of certain fish species such as salmon returning to spawn. One such overly lit bridge in Washington State now is shut off during salmon spawning season.

Recognizing the detrimental effects of light pollution on nocturnal species, U.S. national parks have adopted best lighting practices and now require minimal and shielded lighting. Light pollution along the borders of national parks leads to detrimental effects on the local bio-environment. For example, the glow of Miami, FL extends throughout the Everglades National Park. Proper shielding and proper color temperature of the lighting installations can greatly minimize these types of harmful effects on our environment.

## CONCLUSION

Current AMA Policy supports efforts to reduce light pollution. Specific to street lighting, Policy H-135.932 supports the implementation of technologies to reduce glare from roadway lighting. Thus, the Council recommends that communities considering conversion to energy efficient LED street lighting use lower CCT lights that will minimize potential health and environmental effects. The Council previously reviewed the adverse health effects of nighttime lighting, and concluded that pervasive use of nighttime lighting disrupts various biological processes, creating potentially harmful health effects related to disability glare and sleep disturbance.[25]

## RECOMMENDATIONS

The Council on Science and Public Health recommends that the following statements be adopted, and the remainder of the report filed.

1. That our American Medical Association (AMA) support the proper conversion to community-based Light Emitting Diode (LED) lighting, which reduces energy consumption and decreases the use of fossil fuels. (New HOD Policy)

2. That our AMA encourage minimizing and controlling blue-rich environmental lighting by using the lowest emission of blue light possible to reduce glare. (New HOD Policy)

3. That our AMA encourage the use of 3000K or lower lighting for outdoor installations such as roadways. All LED lighting should be properly shielded to minimize glare and detrimental human and environmental effects, and consideration should be given to utilize the ability of LED lighting to be dimmed for off-peak time periods. (New HOD Policy)

Fiscal Note: Less than $500

REFERENCES

1. Municipal Solid State Street Lighting Consortium.

2. Illuminating Engineering Society RP-8 – Guide to Roadway Lighting.

3. LED Lighting Facts–A Program of the United States Department of Energy.

4. Lin Y, Liu Y, Sun Y, Zhu X, Lai J, Heynderickz I. Model predicting discomfort glare caused by LED road lights. *Opt Express*. 2014;22(15):18056-71.

5. Gibbons RB, Edwards CJ. A review of disability and discomfort glare research and future direction. 18th Biennial TRB Visibility Symposium, College Station TX, United States, April 17-19, 2007.

6. Shang YM, Wang GS, Sliney D, Yang CH, Lee LL. White light–emitting diodes (LEDs) at domestic lighting levels and retinal injury in a rat model. *Environ Health Perspect.* 2014:122(3):269-76.

7. Lougheed T. Hidden blue hazard? LED lighting and retinal damage in rats, *Environ Health Perspect*. 2014;122(3):A81.

8. A Municipal Guide for Converting to LED Street Lighting, 10/13/2013.

9. In depth: Advantages of LED Lighting.

10. Silverman H. How LED Streetlights Work. HowStuffWorks.com. June 22, 2009.

11. Jin H, Jin S, Chen L, Cen S, Yuan K. Research on the lighting performance of LED street lights with different color temperatures. *IEEE Photonics Journal*. 2015;24(6):975-78.

12. Morris N. LED there be light. Nick Morris predicts a bright future for LEDs. *Electrooptics.com*.

13. Mills MP. The LED illumination revolution. *Forbes Magazine*. February 27, 2008.

14. Opinion of the French Agency for Food, Environmental and Occupational Health & Safety, October 19, 2010.
15. U.S. Department of Transportation, Federal Highway Administration, 2005.

16. Sweater-Hickcox K, Narendran N, Bullough JD, Freyssinier JP. Effect of different coloured luminous surrounds on LED discomfort glare perception. *Lighting Research Technology*. 2013;45(4):464-75.

17. Scigliano E. Seattle's new LED-lit streets Blinded by the lights. *Crosscut*. March 18, 2013.

18. Davis will spend $350,000 to replace LED lights after neighbor complaints. CBS Local, Sacramento;October 21, 2014.

19. Chaban M. LED streetlights in Brooklyn are saving energy but exhausting residents. *NY Times*; March 23, 2015.
20. Vos JJ. On the cause of disability glare and its dependence on glare angle, age and ocular pigmentation. *Clin Exp Optom*. 2003;86(6):363-70.

21. Stevens RG, Brainard GC, Blask DE, Lockley, SW, Motta, ME. Breast cancer and circadian disruption from electric lighting in the modern world. *CA Cancer J Clin*. 2014;64:207-18.

22. Evans JA, Davidson AJ. Health consequences of circadian disruption in humans and animal models. *Prog Mol Biol Transl Sci*. 2013;119:283-323.

23. Wright KP Jr, McHill AW, Birks BR, Griffin BR, Rusterholz T, Chinoy ED. Entrainment of the human circadian clock to the natural light-dark cycle. *Curr Biol*. 2013;23:1554-8.

24. Energy Savings Estimates of Light Emitting Diodes in Niche Lighting Applications. Building Technologies Program, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. January 2011.

25. Council on Science and Public Health Report 4. Light pollution. Adverse effects of nighttime lighting. American Medical Association, Annual Meeting, Chicago, IL. 2012.

26. Cajochen C, Frey S, Anders D, et al. Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance. *J Appl Physiol*. 2011;110:1432-8.

27. Chang AM, Aeschbach D, Duffy JF, Czeisler CA. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proc Natl Acad Sci USA.* 2015;112:1232-7.

28. Gooley JJ, Chamberlain K, Smith KA, et al. Exposure to room light before bedtime suppresses melatonin onset and shortens melatonin duration in humans. *J Clin Endocrinol Metab*. 2011;96:E463-72.

29. Koo YS, Song JY, Joo EY, et al. Outdoor artificial light at night, obesity, and sleep health: Cross-sectional analysis in the KoGES study. *Chronobiol Int*. 2016;33(3):301-14.

30. Lucas RJ, Peirson SN, Berson DM, et al. Measuring and using light in the melanopsin age. *Trends Neurosci*. 2014;37:1-9.

31. Falchi F, Cinzano P, Elvidge CD, Keith DM, Haim A. Limiting the impact of light pollution on human health, environment and stellar visibility. *J Environ Manage*. 2011;92:2714-22.

32. Ohayon M, Milesi C. Sleep deprivation/insomnia and exposure to street lights in the American general population. American Academy of Neurology Annual Meeting. April 15-21, 2016. Vancouver, BC.

33. Pawson SM, Bader MK. Led lighting increases the ecological impact of light pollution irrespective of color temperature. *Ecological Applications*. 2014;24:1561-68.

34. Gaston K, Davies T, Bennie J, Hopkins J. Reducing the ecological consequences of night-time light pollution: Options and developments. *J Appl Ecol*. 2012;49(6):1256–66.

35. Salmon M. Protecting sea turtles from artificial night lighting at Florida's oceanic beaches. In-Rich C, Longcore T (eds.). *Ecological Consequences of Artificial Night Lighting.* 2006:141-68. Island Press, Washington, DC.

36. Rusenko KW, Mann JL, Albury R, Moriarty JE, Carter HL. Is the wavelength of city glow getting shorter? Parks with no beachfront lights record adult aversion and hatchling disorientations in 2004. Kalb H, Rohde A, Gayheart K, Shanker, K, compilers. 2008. *Proceedings of the Twenty-fifth Annual Symposium on Sea Turtle Biology and Conservation,* NOAA Technical Memorandum NMFS-SEFSC-582, 204pp.

37. Rusenko KW, Newman R, Mott C, et al. Using GIS to determine the effect of sky glow on nesting sea turtles over a ten year period. Jones TT, Wallace BP, compilers. 2012. *Proceedings of the Thirty-first Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum NOAA NMFS-SEFSC-631:32p.

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# Blue light issues in a nut shell

Recently the American Medical Association published a position paper on the effects of LED lighting on humans. There has been much back and forth over the issue since this paper was written. In order to clarify the issues in a concise way this paper will attempt to abbreviate the topic and list in bullet format the central point's being made on each side. Sternberg does not wish to take sides on this issue as we are not a scientific organization with research that will support either position. We will however try to capture for convenience sake both sides of the argument. The reader will be left to form their own opinions and decide for themselves which side if any to support.

**The issue: Is Blue light bad for people? If so how much is bad and at what exposure rate? What effects does it have on human beings?**

## AMA position:

"Despite the energy efficiency benefits, some LED lights are harmful when used as street lighting," AMA Board Member Maya A. Babu, M.D., M.B.A. "The new AMA guidance encourages proper attention to optimal design and engineering features when converting to LED lighting that minimize detrimental health and environmental effects."

- White (Blue) wavelengths create nighttime glare
- Discomfort and disability created by glare reduces visual acuity
- Blue-rich LED sources produce wavelengths that suppress melatonin production in the human body
- Bright white sources in residential areas reduce sleep times producing fatigue and impaired daytime function as well as contributing to obesity
- Has a disorienting effect on birds, insects, turtles and fish species

Recommended actions:

- Minimize and control blue-rich lighting by using sources with minimal blue wavelengths to reduce glare
- Employ proper shielding to minimize glare and to minimize effects on humans, wildlife and the environment
- Use the ability of LED to be dimmed for off peak periods

## Illuminating Engineering Society of North America (IESNA) response:

The IES is aligned with the AMA in support of the proper conversion of outdoor area and roadway lighting to LED light sources to reduce energy consumption, with proper optics and shielding to reduce glare and light trespass. The IES further supports the AMA recommendation to consider the ability to reduce light levels during off-peak periods.

IES disagrees with AMA polies H-135.927 related to Spectral content for outdoor and roadway lighting sighting more evidence is needed before claims of actual negative health effects can be substantiated. They also disagree on the basis that Correlated Color Temperature (CCT) is inadequate for the purpose of evaluating possible health outcomes.

They call for more research and a collaborative effort with AMA to help research and define the issues going forward.

## U.S. Department of Energy (DOE) response:

As explained in the DOE Fact Sheet True Colors, there's nothing inherently different about the blue light emitted by LEDs; that is, at the same power and wavelength, electromagnetic energy is the same, regardless of source type. And as the potential for undesirable effects from exposure to light at night emerges from evolving research, the implications apply to all light sources — including, but by no means limited to, LEDs. Further, these research results are often also relevant to

light we receive from televisions, phones, computer displays, and other such devices.

- The same prudence taken with traditional light sources should be used with new LED technologies
- LEDs have advantages over older sources in that they are dimmable offering control of intensity for the varying needs of roadways with respect to traffic density and time of day/night
- LEDs are highly controllable in terms of distribution and light patterns on the road surface applying light only to areas of need rather than allowing up light and stray light
- LED sources or inherently more energy efficient with roughly 50% wattage needed to do the same lighting job
- LED spectral content can be mixed and/or changed to emit more or less light in a given part of the color spectrum
- There isn't anything special about blue light from LEDs. In fact, the same blue part of the spectrum is present in almost all light sources
- LEDs with lower CCT values are easy to find but are slightly less efficient than the higher CCT versions
- Lower CCT's lower visual acuity. Although lower CCT's may reduce environmental impact they can increase lighting effectiveness with a possible need to increase lumens in the design to compensate

Recommended actions:

- Match lighting products, sources and performance to the application
- Consider the right amount of light, the right spectral characteristics and directional aspects of lighting products when selecting for a project

<u>Rensselaer Polytechnic Institute (LRC--RPI) response:</u>

Recently the AMA has produced a document cautioning the public about In-Ga-N based LEDs used as sources of illumination both indoors and outdoors. These In-Ga-N LED sources generate short wavelength radiation from a solid state die. Some of that radiation is absorbed by a phosphor that, in turn, reemits long wavelength radiation. Together, the light emitted by the die and the light reemitted by the phosphor appear white to the human eye. Depending upon the relative emissions from the LED package, both the die and the phosphor, the white illumination can appear to have a "warm" tint (yellowish-white) or "cool" tint (bluish-white) or can appear neutral. This solid state lighting technology has, or soon will, displace most other commercially available light sources used for general illumination because they are more energy efficient, have longer life and are more cost effective to own and operate than most other sources of illumination. The concern expressed by the AMA in their report is focused specifically on the short-wavelength emission from these In-Ga-N LED sources as that spectral region might negatively affect, through several modes, human health.

- Predictions of health consequences from light exposure depend upon an accurate characterization of the physical stimulus as well as the biological response to that stimulus. Without fully defining both the stimulus and the response, nothing meaningful can be stated about the health effects of any light source.
- Notwithstanding certain sub-populations that deserve special attention, blue light hazard from In-Ga-N LEDs is probably not a concern to the majority of the population in most lighting applications due to human's natural photophobic response.
- In-Ga-N LED sources dominated by short wavelengths can cause relatively greater discomfort than sources dominated by long wavelengths, including "warm" In-Ga-N LED sources, at the same photopic illuminance at the cornea. As with disability glare, however, discomfort glare is mostly determined by the amount and distribution of light entering the eye, not its spectral content
- In-Ga-N LED sources dominated by short wavelengths have greater potential for suppressing the hormone melatonin at night than sodium-based sources commonly used outdoors. However, the amount and the duration of exposure need to be specified before it can be stated that In-Ga-N LED sources affect melatonin suppression at night.
- Until more is known about the effects of long-wavelength light exposure (amount, spectrum, duration) on circadian disruption, it is inappropriate to single out short- wavelength radiation from In-Ga-N LED sources as a causative factor in modern maladies.

Recommended actions;

- There must be an attempt at rational discussion on this subject not emotional reaction
- Social benefits as well as social costs must be evaluated
- Single metrics such as CCT and its effect on biological response should be avoided at all cost. A holistic approach is needed

Municipal Solid-State Street Lighting Consortium (MSSLC) response;

DOE's Solid-State Lighting Program issued an SSL Postings within a few days of the AMA's release. This notes the importance of matching the characteristics of the product with the specific application, underscoring the AMA's call for the use of appropriate products. Since then, a number of other organizations have also weighed in with very useful perspectives.

- Spectral power distribution is a good indicator of melanopic (non-visual) content but there is overlap between CCT's. CCT is not a good indicator of whether a light source will produce an effect over another source
- Results of a particular response on health is not fully understood by the medical community
- No respect to Dimming is given by the AMA. The idea being that if any source that produces a given melanopic output will decrease that output with dimming giving a potential positive result to total effect on the human body

Recommended actions;

- No actions suggested

## National Electrical Manufacturers Association (NEMA) response:

The National Electrical Manufacturers Association (NEMA) is a long-time proponent of good quality lighting design and application with technical standards and guidance for manufacturers and their end-use customers. The American Medical Association's community guidance on LED outdoor lighting is aligned with lighting manufacturers' long-standing recommendations on how to design safe and efficient light for night.

- Spectral content should be one factor in effective lighting for the outdoor environment
- A single solution is not appropriate for all situations
- The complexity of lighting designs is not well served by implying that CCT or correlated color temperature be the only metric used to design projects
- Sites DOE response regarding CCT and the limitations of using sources of 3000k or lower

Recommended actions;

- NEMA welcomes the opportunity to work with AMA for further research in this area

*References:*


*AMA on-line report*
*"Human and Environmental effects of LED Light emitting Diode lighting" June 14, 2016*

*Lighting Research Center (LRC—RPI) response to AMA*
*Authors Mark S. Rea, PHD and Mariana G, Figuero, PHD June 30th, 2016*

*U.S. Department of Energy (DOE) SSL postings*
*"LED Street Lighting"*
*Author Jim Brodrick June 21st, 2016*

*National Electrical Manufacturers Association (NEMA) response to AMA*
*"NEMA Comments on American Medical Association Community Guidance: Advocating and Support for Light Pollution Control Efforts and Glare Reduction for both Public Safety and Energy Savings"*
*On-line report*
*Author; Tracy Cullen June 24th, 2016*

*Municipal Solid-State Street Lighting Consortium*
*(MSSLC) Article in "The Light Post" newsletter*
*Author; Bruce Kinzey, MSSLC Director July 2016*

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