FEBRUARY / 2020

CITY OF MOUNTAIN VIEW

DOWNTOWN LIGHTING STUDY

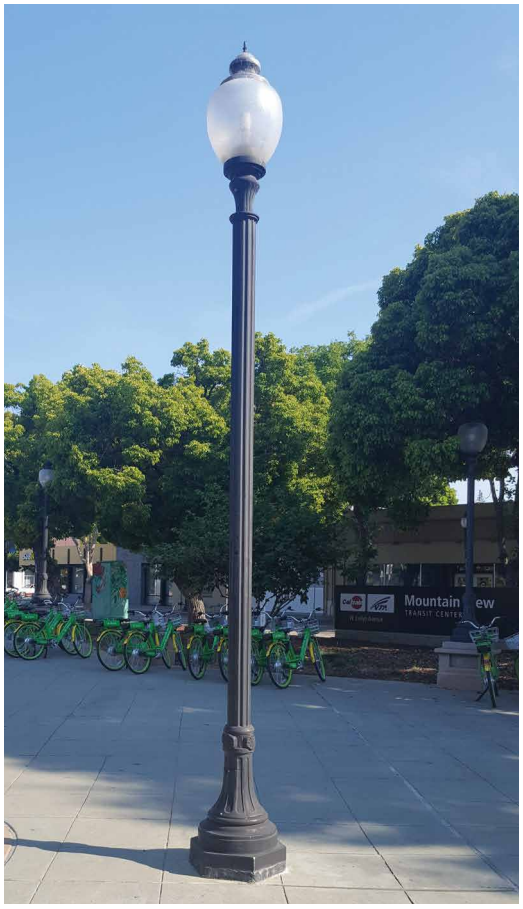


Table of Contents

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

The Downtown Area in the City of Mountain View is a busy and vibrant district consisting of many restaurants and popular late night attractions. In response to concerns regarding a lack of adequate lighting throughout the Downtown Area, the City embarked on a study to evaluate the existing street and pedestrian lighting network and to identify opportunities to improve lighting levels.

Vision and Goals

Through discussions and collaboration with stakeholders, community members and City Public Works staff, the following Downtown Area lighting goals were identified:

- Maintain "sense of place" of the downtown
- Consider different land uses and environments throughout the Downtown Area
- Improve connections between the core Downtown Area and the peripheral residential areas
- Improve lighting between City-owned surface parking lots and the core Downtown Area
- Improve energy efficiency and maintenance activities
- Improve safety and visibility at pedestrian crossing and pedestrian/vehicle conflict areas
- Improve lighting at the Center for Performing Arts and Civic Center Plaza
- Incorporate lighting at Pioneer Park for events
- Improve lighting at the City Hall and Public Library garage exits on Mercy Street

Lighting Recommendations for Downtown Area

A review and evaluation of City of Mountain View standards and industry lighting guidelines was completed to identify recommended lighting criteria for the Downtown Area. Lighting performance guidelines were provided for streets, intersections, walkways and bikeways, and surface parking lots. The guidelines also included considerations for mitigating light pollution and associated environmental impacts. These guidelines and recommendations will be used by City staff as the basis for implementing new lighting and retrofitting existing street lights within the study area or as part of future Capital Improvement projects.

In addition to establishing Downtown Area lighting performance guidelines, a review of lighting technologies (e.g., fixture types and photometric control systems) was completed to identify technology recommendations that meet the City's lighting needs for light levels and aesthetics, including installing lighting with 3000K color temperature.

Deployment Strategies and Prioritization

Through field reviews of the Downtown Area, the development of a calibrated photometric model of existing conditions, and the evaluation of lighting guidelines and recommendations, the study found that light levels are generally lower than desired at the following areas of focus:

- Uncontrolled crosswalks
- Signalized and Unsignalized Intersections
- Parking Lots
- Alleyways
- Center for Performing Arts and Civic Center Plaza
- Pioneer Park
- City Hall and Public Library garage exits

The following strategies and recommended prioritization were developed based on the City's conveyed needs and will aid in the phasing of future capital improvement projects.

Strategy	Deployment Timeline		
1. Improve safety lighting at uncontrolled crosswalks	Near-Term (1-2 Years)		
2. Replace or repair broken lights			
3. Address tree obstructions to street lights			
4. Replace existing non-LED lights with LED energy-efficient lights			
5. Improve lighting levels at high use, night-time activity areas			
6. Improve safety lighting at signal-controlled intersections		Mid-Term (2-5 Years)	
7. Improve safety lighting at stop-controlled intersections and at traffic circles			
8. Improve pedestrian lighting coverage on city walkways between parking and businesses			
9. Enhance lighting and security in city-owned parking lots			
10. Enhance safety lighting on in downtown area			Long-Term (5+ Years)
11. Address tree obstructions to street lights (long-term)			
12. Implement smart lighting control			
13. Implement Dark Sky compliant lighting			

Project Implementation

A series of lighting implementation projects with associated planning-level costs were developed to meet the identified lighting goals, and address known gaps and needs. The projects were ordered per the deployment timeline of the strategy they seek to address. It should be noted that the order in which the projects are presented should not always correlate to the order they be implemented. Appropriate phasing of projects should be evaluated as funds become available. Consideration should be made to simultaneously deploy a mid-term or long-term project with a near-term project based on implementation efficiencies.

Project No.	Project Description
Near-Term Implementation	
Strategy 1 - Improve Safety Lighting at Uncontrolled Crosswalks	
1	Add additional lighting at uncontrolled crosswalks with no median island
2	Add additional lighting at uncontrolled crosswalks with median islands with refuge area
3	Add additional lighting at uncontrolled crosswalks with a median island without refuge area
Strategy 2 - Replace or Repair Broken Lights	
4	Modify existing maintenance program for identifying and repairing broken luminaires in the downtown core (costs provided per year)
Strategy 3 – Address tree obstructions to street lights (near-term)	
5	Augment maintenance program for identifying and trimming trees that are blocking luminaires in the downtown core (costs provided per year)
Strategy 4 - Replace Existing non-LED Lights with LED Energy-Efficient Lights	
6	Replace existing shoebox flood lights with LED E-Cobra by Leotek
7	Replace existing induction post-top lights with LED lights
Strategy 5 - Improve Light Levels at High Use, Night-Time Activity Areas	
8	Additional lighting at the Center for Performing Arts and Civic Center Plaza
Mid-Term Implementation	
Strategy 6 - Improve Safety Lighting at Signal-Controlled Intersections	
9	Modify existing lighting at downtown signal-controlled intersections
Strategy 7 - Improve safety lighting at stop-controlled intersections and at traffic circles	
10	Enhance lighting at all-way stop controlled intersections
11	Enhance lighting at traffic circles
Strategy 8 - Improve Pedestrian Lighting Coverage on City Walkways between Parking and Businesses	
12	Add infill lighting through Cherry Lane alleyway
13	Add infill lighting through Blossom Lane alleyway
14	Add infill lighting through Wild Cherry Lane alleyway

Project No.	Project Description
Strategy 9 - Enhance Lighting and Security in City-Owned Surface Parking Lots	
15	Add infill lighting in Parking Lot 6
16	Add infill lighting in Parking Lot 2
17	Add infill lighting in Parking Lot 5
18	Add lighting at the entrance/exit of the City Hall parking garage and the Public Library Parking Garage
Long-Term Implementation	
Strategy 10 - Enhance Safety Lighting on Corridors in Downtown Area	
19	Enhance safety lighting on Bryant Street
20	Enhance safety lighting on Castro Street
21	Enhance safety lighting on Franklin Street
22	Enhance safety lighting on View Street
23	Enhance safety lighting on Hope Street
24	Enhance safety lighting on California Street
25	Enhance safety lighting on Evelyn Avenue
Strategy 11 - Address tree obstructions to street lights (Long-Term)	
26	Relocate light poles away from trees (cost provided per obstruction)
Strategy 12 - Implement Smart Lighting Control	
27	Pilot project to implement downtown wide smart lighting control (Castro Street)
Strategy 13 - Implement Lights That Are Dark Sky Compliant	
No specific projects, this strategy should be implemented where appropriate in all downtown lighting projects	

Next Steps

The Downtown Lighting Study will be used as the basis for future City Capital Improvement Project requests, development review opportunities, and/or grant funding opportunities to improve lighting in the City's Downtown Area. It is anticipated that the improvements at the Center for the Performing Arts and Civic Center Plaza and at the uncontrolled crosswalks will be the first projects developed and implemented by the City.

SECTION 1: Background

In response to concerns received regarding the lack of adequate lighting in the City of Mountain View's Downtown Area ("study area", shown in **Figure 1**), the City has conducted a study to evaluate existing street, intersection, pathway, and pedestrian lighting conditions and identified opportunities to improve lighting levels. The study area includes all streets within the central downtown Mountain View area from Evelyn Avenue to El Camino Real, and from Franklin Street to View Street, with an emphasis on Castro Street and City Hall Plaza; however, the study excludes the Mountain View Transit Center located east of Castro Street between Central Expressway and Evelyn Avenue because it is being evaluated under the a separate, dedicated transit center study.

The primary purpose for providing lighting on roadways, at intersections, in parking lots, and in other public spaces is to allow for sufficient visibility at night so motorists, pedestrians, and bicyclists can identify and react to obstacles and hazards. Adequate roadway and intersection lighting has been shown to significantly reduce accidents during nighttime conditions. In public spaces like plazas and pedestrian paths, lighting provides pleasing ambiance and contributes to user comfort and security. The installation of lighting along streets, sidewalks, pedestrian plazas, and parks contributes to developing these priorities of visibility and safety. Appropriate lighting should be considered when designing all street and pedestrian facilities. Special attention should be given to areas with high potential for vehicle-pedestrian conflict such as intersections and mid-block crossings.

The goal of the study is to develop a comprehensive and planned approach to street lighting that provides a safe and secure streetscape for pedestrians, bicyclists, and motorists while reinforcing the City's unique character. The lighting in the downtown area consists of a mixture of old and new light fixture types, including incandescent, high-pressure sodium (HPS), and energy-efficient light-emitting diode (LED). Many of the street lights are also decorative post-top light fixtures that produce uplighting (resulting in light pollution). The study evaluated the downtown lighting system, including an inventory of existing lights, establishment of lighting guidelines, development of a photometric model of existing lighting, identification of deficiencies, and recommendations for modifications and upgrades.

Enhancing the safety and the sense of place within the Downtown Area are priorities for the City of Mountain View. Looking to the future, as the City installs new lights and retrofits existing lights, the City can utilize the lighting guidelines presented in this document.

Study Limits

In addition to studying all street and adjacent pedestrian areas within the project limits, the study also evaluates lighting within several other landmarks and features, including:

- Pioneer Memorial Park
- City of Mountain View Public Parking Lots 2,5,6,7,8,9,12

Figure 1 - Study Area

SECTION 2: Existing Conditions

To begin a study reviewing the lighting plan for the Downtown Area, it is vital to get an understanding of the current field conditions. This was completed through the creation of an existing photometric model coupled with a field inventory to establish a comprehensive depiction of the existing conditions. This existing conditions analysis will serve as the "baseline" against which future improvements and optimizations will be evaluated and developed.

Data Collection and Field Inventory

The following City-maintained ArcGIS information was used in the existing conditions analysis:

- Location of street light pole
- Pole Type
- Mounting height of luminaire
- Length of mast arm (where applicable)
- Luminaire Type
- Luminaire Wattage

A field inventory was performed on February 12 and 18, 2019, to verify the existing inventory information. The field review was completed using ArcGIS's iPad Collector application to capture georeferenced photos of each street light, and the application recorded GPS coordinates of each light. Field observations included noting the following attributes:

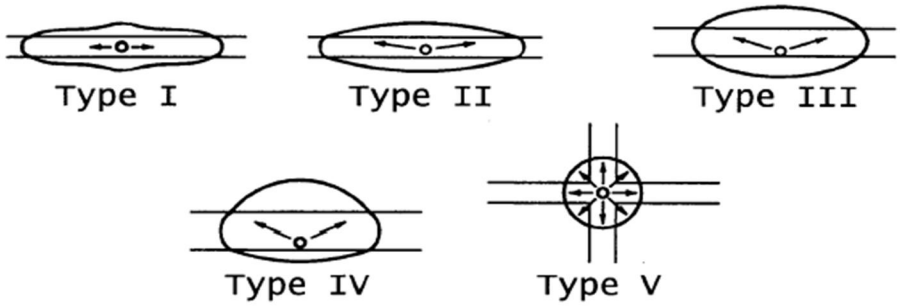
- Location — Used ArcGIS application to confirm City's GIS information
- Pole Type — Decorative, Caltrans Type 15, post top, utility wood pole, etc.
- Pole Height — Estimated from ground level
- Mast Arm Length — Estimated from ground level
- Bulb Wattage — Based on City-provided information. LED wattages confirmed if labeled on luminaire.
- Bulb Type — LED and HPS

The City's ArcGIS database information was updated to reflect conditions observed in the field, including pedestrian passageways on Castro Street and at several surface parking lots where City records were not provided or had limited details.

Based on City inventory information and field observations, luminaire manufacturer photometry files (.IES format) was collected for each luminaire type for use in the photometric model. The manufacturer files provide the representative lumen output and light distributions for the existing luminaires. **Figure 2** shows a simplified plan view of standard lighting distribution patterns. Please note, luminaire light distribution information was not available from the City's existing inventory and the distribution patterns were not clear from field observations. As such, it was assumed 'Type 3' light distribution (typical roadway lighting distribution) for all the mast arm mounted luminaires and 'Type 5' distribution for all post-top pedestrian scale luminaires. In the cases when manufacturers did not have

a photometric data file for a luminaire, an approximate equivalent file was chosen from a similar make and model.

Figure 2 - Luminaire Distribution Patterns



The City's existing lights and the luminaire data files collected for the photometric analysis are shown in **Table 1**. Pictures of the various existing light types are provided in **Appendix A**.

Table 1 - Luminaire .IES Data File Summary

Luminaire Description	Luminaire Analysis Data File
Castro St. LED Post Mount	150W Antique Street Lamps*
'Antique Acorn' Post Mount	60W Serenade*
Dual 'Antique Acorn' Post Mount	2 - 60W Serenade*
27 W LED Cobrahead	27 W EC1-4M Leotek LED
63 W LED Cobrahead	63 W EC3-10M Leotek LED
87 W LED Cobrahead	87 W EC3-10M Leotek LED
130 W LED Cobrahead	130 W EC3-14M Leotek LED
Shoebox Flood Light	400W HPS ED 18*
Dual Shoebox Flood Light	400W HPS ED 18*
Walkway Entrance Acorn	60W Serenade*
Walkway Teardrop Acorn	150W Antique Street Lamps*
Walkway Ceiling Flood Light	150W Antique Street Lamps*
70 W HPS Cobrahead	400W GE HPS*

** Denotes the use of appropriate equivalent (calibrated)*
Note – Light description and analysis file nomenclature may not align.

Collision Data Collection

In addition to information regarding the lighting system, collision data from 2007 through 2016 for the Downtown Area was compiled by the City of Mountain View. Collisions were separated into groups based on the closest intersection to the collision. One collision was a pedestrian fatality that occurred at Franklin Street and California Street where there are uncontrolled crosswalks. The collision data may be used by the City when evaluating where to prioritize lighting implementation projects since lighting is a tool to improve visibility. Collision data is summarized in **Figure 3**.

Figure 3 – Collision Map

Baseline Lighting Model

Model Creation

Using the data collection information, a photometric analysis model was created of the existing (baseline) lighting conditions in Mountain View's Downtown Area. A basemap of curb lines, sidewalk lines, city-owned pathways, and parking lots was created using high-resolution, orthogonally rectified aerials retrieved from Nearmap PhotoMapsTM. This basemap was then imported into an AGI32 model to define the key evaluation areas. Based on ArcGIS shapefiles, the luminaires defined were placed in the model with mounting heights and orientation set appropriately based on City provided data and field observed conditions.

After entering information in the light model, calculation areas were defined. The analysis areas were set based on the study area boundary (external boundary) and the approximate back-of-sidewalk limits, parking lot limits, or park pathways (internal boundaries). Horizontal illuminance, or the light that directly hits a point perpendicular to a surface, was analyzed in the model. Given the size of study area, grid calculation points were set 15 feet apart which provides enough granularity to understand specific corners and paths while at the same time not being overly dense. An analysis was run to determine initial lighting levels throughout the City's Downtown Area. The total light loss factor, which is the depreciation in light due to environmental (dirt, etc.) factors and luminaire degradation over time, was assumed to be 0.9. Since this is an idealized model, it was anticipated that there would be differences between the model outputs from AGI and the existing light levels observed in the field. Therefore, it was necessary to complete a calibration of the lighting model based on field-observed light levels.

Model Calibration

To calibrate the lighting model, a nighttime field survey was conducted from 9:00pm-11:00pm, on March 17, 2019. A light meter was used to measure the actual horizontal lighting levels at various locations around the Downtown Area. To do this, the light meter was placed at pavement elevation and light level results were recorded. These lighting levels were then compared to the lighting levels calculated from the photometric lighting model to determine where model adjustments were required.

In addition to the existing lighting level spot checks, light distribution calibration tests were performed to 'dial-in' the .IES luminaire files for the various light fixtures. For this, a luminaire location with minimal ambient lighting was selected and a grid of light level readings were taken around this luminaire, typically in 5-feet increments within a 20-foot by 20-foot grid. This process was repeated for the different luminaire types using the assumption that all the matching luminaires would have the same light distribution characteristics. Using these lighting grids, the individual lighting files were calibrated by adjusting the light loss factor and/or lighting distribution to best represent the actual lighting levels.

Calibrated Existing Lighting Model Results

Baseline model lighting results are summarized in **Appendix B**. For visual comparative purposes, the lighting level labels have been color coded per the following ranges presented in **Table 2**:

Table 2 - Lighting Level Color Code

Range (footcandles)	Color Code	Interpretation
0 - 0.5	Red	Under lit
0.5 - 1.0	Blue	Okay for streets, under lit for intersection
1.0 - 3.0	Green	Okay for intersection, over lit for streets
3.0 +	Cyan	Over lit

Typical industry lighting levels for streets in a Downtown Area range from 0.3 footcandles to 1.2 footcandles depending on the street classification and the pedestrian classification. As such, most of the calculation points shown along the streets should be in the blue range with some red and green points as well. At intersections, due to the high number of pedestrian conflict areas, the lighting levels should be higher. Typical accepted lighting levels for intersections range from 0.8 footcandles to 3.4 footcandles depending on the street classification and the pedestrian classification. Therefore, it would be desired that calculated light values shown at study area intersections be in the green range with some blue and cyan points as well. A detailed evaluation of existing lighting levels, including identification of deficiencies and recommendations to improve lighting are discussed later in this document.

Baseline Lighting Results Discussion

Inspection of the model results indicates several key discussion points. The first being that most of the downtown lighting is pedestrian scale lights, with the Castro Street LED and Antique Acorn types being the most prevalent. Areas with a high number and concentration of these lights, though, tend to fall within the lower light range of less than 0.5 footcandles. Both post-top light types, have a relatively small, circular light influence area, typically around a 20- to 30-foot radius. Additionally, both lights operate at lower wattages which generally correlates with lower total lumen output. Lastly, both direct a considerable amount of light upwards, which means less light focused towards the pavement, where it is needed. These factors all contribute to the lower light level ranges reflected in the baseline light model.

Areas with overhead LED lights typically have higher calculated light values. Generally, LED light array configurations distribute light more effectively than their HPS or metal halide overhead counterparts and post-top mounted lights. The higher mounting elevation and extended mast arm, allows for a greater distribution influence area. Therefore, locations with these lights generally yield higher light levels. Locations where multiple LED overhead lights are closely space, such as the case at traffic signals, result in even higher light levels.

Castro Street, one of the primary study corridors, generally has good lighting coverage but model calculations and field observations note lower light levels. This is due to the majority of the lights being pedestrian scale, as well as a significant percentage of the overall light coming from adjacent businesses (this is covered in more detail below). Midblock crosswalks show low light levels in the photometric model, and spot checks also reveal light levels towards the lower end of the range. As

noted above, the primary lighting along Castro Street is from post-top decorative lights which do not distribute light far enough to cover the length of the crosswalks.

As noted above, there is a significant amount of off-site ambient lighting (e.g., business facade lighting) from adjacent private properties. This ambient lighting was not included in the existing photometric model and results in a more conservative model which may have lower calculated light levels than what may be experienced in the field. It is recommended that the model only be based on City-owned lights for a couple reasons. First, the ambient lighting may not always be turned on, whereas all city-owned lights are always in operation during night periods. Second, it is widely impractical to model every ambient light source for an area the size of this study. This means that at some locations, the actual light levels may be higher than what is calculated in the light model.

SECTION 3: RECOMMENDED LIGHTING PERFORMANCE GUIDELINES

A review and evaluation of City of Mountain View Standards, ANSI/IES RP-8-18, and other industry lighting guidelines was completed to identify recommendations for lighting guidelines to incorporate within the Downtown Area. These guidelines and recommendations will be used by City staff in implementing new lighting and retrofitting existing street lights within the study area as part of future Capital Improvement Programs projects or ongoing maintenance. The following is a summary of the various design standards, guides, and references utilized for this study.

Lighting Design Resources

City of Mountain View Standards

The City of Mountain View provides lighting standards and details for use when designing or modifying lighting. These standards include City of Mountain View Standard Detail E-1A, City of Mountain View Standard Detail E-1B, and City of Mountain View Streetlight Installation Report (dated December 1989). These reports include information regarding the placement of light poles, height of light poles, wattage of luminaires, and lighting level guidelines for signalized intersections and mid-block crosswalks.

ANSI/IES RP-8-18 Roadway Lighting

Since 1928, the Illuminating Engineering Society (IES) of North America has published guidelines and standards for the lighting design of roadway, streets, bikeways, and pedestrian walkways. IES is recognized as the nation's lead authority on illumination due to its numerous technical publications providing recommended lighting practices for applications such as healthcare, security, offices, sports and recreation, tunnels, and many more. The ANSI/IES RP-8-18, Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting (Approved by IES Standards Committee September 2018), is generally recognized as the industry standard for roadway lighting. This recommended practice document provides criteria for lighting on roadways, freeways, intersections, parking facilities, bikeways, pedestrian walkways, and other facilities related to roadway lighting.

AASHTO Roadway Lighting Design Guide (October 2018 Version)

The Roadway Lighting Design Guide, published by the American Association of State Highway and Transportation Officials (AASHTO), provides overall lighting guidance to design staff of public transportation departments. The document discusses lighting master plans, lighting warranting conditions, lighting design criteria, electrical systems, and maintenance for a variety of applications including freeways, roadways, rest areas, and tunnels. AASHTO's recommended lighting design values for roadways and walkways are based on roadway classification and nearby land use. Note, the AASHTO guide does not provide separate lighting design values for intersections (i.e. pedestrian conflict areas).

FHWA Lighting Handbook (August 2012)

Like the AASHTO design guide, the Lighting Handbook published by the Federal Highway Administration (FHWA) provides roadway guidance to design staff of public transportation departments. The handbook does not provide specific recommendations for lighting criteria but

instead is intended as a supplement to the AASHTO design guide and IES RP-8 guidelines. The handbook focuses on lighting policies, basic roadway lighting principles, lighting warrants, and other general design principles.

International Dark-Sky Association

The International Dark-Sky Association (IDA) is a non-profit organization that advocates for lighting policies and designs which reduce environmental impacts due to light pollution. Through public outreach, education, and research, IDA promotes practices which limit detrimental impacts of outdoor lighting (e.g., glare, light trespass, uplighting). One program developed by IDA includes a certification process which certifies lighting fixtures that are dark-sky friendly.

In partnership with IES, IDA created a Model Lighting Ordinance (MLO) which is a template for public agencies for developing outdoor lighting regulations and municipal codes. The MLO includes an optional ordinance for street lighting which works in conjunction with IES RP-8 guidelines. However, this ordinance is intended for private street lighting applications and IDA does not advise directly applying the MLO to municipal street lighting. Instead, IDA recommends agencies follow IES and AASHTO guidelines while incorporating IDA's glare, backlighting, and uplighting principles where possible.

Lighting Design Guidelines and Standards

Intersection Lighting

Intersection lighting criteria are focused on providing sufficient light in areas where there are potential conflicts between pedestrians and motorists, or motorists and other motorists.

As mentioned in the previous section, AASHTO does not provide light level criteria for intersections; instead, Section 3.4.4 of the AASHTO Roadway Lighting Guide recommends that "Intersections of two continuously lit streets are typically lit to a value equal to the sum of the individual lighting level values"[1]. The guide states that light levels should be based on engineering judgement according to site conditions like pedestrian volumes. AASHTO roadway lighting guidelines are presented in **Table 4** later in this document.

Recommended lighting criteria for intersections as presented in the City of Mountain View Standard Detail E-1B and ANSI/IES RP-8-18 are shown in **Tables 3 and 4** below. These criteria are based on the lighting calculation method of illuminance at pavement (in footcandles, fc) which is a measure of the intensity of light falling onto the roadway surface. Intersection lighting guidelines presented by the City of Mountain View apply for signalized intersections and mid-block crosswalks. See **Appendix E** for City of Mountain View street standard details E-1A and E-1B. The guidelines presented by ANSI/IES apply to both signalized and unsignalized intersections. The light levels required in Standard Detail E-1B appear to be based on a previous version ANSI/IES guidelines (RP-8-14), so

[1] AASHTO Roadway Lighting Design Guide, Page 28

the City and ANSI/IES intersection light criteria are very similar (current ANSI/IES levels are slightly lower).

Table 3 - Illumination Criteria for Signalized and Mid-Block Intersections (City of Mountain View)

Illumination for Signalized Intersections and Mid-Block Crosswalks				
Functional Classification	Average Maintained Illumination at Pavement by Pedestrian Area Classification (fc)			Average Uniformity Ratio (Eavg/Emin)
	High	Medium	Low	
Major/Major*	3.4	2.6	1.8	3.0
Major/Collector	2.9	2.2	1.5	3.0
Major/Local	2.6	2.0	1.3	3.0
Collector/Collector	2.4	1.8	1.2	4.0
Collector/Local	2.1	1.6	1.0	4.0
Local/Local	1.8	1.4	0.8	6.0

**Mid-Block crosswalk area illuminance should at least be equal to that of two major streets.*
Source: City of Mountain View Standard Detail E-1B

Table 4 - Illumination Criteria for Intersections (ANSI/IES)

Illumination for Intersections				
Functional Classification	Average Maintained Illumination at Pavement by Pedestrian Area Classification (fc)			Average Uniformity Ratio (Eavg/Emin)
	High	Medium	Low	
Major/Major	3.2	2.4	1.7	3.0
Major/Collector	2.7	2.0	1.4	3.0
Major/Local	2.4	1.9	1.2	3.0
Collector/Collector	2.2	1.7	1.1	4.0
Collector/Local	2.0	1.5	0.9	4.0
Local/Local	1.7	1.3	0.7	6.0

Source: ANSI/IES RP-8-18 Table 12-1

Average illuminance at pavement values higher than those shown in **Tables 3 and 4** meet the guidelines. The uniformity ratio is the ratio between the average-to-minimum illumination light levels. Average Uniformity Ratios lower than those given in **Tables 3 and 4** meet the guidelines. Intersections in the Downtown Area and their respective assumed functional classifications is provided in **Figure 4**.

Figure 4 - Intersection Functional Classifications

*Roadway classifications based on ANSI/IES RP-8-18 guidelines.

Per ANSI/IES RP-8-18, the pedestrian conflict area classifications are determined based on the following criteria:

- High — areas with significant numbers of pedestrians expected to be crossing the streets during the hours of darkness. Examples are urban commercial areas, downtowns, or city centers with high levels of nighttime activity. An area with high pedestrian activity will have 100 or more pedestrians over the one-hour period with the highest average annual nighttime pedestrian volume.
- Medium — areas where lesser numbers of pedestrians are expected to be crossing the streets during the hours of darkness. These are typically urban commercial or industrial areas that have some or all the following types of development: multifamily residential, community buildings, neighborhood shopping, and transit lines. An area with medium pedestrian activity will have 11 to 99 pedestrians over the one-hour period with the highest average annual nighttime pedestrian volume.
- Low — areas where fewer nighttime pedestrians are expected to be crossing the streets during the hours of darkness. This level of activity can occur in any of the cited roadway classifications but is typical of small urban streets with single-family homes and low-density residential developments. An area with low pedestrian activity will have 10 or fewer pedestrians over the one-hour period with the highest average annual nighttime pedestrian volume.

In ANSI/IES RP-8-18, roadway classifications are determined based on the following criteria:

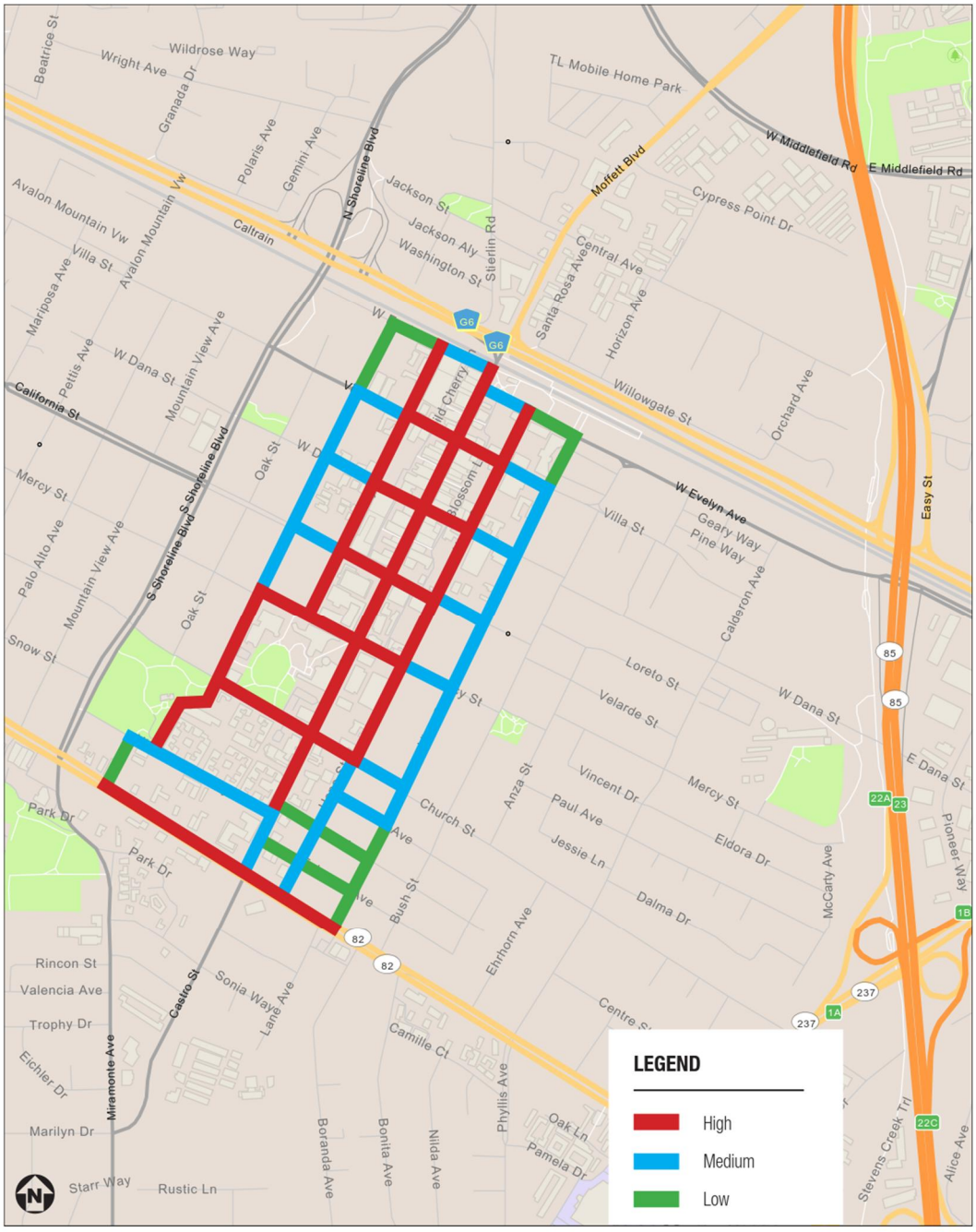
- Major — part of the roadway system that serves as the principal network for through-traffic flow. These routes connect areas of principal traffic generation and important rural roadways entering and leaving the city. They are often known as “arterial” or “thoroughfares”. These routes primarily serve through-traffic and secondarily provide access to abutting property. Typical average daily traffic (ADT) is over 3,500 vehicles per day.
- Collector — part of the roadway system that serves traffic between major and local streets. These are streets used mainly for traffic movement within residential, commercial, and industrial areas. Collector streets may be used for truck or bus movements and give direct access to abutting properties. Typical average daily traffic (ADT) is between 1,500 and 3,500 vehicles per day.
- Local — part of the roadway system that provides direct access to residential, commercial, industrial, or other abutting property. Typical average daily traffic (ADT) is between 100 and 1,500 vehicles per day.

Figure 5 shows the corridors in the Downtown Area as well as their classifications, and **Figure 6** shows the pedestrian classification, based on ANSI/IES RP8-18, for each corridor.

Figure 5 - Roadway Classifications

*Roadway classifications based on ANSI/IES RP-8-18 guidelines.

Figure 6 - Pedestrian Classifications



*Pedestrian classifications based on ANSI/IES RP-8-18 guidelines.

Street Lighting

As previously noted, street lighting is primarily for motorist identification of obstacles, and for visibility of pedestrians and cyclists. The referenced design documents do not "require" street lighting along all roadways since there are times where lighting may be averse to the natural environment (i.e. light pollution); however, the AASHTO Roadway Lighting Design Guide states street lighting is appropriate where "lighting would contribute substantially to the safety, efficiency, and comfort of vehicular or pedestrian traffic."[2]

The City Standard Details E-1A and E-1B do not provide minimum light level criteria for street lighting, but instead provides wattage and lumen guidelines for the LED fixtures to be used.

Street lighting design in ANSI/IES RP-08-18, as opposed to intersection lighting design (which uses illuminance), follows the luminance methodology for establishing light level criteria. The average luminance (candelas per square meter) measures how "bright" the roadway surface appears to the motorist by determining the amount of light reflected from the pavement. Luminance is a very effective design method for straight sections of roadway which have consistent luminaire placement and roadway pavement types, since only one representative segment is evaluated then extrapolated along the entire road. However, since luminance is dependent on a specific observer position, it is more difficult to measure and calculate, particularly on roadways with horizontal curvature.

Table 5 - ANSI/IES Criteria for Streets

Street Classification	Pedestrian Area Classification	Average Luminance Lavg (cd/m2)	Average Uniformity Ratio (Lavg/Lmin)	Maximum Uniformity Ratio (Lmax/Lmin)
Major	High	1.2	3.0	5.0
	Medium	0.9	3.0	5.0
	Low	0.6	3.5	6.0
Collector	High	0.8	3.0	5.0
	Medium	0.6	3.5	6.0
	Low	0.4	4.0	8.0
Local	High	0.6	6.0	10.0
	Medium	0.5	6.0	10.0
	Low	0.3	6.0	10.0

Source: ANSI/IES RP-8-18, Table 11-1

The AASHTO Roadway Lighting Design Guide gives recommended light criteria for street lighting luminance levels, as well as illuminance levels. It is noted, the luminance values provided by AASHTO are consistent with the luminance levels presented in ANSI/IES RP-8-18, though AASHTO

[2] AASHTO Roadway Lighting Design Guide, Page 27

provides more roadway classifications. Lighting criteria for street segments, based on AASHTO guidelines, is presented in **Table 6**.

Average Illuminance and Luminance values higher than those shown in **Tables 5 and 6** meet the guidelines. Average Uniformity Ratios and Maximum Uniformity Ratios lower than those shown in **Tables 5 and 6** meet the guidelines.

Table 6 - AASHTO Roadway Lighting Design Guide Lighting Criteria for Streets

Roadway and Walkway Classification[a]	Area Classifications	Illuminance Method						Luminance Method			Additional Values (both Methods)
		Average Maintained Illuminance (E_{avg})				Minimum Illuminance E_{min}	Illuminance Uniformity Ratio E_{avg}/E_{min}	Average Maintained Luminance			Veiling Luminance Ratio
		R1	R2	R3	R4			L_{avg}	Uniformity		
	General Land Use	(footcandles) (min)	(footcandles) (min)	(footcandles) (min)	(footcandles) (min)	(footcandles)	Avg/min (max)[b]	cd/m² (min)	L_{avg}/L_{min} (min)	L_{max}/L_{min} (max)	$L_{v(max)}/L_{avg}$ (max)[c]
Principal Arterials:											
Interstate and other freeways	All	0.6	0.6	0.6	0.6	0.2	4:1	0.4[d]	3.5:1	6:1	0.3:1
Other Principal Arterials (partial or no control of access)	Commercial	1.1	1.6	1.6	1.4	As uniformity ratio allows	4:1	1.2	3:1	5:1	0.3:1
	Intermediate	0.8	1.2	1.2	1.0		4:1	0.9	3:1	5:1	0.3:1
	Residential	0.6	0.8	0.8	0.8		4:1	0.6	3.5:1	6:1	0.3:1
Minor Arterials	Commercial	0.9	1.4	1.4	1.0		4:1	1.2	3:1	5:1	0.3:1
	Intermediate	0.8	1.0	1.0	0.9		4:1	0.9	3:1	5:1	0.3:1
	Residential	0.5	0.7	0.7	0.7		4:1	0.6	3.5:1	6:1	0.3:1
Collectors	Commercial	0.8	1.1	1.1	0.9		4:1	0.8	3:1	5:1	0.4:1
	Intermediate	0.6	0.8	0.8	0.8		4:1	0.6	3.5:1	6:1	0.4:1
	Residential	0.4	0.6	0.6	0.5		4:1	0.4	4:1	8:1	0.4:1
Local	Commercial	0.6	0.8	0.8	0.8		6:1	0.6	6:1	10:1	0.4:1
	Intermediate	0.5	0.7	0.7	0.6		6:1	0.5	6:1	10:1	0.4:1
	Residential	0.3	0.4	0.4	0.4		6:1	0.3	6:1	10:1	0.4:1
Alleys	Commercial	0.4	0.6	0.6	0.5		6:1	0.4	6:1	10:1	0.4:1
	Intermediate	0.3	0.4	0.4	0.4		6:1	0.3	6:1	10:1	0.4:1
	Residential	0.2	0.3	0.3	0.3		6:1	0.2	6:1	10:1	0.4:1
Sidewalks	Commercial	0.9	1.3	1.3	1.2		3:1	Use illuminance requirements			
	Intermediate	0.6	0.8	0.8	0.8		4:1				
	Residential	0.3	0.4	0.4	0.4		6:1				
Pedestrian Ways and Bicycle Ways[e]	All	1.4	2.0	2.0	1.8		3:1				

[a] See AASHTO's *A Policy on Geometric Design of Highways and Streets* (1) for roadway and walkway classifications.

[b] Higher uniformity ratios are acceptable for elevated ramps near high-mast poles.

[c] $L_{v(max)}$ refers to the maximum point along the pavement, not the maximum in lamp life. The Maintenance Factor applies to both the L_v term and the L_{avg} term.

[d] Use 0.6 for R1 surface.

[e] Assumes a separate facility. For Pedestrian Ways and Bicycle Ways adjacent to roadway, use roadway design values. Use R3 requirements for walkway or bikeway surface materials other than the pavement types shown. Other design guidelines such as IES or CIE may be used for pedestrian ways and bikeways when deemed appropriate.

Notes:
1. Meet either the Illuminance design method requirements or the Luminance design method requirements and meet veiling luminance requirements for both the Illuminance and the Luminance design methods.
2. There may be situations when a higher level of illuminance or luminance is justified. The higher values for freeways may be justified when deemed advantageous by the agency to mitigate off-roadway sources.
3. Physical roadway conditions may require adjustment of spacing determined from the base levels of illuminance indicated above.

Source: AASHTO Roadway Lighting Design Guide, Table 3-5a

Walkways and Bikeways

Lighting for pedestrian and bicycle facilities (including bike paths, mixed-use paths and sidewalks) serves to provide visibility of pedestrians adjacent to roadways, enhance safety and comfort, and provide pedestrians the ability to navigate in their surroundings. Lighting for bikeways, pathways, and sidewalks may be applied to pedestrian paths through parks and plazas.

Per ANSI/IES RP-8-18, the various pedestrian and bicycle facilities are defined as follows:

- Bikeway — any road, street path, or traveled way that is specifically designated open to bicycle travel, regardless of whether such facilities are designed for the exclusive use of bicycles or are to be shared with other transportation modes.
- Pedestrian Walkway — a public walk for pedestrian traffic, not necessarily within the right of way of roadway. Included are skywalks, sub-walks, and walkways giving access through parks or block interiors.
- Sidewalk — a paved or otherwise improved area for pedestrian use, located within a public street right of way, which also contain roadways for vehicular traffic.

ANSI/IES RP8-18 gives guidelines for bikeway lighting and sidewalk lighting but does not include pedestrian walkways that are located outside of the roadway right of way (i.e., pedestrian plazas, parks, and block interiors).

ANSI/IES RP-8-18 lighting recommendations for pedestrian areas are based on the high, medium, or low pedestrian activity classification defined for roadway/street lighting. The recommended illumination criteria for pedestrian areas and bikeways are shown in **Table 7**. The minimum vertical illuminance is the illuminance measured perpendicular to the roadway, at 1.5 meters (approximately 5 feet) above the pavement or sidewalk. Vertical illuminance measures how much light falls on the "face" of an object, making the object visible to an on-coming vehicle. The other values in **Table 5** are horizontal illuminance, which is the illuminance on the pavement surface. The classification of pedestrian areas (high, medium, or low) are the same as presented in "Intersection Lighting" of this report. In **Table 5**, high pedestrian conflict areas with mixed vehicle and pedestrian areas are areas where the sidewalk is directly next to the roadway without a physical separation (i.e. curb or wall).

Table 7 - ANSI/IES Lighting Design Criteria for Pedestrian Areas and Bikeways

Maintained Illuminance Values for Pedestrian Areas and Bikeways			
	Average Horizontal Illuminance, Eavg (fc)	Minimum Vertical Illuminance, EVmin (fc)	Average Uniformity Ratio* (Eavg/Emin)
High Pedestrian Conflict Areas			
Mixed Vehicle and Pedestrian Areas	1.9	0.9	4.0
Pedestrian Only	0.9	0.5	4.0
Medium Pedestrian Conflict Areas			
Pedestrian Only	0.5	0.2	4.0
Low Pedestrian Conflict Areas			
Rural/Semi-rural Areas	0.2	0.1	10.0
Low Density Residential	0.3	0.1	6.0
Medium Density Residential	0.4	0.1	4.0

Source: ANSI/IES RP-8-18, Tables16-1, 16-2, and 16-3
**Horizontal illuminance only*

AASHTO provides horizontal illuminance and uniformity guidelines for sidewalks and pedestrian/bike ways; but does not provide vertical illuminance recommendations. The AASHTO pedestrian lighting criteria are included in **Table 6** in the previous section.

Surface Parking Lot Lighting

ANSI/IES RP-8-18 summarizes illumination values for active surface parking lots open to customers, employees, or the public accounting for pavement material, pedestrian lighting zone type, and time of night. Surface parking lot lighting criteria are focused on providing sufficient light to allow a driver (or pedestrian) looking at the brightest spot in the field of view to also be able to detect an object in the dark areas within the field of view. Therefore, the maximum-to-minimum illuminance uniformity ratio is of greater importance than the average-to-minimum ratio. ANSI/IES RP-8-18 recommended illumination criteria for surface parking lots are presented in **Table 8**.

Table 8 - Recommended Maintained Illuminance Values for Parking Lots

Ground Surface	Application and Task	Time of Day	Horizontal Illuminance (fc)	Vertical Illuminance (fc)	Uniformity Ratio (Max:Min)
Asphalt Surfaces	Drive Isle/Parking Area	Pre-curfew	0.5	0.25	15:1
		Post-curfew	0.2	0.1	15:1
	Transaction Areas (Pedestrian & Vehicle)	Pre-curfew	0.9	0.5	15:1
		Post-curfew	0.2	0.1	15:1
Concrete Surfaces	Drive Isle/Parking Area	Pre-curfew	0.9	0.5	15:1
		Post-curfew	0.2	0.1	15:1
	Transaction Areas (Pedestrian & Vehicle)	Pre-curfew	0.9	0.5	15:1
		Post-curfew	0.2	0.1	15:1

Source: ANSI/IES RP-18-8 Table 17-2

Curfew times are characterized by nighttime pedestrian activity associated with nighttime attraction hours of operation. For locations with a larger business presence and later hours of operation like a theatre, for example, the pre-curfew criteria should be used. In areas where there is substantially less nighttime pedestrian activity due to lack of businesses or attractions the post-curfew criteria should be used.

Light Pollution and Environmental Guidelines

Light pollution can have negative implications on aspects of life, including but not limited to:

- Energy — inefficient lighting that emits unnecessary light (such as uplight and backlight) wastes energy and, in turn, money. New technologies that are often used to mitigate this are LED lights to reduce necessary wattages and dimmers, motion sensors, or timers to reduce lighting levels when areas are not occupied.
- Ecology — artificial light affects wildlife and our ability to view night sky and stars. This is especially true for nocturnal animals and migratory birds which rely on the natural light from the sun, moon, and stars.
- Human Health — artificial light can also affect human health. Artificial light has been proven to modify our biological clocks and disrupt our natural sleep-wake pattern. This is especially evident with blue light, which is the color of most LED lights. Therefore, it is important to consider light temperature to mitigate these changes. Due to potential impacts on humans due to blue light from LEDs, the International Dark-Sky Association and the American Medical Association recommend using LED fixtures with a correlated color temperature of 3000K or less.

- Safety/Crime — typically, it is assumed that more light will lead to more safety. This is not always the case. Glare from lights can unintentionally decrease safety by shining into human eyes, making it harder to see potential dangers and adjust to low-light conditions.

As mentioned previously, IDA has partnered with IES to create a Model Lighting Ordinance (MLO) which can be used as a template to develop outdoor lighting regulations. The MLO should be used in addition to the lighting level guidelines set forth by IES and AASHTO to ensure light level guidelines are met while also mitigating the negative implications of backlight, uplight, and glare from artificial lightings.

The first aspect to understand from the MLO is lighting zones. The lighting zones are summarized in **Table 9**. As described in the table below, downtown Mountain View falls in lighting zone LZ2.

Table 9 - Lighting Zones

Lighting Zone	Description
LZ0 – No ambient lighting	Used for areas where artificial lighting will seriously and adversely affect natural environments. This is used in designated parks, recreation areas, and wildlife preserves.
LZ1 – Low ambient lighting	Used for areas where artificial light might adversely affect the environment or disturb the character of the area. These include residential areas, business parks, and other areas with little nighttime activity.
LZ2 – Moderate ambient lighting	Used for areas where the vision of human residents and uses is adapted to moderate light levels. This is the default recommended zone by IDA for light commercial districts or business areas which may have nearby residential areas. **Lighting zone 2 is where downtown Mountain View would fall.**
LZ3 – Moderately high ambient lighting	Used for areas where the vision of human residents and user is adapted to moderately high light levels. This is zone is for high density commercial corridors in large cities with high nighttime activity.
LZ4 – Hight ambient lighting	Used for areas where the vision of human residents and users has adapted to high light levels. This zone is not typically used but can be used in specific circumstances where very high light levels are required like major city downtown centers.

Since it is recommended to follow IES and AASHTO guidelines for light level criteria, the other important piece from the MLO to consider is the backlight, uplight, and glare rating, commonly abbreviated to B-U-G. The backlight rating measures the amount of light trespass put off by a luminaire behind its intended direction, typically away from the roadway towards adjacent properties. Uplight is the amount of light that is projected above a luminaire and is the primary concern of dark sky impacts. Glare rating evaluates the glow from the luminaire that is directed at oncoming vehicles and may make it difficult for drivers to see. IDA backlight guidelines are summarized in **Table 10**, uplight guidelines are summarized in **Table 11**, and glare guidelines are summarized in **Table 12**.

Table 10 - Maximum Allowable Backlight Ratings

Luminaire Location	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Greater than 2 mounting heights* from property line	B1	B3	B4	B5	B5
Between 1 and 2 mounting heights* from property line and properly oriented**	B1	B2	B3	B4	B4
Between 0.5 and 1 mounting heights* from property line and property oriented**	B0	B1	B2	B3	B3
Less than 0.5 mounting heights* from property line and properly oriented**	B0	B0	B0	B1	B2

**Mounting height refers to the distance between the ground and the height of the luminaire. For example, for a luminaire mounted at 30', 30' would be the equivalent of one mounting height and 60' would be the equivalent of two mounting heights*

***Properly oriented refers to the direction of the last arm in relation to the property line. A mast arm that is extending away from the property line at a perpendicular angle is considered properly oriented.*

Table 11 - Maximum Allowable Uplight Ratings

	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Uplight Rating	U1	U2	U3	U4	U5

Table 12 - Maximum Allowable Glare Ratings

Luminaire Location	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Glare Rating	G0	G1	G2	G3	G4
Between 1 and 2 mounting heights from property line and not properly oriented	G0	G0	G1	G1	G2
Between 0.5 and 1 mounting heights from property line and not property oriented	G0	G0	G0	G1	G1
Less than 0.5 mounting heights from property line and not properly oriented	G0	G0	G0	G0	G1

Lighting Performance Recommendations

The following recommendations have been provided with an understanding that the Mountain View Downtown Area has an established character that must be maintained. As such, the recommendations must be applied using engineering judgement dependent on an individual project's needs, and the neighborhood context. Care should be taken to avoid a blanket approach to implementing lighting recommendations and future projects which may lead to negative impacts to the downtown's ambiance. Based on the scope of this study and the study limits, the recommendations that follow should be considered as guidelines for the Downtown Area only. Recommendations that suggest updates to City standard details or adoption of policies (e.g., adoption of Dark Sky practices) would require City Council approval and as such are considered as guidelines only.

Intersection Lighting

As the City's existing illumination criteria included in Standard Detail E-1B are similar to those provided in ANSI/IES RP-8-18, it is recommended to continue using the Standard Detail E-1B criteria but update to match the latest IES intersection lighting guidelines presented in **Table 13**. Using the latest IES light level guidance (which are slightly lower than currently required by the City) will help address City stakeholder concerns that new intersection lighting can be too bright.

In the Downtown Area, it is recommended that Castro Street be considered a high pedestrian area while most of the remaining streets in the Downtown Area be considered medium pedestrian areas. For the residential areas along the borders of the Downtown Area, low pedestrian light criteria should be considered to minimize light infiltration to neighborhood residents. Refer to **Table 14** and **Figure 4** for street classifications within the Downtown Area.

Table 13 - Lighting Design Criteria for Intersections in Downtown Area

Functional Classification	Average Maintained Illumination at Pavement in High Pedestrian Area Classification) (fc)	Average Maintained Illumination at Pavement in Medium Pedestrian Area Classification) (fc)	Average Maintained Illumination at Pavement in Low Pedestrian Area Classification) (fc)	Average Uniformity Ratio (average/ minimum)
Major/Major	3.4	2.6	1.8	3.0
Major/Collector	2.9	2.2	1.5	3.0
Major/Local	2.6	2.0	1.3	3.0
Collector/Collector	2.4	1.8	1.2	4.0
Collector/Local	2.1	1.6	1.0	4.0
Local/Local	1.8	1.4	0.8	6.0

Street Lighting

Based on luminance criteria presented in AASHTO design guide and ANSI/IES RP-8-18, it is recommended to adopt the street lighting guidelines of the AASHTO Roadway Lighting Design Guide (presented in **Table 6** above) and to incorporate them into the City's standard details. For consistency of design methodology with other lighting categories, it is recommended to use illumination criteria for street lighting, not the luminance method. The luminance method is not recommended because calculating luminance will be difficult in the Downtown Area due to the variety of existing luminaire types, and inconsistent spacing between luminaires. Additionally, light levels will be difficult to field confirm due to the need for cost prohibitive equipment and techniques to measure luminance.

Street classifications were determined for each of the streets within the study area and are presented in **Table 14**. The streets were identified based on street characteristics, adjacent land uses, and classifications in Caltrans' California Road System Maps.

Table 14 - Downtown Area Street Classifications

Street	Street Classification
El Camino Real	Major
Castro Street	Collector
California Street	
Franklin Street	
View Street	
Evelyn Avenue	
Church Street	
Bryant Street	Local
Hope Street	
Villa Street	
Dana Street	
Mercy Street	
Sierra Avenue	
Yosemite Avenue	
Fairmont Avenue	
High School Way	
Cherry Lane	Alley
Blossom Lane	

Walkways and Bikeways

Based on illumination criteria presented in ANSI/IES RP-8-18, it is recommended to adopt the bikeway, pathway, and sidewalk lighting presented in **Table 15** below. Nighttime pedestrian activity in the Mountain View Downtown Area is anticipated to be medium to high, with some low pedestrian usage along the borders of the downtown study area.

Table 15 - Recommended Lighting Design Criteria for Pedestrian Areas and Bikeways

Maintained Illuminance Values for Pedestrian Areas and Bikeways			
	Average Illuminance, Eavg (fc)	Minimum Vertical Illuminance, EVmin (fc)	Average Uniformity Ratio* (Eavg/Emin)
High Pedestrian Conflict Areas			
Sidewalks Adjacent to Roadway	1.9	0.9	4.0
Separated Pathways	0.9	0.5	4.0
Medium Pedestrian Conflict Areas			
Sidewalks and Pathways	0.5	0.2	4.0
Low Pedestrian Conflict Areas			
Sidewalks and Pathways	0.4	0.1	4.0

**Horizontal illuminance only*

Surface Parking Lot Lighting

Based on illumination criteria presented in ANSI/IES RP-8-18, it is recommended to adopt the surface parking lot lighting guidelines previously presented in **Table 8** above. In the absence of lighting control systems that will allow for the adjustment of light levels pre- and post- business hours (i.e. curfew), it is recommended that all City owned surface parking lots be designed to post-curfew light levels to prevent providing excessive light. However, for surface parking lots with particularly high usage and/or safety concerns, such as lots directly adjacent to Castro Street, it is recommended to design to pre-curfew lighting levels.

Light Pollution and Environmental Guidelines

Based on International Dark Sky recommendations and guidance, the Downtown Area in Mountain View is classified as lighting zone LZ2. Moderate ambient lighting. Per the IDA, the light pollution guidelines should be adhered to but not in the event they cause insufficient lighting levels. Within the study area, many of the existing lights are less than 0.5 mounting height from their adjacent property lines and are properly oriented. As such, the recommended maximum B-U-G rating for lights is B1-U3-G1. As feasible, based on manufacturer availability, shielding should be included on downtown light fixtures to minimize backlighting and glare which would impact adjacent buildings and properties where setbacks are little to none.

Consistent with IDA recommendations and the desire to maintain a warm and inviting ambiance in the Downtown Area, new LED fixtures should have a correlated color temperature of 3000K to lower blue spectrum light emissions.

Table 16 - Recommended IDA Guidelines

Recommended IDA Ratings			
Maximum Backlight Rating	Maximum Uplight Rating	Maximum Glare Rating	Maximum Color Temperature
B1	U3	G1	3000K

Luminaire Evaluation

To determine the best luminaires to address the needs of the Downtown Area, several luminaires were evaluated based on City needs, downtown aesthetics and character, IDA guidelines, and the recommended light level guidelines set forth in the Recommended Lighting Performance Guidelines section.

Post Top Luminaires

Post top luminaires are typically used for pedestrian scale lighting and are often seen in downtown areas as they enhance the aesthetics and the sense of place. Downtown Mountain View is no exception as most luminaires in the downtown core are post top style.

Existing Post Top Luminaires

The current post top luminaires being used throughout the downtown core are AL25 LED Acorn Style Luminaires by Antique Street Lamps (model AL25-A-24LED 700MA-4K-ACT-MVOLT-MT-N3-PE1-DLB) installed on New York Series Cast Aluminum Decorative Posts, as shown in **Figure 7**. Based on manufacturer documentation, the existing fixtures have an LED wattage of 57W, a color temperature of 4000K, and a Backlight-Uplight-Glare (BUG) rating of 2-5-3. Per a maintenance order form provided by the City, the existing acorn lights have type III light distribution but from field investigations, these luminaires appear to be type V which is a symmetrical distribution of light surrounding the luminaire.

Figure 7 - Existing Post Top Luminaire

Due to the shape and characteristics of the fixture, the existing acorn light has an uplight rating of three (3), which matches the recommended maximum value for downtown Mountain View. Also, the existing luminaire has a color temperature of 4000K which is higher than the maximum recommended value of 3000K. While this luminaire is available with 3000K color temperature, there is no option to reduce the uplight rating using this exact luminaire. Additionally, as shown in the existing conditions photo metric model, the existing luminaire does not provide enough lumen output to reach proposed light level guidelines. This luminaire series does have higher wattage and lumen output options which would improve light levels but would further compound uplighting and glare concerns.

Alternative 1 – New Luminaire on Existing Post - Preferred

Another luminaire option that can be installed on the existing posts is the Serenade S55 DSX LED series luminaire, as shown in **Figure 8**. While these luminaires are typically mounted on 4-1/8" poles, they do have an adapter that allows mounting on the City's existing 3" poles. There are three versions of this luminaire that could be used throughout the Downtown Area:

Figure 8 - Proposed Serenade S55 Post Top Luminaire

- S55-55W32LED3K-T-LE3-120 – This light provides a BUG rating of 1-3-1 so it falls within the recommended guidelines. It has an asymmetrical distribution (Type III) so the light can be aimed rather than distributed evenly around. This would be beneficial for providing sufficient lighting in the uncontrolled crosswalks or roadway corridors without needing to install mast arm luminaires.
- S55-55W32LED3K-T-LE5-120 – This light provides a BUG rating of 3-3-1 so it does not within the recommended guidelines. However, a higher backlight rating is not an important factor for a Type V (symmetrical distribution) light because it is designed to distribute light evenly around the post in all directions. This light would be used to supplement (or replace) existing post top luminaires throughout the Downtown Area on sidewalks, in alleyways, and in parking lots.
- S55-80W48LED3K-T-LE3W-120 – This light provides a BUG rating of 2-3-2 so it also does not fall within the recommended guidelines but this model could be used in instances when the first light (S55-55W32LED3K-T-LE3W-120) is not able to provide sufficient lighting levels. This light is also asymmetrically distributed so it can be aimed to provide additional lighting for uncontrolled mid-block crosswalks. In locations where the 55W light is not sufficient, it is recommended to use this 80W light even though it does not satisfy all of the B-U-G level recommendations.

Alternative 2 – New Luminaire on Existing Post – Not Recommended

The post top light evaluation included fixtures that could meet the recommended ratings provided by IDA and proposed light level guidelines for the City but differed from the Acorn style of the City's existing post top lights. One sample luminaire option is the MetroScape LED Post-Top from Lumec, as shown in **Figure 9**. The recommended option (MPTR-35W32LED-3K-G2-LE5-XX) provides 37W at a color temperature option of 3000K and has BUG rating of 2-0-1, nearly satisfying the recommended 1-3-1 rating. However, it should be noted that for luminaires distributing light symmetrically all around the luminaire (e.g., distribution type V), it is not realistic to have a backlight rating of 1. In addition, with an uplight rating of 0, this luminaire would meet the guidelines set by IDA. As mentioned in Alternative 1, this fixture would require a large-scale replacement project to maintain a consistent lighting character throughout the Downtown Area. Lastly, while this luminaire is not specifically

Figure 9 - Dark Sky Compliant Post Top Luminaire

designed to be installed on the existing light poles, it has the option to purchase adapters which should allow it to be mounted on the existing 3.5" diameter posts. It is understood that this luminaire is not feasible option as it does not match the existing character of the downtown.

Alternative 3 – New Luminaire on New Post

While installing new lighting on new light posts is an option to address all recommendations for the post top lighting improvements throughout the downtown core, it is not recommended due to high costs associated with replacing both the light and the light post. A potential positive outcome of this alternative is it provides the ability to adjust light placement and spacing to better meet light levels using the existing light poles and fixtures.

Mast Arm Luminaires

Mast arm luminaires are typically chosen as the most effective configuration for lighting roadways and intersections. The mounting height and distribution of mast arm luminaires make them ideal for providing light with vehicle and pedestrian conflict areas.

Existing Mast Arm Luminaires

The majority of mast arm luminaires in the Downtown Area are E-Cobra LED Street and Area Light by Leotek, consistent with City Standard Plans. A typical model is illustrated in **Figure 10**. The exceptions are the shoebox flood lights and several HPS cobrahead lights. E-Cobra lights come in a variety of wattages, light distribution patterns, and control options. The City of Mountain View has 27W, 63W, 87W, and 130W E-Cobra lights in the Downtown Area. From field observations, most existing lights are either 4000K or 5000K CCT; however, the series is available in 3000K CCT and some have BUG ratings within the recommended limits of 1-3-1. It is recommended to continue using the E-Cobra lights with 3000K CCT but selection of the wattage and light distribution type must be based on project constraints. Maximum BUG ratings should be maintained, but shields may be needed if the backlight rating must be exceeded to meet minimum light levels. Shields will help minimize excessive light entering adjacent properties and residences.

Figure 10 - Leotek E-Cobra LED Street and Area Light

Alternative 1 – New Luminaire on Existing Pole

An alternative to the standard Leotek lights seen above and throughout the Downtown Area, is the Leotek ComfortView Neighborhood LED Street Lights, shown in **Figure 11**. These lights are designed to be used for roadway lighting in residential areas by utilizing 2700K color temperature LED lights. The CV1-H-MV-27K-2R-XX model would be best suited for the roadway and stop-controlled intersections or roundabouts throughout the residential areas of the Downtown Core. This light complies with the recommended BUG ratings as it has a rating of 1-0-1.

Figure 11 - Leotek ComfortView Neighborhood LED Street Light

SECTION 4: IMPLEMENTATION STRATEGIES AND PRIORITIZATION

Based on discussions with City staff and project stakeholders during previous project meetings and a community outreach night walk, the following downtown lighting goals were identified. These goals form the framework for the development of the implementation strategies detailed later in this section. The goals and strategies include:

- Maintain "sense of place" of the downtown
  - Develop lighting guidelines and criteria, and system modifications and improvements consistent with the character of the Downtown Area. This includes predominantly using decorative poles rather than standard Caltrans type poles.
- Consider different land uses and environments throughout the Downtown Area
  - Establish lighting guidelines and associated projects based on the various environments such as: business district, parks, and residential.
- Improve connections between the core Downtown Area and the peripheral residential areas
  - Encourage and enhance walkability by providing lighting on corridors connecting to Castro Street.
- Improve lighting between City-owned surface parking lots and the core Downtown Area
  - Enhance visibility and safety in walkways and alleyways between parking areas and businesses/restaurants.
- Improve energy efficiency and maintenance activities
  - Replace all non-LED lighting with LED energy-efficient lights which have lower energy usage and higher life expectancies. Use consistent light fixtures to reduce repair times.
- Improve safety and visibility at pedestrian crossing and pedestrian/vehicle conflict areas
  - Upgrade or modify lighting at intersections and mid-block crossings to address low light levels throughout the Downtown Area.
- Improve lighting at the Center for Performing Arts and Civic Center Plaza
  - Provide additional lighting for events at the Performing Arts Center to enhance use of plaza as a gathering space.
- Incorporate lighting at Pioneer Park for events
  - Implement additional lighting with electrical access (i.e., outlets) to better serve special events that take place in Pioneer Park as well as improve pedestrian lighting along pathways.
- Improve lighting at the City Hall and Public Library garage exits on Mercy Street
  - Install new lighting at garage exits to improve visibility for pedestrians and vehicles.

Deployment Summary and Prioritization

Using the previously established photometric baseline model and preliminary feedback received from both City staff and the community during a night-walk, the following list of strategies and potential projects has been developed. Having prioritized implementation strategies based on the City's conveyed needs and goals will serve as a roadmap for future lighting improvements in the Downtown Area. The strategies represent types/groups of projects and implementation approaches identified to address the City's needs. The strategies summarize where to implement project elements, how to proceed with the deployment, and when improvements should be implemented. The proposed strategies are separated into near-term (1- to 2-years), mid-term (2- to 5-years), and long-term (more than 5-years). The intent of the strategies is not to be a rigid set of requirements; rather, the City should periodically reevaluate its evolving priorities and adjust these strategies as necessary. Potential projects and additional details are discussed in the following "Project Implementation" section of this document.

Near-Term Implementation (1 to 2 Years)

The near-term strategies are intended to establish a strong functional and operational network on which the City can improve and expand. Near-term strategies aim to address the City's highest and most pressing needs while considering the level of effort to complete.

1. Improve Safety Lighting at Uncontrolled Crosswalks

Baseline photometric results and night time field investigation revealed uncontrolled crosswalks in the Downtown Area do not meet updated lighting guidelines. The primary strategy to improve these crossings is to provide lights in advance (upstream) of and at the crosswalks to improve pedestrian visibility through increased vertical lighting levels. Supplemental improvements may be desired by the City, including modifying curbs, removing landscaping or other obstructions, and adding high visibility signage and striping. The locations of uncontrolled crossings requiring lighting upgrades are discussed in the "Project Implementation" section below.

2. Replace or Repair Broken Lights

Inherently, lighting systems are only effective when they are fully operational and functional. The City should evaluate its current maintenance and replacement policy for city-owned lighting in the Downtown Area. Currently, the City's roadway group reviews lighting in the downtown area about once every several months. The omitted lights are currently identified as needing repairs when reported by the public or by forestry/landscape staff conducting other work activities in the area during hours of darkness. It is recommended that lights and lighting infrastructure be inspected more regularly to confirm lights are operating and to address any necessary repairs or replacements.

3. Address Tree Obstructions to Street Lights

Like Strategy 2, lighting infrastructure blocked by trees or other vegetation cannot fulfill its purpose, leaving affected areas with degraded lighting. There are areas in the downtown area where tree canopies partially or fully block city-owned lights. The City should evaluate its current tree trimming services and schedule to ensure routine trimming occurs and luminaires are free from tree obstructions (where feasible). Currently, the City's forestry/landscape department trims trees in the

Downtown Area to maintain tree health two times a year. While some consideration may be given to remove tree branch obstructions from street light, the primary purpose of the trimming is to maintain tree health. Additional attention for maintaining light levels should be provided when evaluating tree trimming.

4. Replace existing non-LED lights with LED energy-efficient lights

Induction and other types of light fixtures were once the standard light type used by municipalities and state highway agencies across the country. With the advance of lighting technology, energy-efficient LED lights are now standard. Older non-LED lights may use two to three times as much energy as an equivalent LED replacement. LED fixtures may have a lifespan ten times that of traditional non-LED light fixtures. Furthermore, older generation lights tend to have higher backlight, uplight, and glare (BUG) ratings than newer LED lights, indicating more light intrusion and pollution. The City of Mountain View should aim to replace all non-LED lights with LED lights for increased energy savings and better lighting control and performance.

5. Improve Lighting Levels at High Use, Night-Time Activity Areas

The City should seek to improve lighting in locations with high night-time activity like Civic Center Plaza and Pioneer Memorial Park. This includes locations where high numbers of people are expected to be gathering or walking, such as, businesses, areas hosting community gatherings or meetings, voting precincts, or other civic events. Security lighting is recommended in these areas, while balancing the aesthetic appeal of the Downtown Area.

Mid-Term Implementation (2 to 5 Years)

After the near-term activities have been completed, focus can be placed on strategies that may require more effort and time to complete and have less priority. Recommended project solutions may be in the form of stand-alone projects or included as part of other capital improvement projects.

6. Improve Safety Lighting at Signal-Controlled Intersections

Traffic signals are important regulatory facilities in the transportation network that can lessen the potential of conflict between vehicles, pedestrians, and other users of the road. Having properly lit signalized intersections is imperative in a multi-modal and high activity area such as Downtown Mountain View. Several traffic signals (specific signals are listed in “Project Implementation” section below) in the project area have lower than updated lighting guidelines. Strategies for improvements include: replacing old induction-type lights with new LED lights, replacing existing poles with new standards with mast-arms, and adding infill lighting. Traffic signal intersection lighting should conform with industry recommended values.

7. Improve Safety Lighting at Stop-Controlled Intersections and at Traffic Circles

Once lighting improvements have been made at uncontrolled crosswalks and traffic signal locations, the City should focus attention at improving lighting levels at stop-controlled intersections and at traffic circles within the Downtown Area through the replacement of existing fixtures and the addition of infill lights. These locations generally have lower traffic volumes than a signalized intersection and likely fewer potential conflicts. Nevertheless, these locations still should meet minimum safety light levels for visibility of obstacles and pedestrians during night hours.

8. Improve Pedestrian Lighting Coverage on City Walkways between Parking and Businesses

Providing safe and secure walkways to and from parking areas and businesses is essential in the Downtown Area. Many designated connections have lighting within the alley to the downtown core but not from the alley to the parking structures. Other locations rely on private lighting which may or may not be on during night-time hours depending on the business's hours of operations. The City should identify City owned pedestrian passageways and light them at appropriate levels according to industry guidelines by upgrading existing fixtures and adding new lights where there are gaps.

9. Enhance Lighting and Security in City-Owned Surface Parking Lots

All City-owned surface parking lots currently have existing lighting infrastructure in place; however, some areas within the parking lots do not meet the updated lighting guidelines. The City should focus on adding infill lighting in these locations to meet updated lighting guidelines. See "Project Implementation" section for new infill lighting recommendations. Another important aspect to evaluate in parking areas is the glare rating of the lights. High glare lights can make it hard for vehicles to identify pedestrians and pedestrians to identify potential risks. The replacement of existing fixtures with new lights with lower glare rating would provide an enhanced level of security for people using these facilities.

Long-Term Implementation (5+ Years)

Long-term strategies include approaches that will provide extra enhancements to current lighting infrastructure. These strategies would include projects that are more preference-based rather than necessary. They will move the City into better compliance with industry trends and offer more functionality for the future.

10. Enhance Safety Lighting on Corridors in the Downtown Area

While there is not an industry requirement to provide lighting along roadways, there are industry guidelines that recommend what levels should be achieved in a variety of scenarios and locations. The City should adopt this study's recommended lighting guidelines for priority corridors and work to enhance the lighting along these corridors. This would include adding infill lighting and replacing existing lights with more energy and optically efficient lights.

11. Address Tree Obstructions to Street Lights (Long-Term)

In addition to the improvements presented in Strategy 3, it is also important to review alternative methods to tree trimming that would help lights avoid the tree canopies. These strategies could include: lowering mounting height of the lights under the canopy, extending mast arm lengths to protrude farther into the road than the tree canopy, or relocating lights so they are installed between trees rather than adjacent to trees.

12. Implement Smart Lighting Control

Traditionally, the only lighting control used by municipalities has been activation/deactivation control. This is most commonly achieved through a light sensing photocell unit that detects when light is below or above a certain threshold. New technology allows agencies more control options than just activation such as adjusting light output for certain periods of the night. This would be utilized in areas such as surface parking lots where high light levels are recommended for certain peak periods with high expected activity. During non-peak periods, the lights could be dimmed to a lower power setting both saving money and reducing light impacts on the surrounding area. Other forms of control could be motion activated lighting for passageways and alleys. While the approach discussed here is targeted towards larger downtown initiatives, smart lighting control strategies can be incorporated into the projects associated with strategies above and any new lighting installation where the increased control is applicable.

13. Implement Dark Sky Compliant Lighting

The City should work to implement environmentally conscious lighting by using lighting that is compliant with the International Dark Sky Fixture Approval Program. This program provides, "objective, third-party certification for lighting that minimizes glare, reduces light trespass and doesn't pollute the night sky." Fixtures that are compliant have no uplight, minimum glare, and lower color-correlated temperature (CCT). Most of the existing downtown post-top decorative lights do not meet the criteria for the approval program because they have high uplight and glare characteristics. Additionally, the existing LED street and safety lights have CCT of 4000K, exceeding International Dark Sky's recommended maximum CCT of 3000K. The City should evaluate and select Dark Sky Compliant lighting fixtures that effectively utilize the existing infrastructure thus saving costs. Many of the City's existing post-top and mast-arm mounted lights have universal housings which could facilitate the retrofit to Dark Sky compliant lighting. While the approach discussed here is targeted towards larger replacement on LED fixtures that have already been deployed, it is important to note that Dark Sky lighting should be incorporated into all the projects discussed for the previous strategies and any new lighting installations.

This strategy should be used as a best practice on a project-by-project basis, especially in the Downtown Area. For this strategy to be formally adopted on a larger city-wide scale, the City would need to develop a new policy for consideration and approval by City Council.

Summary

Table 17 provides a summary of the lighting improvement strategies discussed above and their prioritization into near-term, mid-term, and long-term timeframes.

Table 17 - Summary of Lighting Improvement Strategies

Strategy	Deployment Timeline		
1. Improve safety lighting at uncontrolled crosswalks	Near-Term (1-2 Years)		
2. Replace or repair broken lights			
3. Address tree obstructions to street lights			
4. Replace existing non-LED lights with LED energy-efficient lights			
5. Improve lighting levels at high use, night-time activity areas			
6. Improve safety lighting at signal-controlled intersections		Mid-Term (2-5 Years)	
7. Improve safety lighting at stop-controlled intersections and at traffic circles			
8. Improve pedestrian lighting coverage on city walkways between parking and businesses			
9. Enhance lighting and security in city-owned parking lots			
10. Enhance safety lighting on in downtown area			Long-Term (5+ Years)
11. Address tree obstructions to street lights (long-term)			
12. Implement smart lighting control			
13. Implement Dark Sky compliant lighting			

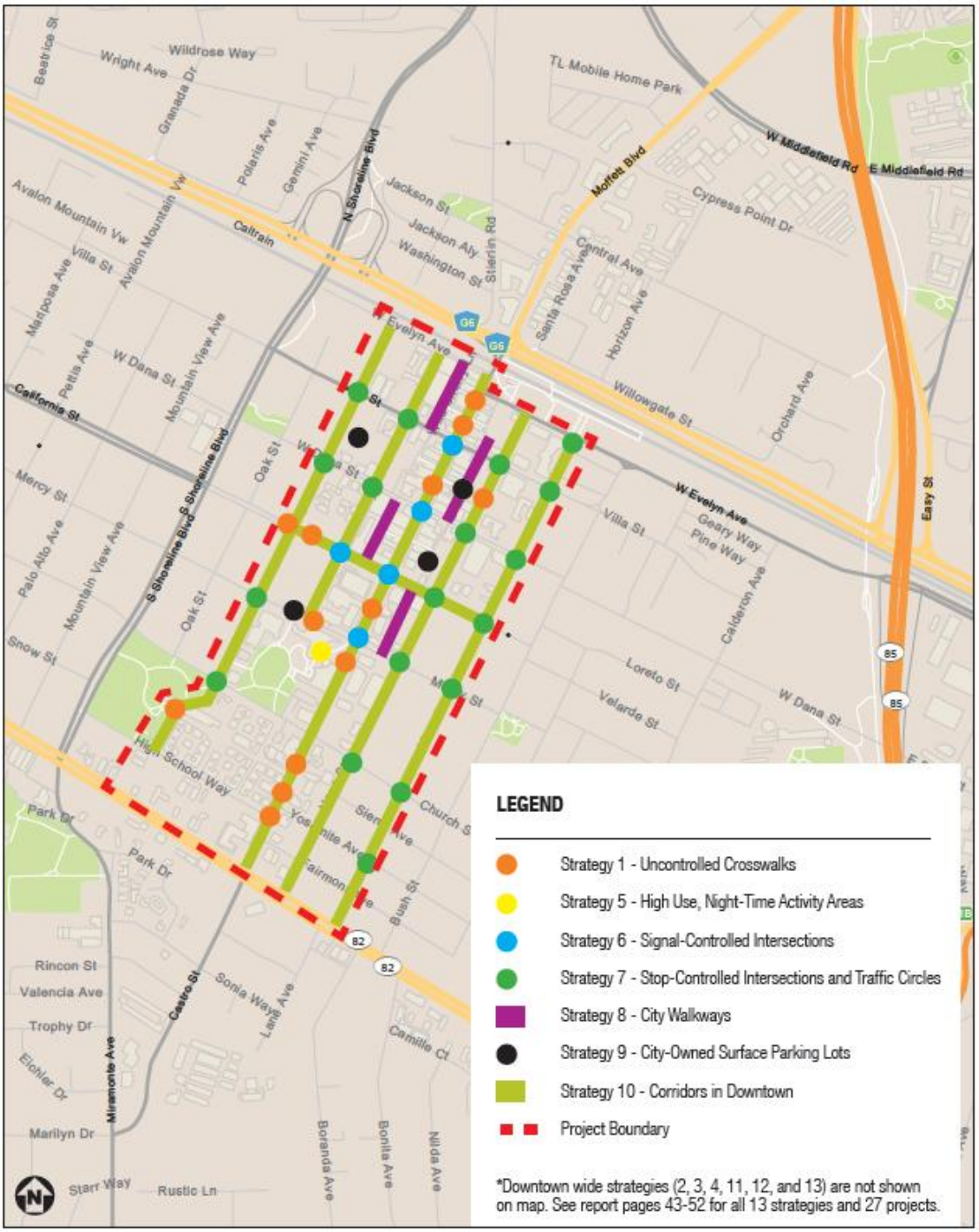
Project Implementation

The projects listed in this section have been identified to implement the strategies discussed above. The projects presented are ordered per deployment timeline and organized into which strategy they will address. Note that the order in which the projects are presented should not always correlate to the order they would be implemented. Appropriate phasing of projects should be evaluated as funds become available and opportunities of a mid-term or long-term project being deployed simultaneous to a near-term project should be considered based on implementation efficiencies.

Specific Projects

The following list of projects highlight the work and elements to be included. Overall planning-level project costs for each are included in **Table 18** while detailed project assumptions and costs are presented in **Appendix C.** To show potential improvements described in the various projects, concept designs for sample locations have been developed, and are shown in **Appendix D**. The locations of the proposed projects, grouped by implementation strategy, are shown in **Figure 12**.

Figure 12 – Project Locations



Strategy 1 – Improve Safety Lighting and Uncontrolled Crosswalks

Based on the crosswalk conditions and required improvements at each, it is recommended to break the safety lighting improvements at uncontrolled crosswalks into three separate projects; crosswalks without median refuge areas, crosswalks with median refuge areas, and crosswalks with a median without refuge areas. As shown in the two uncontrolled crossing design concepts in **Appendix D** (Figures D-1 and D-2), the improvements would include installation of post top mounted luminaires in advance of crosswalks to increase pedestrian visibility. The projects could also include luminaire retrofits for existing nearby post-top mounted luminaires and relocations of existing street lights. At crosswalk locations with existing medians, new post top lights in the median will be added to meet the proposed light guidelines. Also, these projects will require the installation of conduit and conductor wire to power the new luminaires. It is assumed that no pull boxes will be used to reduce landscaping intrusion and maintain aesthetics. Electrical service will be obtained from existing street light circuits along the corridor.

Project 1 – Add additional lighting to uncontrolled crosswalks with no median island

In the Downtown Area, there are ten (10) existing uncontrolled crosswalks which do not have a median refuge area. It is assumed that each of these crosswalks will require two new poles, one additional pole relocation, and two additional luminaire retrofits, as shown in Figure D-1, for a total of five new luminaires per location. The locations included in this project are:

- Castro Street at Yosemite Avenue (2 crosswalks)
- Castro Street South of Church Street
- Castro Street South of Evelyn Avenue
- Castro Street North of California Street
- Castro Street North of Villa Street
- Castro Street North of Dana Street
- Hope Street South of Villa Street
- Mercy Street at Bryant Street
- Franklin Street South of Church Street

Project 2 – Add additional lighting to uncontrolled crosswalks with median islands with refuge area

In the Downtown Area, there are two (2) existing uncontrolled crosswalks which do have a median refuge area. It is assumed that each of these crosswalks will require three new poles, one additional pole relocation, and three additional luminaire retrofits, as shown in Figure D-2, for a total of seven new luminaires per location. The locations included in this project are:

- Castro Street North of Mercy Street
- Castro Street South of Mercy Street

Project 3 – Add additional lighting to uncontrolled crosswalks with a median island without refuge area

In the Downtown Area, there are two (2) existing uncontrolled crosswalks which have a median island but no refuge areas. Based off what is seen in Figures D-1 and D-2, it is assumed that each of these

crosswalks will require three new poles and two additional luminaire retrofits for a total of five new luminaires per location. The locations included in this project are:

- California Street at Franklin Street (2 crosswalks)

Strategy 2 – Replace or Repair Broken Lights

To address the issue of broken lights within the Downtown Area, the best approach is to improve the identification and repair of out-of-service lights. As mentioned earlier, the City of Mountain View already has a system in place that should be expanded to better address and maintain the lighting infrastructure. Therefore, there is only one project that arises for this strategy.

Project 4 – Modify existing maintenance program for identifying and repairing broken luminaires in the Downtown Area

It is recommended to increase the number of inspections to occur once per month in the Downtown Area. These inspections are to be conducted during nighttime as nighttime inspections will help staff identify issues beyond light outages, such as dimmed LEDs. This project assumes that all work associated with this project, from identification to repairs, will be completed by the City's streets group. However, if there are staffing constraints, the use of an on-call electrical contractor may be considered. As this is a program modification and not a new program altogether, the cost will include only the additional inspection time (assumed four hours per month) and not any repair costs as those are already being done with the current program.

Strategy 3 – Address tree obstructions to street lights

As a near-term solution to address the issue of having tree canopies blocking lighting through the downtown core, it is recommended to augment the existing program to identify and trim trees for the purpose of improving lighting.

Project 5 – Augment maintenance program for identifying and trimming trees that are blocking luminaires in the downtown core

Currently, the City's forestry/landscaping department has a program for identifying tree trimming needs, but this program does not consider lighting infrastructure. It is recommended to augment the existing program that looks at tree trimming opportunities from a lighting standpoint. These inspections would occur twice per year and would be completed by the City's streets group. The program should include nighttime inspections (which could potentially be completed concurrently with Strategy 2) to identify locations where trees inhibit street lighting in addition to daytime work to trim the obstruction areas.

Strategy 4 – Replace existing non-LED lights with LED energy-efficient lights

The following projects include the replacement of the non-LED lights throughout the Downtown Area. By replacing existing lights with LED fixtures, the City will not only be able to improve energy efficiency but will also improve lighting levels to reach proposed lighting guidelines.

Project 6 –Replace existing shoebox flood lights with LED lights

Throughout the Downtown Area there are old shoebox flood lights, as shown in **Figure 13**, and these lights should be replaced with the LED E-Cobra lights with a light temperature of 3000K. It is expected that the LED E-Cobra can be purchased with an adapter that will allow for installation of the new luminaire on the existing pole. Many shoebox lights are located at signalized intersections throughout the Downtown area, therefore, this project and Project 9 can be done in conjunction or coordinated to take advantage of cost effectiveness of purchasing equipment in bulk.

Figure 13 - Existing Shoebox Style Flood Light

Project 7 –Replace existing induction post top lights with LED lights

From the field review and per City GIS records, many of the post top lights throughout the Downtown Area have still not been upgraded to LED energy efficient lighting. While all the post top lights along Castro Street have been upgraded, it appears that all the other post top lights are still using the old induction bulbs. There are about 340 induction post top lights that would need to be upgraded to LED energy efficient lights. In addition to improved energy efficiency, as discussed in the luminaire evaluation section above, replacement of the existing fixtures with LED luminaires with higher lumen outputs and different light distributions can help improve light levels throughout the Downtown Area. New fixtures should be "smart lighting control" ready to allow for potential future applications of advanced lighting control (see Project 27)

Strategy 5 – Improve light levels at high use, night-time activity areas

Per discussions with City staff regarding the high use, night-time activity areas, the most pressing issue is to address the Center for Performing Arts and Civic Center Plaza lighting during events. Currently, there is not sufficient lighting to maintain sense of place and security for patrons entering or exiting these two buildings before and after nighttime events. Therefore, the single project that will be addressed in this strategy will focus on the Center for Performing Arts and Civic Center Plaza.

Project 8 –Add lighting at the Center for Performing Arts and Civic Center Plaza

To minimize impacts to the plaza surface, it is recommended that additional lighting be provided using wall mounted lights installed on the Center for Performing Arts and the fixtures should be chosen to be consistent with the building architecture. It is assumed any additional lights will be connected to the existing electrical in the Center for Performing Arts; however, detailed design development will be required to identify where electrical infrastructure is located within the building and the level of electrical work required to service the wall mounted lights.

It is recommended that the new lights in the plaza be installed with smart lighting control, enabling the City to provide additional lighting to patrons while entering and existing the buildings without providing

excess light and light pollution when not needed. In addition to providing the ability to turn lights on/off for events, the smart lighting controls could include motion detection in conjunction with dimmable lights to switch between pre-curfew and post-curfew lighting levels depending on the occupancy of the plaza.

In conjunction with the primary wall mounted lights, it is recommended that lighted bollard or pedestrian scale lighting be installed in landscaped areas around the plaza and near stairs for improved lighting and ambiance.

Strategy 6 – Improve safety lighting at signal-controlled intersections

At the signalized intersections, some of the existing lights are shoebox style flood lights rather than City standard LED E-Cobra lights. These lights could be replaced as part of Project 6 to take advantage of economy of scale purchasing and construction. This project is anticipated to include replacing existing luminaires as well as adding any additional infill poles. One example (California Street and Bryant Street intersection) can be seen in **Appendix D**, Figure D-3. As seen in this example, replacing the existing luminaires with new LED E-Cobra luminaires will sufficiently light the intersection. This is an ideal situation but it is assumed that this will not be the case at every signalized intersection in the downtown area, therefore, the costs provided for these improvements are estimated to include light retrofits and the addition of two additional infill poles and luminaires.

Project 9 –Modify existing lighting at downtown signal-controlled intersections.

In the Downtown Area, there are six (6) existing signal-controlled intersections. It is assumed that five (5) of these intersections would need to be updated as Castro Street and Church Street already meets the lighting recommendations.

- Castro Street and Mercy Street
- Castro Street and California Street
- Castro Street and Dana Street
- Castro Street and Villa Street
- Castro Street and Church Street (safety lights are new at this intersection and do not need to be updated)
- California Street and Bryant Street

Strategy 7 – Improve safety lighting at stop-controlled intersections and traffic circles

Based on the number of each intersection type, it is recommended to break this strategy into two projects, one to address stop-controlled intersections and one to address traffic circles. Since these intersections tend to have similar sizes and conditions, the improvements are assumed to be the same for all intersections. To provide sufficient lighting, it is recommended that two new mast arm poles with LED luminaires be provided at each intersection, at opposite corners. An example (Mercy Street and View Street traffic circle) of the potential lighting improvements to meet lighting guidelines at stop-controlled intersections and traffic circles is provided in **Appendix D**, Figure D-4. As seen in this example, light level recommendations can be met by retrofitting the existing luminaire and installing one infill pole and luminaire. The project costs in **Appendix C** assume this same condition is applicable to all stop-controlled and traffic circle locations within the project area.

Project 10 –Enhance lighting at all-way stop controlled intersections
In the Downtown Area, there are fourteen (14) existing all-way stop controlled intersections, all of which will require improvements.

- View Street and Evelyn Avenue
- View Street and Villa Street
- View Street and Dana Street
- Hope Street and Villa Street
- Hope Street and Dana Street
- Hope Street and California Street
- Hope Street and Mercy Street
- Hope Street and Church Street
- Bryant Street and Villa Street
- Bryant Street and Dana Street
- Franklin Street and Villa Street
- Franklin Street and Dana Street
- Franklin Street and Mercy Street
- Franklin Street and Church Street

Project 11 –Enhance lighting at traffic circles
In the Downtown Area, there are four (4) intersections with existing traffic circles, all of which will require improvements.

- View Street and California Street
- View Street and Mercy Street
- View Street and Church Street
- View Street and Yosemite Avenue

Strategy 8 – Improve Pedestrian Lighting Coverage on City Walkways between Parking and Businesses

Providing additional lighting through the alleys will require supplemental decorative post top luminaire installations in addition to retrofitting the existing post-tops with new luminaires. It is assumed that any new light installation will get electrical service from adjacent lights, and there will be no pull box installations to maintain the character and aesthetics of the Downtown Area. An example of the recommended lighting for City Walkways (Cherry Lane) can be seen in **Appendix D**, Figure D-5.

Project 12 –Add infill lighting along Cherry Lane Alley
For the Cherry Lane Alley, it is estimated that 6 luminaires should be retrofitted and 3 luminaires should be added to reach sufficient lighting levels.

Project 13 –Add infill lighting along Blossom Lane Alley
For the Blossom Lane Alley, due to its vicinity to surface parking lots 5 and 6, many of the necessary improvements can be included in the projects to improve the lighting in these parking lots (Projects 15 and 17). In addition to these improvements, it is estimated that 4 luminaires should be added for the Blossom Lane Alley.

Project 14 –Add infill lighting along Wild Cherry Lane Alley

Based off the luminaire spacing shown to provide sufficient lighting for the Cherry Lane Alley, it is estimated that 9 luminaires should be added for the Wild Cherry Lane Alley. There are no existing post-top luminaires to retrofit in this alley so all new luminaires will be installed on new post-top poles.

Strategy 9 – Enhance Lighting and Security in City-Owned Surface Parking Lots

Initial proposed lighting photometric analyses identified that supplemental decorative post top luminaire installations will be required to meet recommended light levels in each of the city-owned surface parking lots. New, symmetrically distributed (Type V), luminaires will be added to provide sufficient lighting through the entire parking lot while also eliminating dark spots to maintain sufficient min/max lighting output ratios. In addition, it is recommended that the existing luminaires in the surface parking lots be replaced with new luminaires to help reach sufficient lighting levels. In surface parking lots, it is recommended that all new luminaires be compatible with smart lighting control systems to facilitate pre- and post-curfew lighting. The enhanced lighting control functionality may include motion detection to adjust lighting levels depending on the occupancy of the lot. An example of the recommended lighting for surface parking lots (Parking Lot 6) can be seen in **Appendix D**, Figure D-6.

Project 15 –Add infill lighting in City Parking Lot 6

For Parking Lot 6, it is estimated that 2 new poles should be added, and 16 new lights should be retrofitted.

Project 16 –Add infill lighting in City Parking Lot 2

Based off the required improvements in Parking Lot 6 and the relative size of Parking Lot 2, it is estimated that 4 new poles should be added, and 16 new lights should be retrofitted in Parking Lot 2.

Project 17 –Add infill lighting in City Parking Lot 5

Based off the required improvements in Parking Lot 6 and the relative size of Parking Lot 5, it is estimated that 2 new poles should be added, and 14 new lights should be retrofitted in Parking Lot 5.

Project 18 –Add lighting at the entrance/exit of the City Hall and Public Library parking areas

In addition to the surface parking lot improvements, the pedestrian and vehicle conflict areas at the entrance/exit to the City Hall parking garage and the Public Library parking lot are not well lit and improvements should be considered in this strategy. Since these two parking lot driveways are close to each other, providing sufficient lighting can be accomplished by installing two new post top luminaires, retrofitting the two existing post-top luminaires, and retrofitting the mast arm luminaire across the street. Recommended lighting for the garage entrance/exit area can be found in **Appendix D**, Figure D-7.

Strategy 10 – Enhance safety lighting on corridors in the Downtown Area

Due to the expected high cost associated with corridor improvement projects, it is recommended to break out each corridor into its own project. To provide recommended lighting levels, the corridor lighting projects will utilize the asymmetrical post-top lights. An example of the recommended lighting improvements for roadway corridors (Bryant St) can be seen in **Appendix D**, Figure D-8. This sample shows one block of Bryant Street where the existing post-top luminaires have spacing that allows

sufficient lighting levels to be reached simply by retrofitting all the existing poles. As this will not always be the case, to get a more conservative project planning cost, it is assumed that the spacing of the luminaires along any corridor will match what is shown along this block of Bryant Street but half of the new luminaires will require new poles.

Project 19 – Enhance safety lighting on Bryant Street
For Bryant Street, it is estimated that 12 luminaires should be added and 12 additional luminaires should be retrofitted.

Project 20 – Enhance safety lighting on Castro Street
Based off the spacing for Bryant Street, it is estimated that 23 luminaires should be added and 23 additional luminaires should be retrofitted along Castro Street.

Project 21 – Enhance safety lighting on Franklin Street
Based off the spacing for Bryant Street, it is estimated that 24 luminaires should be added and 24 additional luminaires should be retrofitted along Franklin Street.

Project 22 – Enhance safety lighting on View Street
Based off the spacing for Bryant Street, it is estimated that 23 luminaires should be added and 23 additional luminaires should be retrofitted along View Street.

Project 23 – Enhance safety lighting on Hope Street
Based off the spacing for Bryant Street, it is estimated that 23 luminaires should be added and 23 additional luminaires should be retrofitted along Hope Street.

Project 24 – Enhance safety lighting on California Street
Based off the spacing for Bryant Street, it is estimated that 9 luminaires should be added and 9 additional luminaires should be retrofitted along California Street.

Project 25 – Enhance safety lighting on Evelyn Avenue
Based off the spacing for Bryant Street, it is estimated that 9 luminaires should be added and 9 additional luminaires should be retrofitted along Evelyn Avenue.

Strategy 11 – Address tree obstructions to street lights (Long-Term)

As a long-term solution to address the issue of having tree canopies blocking lighting through the downtown core, in locations where tree trimming does not clear the obstruction, it is recommended to move street light poles away from the tree.

Project 26 – Relocate light poles away from trees
In the locations where trimming the adjacent trees does not clear the obstruction, it is recommended to relocate the existing light away from the tree canopy. These relocations should be assessed on a pole-by-pole basis whenever it is identified that trimming the adjacent tree will not be enough to clear the light obstruction. The project cost shown in **Table 18** represents the planning level cost per light to be relocated.

Strategy 12 – Implement smart lighting control

As noted previously, smart lighting control can be incorporated, where applicable, into the previous projects. Depending on project type, some of the commonly used smart lighting control systems (motion detection, dimming, etc.) should be incorporated on a project-by-project basis. By incorporating smart lighting controls, lighting systems become more sustainable, efficient, and cheaper. Smart lighting control would also be a strategy that can be considered in any future lighting project in the City of Mountain View.

Project 27 – Pilot project to implement downtown wide smart lighting control (Castro Street)

In addition to the improvements that can be made is previous projects, it is recommended to complete a pilot project to assess the feasibility of installing downtown wide smart lighting control. For this project, it is assumed that Castro Street will act as the pilot program to evaluate corridor wide adjustment of light levels. Under the pilot project, the City could evaluate opportunities to lower light levels at non-intersection segments during late night periods. Alternatively, the City may be able to utilize the smart control system to remotely increase light levels during special evening events along Castro Street.

The required improvements to complete the project include:

- New Ethernet communication equipment and cables the entire length of the corridor to each street light.
- New conduit to connect the adjacent street light with the traffic signal controller cabinet.
- New conduit to connect smart control system back to City TMC

Important assumptions that were made when compiling the list of improvements that will need to be assessed and potentially added to the project include:

- No new conduit will be necessary to connect street lights; all communication cable will be installed with electrical wiring in existing conduits
- All luminaires will have previously been replaced with luminaires capable of incorporating smart lighting controls (can be completed in Project 20)

Strategy 13 – Implement dark sky compliant lighting

As noted previously, in order for dark sky compliant lighting to be fully adopted by the City, a new policy would have to be developed for and approved by City Council. On a project-by-project basis, a best practice would be install new luminaires that meets the proposed guidelines in this report. As such, no specific projects have been identified solely to deploy Dark Sky compliant lighting, but it is recommended to conform to proposed lighting guidelines where feasible on Downtown Area lighting projects.

Table 18 - Project and Planning Level Costs Summary

Project No.	Project Description	Total Project Cost* (2019 Dollars)
Near-Term Implementation		
Strategy 1 - Improve Safety Lighting at Uncontrolled Crosswalks		
1	Add additional lighting at uncontrolled crosswalks with no median island	$ 500,000
2	Add additional lighting at uncontrolled crosswalks with median islands with refuge area	$ 140,000
3	Add additional lighting at uncontrolled crosswalks with a median island without refuge area	$ 116,000
Strategy 2 - Replace or Repair Broken Lights		
4	Modify existing maintenance program for identifying and repairing broken luminaires in the downtown core (costs provided per year)	$ 10,000
Strategy 3 – Address tree obstructions to street lights (near-term)		
5	Augment maintenance program for identifying and trimming trees that are blocking luminaires in the downtown core (costs provided per year)	$ 8,000
Strategy 4 - Replace Existing non-LED Lights with LED Energy-Efficient Lights		
6	Replace existing shoebox flood lights with LED E-Cobra by Leotek	$ 29,000
7	Replace existing induction post-top lights with LED lights	$ 442,000
Strategy 5 - Improve Light Levels at High Use, Night-Time Activity Areas		
8	Additional lighting at the Center for Performing Arts and Civic Center Plaza	$ 321,000
	Near-Term Implementation Total	$ 1,566,000
Mid-Term Implementation		
Strategy 6 - Improve Safety Lighting at Signal-Controlled Intersections		
9	Modify existing lighting at downtown signal-controlled intersections	$445,000
Strategy 7 - Improve safety lighting at stop-controlled intersections and at traffic circles		
10	Enhance lighting at all-way stop controlled intersections	$ 630,000
11	Enhance lighting at traffic circles	$ 180,000
Strategy 8 - Improve Pedestrian Lighting Coverage on City Walkways between Parking and Businesses		

Project No.	Project Description	Total Project Cost* (2019 Dollars)
12	Add infill lighting through Cherry Lane alleyway	$ 61,000
13	Add infill lighting through Blossom Lane alleyway	$ 69,000
14	Add infill lighting through Wild Cherry Lane alleyway	$ 155,000
Strategy 9 - Enhance Lighting and Security in City-Owned Surface Parking Lots		
15	Add infill lighting in Parking Lot 6	$ 68,000
16	Add infill lighting in Parking Lot 2	$ 103,000
17	Add infill lighting in Parking Lot 5	$ 65,000
18	Add lighting at the entrance/exit of the City Hall parking garage and the Public Library Parking Garage	$ 48,000
	Mid-Term Implementation Total	$ 1,824,000
Long-Term Implementation		
Strategy 10 - Enhance Safety Lighting on Corridors in Downtown Area		
19	Enhance safety lighting on Bryant Street	$ 518,000
20	Enhance safety lighting on Castro Street	$ 942,000
21	Enhance safety lighting on Franklin Street	$ 980,000
22	Enhance safety lighting on View Street	$ 942,000
23	Enhance safety lighting on Hope Street	$ 942,000
24	Enhance safety lighting on California Street	$ 403,000
25	Enhance safety lighting on Evelyn Avenue	$ 403,000
Strategy 11 - Address tree obstructions to street lights (Long-Term)		
26	Relocate light poles away from trees (cost provided per obstruction)	$43,000
Strategy 12 - Implement Smart Lighting Control		
27	Pilot project to implement downtown wide smart lighting control (Castro Street)	$170,000
Strategy 13 - Implement Lights That Are Dark Sky Compliant		
No specific projects, this strategy should be implemented where appropriate in all downtown lighting projects		
	Long-Term Implementation Total	$ 5,343,000
	Total Project Cost	$ 8,733,000

* Project cost include capital improvements, project development and design, construction administration, and a 30% contingency. See Appendix C for further information and assumptions.

SECTION 5: NEXT STEPS

Community input on the draft study will be gathered at public outreach meetings with the Downtown Committee and the Bicycle/Pedestrian Advisory Committee. Feedback received will be evaluated and incorporated into the Final Downtown Lighting Study. The Final Downtown Lighting Study will be used as the basis for future City Capital Improvement project requests, development review opportunities, and grant funding opportunities to improve lighting in the City's Downtown Area.

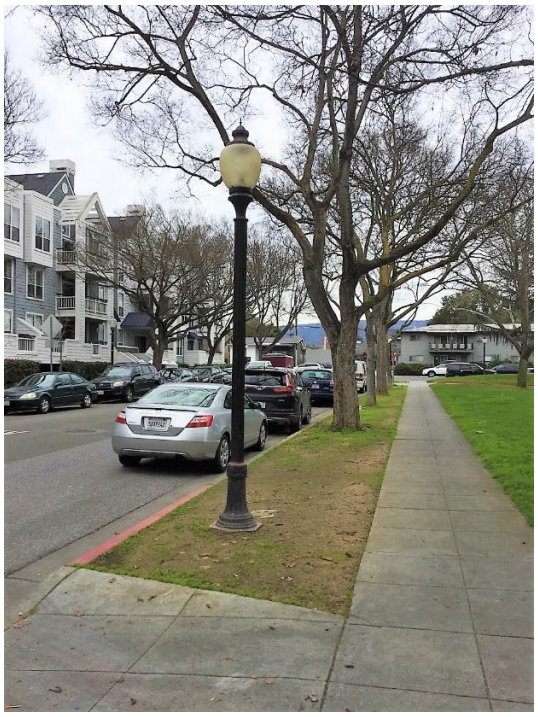
In addition, the lighting guidelines presented in the Downtown Lighting Study will supplement existing City Standards during the design development of future lighting improvement projects.

Appendix A – Pictures of Existing Light Types

Castro Street LED Post-Mount Light (14’ Mounting Height)

‘Antique Acorn’ Post-Mount Light (14’ Mounting Height)

Single



Dual

27 W LED Cobrahead Light

3’ Mast Arm

6’ Mast Arm

9’ Mast Arm

63 W LED Cobrahead Light (6’ Mast Arm)

87 W LED Cobrahead Light (3’ Mast Arm)

130 W LED Cobrahead Light

3’ Mast Arm

12’ Mast Arm

Shoebox Floodlight

Single (30’ Mounting Height)

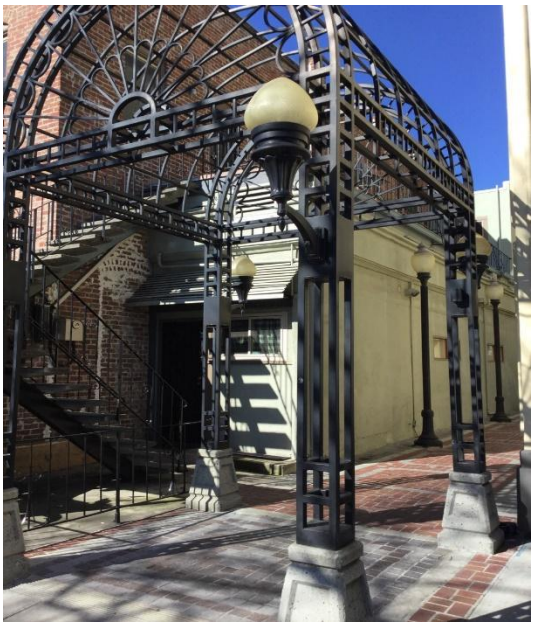
Double (30’ Mounting Height)

Walkway Post-Mount Lights

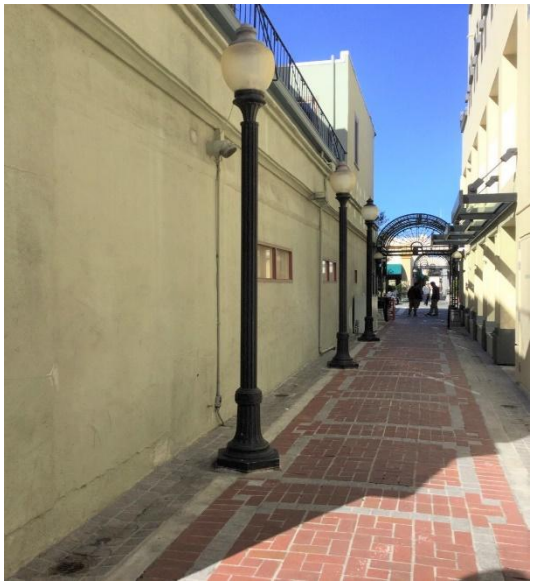
Side-Mount Acorn (9’ Mounting Height)

Entrance Acorn

(9’ Mounting Height)



Antique Acorn Post-Mount (12’ Mounting Height)



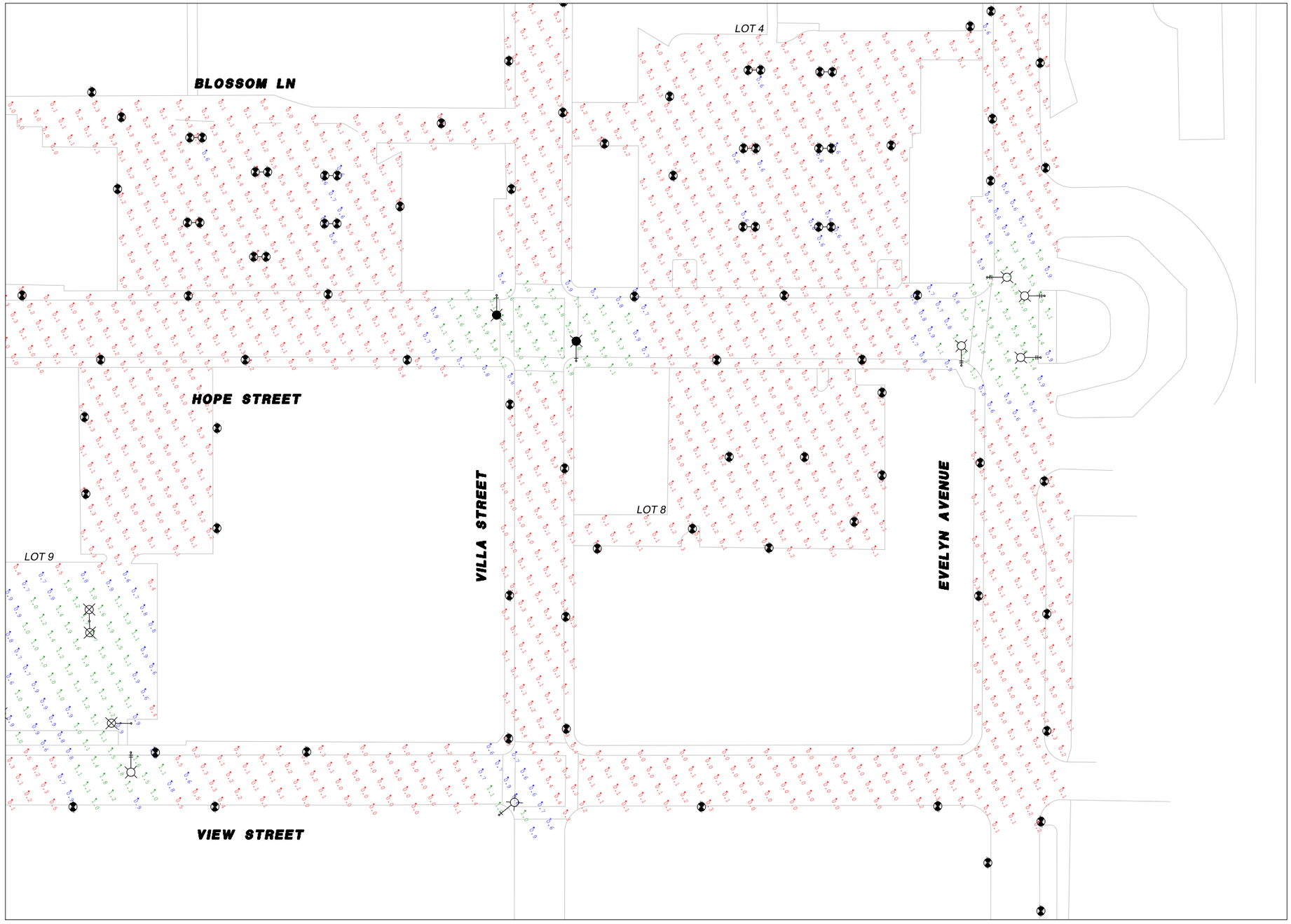
Other Walkway Lights

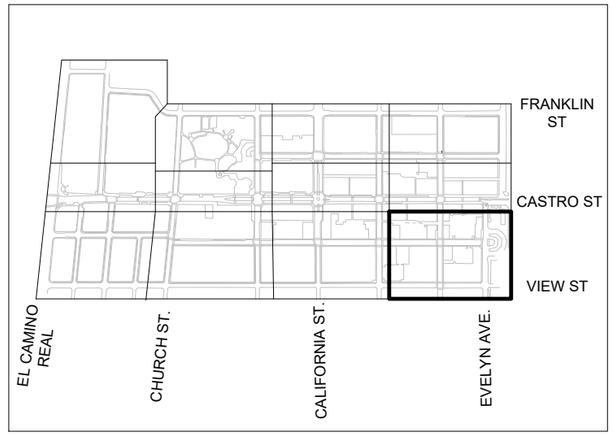
Ceiling Floodlight

Teardrop Acorn

70 W HPS Cobrahead Light (6’ Mast Arm)

Appendix B – Base Model Lighting Results





VICINITY MAP

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- ANTIQUE ACORN POST-TOP - DOUBLE (14' MH)
- 27 W LED (3' MA)
- 27 W LED (9' MA)
- 63 W LED (3' MA)
- 63 W LED - DUAL (3' MA)
- 130 W LED (3' MA)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

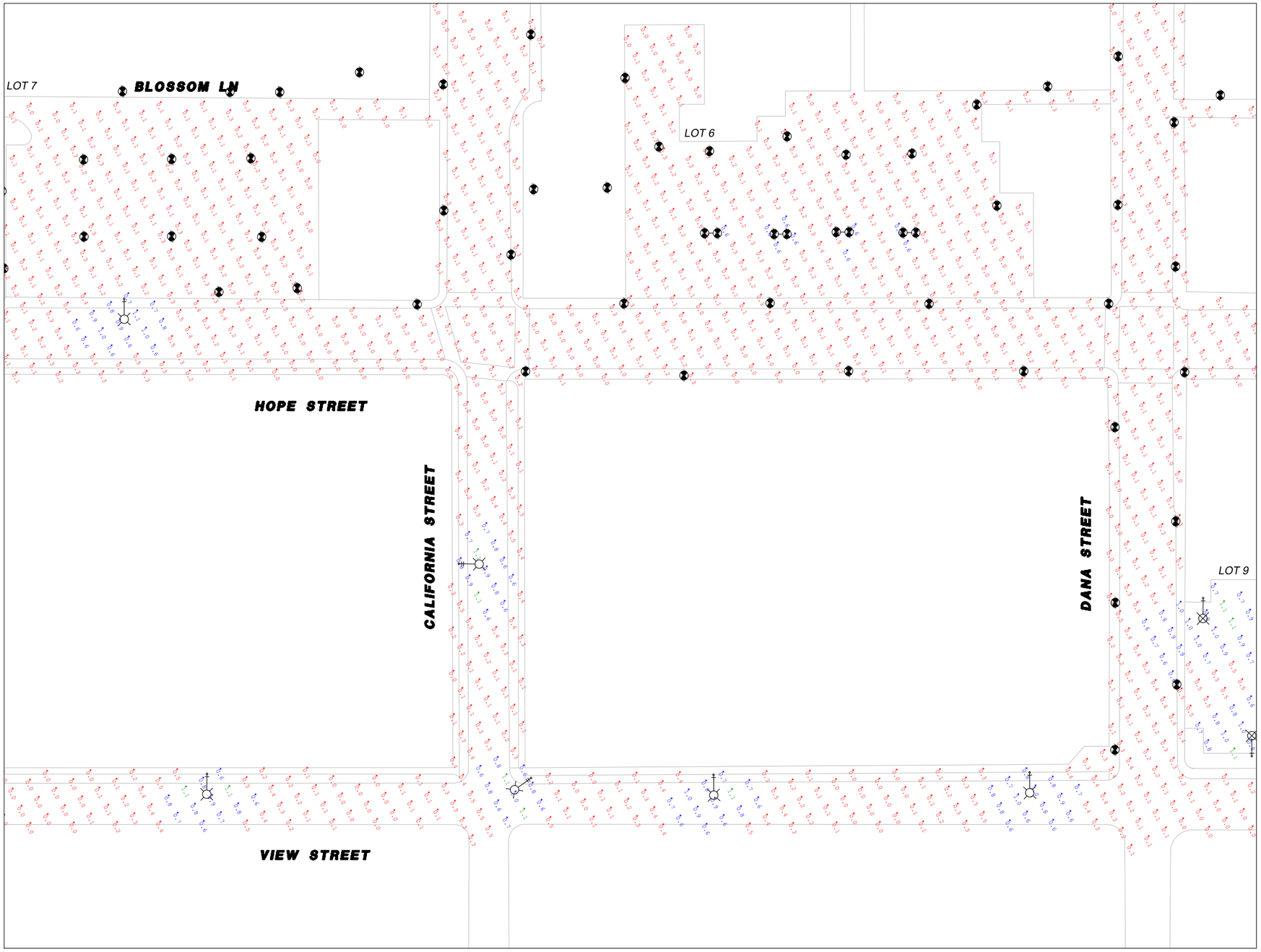
40 0 20 40 80

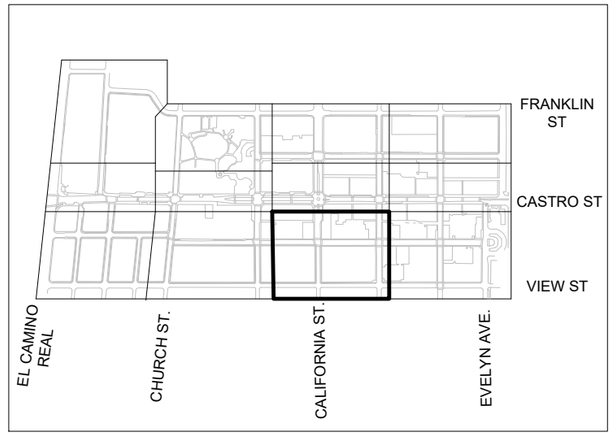
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-1





VICINITY MAP

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- ANTIQUE ACORN POST-TOP - DOUBLE (14' MH)
- 27 W LED (3' MA)
- 27 W LED (9' MA)
- 63 W LED (3' MA)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

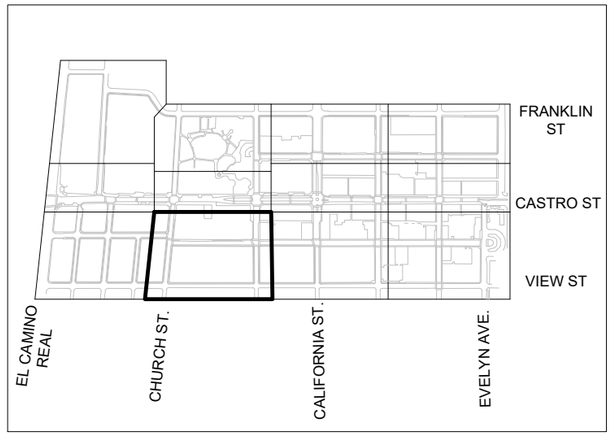
40 0 20 40 80

(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-2



VICINITY MAP

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- 27 W LED (3' MA)
- 27 W LED (9' MA)
- 63 W LED (6' MA)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

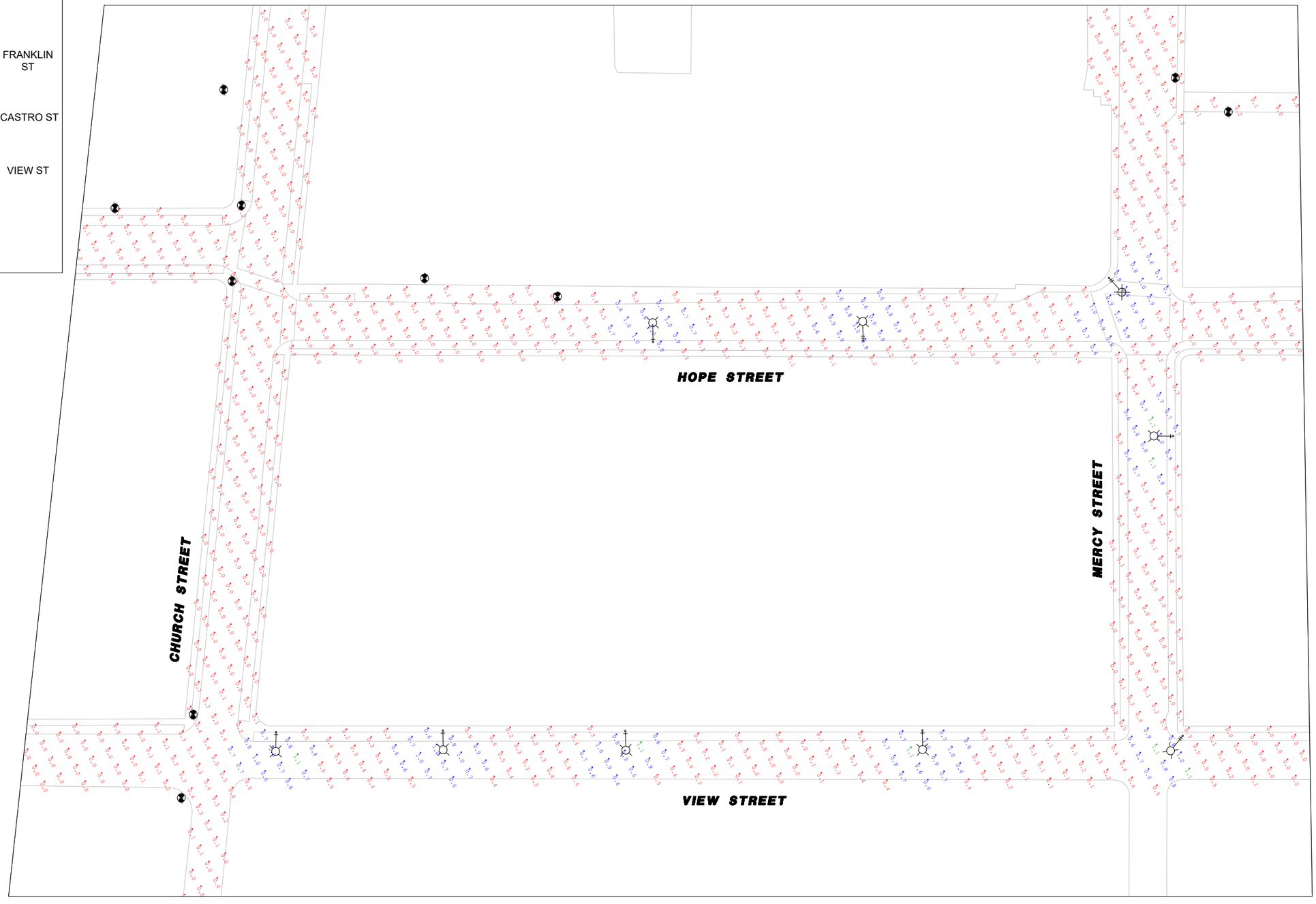
ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

40 0 20 40 80

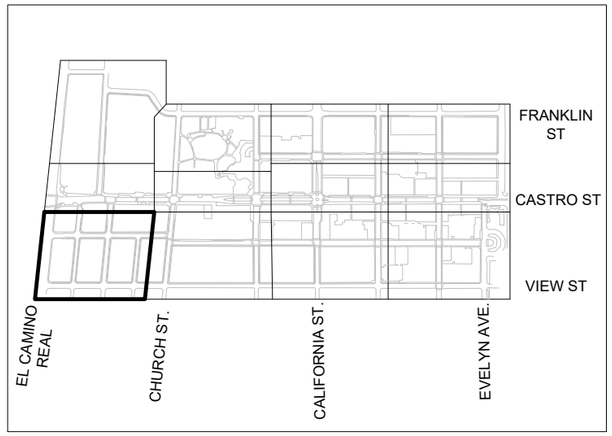
(IN FEET)
1 inch = 40 ft.



Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-3



VICINITY MAP

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- 27 W LED (3' MA)
- 27 W LED (9' MA)
- SHOEBOX (30' MH)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

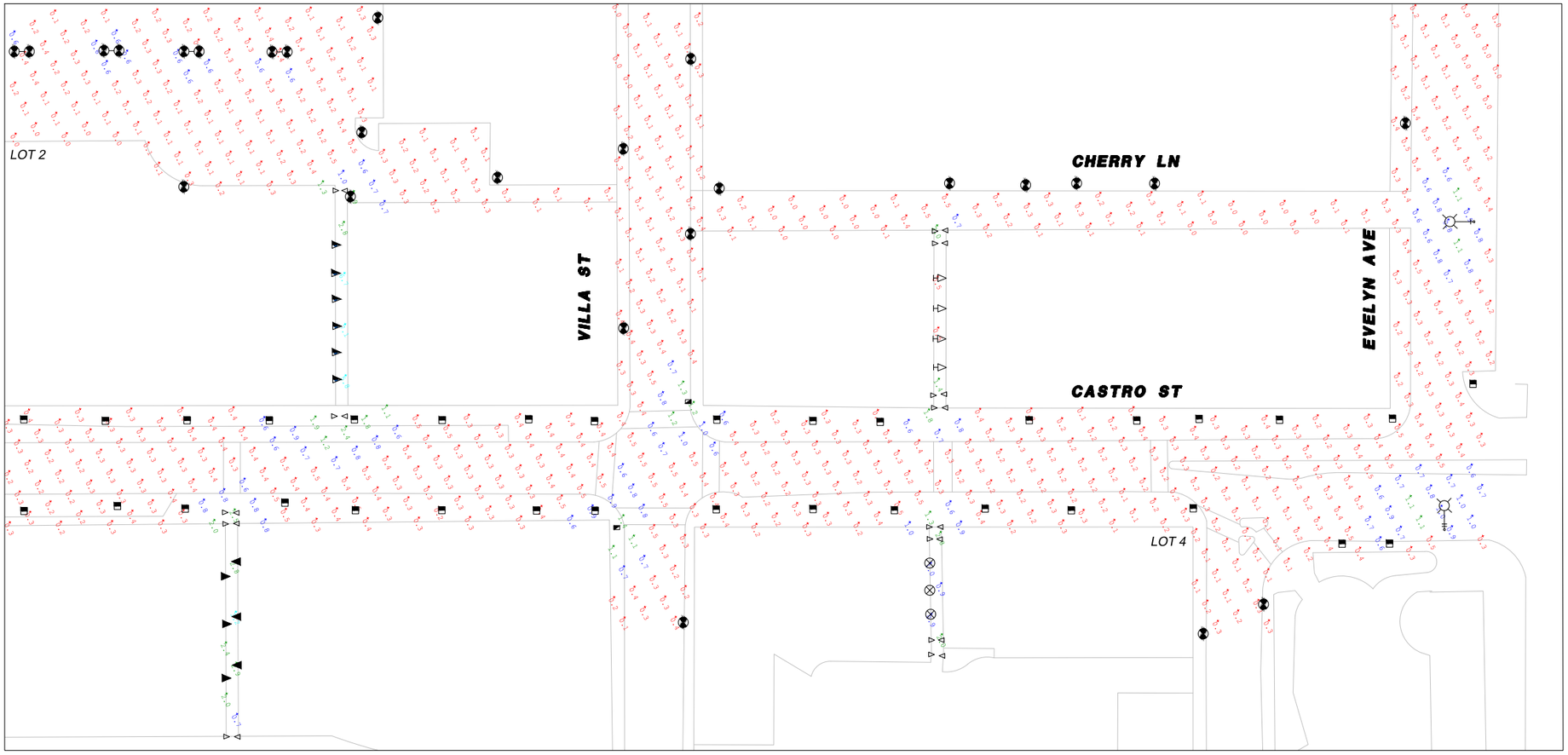
40 0 20 40 80

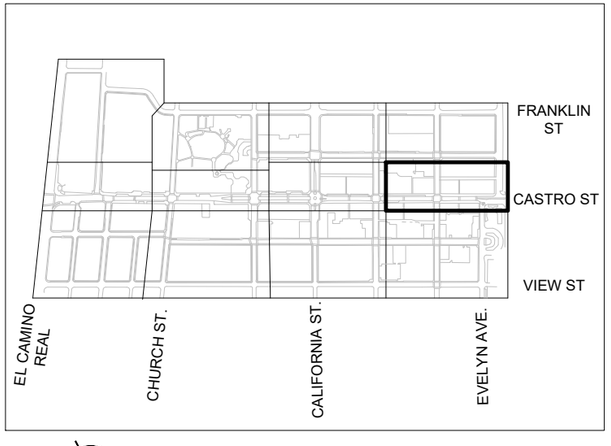
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-4





VICINITY MAP

LUMINAIRE LEGEND

- CASTRO LED POST-TOP (14' MH)
- ANTIQUE ACORN POST-TOP (14' MH)
- ANTIQUE ACORN POST-TOP - DOUBLE (14' MH)
- 27 W LED (3' MA)
- 27 W LED (9' MA)
- WALKWAY SIDE-MOUNTED ACORN (9' MH)
- WALKWAY BOTTOM-MOUNTED ENTRANCE (9' MH)
- WALKWAY TEARDROP
- WALKWAY CEILING-MOUNTED FLOODLIGHT
- WALKWAY ANTIQUE ACORN POST-TOP (12' MH)
- SHOEBOX (30' MH)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

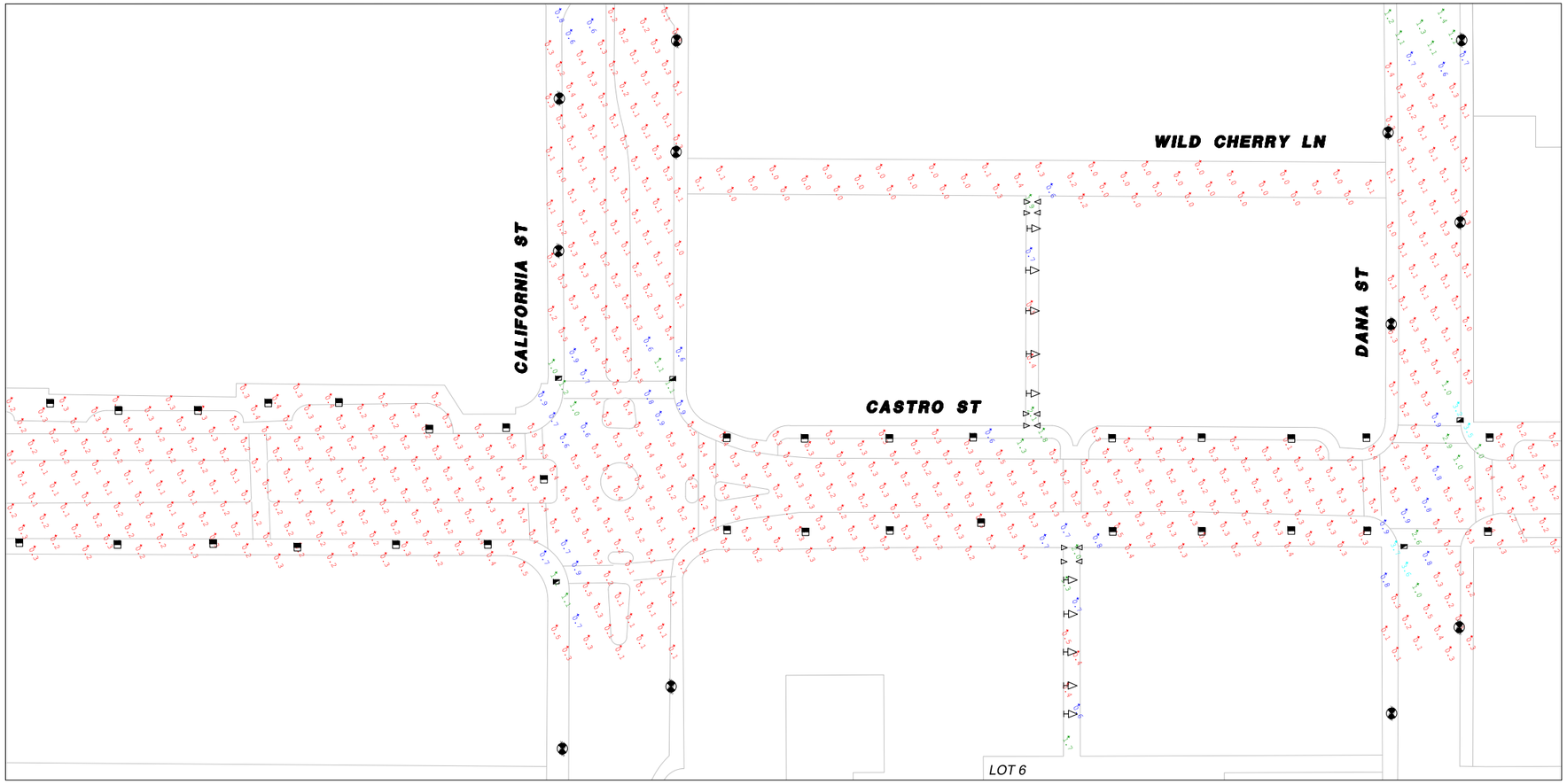
40 0 20 40 80

(IN FEET)
1 inch = 40 ft.

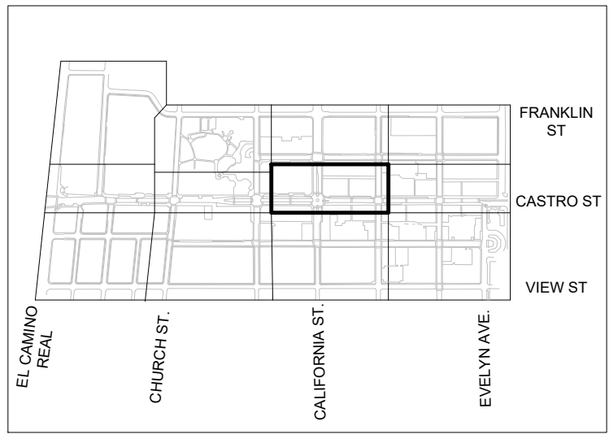
Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-5



NORTH



NORTH

VICINITY MAP

LUMINAIRE LEGEND

- CASTRO LED POST-TOP (14' MH)
- ANTIQUE ACORN POST-TOP (14' MH)
- WALKWAY BOTTOM-MOUNTED ENTRANCE (9' MH)
- WALKWAY TEARDROP
- SHOEBOX (30' MH)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

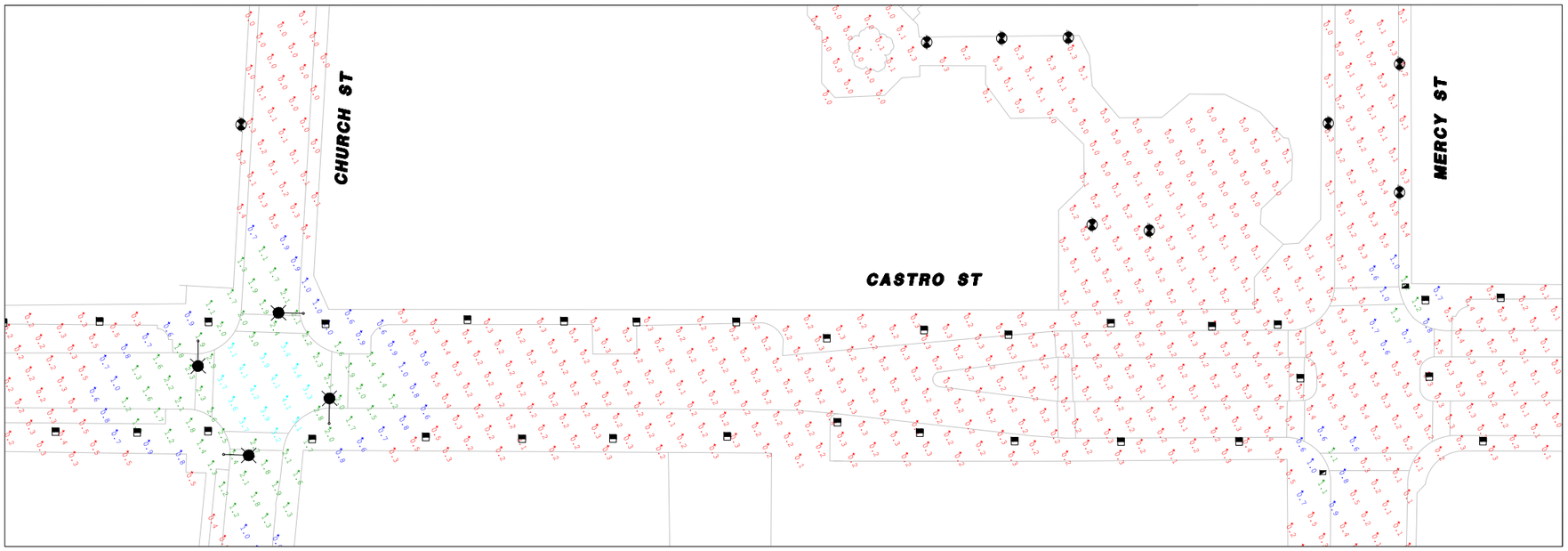
40 0 20 40 80

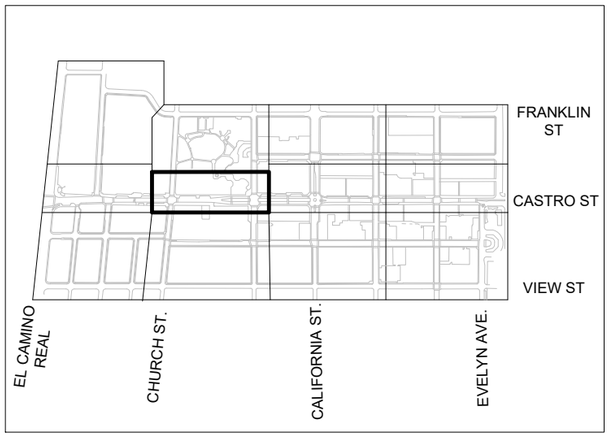
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-6





VICINITY MAP

NORTH

LUMINAIRE LEGEND

- CASTRO LED POST-TOP (14' MH)
- ANTIQUE ACORN POST-TOP (14' MH)
- 130 W LED (12' MA)
- SHOEBOX (30' MH)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

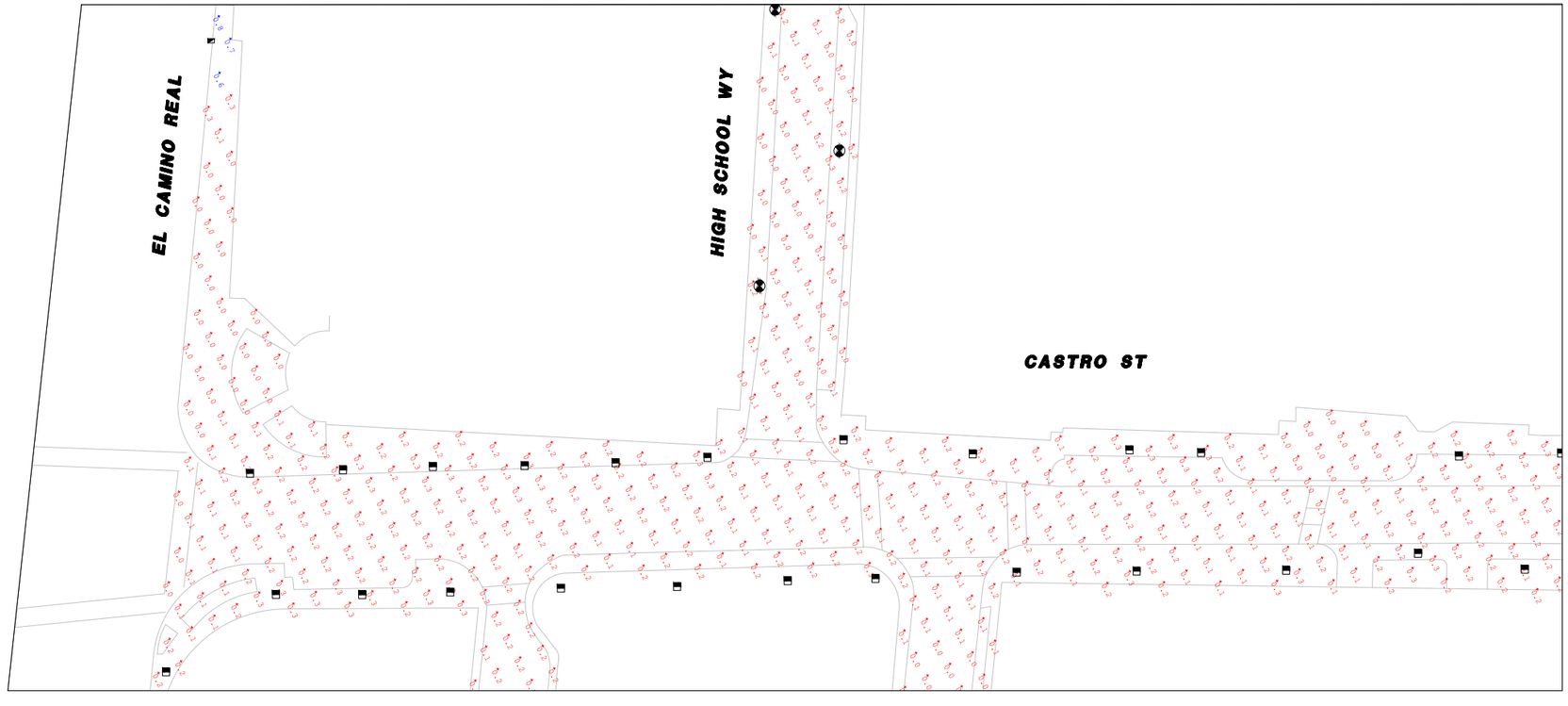
40 0 20 40 80

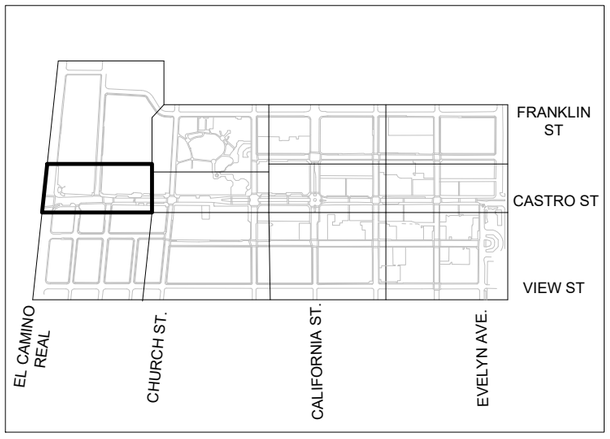
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-7





VICINITY MAP

LUMINAIRE LEGEND

- CASTRO LED POST-TOP (14' MH)
- ANTIQUE ACORN POST-TOP (14' MH)
- SHOEBOX (30' MH)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

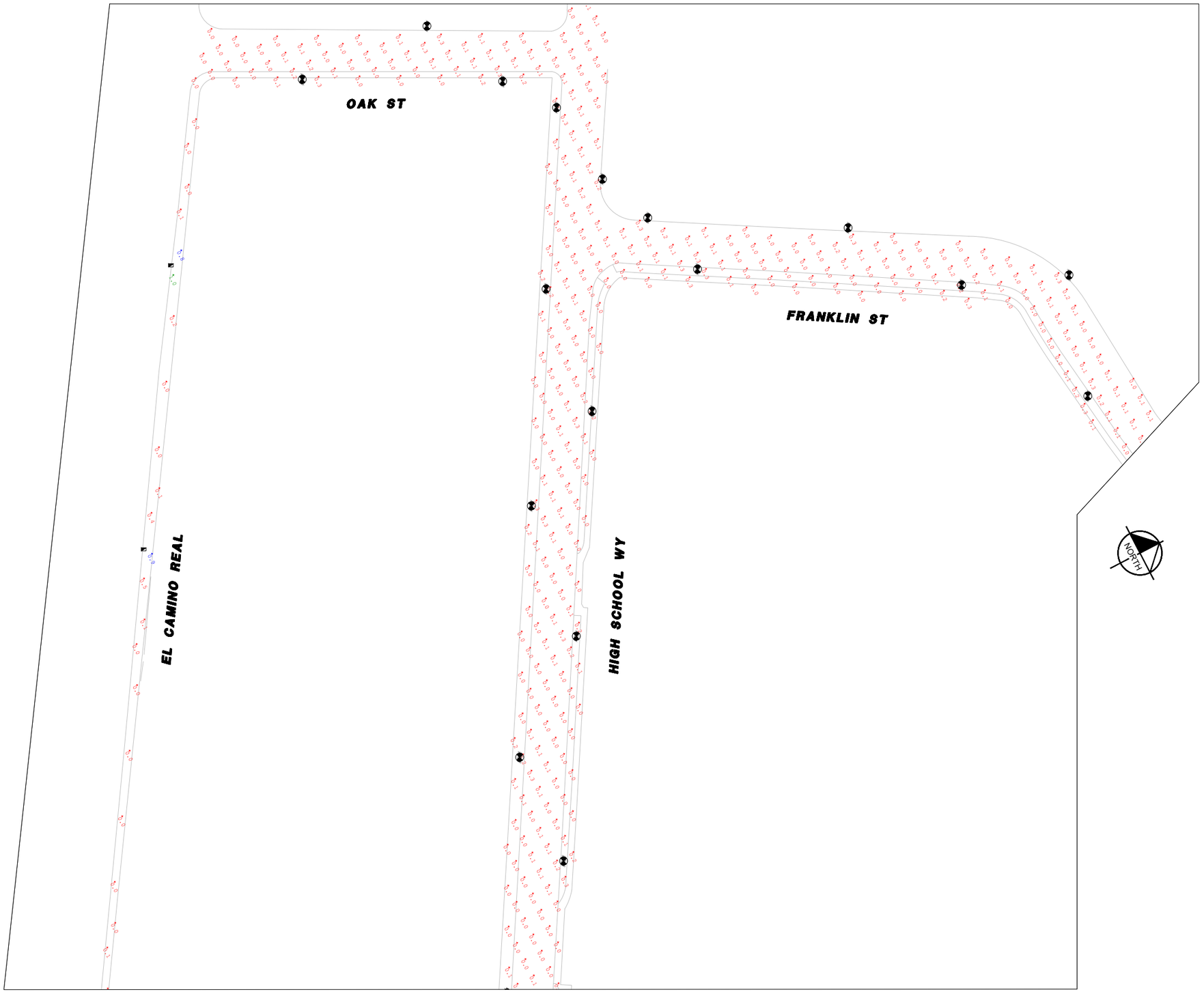
40 0 20 40 80

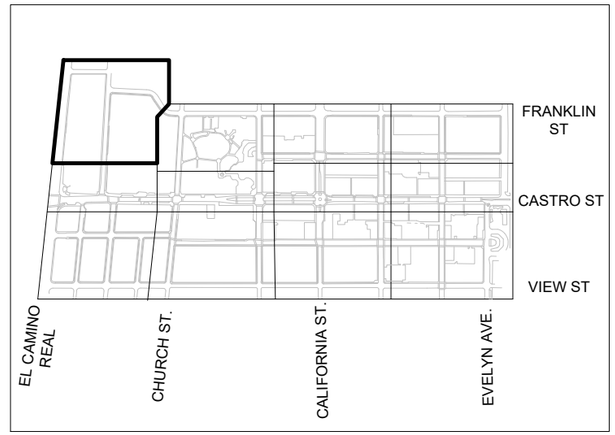
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-8





VICINITY MAP

NORTH

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- SHOEBOX (30' MH)

NORTH

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

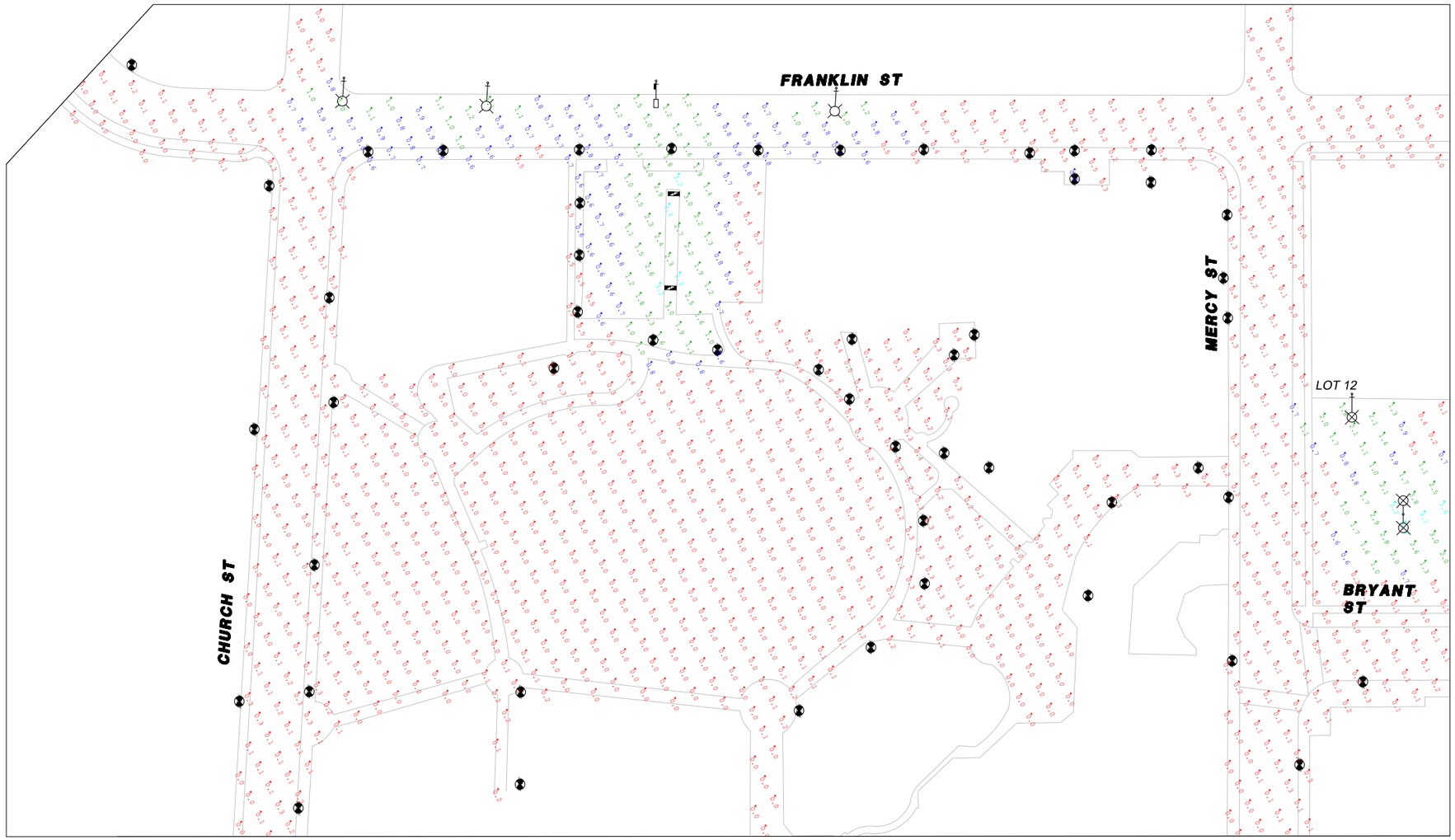
40 0 20 40 80

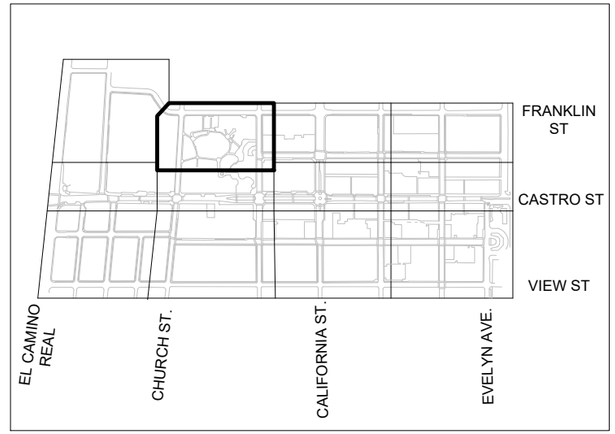
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-9





VICINITY MAP

NORTH

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- 27 LED (3' MA)
- 63 W LED (3' MA)
- 63 W LED - DUAL (3' MA)
- 70 W HPS (3' MA)
- SHOEBOX - DOUBLE (30' MH)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

NORTH

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

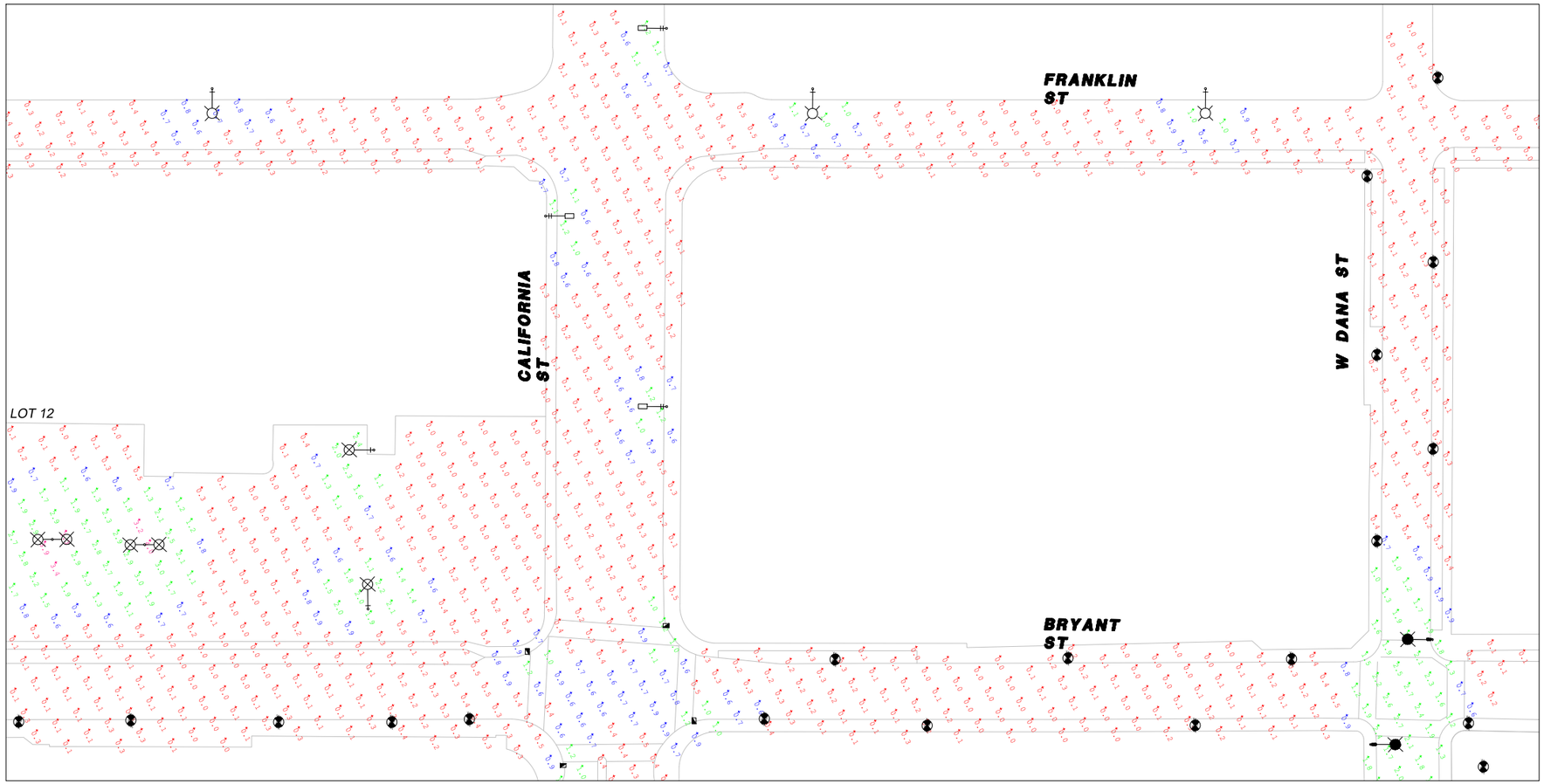
40 0 20 40 80

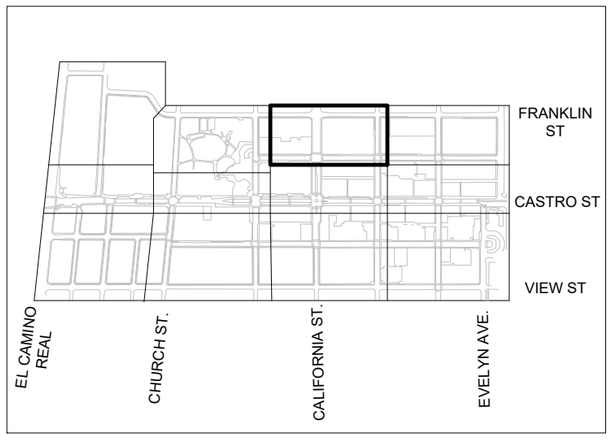
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-10





VICINITY MAP

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- 27 W LED (3' MA)
- 63 W LED (3' MA)
- 70 W HPS (8' MA)
- SHOEBOX (30' MH)
- 70 W HPS (8' MA)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

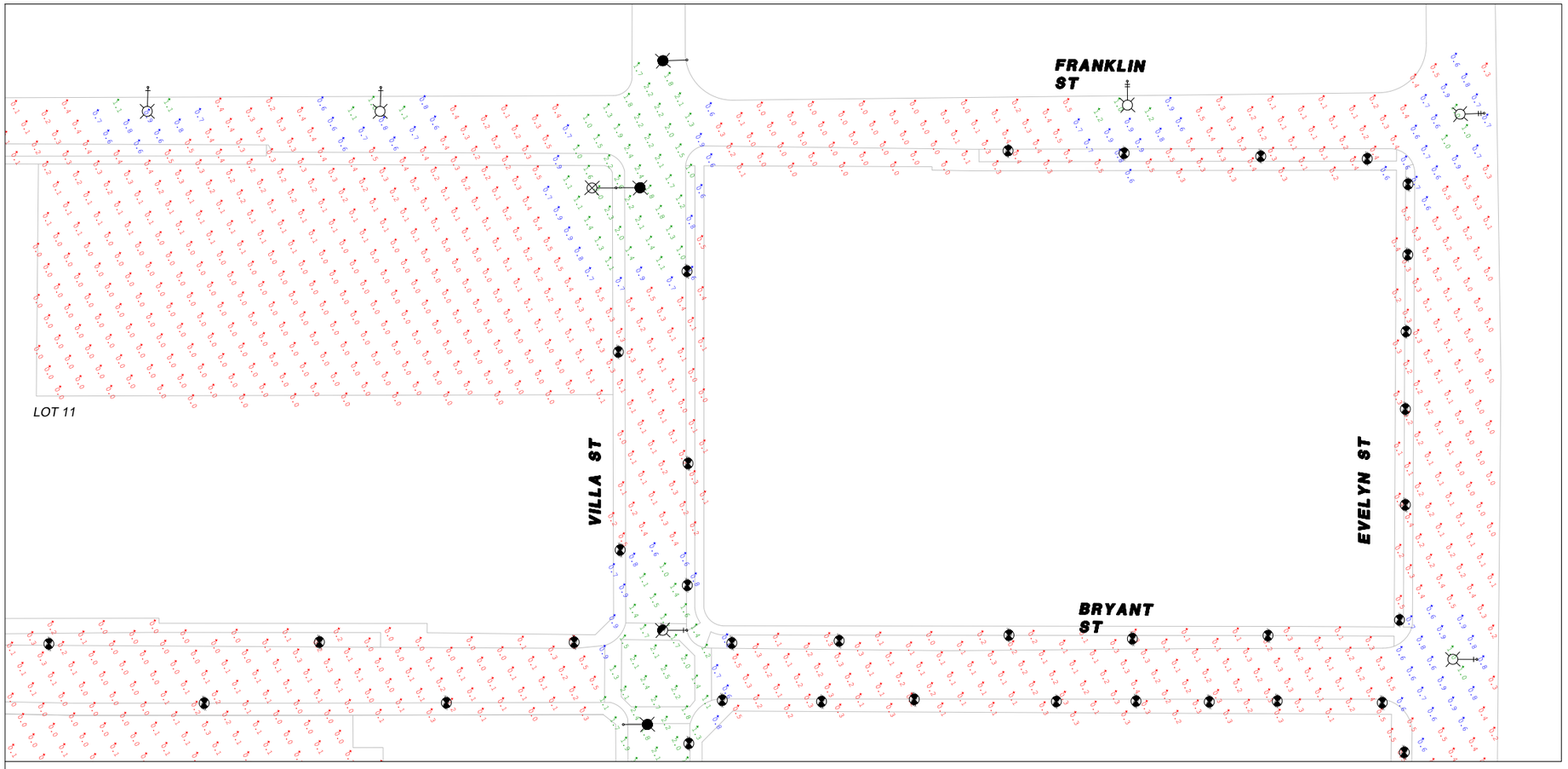
40 0 20 40 80

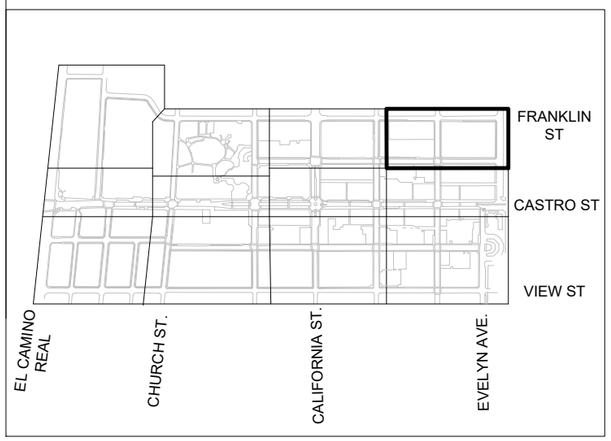
(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-11





VICINITY MAP

LUMINAIRE LEGEND

- ANTIQUE ACORN POST-TOP (14' MH)
- 27 W LED (3' MA)
- 27 W LED (9' MA)
- 63 W LED (6' MA)
- 87 W LED (2' MA)
- 130 W LED (12' MA)

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
EXISTING CONDITIONS - FIGURE B-12

Appendix C – Cost Estimate Assumptions

City of Mountain View Downtown Light Study - Cost Estimate Assumptions

Project No.	Project Desription	Items	Unit Costs	Approximate Quantity	Unit	Item Cost	Capital Cost	Project Development and Design (20% of Capital Cost)	Construction Administration (10% of Capital Costs)	Contingency (30% of Capital Costs)	Total Project Cost	Assumptions
Near-Term Implementation												
Strategy 1 - Improve Safety Lighting at Uncontrolled Crosswalks												
1	Add additional lighting at unctrolled crosswalks with no median island	Decorative Post Top Pole	$ 7,500	2	EA	$ 15,000	$ 29,400	$ 5,880	$ 2,940	$ 11,470	$ 50,000	-Total cost provided is per crosswalk location -No Mast Arm Poles -1 additional Post Top Light at each ramp -1 additional Post Top Light in available medians -Electrical service obtained from adjacent street light circuits -30' of new conduit per pole -50' of new conductors per pole -No pull boxes, conduit installed directly into new poles
		Decorative Post Top Pole Relocation	$ 5,000	1	EA	$ 5,000						
		Luminaire	$ 1,000	5	EA	$ 5,000						
		Conductor Wire	$ 2	100	LF	$ 200						
		2" PVC Conduit	$ 70	60	LF	$ 4,200						
2	Add additional lighting at uncontrolled crosswalks with median islands with refuge area	Decorative Post Top Pole	$ 7,500	3	EA	$ 22,500	$ 41,100	$ 8,220	$ 4,110	$ 16,030	$ 70,000	
		Decorative Post Top Pole Relocation	$ 5,000	1	EA	$ 5,000						
		Luminaire	$ 1,000	7	EA	$ 7,000						
		Conductor Wire	$ 2	150	LF	$ 300						
		2" PVC Conduit	$ 70	90	LF	$ 6,300						
3	Add additional lighting at uncontrolled crosswalks with a median island without refuge area	Decorative Post Top Pole	$ 7,500	3	EA	$ 22,500	$ 34,100	$ 6,820	$ 3,410	$ 13,300	$ 58,000	
		Luminaire	$ 1,000	5	EA	$ 5,000						
		Conductor Wire	$ 2	150	LF	$ 300						
		2" PVC Conduit	$ 70	90	LF	$ 6,300						
Strategy 2 - Replace or Repair Broken Lights												
4	Modify existing maintenance program for identifying and repairing broken luminaires in the Downtown Area	Inspection Time	$ 150	48	Hour	$ 7,200	$ 7,200	N/A	N/A	$ 2,160	$ 10,000	-Cost provided per year -Cost of luminaire replacements not included since replacements are included under City's existing maintenance program budget. -One night-time inspection by City staff of the Downtown Area per month (4 hours per month)

City of Mountain View Downtown Light Study - Cost Estimate Assumptions

Project No.	Project Desription	Items	Unit Costs	Approximate Quantity	Unit	Item Cost	Capital Cost	Project Development and Design (20% of Capital Cost)	Construction Administration (10% of Capital Costs)	Contingency (30% of Capital Costs)	Total Project Cost	Assumptions
Strategy 3 - Address tree obstructions to street lights												
5	Augment maintenance program for identifying and trimming trees that are blocking luminaires in the downtown core	Materials	$ 1,200	1	LS	$ 1,200	$ 6,000	N/A	N/A	$ 1,800	$ 8,000	-Cost provided per year -Two inspections of the downtown core per year, each inspection conducted over two days by two staff -All inspections and trimming completed by City staff
		Inspection Time	$ 150	32	Hour	$ 4,800						
Strategy 4 - Replace Existing non-LED Lights with LED Energy-Efficient Lights												
6	Replace existing shoebox flood lights with LED	Replacement Luminaire	$ 1,000	22	EA	$ 22,000	$ 22,000	N/A	N/A	$ 6,600	$ 29,000	-Cost provided for entire Downtown Area
7	Replace existing induction post-top lights with LED lights	Replacement Luminaire	$ 1,000	340	EA	$ 340,000	$ 340,000	N/A	N/A	$ 102,000	$ 442,000	-No new poles will be required to retrofit lights to LED
Strategy 5 - Improve Light Levels at High Use, Night-Time Activity Areas												
8	Additional lighting at the Center for Performing Arts and Civic Center Plaza	Wall Mount Fixtures	$ 3,000	6	EA	$ 18,000	$ 201,000	$ 40,200	$ 20,100	$ 60,300	$ 321,600	-Electrical service for new lights would be from the Performing Arts Center. -100' new conduit per bollard/pole -150' new conductor per bollard/pole
		Wall Mounted Fixture Electrical Connections	$ 25,000	1	LS	$ 25,000						
		Bollards or Pedestrian Scale Lighting	$ 8,000	10	EA	$ 80,000						
		Conductor Wire	$ 2	1500	LF	$ 3,000						
		2" PVC Conduit	$ 70	1000	LF	$ 70,000						
		Smart Lighting Control System	$ 5,000	1	LS	$ 5,000						
Mid-Term Implementation												
Strategy 6 - Improve Safety Lighting at Signal-Controlled Intersections												
9	Modify existing lighting at downtown signal-controlled intersections	Mast Arm Pole	$ 15,000	2	EA	$ 30,000	$ 55,600	$ 11,120	$ 5,560	$ 16,680	$ 89,000	-Cost provided per intersection -Two new poles required -Two Luminaire Retrofits Required -1 pull box for each new pole -100' new conduit per pole -150' new conductor per pole
		Luminaire	$ 1,000	4	EA	$ 4,000						
		Conductor Wire	$ 2	300	LF	$ 600						
		2" PVC Conduit	$ 70	200	LF	$ 14,000						
		Pull Box	$ 3,500	2	EA	$ 7,000						

City of Mountain View Downtown Light Study - Cost Estimate Assumptions

Project No.	Project Desription	Items	Unit Costs	Approximate Quantity	Unit	Item Cost	Capital Cost	Project Development and Design (20% of Capital Cost)	Construction Administration (10% of Capital Costs)	Contingency (30% of Capital Costs)	Total Project Cost	Assumptions
Strategy 7 - Improve safety lighting at stop-controlled intersections and traffic circles												
10	Enhance lighting at all-way stop controlled intersections	Mast Arm Pole	$ 15,000	1	EA	$ 15,000	$ 27,800	$ 5,560	$ 2,780	$ 8,340	$ 45,000	-Cost provided per intersection -New mast arm street light poles will be required, 2 at each intersections -Electrical service for new poles will be obtained from adjacent street lights -100' new conduit per pole -150' new conductors per pole -1 pull box per pole
		Luminaire	$ 1,000	2	EA	$ 2,000						
		Conductor Wire	$ 2	150	LF	$ 300						
		2" PVC Conduit	$ 70	100	LF	$ 7,000						
		Pull Box	$ 3,500	1	EA	$ 3,500						
11	Enhance lighting at traffic circles	Mast Arm Pole	$ 15,000	1	EA	$ 15,000	$ 27,800	$ 5,560	$ 2,780	$ 8,340	$ 45,000	
		Luminaire	$ 1,000	2	EA	$ 2,000						
		Conductor Wire	$ 2	150	LF	$ 300						
		2" PVC Conduit	$ 70	100	LF	$ 7,000						
		Pull Box	$ 3,500	1	EA	$ 3,500						
Strategy 8 - Improve Pedestrian Lighting Coverage on City Walkways between Parking and Businesses												
12	Add infill lighting along Cherry Lane alleyway	Decorative Post Top Pole	$ 7,500	3	EA	$ 22,500	$ 38,100	$ 7,620	$ 3,810	$ 11,430	$ 61,000	-Electrical service for new poles will be obtained from adjacent street lights -30' new conduit per pole -50' new conductors per pole -No pull boxes, conduit installed directly into new poles
		Luminaire	$ 1,000	9	EA	$ 9,000						
		Conductor Wire	$ 2	150	LF	$ 300						
		2" PVC Conduit	$ 70	90	LF	$ 6,300						
13	Add infill lighting along Blossom Lane alleyway	Decorative Post Top Pole	$ 7,500	4	EA	$ 30,000	$ 42,800	$ 8,560	$ 4,280	$ 12,840	$ 69,000	
		Luminaire	$ 1,000	4	EA	$ 4,000						
		Conductor Wire	$ 2	200	LF	$ 400						
		2" PVC Conduit	$ 70	120	LF	$ 8,400						
14	Add infill lighting along Wild Cherry Lane alleyway	Decorative Post Top Pole	$ 7,500	9	EA	$ 67,500	$ 96,300	$ 19,260	$ 9,630	$ 28,890	$ 155,000	
		Luminaire	$ 1,000	9	EA	$ 9,000						
		Conductor Wire	$ 2	450	LF	$ 900						
		2" PVC Conduit	$ 70	270	LF	$ 18,900						

City of Mountain View Downtown Light Study - Cost Estimate Assumptions

Project No.	Project Desription	Items	Unit Costs	Approximate Quantity	Unit	Item Cost	Capital Cost	Project Development and Design (20% of Capital Cost)	Construction Administration (10% of Capital Costs)	Contingency (30% of Capital Costs)	Total Project Cost	Assumptions
Strategy 9 - Enhance Lighting and Security in City-Owned Surface Parking Lots												
15	Add infill lighting in Parking Lot 6	Decorative Post Top Pole	$ 7,500	2	EA	$ 15,000	$ 42,400	$ 8,480	$ 4,240	$ 12,720	$ 68,000	-Electrical service for new poles will be obtained from existing poles -30' new conduit per pole -50' new conductors per pole -No pull boxes, conduit installed directly into new poles -Smart Lighting Controls will be incorporated in each lot
		Luminaire	$ 1,000	18	EA	$ 18,000						
		Conductor Wire	$ 2	100	LF	$ 200						
		2" PVC Conduit	$ 70	60	LF	$ 4,200						
		Smart Lighting Control System	$ 5,000	1	LS	$ 5,000						
16	Add infill lighting in Parking Lot 2	Decorative Post Top Pole	$ 7,500	4	EA	$ 30,000	$ 63,800	$ 12,760	$ 6,380	$ 19,140	$ 103,000	
		Luminaire	$ 1,000	20	EA	$ 20,000						
		Conductor Wire	$ 2	200	LF	$ 400						
		2" PVC Conduit	$ 70	120	LF	$ 8,400						
		Smart Lighting Control System	$ 5,000	1	LS	$ 5,000						
17	Add infill lighting in Parking Lot 5	Decorative Post Top Pole	$ 7,500	2	EA	$ 15,000	$ 40,400	$ 8,080	$ 4,040	$ 12,120	$ 65,000	
		Luminaire	$ 1,000	16	EA	$ 16,000						
		Conductor Wire	$ 2	100	LF	$ 200						
		2" PVC Conduit	$ 70	60	LF	$ 4,200						
		Smart Lighting Control System	$ 5,000	1	LS	$ 5,000						
18	Add lighting at the entrance/exit of the City Hall and Public Library parking areas	Decorative Post Top Pole	$ 7,500	2	EA	$ 15,000	$ 29,400	$ 5,880	$ 2,940	$ 8,820	$ 48,000	-Electrical service for new poles will be obtained from existing poles -30' new conduit per pole -50' new conductors per pole -No pull boxes, conduit installed directly into new poles
		Luminaire	$ 1,000	5	EA	$ 5,000						
		Conductor Wire	$ 2	100	LF	$ 200						
		2" PVC Conduit	$ 70	60	LF	$ 4,200						
		Smart Lighting Control System	$ 5,000	1	LS	$ 5,000						

City of Mountain View Downtown Light Study - Cost Estimate Assumptions

Project No.	Project Desription	Items	Unit Costs	Approximate Quantity	Unit	Item Cost	Capital Cost	Project Development and Design (20% of Capital Cost)	Construction Administration (10% of Capital Costs)	Contingency (30% of Capital Costs)	Total Project Cost	Assumptions
Long-Term Implementation												
Strategy 10 - Enhance Safety Lighting on Corridors in Downtown Area												
19	Enhance safety lighting on Bryant Street	Decorative Post Top Pole	$ 7,500	12	EA	$ 90,000	$ 323,720	$ 64,744	$ 32,372	$ 97,120	$ 518,000	-1/2 of new luminaires will require new post top poles -Electrical service for new poles will be obtained from adjacent street lights -100' new conduit per pole -150' new conductors per pole -1 pull box per pole
		Luminaire	$ 1,000	24	EA	$ 24,000						
		Conductor Wire	$ 2	3360	LF	$ 6,720						
		2" PVC Conduit	$ 70	2400	LF	$ 168,000						
		Pull Box	$ 3,500	10	EA	$ 35,000						
20	Enhance safety lighting on Castro Street	Decorative Post Top Pole	$ 7,500	23	EA	$ 172,500	$ 588,380	$ 117,676	$ 58,838	$ 176,510	$ 942,000	
		Luminaire	$ 1,000	46	EA	$ 46,000						
		Conductor Wire	$ 2	6440	LF	$ 12,880						
		2" PVC Conduit	$ 70	4600	LF	$ 322,000						
		Pull Box	$ 3,500	10	EA	$ 35,000						
21	Enhance safety lighting on Franklin Street	Decorative Post Top Pole	$ 7,500	24	EA	$ 180,000	$ 612,440	$ 122,488	$ 61,244	$ 183,730	$ 980,000	
		Luminaire	$ 1,000	48	EA	$ 48,000						
		Conductor Wire	$ 2	6720	LF	$ 13,440						
		2" PVC Conduit	$ 70	4800	LF	$ 336,000						
		Pull Box	$ 3,500	10	EA	$ 35,000						
22	Enhance safety lighting on View Street	Decorative Post Top Pole	$ 7,500	23	EA	$ 172,500	$ 588,380	$ 117,676	$ 58,838	$ 176,510	$ 942,000	
		Luminaire	$ 1,000	46	EA	$ 46,000						
		Conductor Wire	$ 2	6440	LF	$ 12,880						
		2" PVC Conduit	$ 70	4600	LF	$ 322,000						
		Pull Box	$ 3,500	10	EA	$ 35,000						

City of Mountain View Downtown Light Study - Cost Estimate Assumptions

Project No.	Project Desription	Items	Unit Costs	Approximate Quantity	Unit	Item Cost	Capital Cost	Project Development and Design (20% of Capital Cost)	Construction Administration (10% of Capital Costs)	Contingency (30% of Capital Costs)	Total Project Cost	Assumptions
23	Enhance safety lighting on Hope Street	Decorative Post Top Pole	$ 7,500	23	EA	$ 172,500	$ 588,380	$ 117,676	$ 58,838	$ 176,510	$ 942,000	-1/2 of new luminaires will require new post top poles -Electrical service for new poles will be obtained from adjacent street lights -100' new conduit per pole -150' new conductors per pole -1 pull box per pole
		Luminaire	$ 1,000	46	EA	$ 46,000						
		Conductor Wire	$ 2	6440	LF	$ 12,880						
		2" PVC Conduit	$ 70	4600	LF	$ 322,000						
		Pull Box	$ 3,500	10	EA	$ 35,000						
24	Enhance safety lighting on California Street	Decorative Post Top Pole	$ 7,500	9	EA	$ 67,500	$ 251,540	$ 50,308	$ 25,154	$ 75,460	$ 403,000	
		Luminaire	$ 1,000	18	EA	$ 18,000						
		Conductor Wire	$ 2	2520	LF	$ 5,040						
		2" PVC Conduit	$ 70	1800	LF	$ 126,000						
		Pull Box	$ 3,500	10	EA	$ 35,000						
25	Enhance safety lighting on Evelyn Avenue	Decorative Post Top Pole	$ 7,500	9	EA	$ 67,500	$ 251,540	$ 50,308	$ 25,154	$ 75,460	$ 403,000	
		Luminaire	$ 1,000	18	EA	$ 18,000						
		Conductor Wire	$ 2	2520	LF	$ 5,040						
		2" PVC Conduit	$ 70	1800	LF	$ 126,000						
		Pull Box	$ 3,500	10	EA	$ 35,000						

City of Mountain View Downtown Light Study - Cost Estimate Assumptions

Project No.	Project Desription	Items	Unit Costs	Approximate Quantity	Unit	Item Cost	Capital Cost	Project Development and Design (20% of Capital Cost)	Construction Administration (10% of Capital Costs)	Contingency (30% of Capital Costs)	Total Project Cost	Assumptions
Strategy 11 - Address tree obstructions to street lights (Long-Term)												
26	Relocate light poles away from trees	Mast Arm Pole	$ 15,000	1	EA	$ 15,000	$ 26,800	$ 5,360	$ 2,680	$ 8,040	$ 43,000	-Cost provided per obstruction -New mast arm street light poles will be required, 2 at each intersections -Electrical service for new poles will be obtained from adjacent street lights -100' new conduit per pole -150' new conductors per pole -1 pull box per pole
		Luminaire	$ 1,000	1	EA	$ 1,000						
		Conductor Wire	$ 2	150	LF	$ 300						
		2" PVC Conduit	$ 70	100	LF	$ 7,000						
		Pull Box	$ 3,500	1	EA	$ 3,500						
Strategy 12 - Implement Smart Lighting Control												
27	Pilot project to implement downtown wide smart lighting control (Castro Street)	Communication Cable	$ 10	4000	EA	$ 40,000	$ 105,750	$ 21,150	$ 10,575	$ 31,730	$ 170,000	-All communication cable to luminaires will be installed in existing conduit -New conduit and communication cable will be required to connect lighting circuit to existing traffic signal at 3 locations (50' each) -One new ethernet switch, pull box upgrade, and splice box per connection point (3 assumed per corridor) -New conduit and communication cable will be required to connect lighting communication to City TMC (500' total)
		Ethernet Switch	$ 1,000	3	EA	$ 3,000						
		Conduit	$ 70	650	LF	$ 45,500						
		Splice Case and Splices	$ 750	3	EA	$ 2,250						
		Pull Box Upgrade	$ 5,000	3	EA	$ 15,000						
Strategy 13 - Implement Lights That Are Dark Sky Compliant												
No specific projects, this strategy should be implemented where appropriate in all downtown lighting projects												N/A

Appendix D – Proposed Concepts

LUMINAIRE LEGEND

RETROFIT EXISTING PEDESTRIAN LIGHT POST WITH 80W LUMINAIRE

INSTALL NEW PEDESTRIAN LIGHT POST WITH 80W LUMINAIRE

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

HORIZONTAL ILLUMINATION CALCULATIONS

REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
3.20	3.00	3.55	1.61

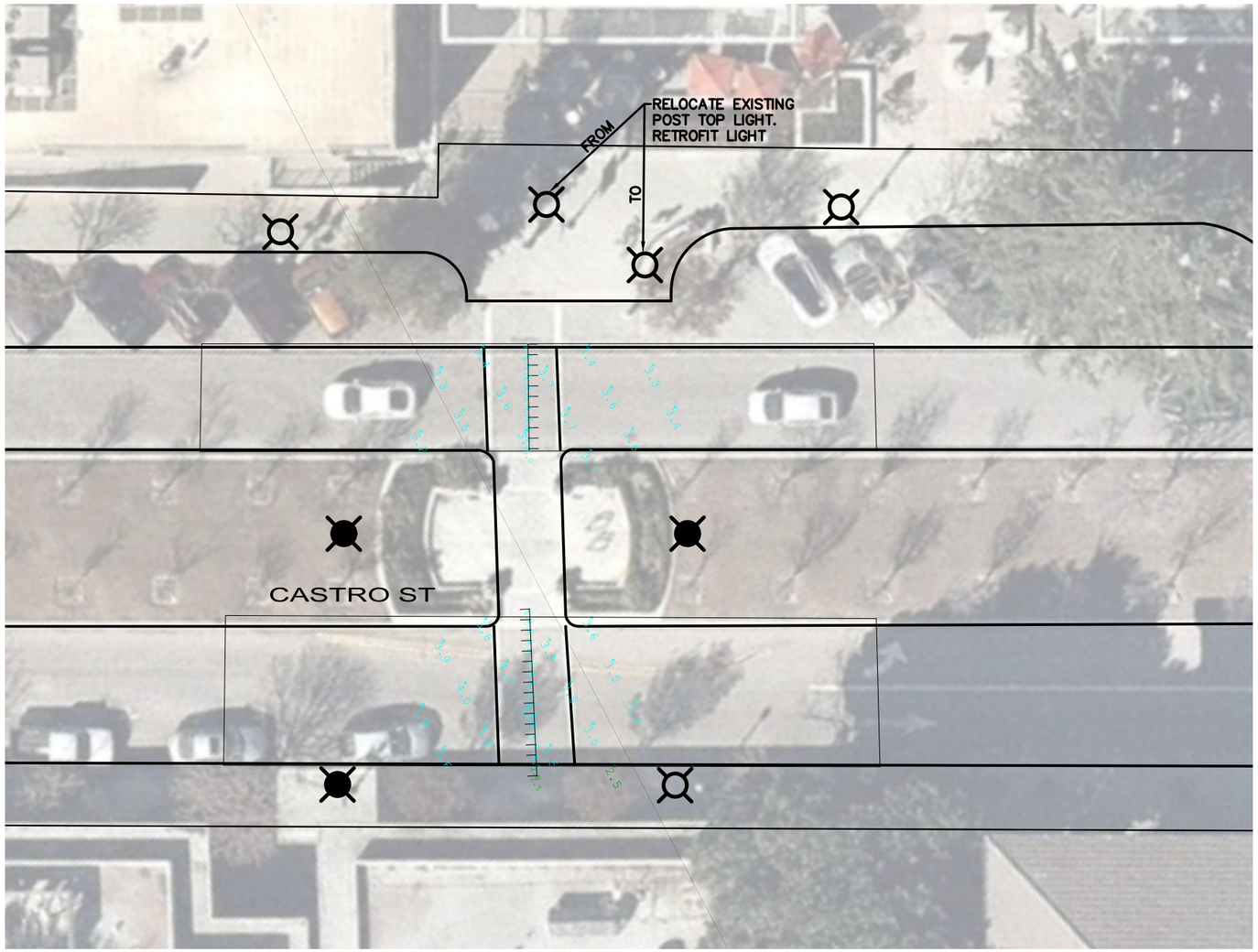
NORTH

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT

PROPOSED CONCEPT - MID BLOCK CROSSING (NO MEDIANS) - FIGURE D-1



LUMINAIRE LEGEND

- RETROFIT EXISTING POST TOP LIGHT WITH 80W LUMINAIRE
- INSTALL NEW POST TOP LIGHT WITH 80W LUMINAIRE

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

VERTICAL ILLUMINATION CALCULATIONS

REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
0.00	0.00	0.00	0.00

HORIZONTAL ILLUMINATION CALCULATIONS

REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
3.20	3.00	3.55	1.61

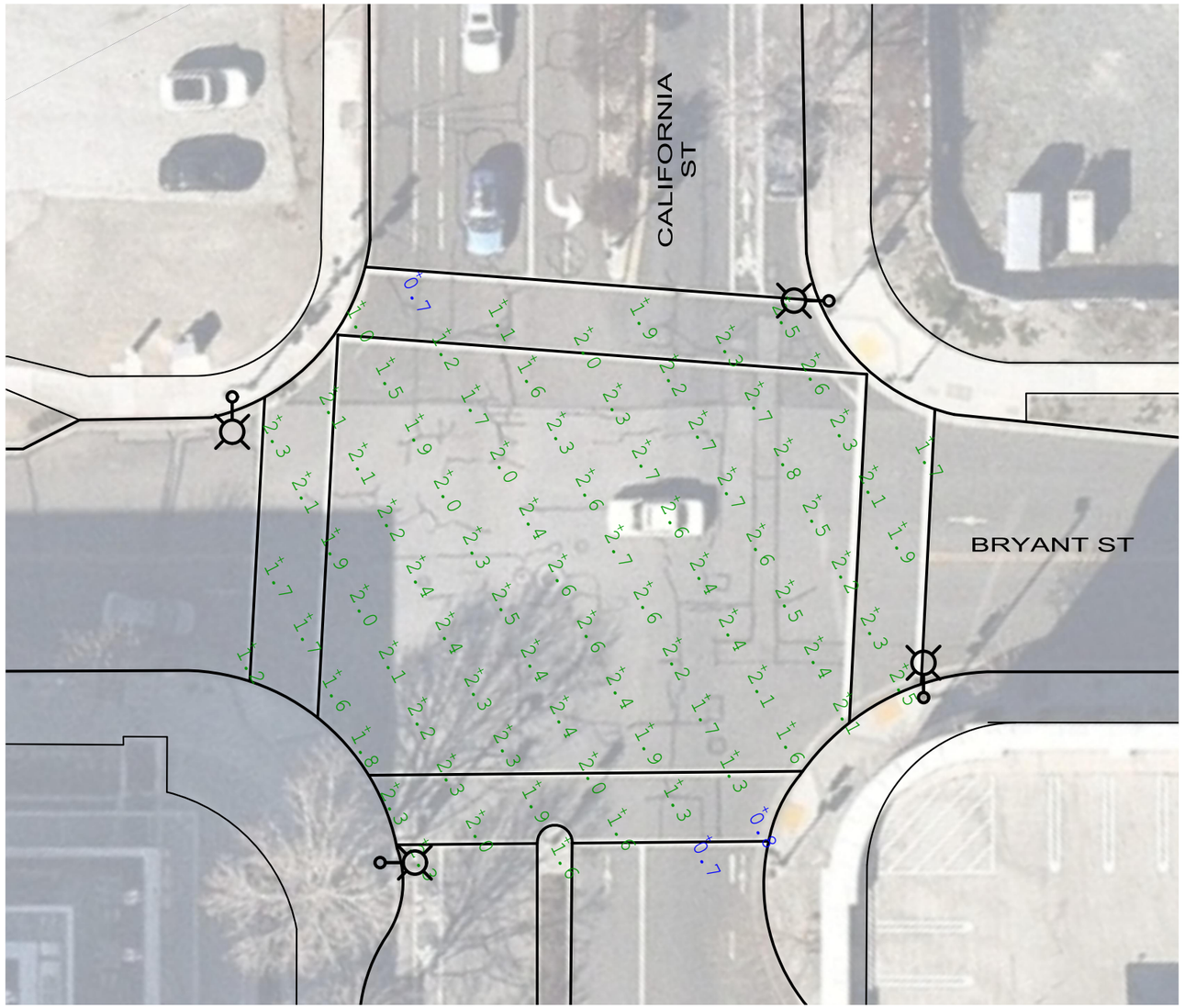
NORTH

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT

PROPOSED CONCEPT - MIDBLOCK CROSSING (WITH MEDIANS) - FIGURE D-2



LUMINAIRE LEGEND

RETROFIT EXISTING 2' MAST ARM SHOEBOX HPS LIGHT WITH 107W LED LUMINAIRE.

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

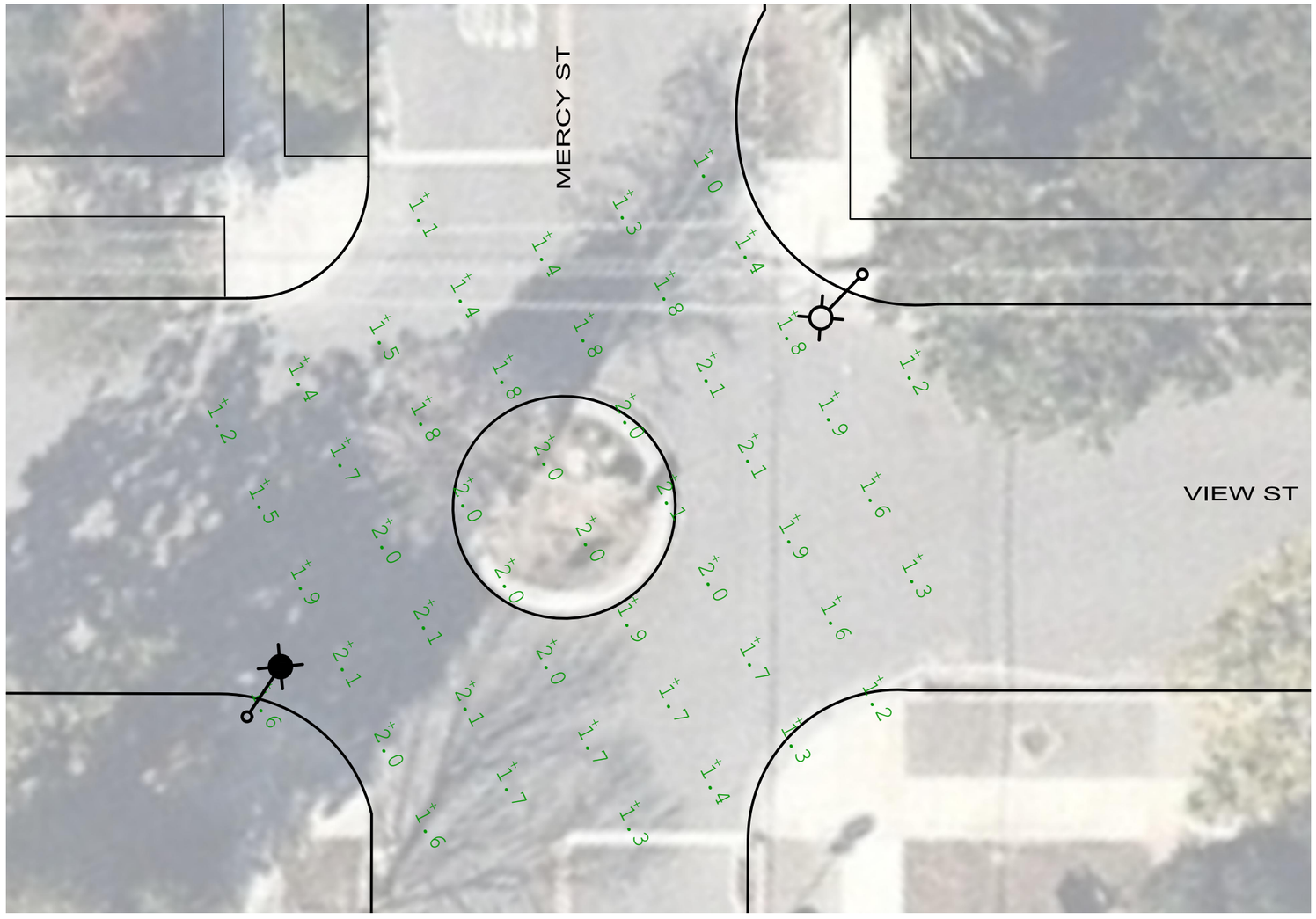
ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

HORIZONTAL ILLUMINATION CALCULATIONS

REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
1.70	4.00	2.08	2.97

NORTH



LUMINAIRE LEGEND

RETROFIT EXISTING STREET LIGHT POLE WITH 55W LED LUMINAIRE

INSTALL NEW STREET LIGHT POLE WITH 55W LED LUMINAIRE

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

HORIZONTAL ILLUMINATION CALCULATIONS

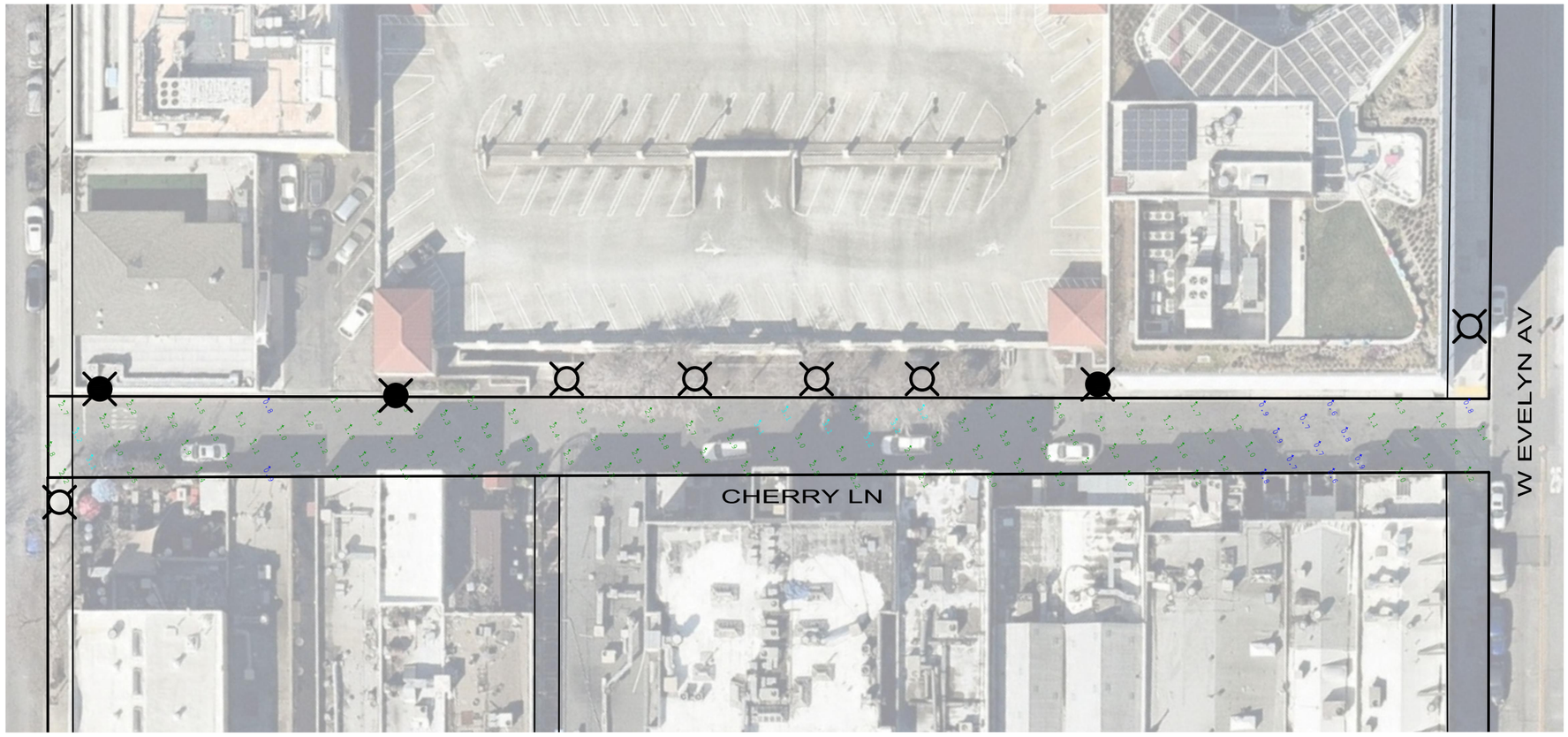
REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
1.30	6.00	1.69	1.69

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT

PROPOSED CONCEPT - STOP-CONTROLLED INTERSECTION (WITH ISLAND) - FIGURE D-4



LUMINAIRE LEGEND

RETROFIT EXISTING PEDESTRIAN LIGHT POST WITH 80W LUMINAIRE

INSTALL NEW PEDESTRIAN LIGHT POST WITH 80W LUMINAIRE

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

HORIZONTAL ILLUMINATION CALCULATIONS

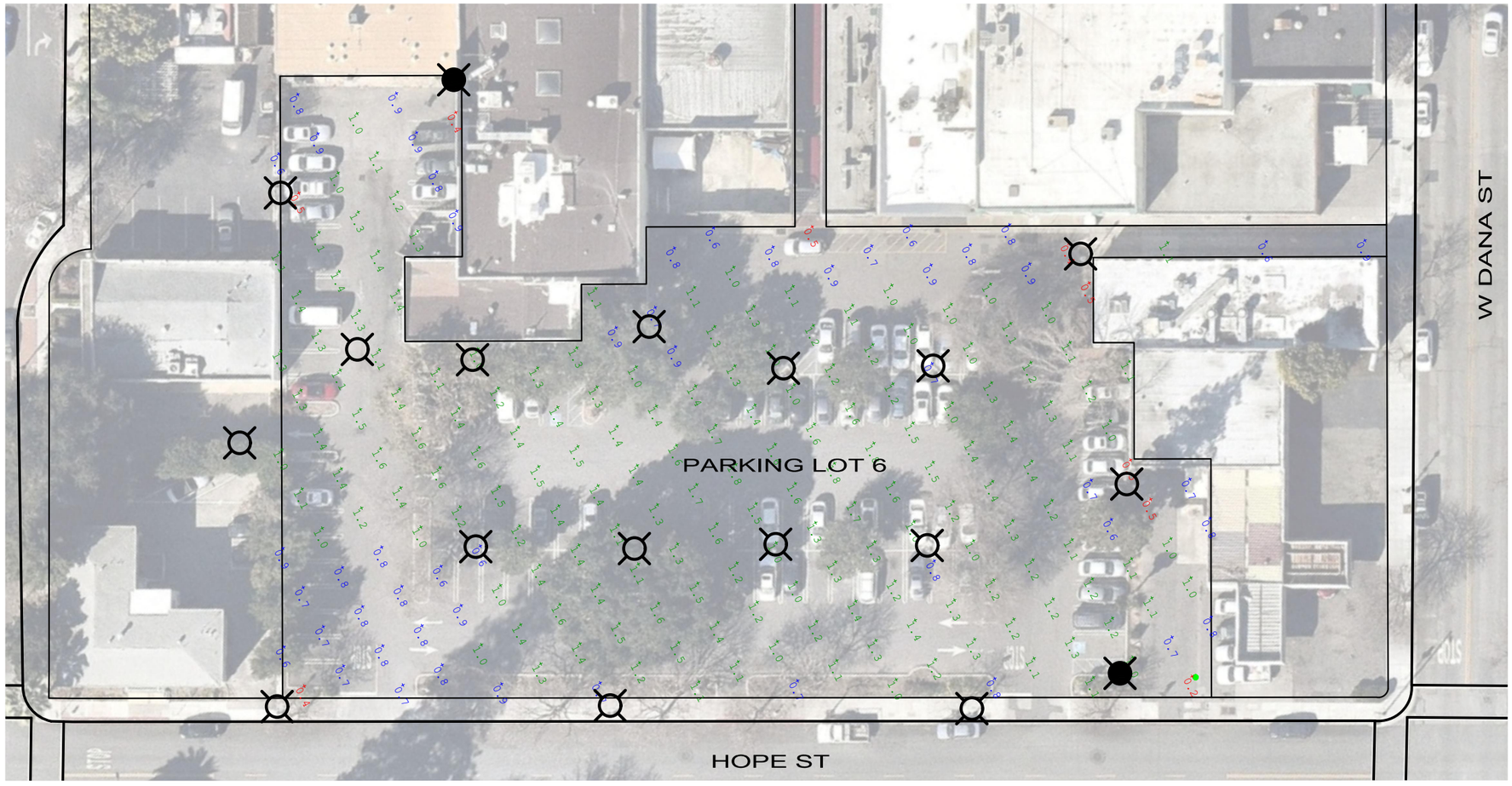
REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
1.90	4.10	1.99	3.32

NORTH

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT
PROPOSED CONCEPT - ALLEY WAY - FIGURE D-5



LUMINAIRE LEGEND

- RETROFIT EXISTING PEDESTRIAN LIGHT POST WITH 55W LUMINAIRE
- INSTALL NEW PEDESTRIAN LIGHT POST WITH 55W LUMINAIRE

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

HORIZONTAL ILLUMINATION CALCULATIONS

REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
0.90	15:01	1.12	5.60

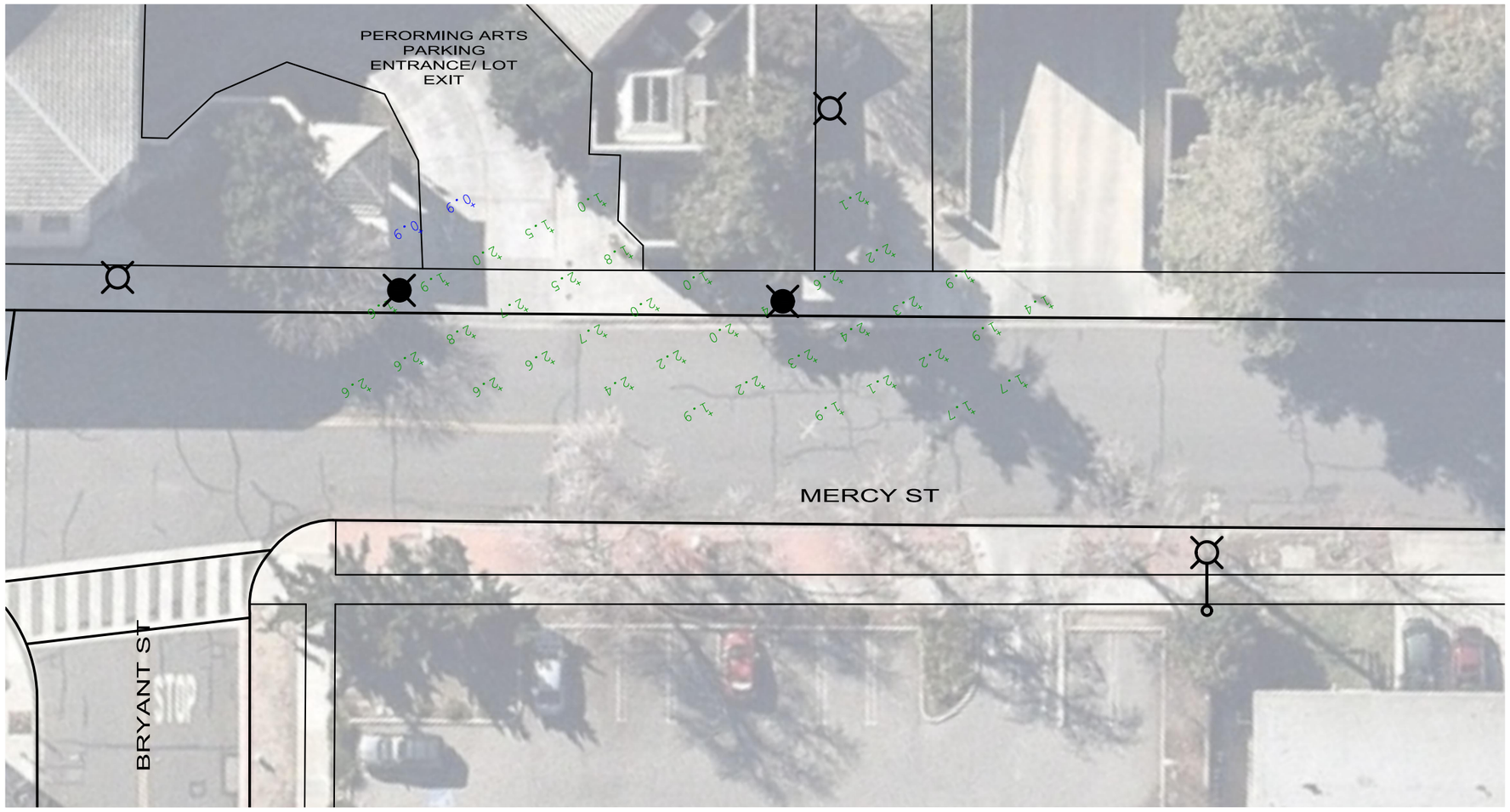
NORTH

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT

PROPOSED CONCEPT - PARKING LOT RETROFIT AND INFILL - FIGURE D-6



LUMINAIRE LEGEND

- RETROFIT EXISTING PEDESTRIAN LIGHT POST WITH 80W LUMINAIRE
- INSTALL NEW PEDESTRIAN LIGHT POST WITH 80W LUMINAIRE
- RETROFIT EXISTING STREET SAFETY LIGHT WITH 87W LUMINAIRE

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0

HORIZONTAL ILLUMINATION CALCULATIONS

REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
1.90	4.00	2.04	2.27

NORTH

Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT

PROPOSED CONCEPT - PERFORMING ARTS DRIVEWAYS - FIGURE D-7

LUMINAIRE LEGEND

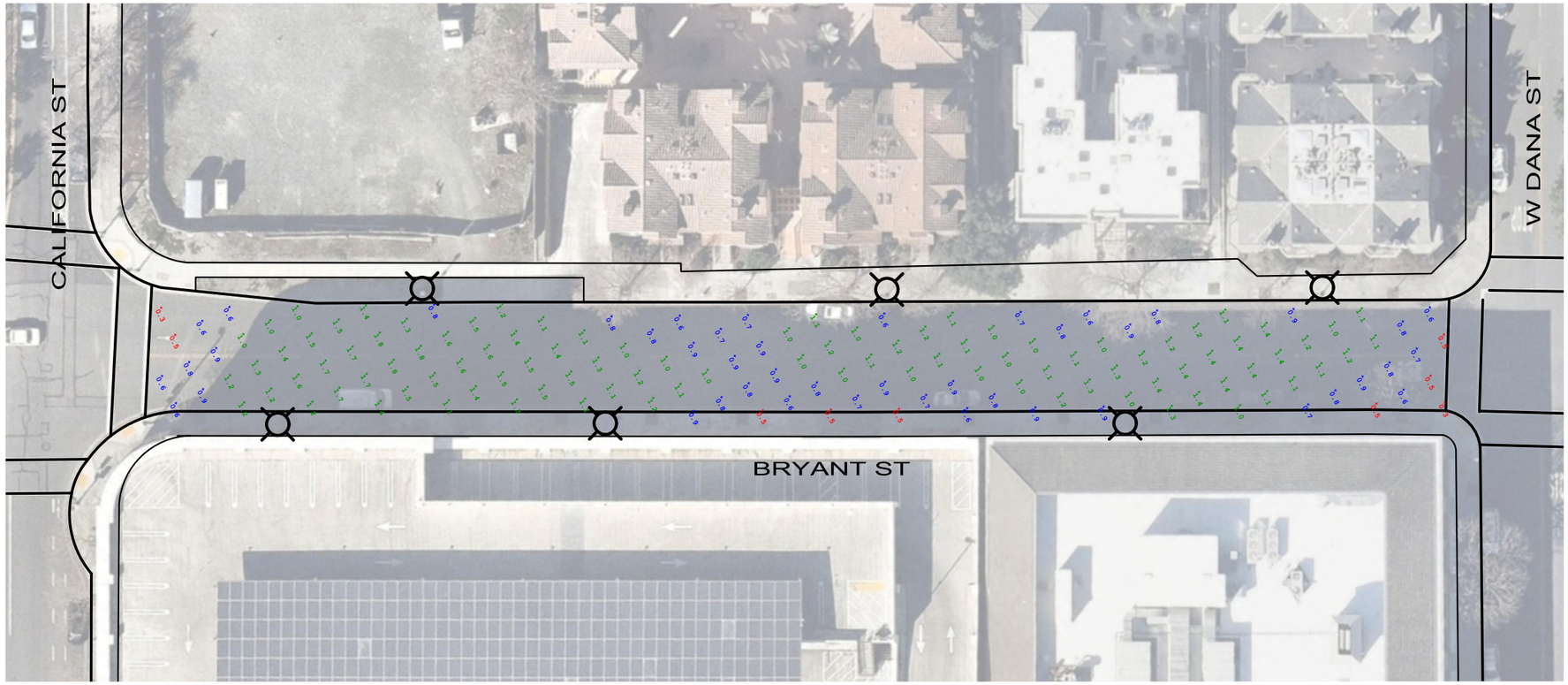
RETROFIT EXISTING PEDESTRIAN LIGHT POST WITH 80W LUMINAIRE

ABBREVIATIONS

HPS	HIGH PRESSURE SODIUM
LED	LIGHT EMITTING DIODE
MA	MAST ARM
MH	MOUNTING HEIGHT

ILLUMINANCE LEVELS (FC)

- <0.5
- 0.5 to 1.0
- 1.0 to 3.0
- >3.0



HORIZONTAL ILLUMINATION CALCULATIONS

REQUIRED		PROPOSED	
AVG	AVG/MIN	AVG	AVG/MIN
0.80	4.00	1.06	2.65

NORTH

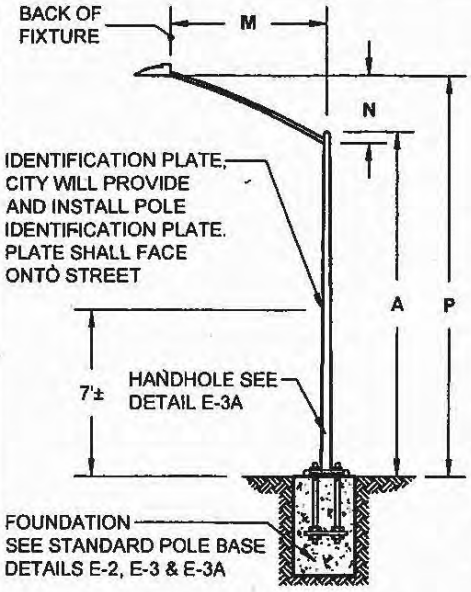
Kimley»Horn
1300 Clay Street, Suite 325
Oakland, California 94612

OCTOBER 2019

DOWNTOWN LIGHTING ASSESSMENT

PROPOSED CONCEPT- POST-TOP RETROFIT - FIGURE D-8

Appendix E – City Standard Details (E-1A, E-1B)



ELEVATION-TYPE 15

POLE TYPE	POLE DATA			
	A HEIGHT	MIN. O.D.		WALL THICKNESS
		BASE	TOP	
15	30'-0"	8"	3-11/16"	0.1196"

LUMINAIRE MAST ARM DATA				
M PROJECTED LENGTH	N RISE	MIN. O.D. AT POLE	NOMINAL THICKNESS	P - MOUNTING HEIGHT
				TYPE 15
6'-0"	2'-0"±	3-1/4"	0.1196"	31'-6"±
8'-0"	2'-6"±	3-1/2"		32'-0"±
10'-0"	3'-3"±	3-7/8"		32'-9"±
12'-0"	4'-3"±	3-7/8"		33'-9"±
15'-0"	4'-9"±	4-1/4"		34'-3"±

LED STREETLIGHT FIXTURE: LEOTEK EC-SERIES, GE ERS1-SERIES, OR APPROVED EQUAL.

STREET LIGHT DESIGN CRITERIA				
LAND USE AND/OR STREET CLASSIFICATION	MINIMUM MAST ARM LENGTH (FT)	LEDs		
		WATTAGE (W)	LUMENS* (Lm)	VOLTAGE (V)
RESIDENTIAL	8	≤35	2,500-3,000	120-277
COMMERCIAL	12	≤75	6,500-7,000	120-277
INDUSTRIAL	12	≤75	6,500-7,000	120-277
ARTERIAL	12-15	≤95	8,000-9,000	120-277
SIGNALIZED INTERSECTIONS	SEE TABLE ON STANDARD DETAIL E-1B			
MID-BLOCK CROSSWALKS				

*MINIMUM REQUIRED AT INSTALLATION

NOTES:

1. HANDHOLE SHALL BE LOCATED ON DOWNSTREAM SIDE OF TRAFFIC.
2. POLE AND MAST ARM MUST BE UNPAINTED GALVANIZED STEEL.
3. SEE CURRENT CALTRANS STANDARD PLANS FOR LUMINAIRE MAST ARM CONNECTION DETAIL.
4. LUMINAIRES MUST BE LIGHT EMITTING DIODE (LED) WITH 4000K TO 4500K COLOR TEMPERATURE.
5. LEDs MUST PROVIDE ILLUMINATING ENGINEERING SOCIETY (IES) TYPE II DISTRIBUTION UNLESS OTHERWISE NOTED ON THE PLANS.
6. EACH STREETLIGHT MUST HAVE AN INDIVIDUAL AND INDEPENDENT PHOTO CELL.
7. NON-SIGNALIZED INTERSECTIONS SHALL REFER TO "LAND USE AND/OR STREET CLASSIFICATION" IN TABLE ABOVE.
8. SEE CITY STANDARD DESIGN CRITERIA FOR STREET LIGHT PLACEMENT.

Revision	Date	Approved
Drawn: TE	Date: 6/13/2018	
Checked: AB	Scale: NTS	

APPROVED BY: No. 57093 PROFESSIONAL ENGINEER CIVIL STATE OF CALIFORNIA

Jacqueline C. Solomon

7/10/18 DATE | 12/31/2019 EXP. | 57093 R.C.E. NO.

CITY OF MOUNTAIN VIEW
PUBLIC WORKS DEPARTMENT
STANDARD DETAIL

STANDARD ELECTROLIER

FILE NO. E-1A

SIGNALIZED INTERSECTIONS & MID-BLOCK CROSSWALKS*				
FUNCTIONAL CLASSIFICATION	MAINTAINED ILLUMINATION AT PAVEMENT WITHIN CROSSWALK AREA BASED ON FUNCTIONAL CLASSIFICATION (Lux/fc)**			E_{avg}/E_{min}
	HIGH	MEDIUM	LOW***	
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

* THE ILLUMINANCE LEVEL IN A MID-BLOCK CROSSWALK AREA SHOULD AT LEAST BE EQUAL TO THAT PROVIDED AT THE INTERSECTION OF TWO MAJOR STREETS.

** THE RANGE OF ILLUMINATION BETWEEN HIGH & LOW IS FOR ALL NEW INSTALLATIONS AT THE TIME OF ACCEPTANCE. DETERIORATION OF ILLUMINATION IS EXPECTED WITH TIME.

*** MINIMUM REQUIRED AT TIME OF INSTALLATION

E_{avg}/E_{min} = UNIFORMITY RATIO

E_{avg} = AVERAGE HORIZONTAL ILLUMINANCE AT WALKWAY/BIKEWAY

E_{min} = MINIMUM HORIZONTAL ILLUMINATION AT WALKWAY/BIKEWAY

Revision	Date	Approved
Drawn: TE	Date: 6/13/2018	
Checked: AB	Scale: NTS	

APPROVED BY: C No. 57093 Jacqueline A Solomon
7/16/18 — DATE
12-31-2019 — EXP.
57093 — R.C.E. NO.

CITY OF MOUNTAIN VIEW
PUBLIC WORKS DEPARTMENT
STANDARD DETAIL

ILLUMINATION LEVELS AT SIGNALIZED INTERSECTIONS & MID-BLOCK CROSSWALKS

FILE NO. E-1B