FRONTAGE ROAD LIGHTING MASTER PLAN

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Acknowlegements

We appreciate the following people and organizations in assisting in evaluation of the Master Plan, and contributing to the development of a Plan that is in compliance with Town of Vail guidelines, standards, and character.

Town Council

Mayor Dick Cleveland
Mayor Pro-tem Kim Newbury
Council Member Kerry Donovan
Council Member Susie Tjossem
Council Member Margaret Rogers
Council Member Andy Daly
Council Member Kevin Foley

Public and Environmental Commission

Chairman Bill Pierce
Co-Chair David Viele
Commissioner Sarah Robinson-Paladino
Commissioner Tyler Schneidman
Commissioner Henry Pratt
Commissioner Luke Cartin
Commissioner Michael Kurz

Design Review Board

Chairman Pete Dunning
Co-Chair Tom DuBois
Board Member Elizabeth Plante
Board Member Brian Gillette
Board Member Rollie Kjesbo

We extend appreciation to the community for participating in the survey at the lighting test site during the summer of 2009.

We appreciate the following enterprises for assisting in the preparation of the Frontage Road Lighting Master Plan:

Cator Ruma and Associates, Co.
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DHM Design Inc.
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Part 1: Introduction to Frontage Roads Master Lighting Plan

A. Executive Summary

The Frontage Roads Master Lighting Plan is the culmination of research, discussion, test applications, and community input. This document represents the best evaluation and recommendations, based on the most current theory and practices for safe roadway lighting, weighted with the imperative to support the character and aesthetic that has made Town of Vail a unique, premier destination resort.

The purpose of the Frontage Roads Lighting Master Plan is to evaluate the current lighting conditions along the Frontage Roads and provide direction to Town of Vail for improvements that are intended to:

1. Improve safe utilization of the frontage roads by motorists, bicyclists, pedestrians, and overflow vehicle parking.
2. Manage appropriate light levels and illumination strategies along the frontage roads.
3. Manage long term economics and maintenance for lighting systems.
4. Establish consistency in the aesthetic appearance of lighting systems.

The Lighting Master Plan is a guiding document and does not constitute final approval to proceed with any of the recommendations. Any specific project, private or public, will prepare and submit required documents to the agencies, boards, commissions, and councils within the Town of Vail who are charged with review and approval prior to implementation.

The Frontage Road Lighting Master Plan conforms to current lighting ordinances and standards adopted by Town of Vail to the extent that the purpose of the Lighting Master Plan is achieved. A variance is recommended in the Frontage Roads Lighting Master Plan to increase the pole height for frontage roadway lighting to 25'-0". Per the Town Code, 14-10-7.D.2, "Height Limits For Light Fixtures: Outdoor lights affixed to a structure shall not exceed the height of the roof eaves. The maximum mounting height for light sources on a pole shall not exceed twenty feet (20')." Supporting documentation for the variance recommended in the Frontage Roads Master Lighting Plan is explained in detail in Part 2/C.

Periodic review of the Lighting Master Plan is advised to evaluate suitability of applications, evolving technologies that may equate to cost savings and improved performance, and trends in design practices.

B. Areas of the frontage roads addressed by the Frontage Road Lighting Master Plan include (see Figure 1.1):

1. The south frontage road: Ford Park to West Vail
2. The north frontage road: Main Vail to West Vail
3. The future Simba Run underpass

C. Areas of the Frontage Road NOT addressed by the Frontage Road Lighting Master Plan include:

1. Main Vail interchange and roundabouts
2. West Vail Interchange and roundabouts
3. Private Property
4. Commercial Core Areas

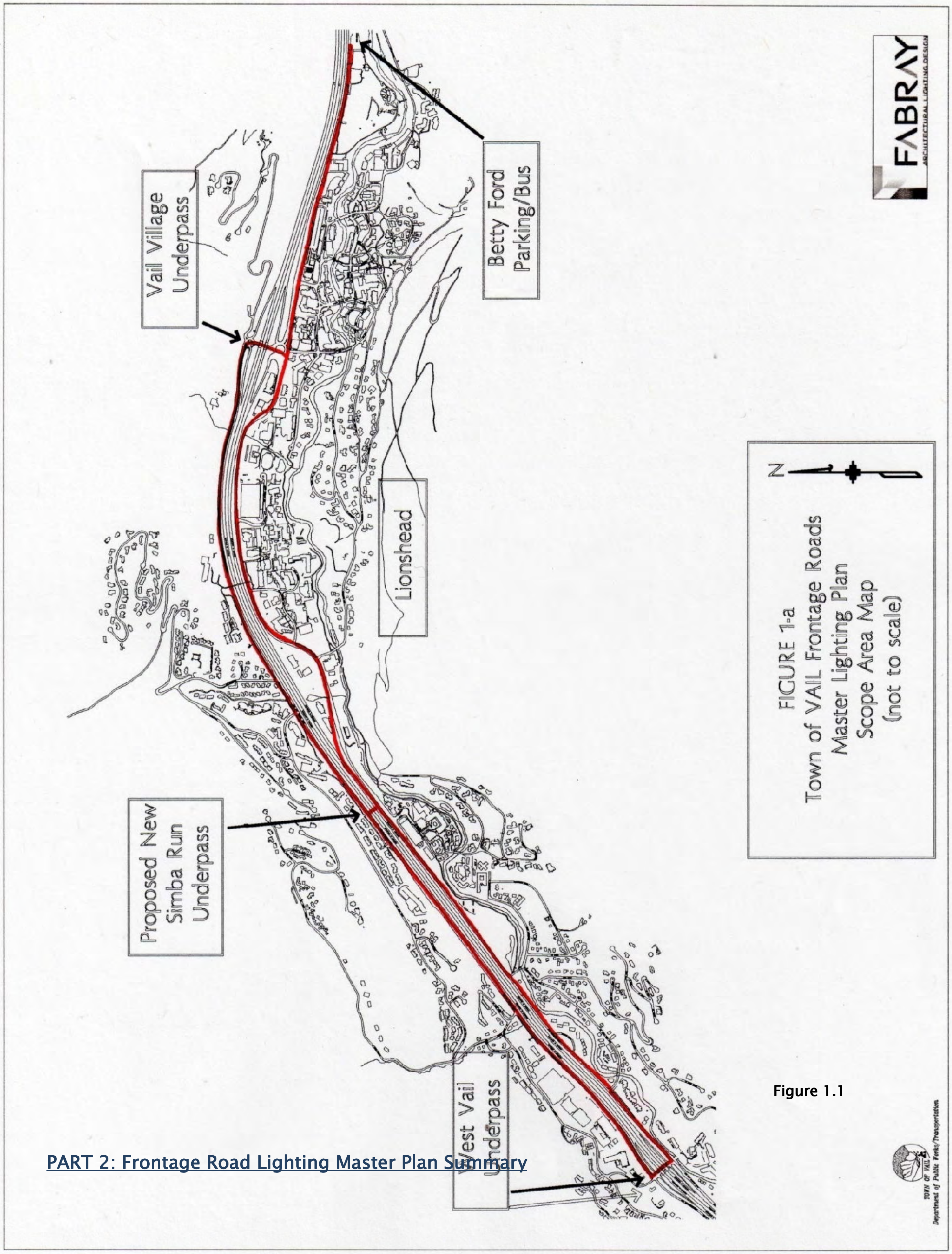


Figure 1.1

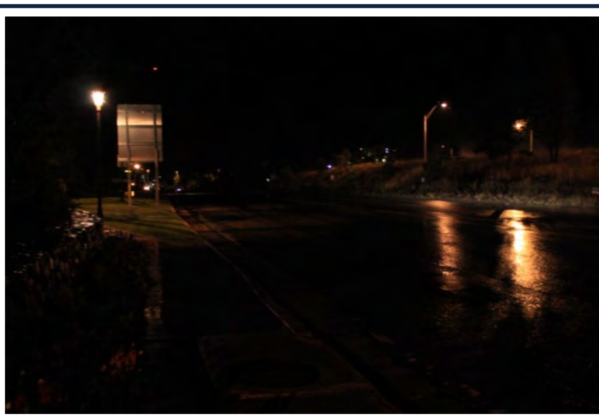
PART 2: Frontage Road Lighting Master Plan Summary

A. Conclusion

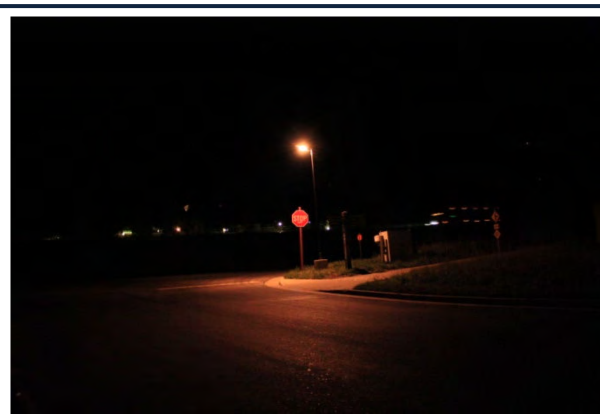
1. Based on the lack of effective roadway lighting along the Frontage Roads, and the resulting safety hazard to all Frontage Road users, the Frontage Roads Lighting Master Plan proposes lighting systems that:
   a. address the conditions conducive to night-time visibility,
   b. support the Town of Vail commitment to environmental stewardship through energy efficiency and dark-skies compliance,
   c. minimize the impact of additional lighting on the character of Town of Vail through considerations for quality and quantity of light,
   d. and minimize the life-cycle cost of such a system to the town.
2. The Frontage Roads Lighting Master Plan proposes a solid-state LED roadway lighting system, based on anticipated energy savings of approximately 50% and 25% minimum life cycle cost savings compared to the Town of Vail standard lamp source, which is high pressure sodium.
3. In addition to the proposed roadway lighting system, which is a “whiter” light source, The Frontage Roads Lighting Master Plan recommends integrating other methods to enhance the “romantic” character of the Town of Vail including:
   a. The use of the Village Lantern, a warmer lamp source, on a decorative 14’-0” pedestrian scale pole.
   b. Placement of bollards to match those installed on the bike paths leading to Donovan Park at high density traffic intersections with bike/pedestrian path crossovers to improve visibility for bicyclists and motorists.
   c. 14’-0” height banner arm poles to match the Village Lantern pole installed in new medians at key high activity turn lanes, such as the Village and Lionshead parking structures, as an opportunity to educate and inform residents and visitors of Town of Vail features and events. The Frontage Roads Lighting Master Plan does not recommend locations for placement of banner arm poles, however product specifications are included to suggest design characteristics consistent with the roadway lighting equipment characteristics.

B. Conditions Validating the Frontage Roads Lighting Master Plan

1. **The frontage roadways are not adequately illuminated for safety.**
   a. Existing frontage roadway lighting is limited to street lights at the Village and West Vail roundabouts, area lights in the underpasses, and pedestrian-scale street poles at intermittent properties and intersections such as at Matterhorn Drive. There is no effective street lighting along either frontage road. See figure 2.1 and 2.2 as an example.
   b. The north and south frontage roads are arterial roadways shared by vehicles, public transportation, bicyclists, and pedestrians. Specific areas of the frontage roads also serve as roadside parking when the Vail parking structures are full, which occurs 25-30 times per year.
   c. The lack of appropriate roadway lighting inhibits the quick, accurate, and comfortable visibility at night needed for safe utilization of the Frontage Roads. The benefit of quality nighttime roadway lighting, as substantiated by IDA Outdoor Lighting Code Handbook, IESNA RP-8-00, and the NEMA/ANSI Standard for Roadway and Area Lighting (see Appendix A for more information on these referenced organizations), is to facilitate assessment of roadway conditions such as:
      - Pavement that is clear and free of obstacles for a reasonable distance.
      - Position of a moving vehicle relative to lane and roadway edges.
      - Location and meaning of traffic and directional signage.
      - Position and anticipated course of moving objects on and near the roadway.
      - Recognition of destinations in order to make timely driving decisions.
   d. The recent adoption of an updated Transportation Master Plan, which responds to current and future growth and development for Town of Vail, identifies a clear recognition that frontage road improvements provide a benefit to the community. Addressing visibility deficits is key to the safe utilization of the Town's frontage roadway system.



Pedestrian Pole at Village Garage - South Frontage Road
Figure 2.1



Area Light at Matterhorn Dr - South Frontage Road
Figure 2.2

2. **Providing roadway lighting at selected sections along the Frontage Roads will benefit the safe utilization of the roadways by residents and visitors.**
   a. IESNA RP-8-00 is an industry standard which identifies recommended practices for roadway lighting applications (See Part 6/Appendix A for more information on this standard). Criterion in the Recommended Practice used in developing the Frontage Road Lighting Master Plan includes:
      - Light levels expressed in terms of maximum, minimum, and average footcandle illuminance (direct light incident on the roadway) for roadway usage classifications in conjunction with high,

medium, and low pedestrian conflict classifications. These are baseline light levels appropriate for an urban setting.
- Values for uniformity of lighting based on the ratio of average to minimum illuminance.

b. The Frontage Roads Lighting Master Plan establishes light levels that are appropriate for the rural setting and character of Town of Vail. The Local classification for roadway usage, as defined by IESNA RP-8-00, is the criterion that most closely fits the light levels appropriate for Town of Vail. Determination of these light levels was made based on:
- Measurement of existing light levels at the Village and West Vail turnabouts and I-70 off-ramps, as the baseline for the highest level of light acceptable for Town of Vail.
- Comparative studies and light level measurements for illuminated sites and intersections in the Town of Vail including Safeway and City Market parking lots, Village pedestrian cross walks, Matternhorn Drive intersection, and Donovan Park parking lot.
- A test site installed at the Ford Park bus stop drive an LED source and the standard High Pressure Sodium source installed.
- Photometric studies of a sample roadway section (Village round about to Ford Park)
- Feedback from Town of Vail City Council, Planning and Environmental Commission, and Design Review Board, expressing the community value to maintain a low level of lighting.

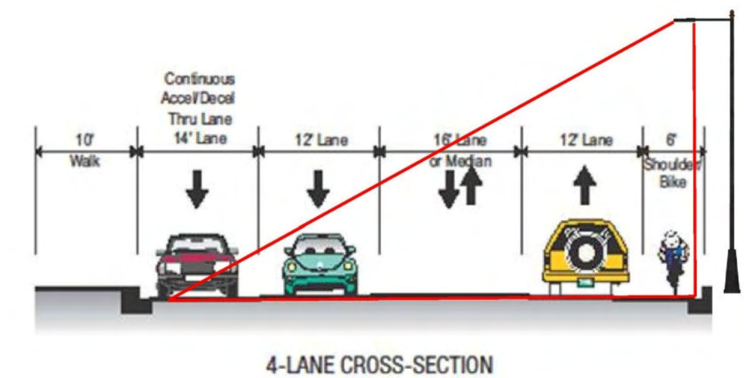
c. Based on preferences expressed by TOV City Council, Planning and Environmental Commission, and Design Review Board, the Frontage Roads Lighting Master Plan recommends a zone strategy for light levels, based on volume and complexity of traffic/pedestrian activity at sections of the Frontage Roads:
- High Zone: Existing Village and West roundabouts. This represents the maximum target light level and applies to the portions of the Frontage Roads with highest volume and complexity of activity such as the proposed Simba Run roundabouts.
- Medium Zone: High volume, high activity, and high potential for conflict (between motorists, pedestrians, bicycles, and/or parked vehicles) – primarily major parking structures and approaches to such.
- Low Zone: Medium to high volume traffic, medium activity, and medium potential conflict – primarily transitional roadway sections between major commercial access and medium/high zones.
- Secondary Intersections Zone: Intermittent intersections along the Frontage Roads, not within a low or medium zone, with volume, activity, and/or potential conflict substantial enough to benefit from area lighting.
- Portions of the Frontage Roads with limited residential and/or commercial access and minimal conflict potential (any zone not included in one of the four previously defined zones) which are intended to remain “dark zones” – no roadway lighting recommendation in the Frontage Roads Lighting Master Plan.

C. Study of Pole Height Options:

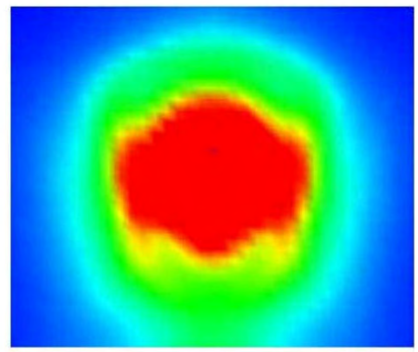
1. Calculation of light levels were performed for a sample roadway section (Medium Zone classification), from the Village Roundabout to Village Parking Garage, using a 20’-0” pole and 25’-0” pole to understand the potential impact of pole height on the application of Frontage Road lighting. Three significant conditions were revealed in the study, indicating the 25’-0” pole provided benefit associated with cost, performance, and aesthetics:
   - The 25’-0” pole provided better uniformity of illumination across the roadway as compared to the 20’-0” pole.
   - The 25’-0’ pole met target illuminance values across the width of the Frontage Road for most 3 and 4 lane sections with poles positioned on just one side of the roadway – see figure 2.5 which illustrates the light coverage for the 4-lane section of roadway (diagram from the Master Transportation Plan). The 20’-0” pole, which reduces the area of illumination by 20% commensurate with the proximity of the source to the pavement by 5’-0”, requires poles placement on both sides of the roadway to meet target illuminance values across the width of the Frontage Road.

- The 25’-0” pole met target illuminance values with 20% fewer poles compared to the 20’-0” pole in the sample study area

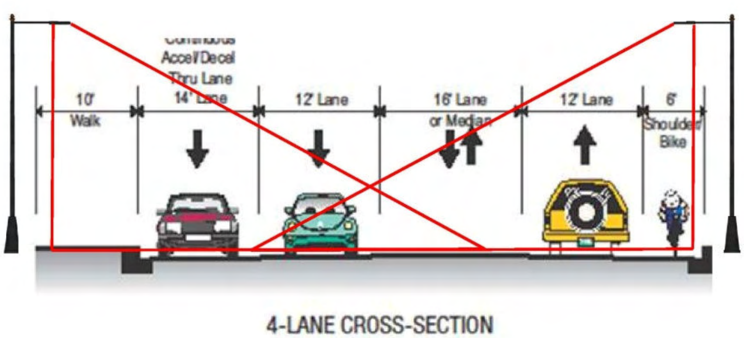
2. The benefits of using 25’-0’ poles installed primarily on one side, in the shoulder adjacent to the Interstate, are:
    a. Reduced initial equipment cost due to fewer poles and lights.
    b. Reduced installation cost associated with earthwork and electrical distribution/branch circuiting.
    c. Lower life-cycle cost.
    d. Reduced disturbance to private and public properties during installation.
    e. Less visual impact with fewer poles.



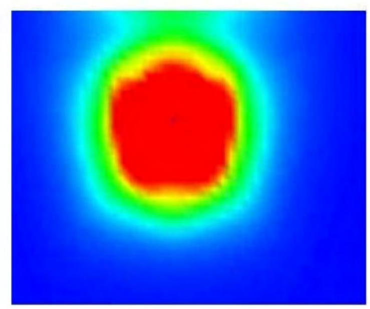
25’-0” Pole – light distribution at 60 degree angle



Pseudo-color lamp distribution at 25’



20’-0” Pole – light distribution at 60 degree angle



Pseudo-color lamp distribution at 20’

Figure 2.5

D. **Study of Light Source (lamping) Options:** The standard street lighting lamp utilized in Town of Vail is a 100W high pressure sodium (HPS) lamp, GE LongLife Lucalox ED23.5, which is a common industry lamp for roadway applications, predicated on the rated lamp life (40,000 hours) and efficacy (66 lumens per watt – a measure of light output relative to power input). The intent of the Frontage Roads Lighting Master Plan is to achieve equal or improved cost and performance, using the standard HPS lamp as the baseline for comparison. Three lamp sources representing newer developments in lamp technology – Ceramic Metal Halide (CMH), Induction, and LED solid state – were compared to the standard HPS for technical characteristics, cost, and actual visual performance. The studies performed are summarized in the following. The resulting conclusions of the combined studies were:

- The CMH compared unfavorably in the cost analysis, and was eliminated from further consideration.
- The induction source, in visual observation, produced distracting shadows and distorted modeling, and was eliminated from further consideration.
- The LED solid state source exceeded the HPS baseline in most categories of technical, cost, and visual performance.

1. Technical characteristics of the four lamp sources were compared. The study results is summarized in the table below, and characteristics which represent improvement compared to the HPS baseline source are highlighted in red/bold text.
   a. Light Output and Efficiency Characteristics: data published by lamp manufacturer's based on industry testing standards.
      - Efficacy – lumen output relative to wattage input, or light delivered relative to power used. Expressed as lumens per watt (LPW). The higher the LPW value the better the efficacy.
      - Rated Lamp Life - The average life of a lamp of a given type, as determined from a large sample operated under laboratory conditions.
      - Lumen Depreciation – A value, expressed as a percentage, which reflects the overall performance of a lamp over its life. As lamps are burned, their lumen output decreases. The lower the percentage, the better the life time performance of the lamp.
   b. Quality of Light Characteristics: data published by lamp manufacturer's based on industry testing standards. These qualitative characteristics improve night time visibility in that they effect perception of color, depth, and contrast:
      - CRI – color rendering index, a value from 0-100, which indicates the spectral range of colors detectable under the source. The higher the value, the better the source allows us to see objects as we would expect to see them in daylight.
      - CCT – correlated color temperature, a value expressed in degrees Kelvin (K) that describes the overall color appearance of the source, from yellow or orange/warmer (2600K is incandescent) to bluish/cooler (4100K is the color of moonlight). Recent studies indicate that the eye adapts better to cooler color temperatures at night.

Source	**Specification**	**System Wattage**	**Initial Lumens**	**Efficacy**	**Rated Lamp Life (hrs)**	**Lumen Depreciation**	**CRI**	**CCT**
HPS baseline	Lucalox LU100/100/SBY/D	138	9200	66 LPW	40,000	20%	25	2000K
CMH	Phillips Pulse Start CDM/100/U/PS/4K/ALTO	125	9000	**72 LPW**	24,000	25%	**85**	**4000K**
LED – 525mA	BetaLED 90/525mA/4300K	166	8998	55 LPW	**75,000**	**15%**	**70**	**4300K**
Induction	U.S.Lighting Tech	110	8500	**77 LPW**	**100,000**	30%	**85**	**4000K**

2. Initial and life-cycle costs were compared for the four sources, based on a sample pole layout for a section of the Frontage Road, from the Village Roundabout to the Village Parking Garage, and targeting the illuminance and uniformity values as defined by IESNA RP-8-00 for local roadway usage classification. In the summary table below the costs which represent an improvement compared to the HPS baseline source are highlighted in red/bold text. The CMH source was eliminated from consideration based on cost.

Source	Life Cycle Energy Cost	Life Cycle Maintenance Cost	Initial System Cost	Total Life Cycle Cost(*1)	Amortized Annual Cost (*2)
HPS Baseline	$31,639.00	$53,729.00	$64,550.00	$149,918.00	$5,997.00
CMH	**$28,659.00**	$106,858.00	**$62,284.00**	$197,801.00	$7,912.00
LED – 525mA	**$28,246.00**	$56,776.00	**$56,804.00**	**$141,826.00**	**$5,673.00**
Induction	**$27,237.00**	$57,097.00	**$45,630.00**	**$129,965.00**	**$5,199.00**

(*1)Total Life Cycle Cost is for the total quantity of luminaires represented in the sample pole layout for 25 years
(*2) Amortized Annual Cost is for the total quantity of luminaires represented, annually for a 25 year life cycle.

3. In addition to the statistical analysis, the actual visual performance of the sources was evaluated:
   a. The City of Loveland, Colorado, installed a roadway lighting test site using LED, Induction, and HPS on 25'-0" poles. Public Works officials including Greg Hall, Tom Kassmel, Todd Oppenheimer, and Leo Vasquez visited the test site to evaluate the sources. Observations of the three sources facilitated the selection of a single comparative source – LED – for a test site at Ford Park.
   b. Ford Park Test Site: Comparison between a HPS and LED roadway light, installed on 25'-0" poles, yielded the following results:
      - The LED source, with a similar lumen output to the HPS, appeared too bright. By adjusting the power driver current at the luminaire (a characteristic unique to LED technology), the LED source light output could be reduced by 40%, which resulted in less light but acceptable visibility. Less light equates to less energy usage, and increased anticipated lamp life. Technical and cost studies between the LED source and HPS were then re-evaluated with the new LED performance metrics, and results are summarized in the tables below. The LED source outperformed the HPS in most categories studied.

Source	Specification	System Wattage	Initial Lumens	Efficacy	Rated Lamp Life (hrs)	Lumen Depreciation	CRI	CCT
HPS baseline	Lucalox LU100/100/SBY/D	138	9200	66 LPW	40,000	20%	25	2000K
LED – 350mA	BetaLED 60/350mA/4300K	**76**	4472	59 LPW	**131,000**	**15%**	**70**	**4300K**

Source	Life Cycle Energy Cost	Life Cycle Maintenance Cost	Initial System Cost	Total Life Cycle Cost(*1)	Amortized Annual Cost (*2)
HPS Baseline	$31,639.00	$53,729.00	$64,550.00	$149,918.00	$5,997.00
LED – 350mA	**$15,333.00**	$56,752.00	**$41,602.00**	**$113,687.00**	**$4,547.00**

- Figure 2.6, photographs taken at the Ford test site, illustrates the difference in color appearance and impact on visibility for the two sources. The white LED source clearly outperforms HPS.
- Surveys were left at the site for community response. Two of the three responses collected supported the improvement in visibility and quality of light produced by the LED. The third response indicated that the LED was less desirable than HPS for the atmosphere in Vail.

100W HPS Source

60LED Source @350mA

Figure 2.6

PART 3: Frontage Road Lighting Master Plan Objectives

A. Improvements in Roadway Safety

I. Improve Roadway Visibility
   a. The north and south frontage roads are arterial roadways shared by vehicles, public transportation, bicyclists, and pedestrians. They also serve as roadside parking when Vail Parking structures fill, which occurs 25-30 times per year. Roadway visibility is key to safe use of the Frontage Roads in user conflict zones.
   b. Visibility deficits are key factors in a number of undesirable safety conditions.
      - Reduced potential for night-time collisions.
      - Aid to police protection and enhanced sense of personal security.
   c. Improved nighttime visibility facilitates driver confidence and encourages usage of private and public enterprises during the night-time hours, providing economic benefit to the community.

2. Assist motorists in anticipating and responding to traffic circulation and roadway transitions.
   a. Public Works recently submitted an updated Transportation Master Plan that responds to current and projected future growth and development studies for Town of Vail. The Transportation Master Plan recommends improvements to traffic management and access strategies along the frontage roads, including widening portions of the roadway and establishing turn lanes. The Frontage Roads Master Lighting Plan addresses night-time visibility strategies to parallel the Transportation Master Plan improvements.
   b. In addition to aiding in visibility, lighting is a visual cue that is easily recognized and interpreted. Light identifies roadway transitions and signals important driving decisions. The main village roundabouts and the west Vail roundabouts are well illuminated nodes that provide this type of signaling. They are memorable markers that help to orient the community.

B. Support Objectives of Vail Lighting Ordinance and Environmental Stewardship

1. Dark Sky
   a. With the adoption of a dark-sky ordinance in 2008, Vail is clearly championing the philosophy of dark-sky preservation. The ordinance governs the use of full cutoff light sources directed where needed and requires that light levels be the minimum needed for safety and security. The Frontage Roads Lighting Master Plan is strictly in conformance with full cutoff criteria and minimum light levels for roadway safety.
   b. The Frontage Roads Lighting Master Plan establishes zones of beneficial light, as described in “Part 2/B/2/b” and illustrated in “Part 4/A”, at light levels appropriate for Town of Vail. The Lighting Master Plan supports sections determined to be best served by no new roadway lighting, to promote the accessibility of night time viewing.
   c. Patterns of light distribution along the frontage roads have been selected specific to the roadway configuration in each zone of beneficial light to optimize roadway coverage without light trespass.
2. Energy Efficiency
   a. The cost of procurement, utilization, and maintenance of a public lighting system is carried by the municipality. The Frontage Road Master Lighting Plan addresses the many variables to lighting systems that factor into the successful life time performance and cost of a roadway lighting system, including:
      - Usable life of the equipment and all associated parts
      - Durability of finishes
      - Efficiency of lamp sources and reflectors that house the source

- Measurable performance of the source
- Proper maintenance practices that may impact the life and performance of the equipment
- Environmental factors that may impact life and performance of the equipment
- Equipment design that may ease or hinder the economics of maintenance
- Hazardous materials that may require special disposal

b. Specific criteria for energy efficiency addressed by the Frontage Roads Lighting Master Plan include:
- Life-cycle energy cost reduced compared to current Town of Vail standard municipal lighting standards.
- Flexible control options that allow Town of Vail to adjust light levels in accordance with need.
- Modular equipment design that can be easily retrofitted over time as advancements in technology provide greater efficiency and performance.

C. Positive Aesthetic Impact

1. Consistent Character
   a. While the Frontage Road Lighting Master Plan is not intended to direct the selection of lighting equipment outside of the municipal right-of-way, the standardization of roadway lighting applications will help guide the interface of current and future developments with Frontage Road access.
   b. The Lighting Master Plan defines the selection of equipment, including the roadway pole, pedestrian scale pole, and bike/pedestrian path bollard, for the Frontage Roads. In doing so, the visual impact of the lighting systems, by day or night, is consistent and replicates the visual language from east to west Vail.
   c. In taking a global approach, the Frontage Roads Lighting Master Plan controls light levels and the appearance of light in a way that address both need/safety and balance with ambient light conditions in the community. In this way, roadway lighting can serve the community with the most desirable results.
2. Appropriate Light Levels
   a. The Frontage Roads Lighting Master Plan includes adjustments in target light levels as defined by IESNA RP-8-00 based on the following:
      - Field measurement of existing lighting levels in specific public right-of-way areas in Vail, as well as familiar private enterprise lighting installations. Refer to Appendix D for photographs and measured light levels at these location including: Village and West Vail roundabouts, I-70 off ramps at the roundabouts, Safeway parking lot, City Market parking lot, Donovan Park parking lot, and the intersection of South Frontage Road and Matterhorn Drive.
      - Observation, light level measurements, and community response for the selected LED pole mounted light installed as a test site at Ford Park.
      - Studies and community response from similar LED installations in the United States – refer to "Part 2/E" for a summary of similar installations.
3. Color
   a. The color appearance of the roadway lighting system is a factor in successful performance of the system as well as acceptance within the community by residents, business enterprises, and visitors. The objective of the Frontage Roads Lighting Master Plan is to provide the best color characteristics of the light source used in roadway lighting to facilitate good night time vision.
   b. "Part 2/D/b" explained CCT – the appearance of a light source as whiter/bluish or yellow/orangish – and CRI – the measure of a light source's ability to make people and objects appear as they would during daylight.
   c. The Frontage Roads Master Lighting Plan follows conclusive evidence that night time vision is improved under whiter/blue light sources (higher CCT and CRI) as compared to yellow/orange sources (lower CCT and typically lower CRI). One such study conducted by The Lighting Research

Center (LRC)/Rennselaer Polytechnic Institute is identified in Part 6/Appendix A. The affects of higher CCT and CRI sources on night time visual functions include:

- Targets in the field of vision are more easily detected
- Peripheral vision is enhanced
- Same or better visibility in low-light conditions, including lower roadway surface lighting
- Enhanced sense of safety and security

d. Supplemental lighting, such as the standard Village pedestrian lantern and bike path bollard, will be integrated with the roadway lighting to enhance the frontage roads with familiar color appearance and characteristic appeal.

4. Glare Control

a. All light sources inherently produce glare, a function of the angle of light source distribution at a specific viewing angle. According to industry standards, glare is classified as either disabling or discomforting.

b. Disability glare can impair the ability of a driver to perform necessary tasks. The Frontage Roads Lighting Master Plan includes strategies to help mitigate the potential for disabling glare from roadway turn lanes and cross traffic access points. Strategies include:

- Placement of poles so that source distribution angle is outside the visual field of the driver
- Addressing lighting uniformity and contrast ratios to minimize visual adaptation between light and dark fields.

c. Discomfort glare is an unwelcome by-product of bright light sources, although it is not considered to impair visibility. The Frontage Roads Lighting Master Plan includes strategies to mitigate the potential for discomfort glare for residences and business enterprises with frontage road views. Strategies include:

- Placement of poles so that the source distribution angle is outside the visual field of the viewer to the greatest extent possible.
- Utilizing "backlight" shielding to eliminate light distribution behind the pole, where poles are installed adjacent to commercial and residential properties.
- Limiting roadway lighting to sections of the frontage roads where it is most needed, an out of primarily residential zones.
- Utilizing pedestrian lanterns in concert with roadway lighting where commercial enterprises are built to the property line shared by the frontage roads.

PART 4: Frontage Roads Lighting Master Plan Recommendations

A. Location of Equipment Along Frontage Roads

1. Roadway Lighting Zones Strategy: Figures 4.1, 4.2, 4.3 and 4.4 illustrate the recommended strategy for zones of roadway lighting. The illuminance design basis for each of the four zone categories, as recommended in IESNA RP-8-00 Table 2 for local roadway classification, is as follows. These are target illuminance values and may vary slightly in application depending on roadway and median configurations and conditions.

Lighting Zone Designation	Traffic Description	Target Average Illuminance – Roadway (footcandle)	Target Average Illuminance –Intersection (footcandle)	Target Avg:Min Uniformity	Pole spacing (*1)
High Zone	Existing TOV roundabouts (based on field measurements)				As required
Medium Zone	High volume, high activity, high conflict	0.7	1.4	6:1	100’-150’
Low Zone	High volume, medium activity, medium conflict	0.4	0.8	6:1	150’-225’
Secondary Intersections	Intermittent roadway intersections with enough volume, activity, and conflict potential to justify lighting	0.4	0.8	6:1	100’-150’

(*1) pole spacing will vary within the zone depending on roadway and median configurations, and location of intersections.

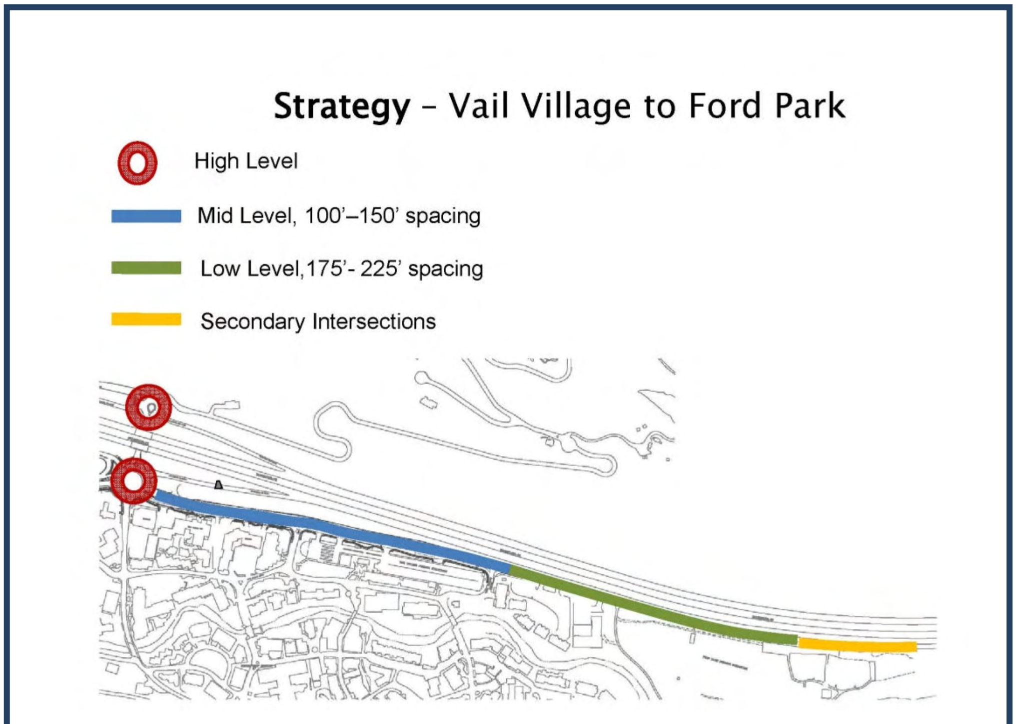


Figure 4.1

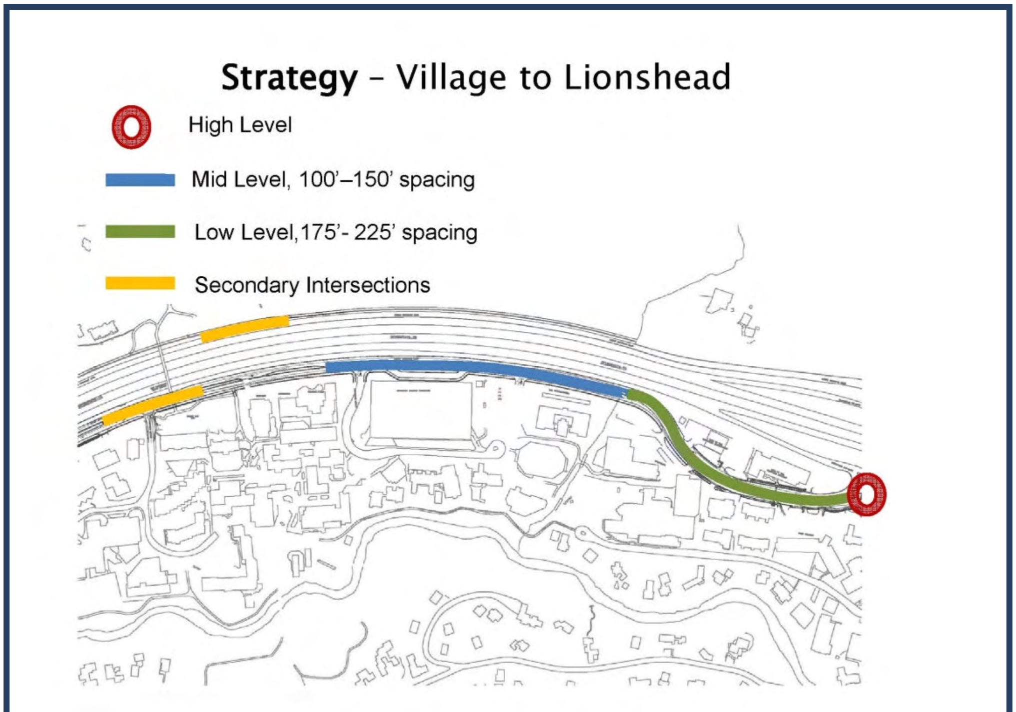


Figure 4.2

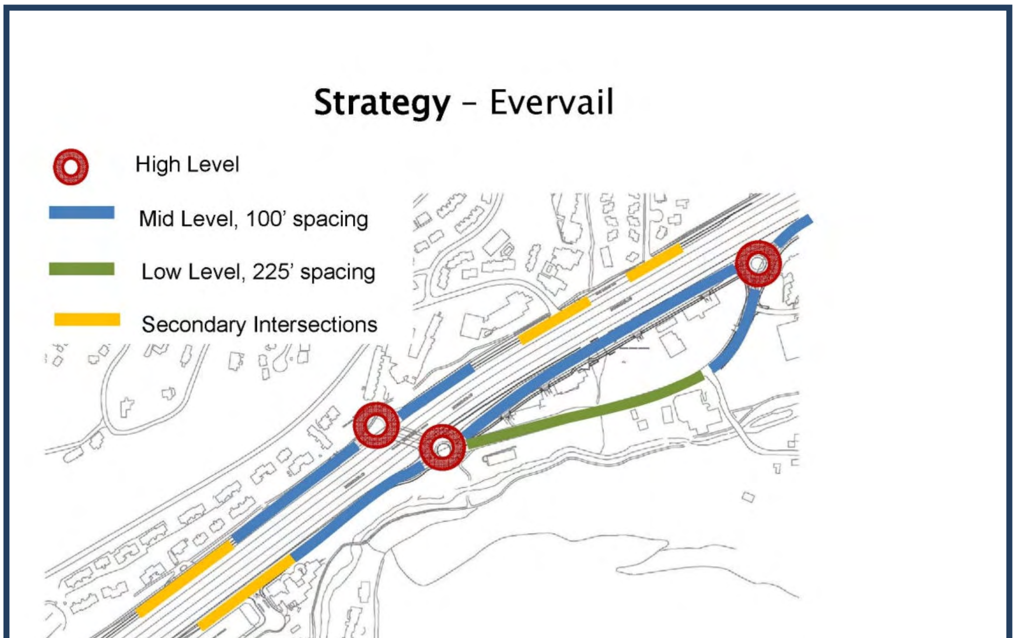


Figure 4.3

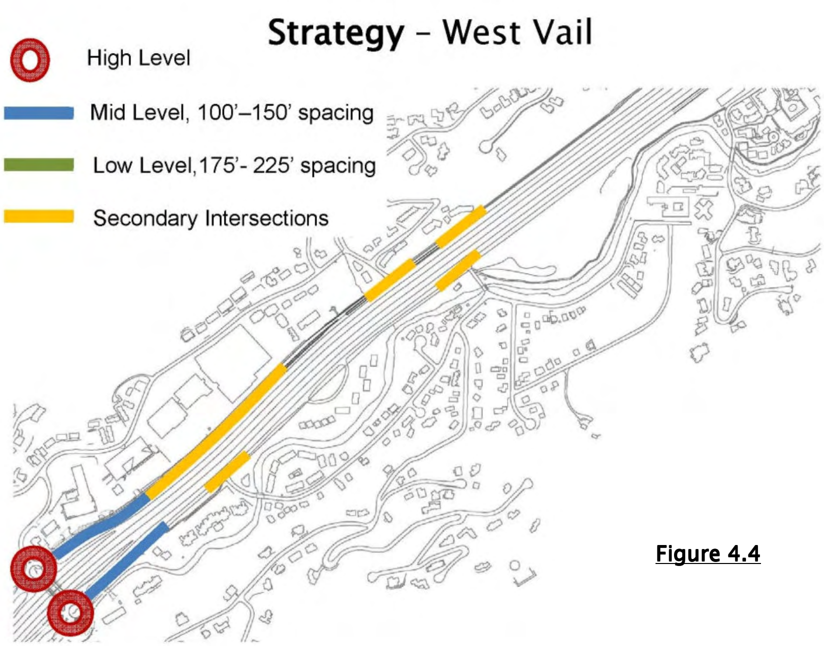


Figure 4.4

2. Placement of LED roadway lighting poles within the zone strategy, to achieve target illuminance and uniformity values, is guided by:
    - The roadway configurations for typical 3, 4, and 5 lane roadway sections, as proposed in the Master Transportation Plan. Primarily, roadway lighting pole placement is recommended on the Interstate side of the Frontage Roads to minimize installation cost and constructon impact. 4- land and 5-lane roadway sections in Medium Zones, in some cases, require pole placement on both sides of roadway (and/or in the median) to provide sufficient illuminance and uniformity.
    - Proximity of roadway section to commercial and/or residential development property. Where direct glare from the roadway light cannot be mitigated by any other means, pole placement is recommended on the development side of the roadway so that the light source can be directed away from the property.
    - Viewing angles for motorist positions at turn lanes and stops. Pole position is offset by 60 degrees to mitigate potential for glare at fixed motorist positions.
3. Recommendation for placement of HPS decorative Village Lantern pedestrian pole is guided by:
    - Contribution to night time visibility for pedestrians.
    - Contribution to roadway illuminance where needed to supplement roadway lighting.
    - Contribution to character.
4. Recommendation for placement of low level bollards is guided by:
    - Convergence of city bike/pedestrian paths with moderately to heavily used intersections.

5. Dimensioned Lighting Layout Plans correspond to the Lighting Zone Strategy and to Photometric studies included in the Frontage Roads Lighting Master Plan, Part 10. Lighting Layout Plans included in the Lighting Master Plan are:

    - LD-1 West Vail Part 1
    - LD-2 West Vail Part 2
    - LD-3 West Vail Part 3
    - LD-4 Timber Ridge Part 1
    - LD-5 Timber Ridge Part 2
    - LD-6 Lionshead Part 1
    - LD-7 Lionshead Part 2
    - LD-8 Lionshead Part 3
    - LD-9 Vail Village Part 1
    - LD-10 Vail Village Part 2
    - LD-11 Vail Village Part 3
    - LD-12 Vail Village Part 4
        a. Dimensions shown are intended to reasonably predict placement of poles to achieve anticipated target light levels and uniformity. Prior to implementation, field conditions relative to pole placement must be reviewed and necessary adjustments to pole placement identified. Additional photometric studies are advised if pole placement requires adjustment of more than 10% of the dimension indicated in the Frontage Roads Lighting Master Plan.
        b. Dimensioned Lighting Layout Plans are based on roadway, right-of-way, public and private property apportionment as it exists or is anticipated at the time of Adoption of the Frontage Roads Lighting Master Plan. Future modifications to any of these may impact the feasibility of the Lighting Layout Plans, and further study of the frontage roads lighting plans must preclude the implementation.
6. Landscape material including trees, monuments, artwork, etc. that may be part of future frontage road planning and development should be coordinated with the Lighting Layout Plans to avoid creating obstructions that may interfere with anticipated performance of the frontage roads lighting systems. Refer to Part 8/Appendix C/Details for diagrams which suggest clearances between lighting poles and landscape vegetation or features.
7. Refer to Part 8/Appendix C/Details for recommended set-back of poles relative to roadway, bike-path, shoulder, and/or pedestrian walkways.

B. Pole Recommendations

1. Based on studies conducted and described in “Part 2: Frontage Roads Lighting Master Plan Summary”, a 25’-0” pole for roadway lighting is recommended to capture cost benefits, minimize the visual impact of the lighting system, and minimize construction disturbance.
2. Manufacturer’s Technical Specification Sheets for the following scheduled equipment are included in “Part 7: Appendix B”.
3. Design of structural base for the poles is not included in the Frontage Roads Lighting Master Plan.

Equipment Designation (*1)	Description	Pole Height	Pole Diameter	Pole Construction	Finish	Pole Accessories
P1	Village Pedestrian Pole	12'-0" (24" head on top)	4"	Straight Steel	Epoxy Primer and Black Electrostatic Powdercoat Painted Topcoat	5"h x 15.25"D base cover. Optional GFI receptacle,planter arms, irrigation (*2)
P2, P3, P4, P5	Roadway Lighting Pole	25'-0"	5"	Straight Steel	Epoxy Primer and Black Electrostatic Powdercoat Painted Topcoat	36"H tapered cast iron pole base, cast aluminum acorn finial
BA1	Decorative Banner Arm	14'-0"	4"	Straight Steel	Epoxy Primer and Black Electrostatic Powdercoat Painted Topcoat	5"h x 15.25"D base cover, 24"L alum dual break-away banner arms, cast alum decorative acorn finial
BL1	Bikeway Bollard	3'-8.5"	7.8" shaft	Corten Steel shaft, cast iron head	Raw (appears rusty over time)	NA

(*1) Equipment designation is referenced on the Lighting Layout Plans and describes all components including the pole.
(*2) Planter Arm and receptacles are options that need to be discussed with Town of Vail planners prior to implementation of this Lighting Master Plan.

C. Lamp Recommendations

1. The Frontage Roads Lighting Master Plan recommends the 4300K LED lamp, operated at 350mA drive current, as the primary roadway lighting source for the performance benefits associated with the task of driving and for the life-cycle cost benefits. The complete life-cycle cost analysis is included in Part 8: Appendix B. Based on the analysis, the lighting system using the recommended LED source, compared to the High Pressure Sodium source which is standard to the Town of Vail, anticipates 52% less energy usage and a life-cycle cost savings of 25%.
2. The High Pressure Sodium lamp, standard to the Village lantern and bollard, is recommended:
   - As a decorative element, where the warmer color appearance supports the aesthetic and character of Town of Vail.
   - For pedestrian zones where visual acuity is less critical than for the task of driving.
   - As a visual cue at roadway intersections where bike/pedestrian paths cross over.
3. Lamp characteristics for each of the pole/fixture assemblies are described in the following table. LED lamp specifications are integrated with fixture specifications. HPS lamp and ballast specification sheets are provided independent of the fixtures they are installed in. All Manufacturers' Technical Specification Sheets included in "Part 7: Appendix B".

Equipment Designation (*1)	Description	Lamp Source	Wattage	CRI (Color Rendering Index)	CCT (Correlated Color Temperature)
P1	Village Pedestrian Pole	HPS/LED (in the decorative chimney)	100W/1W	22	2000K
P2, P3, P4, P5	Roadway Lighting Pole	LED modules with 20 LEDs each	60W (3 modules at 20W each)	70	4300K
BL1	Bikeway Bollard	HPS	50W	22	2000K

(*1) Equipment designation is referenced on the Lighting Layout Plans and describes all components including the pole.

4. Operating voltage for lamps recommended in the Frontage Roads Lighting Master Plan are 120-220V, and voltage will be verified with Town of Vail Public Works at the time of implementation.
5. LED lamps included in this specification are Generation C release product. At the time of implementation, the intent of the Frontage Roads Lighting Master Plan is to verify the most current LED product and modify the specification as required to compensate for improvements in technology.

D. Fixture Selection

1. Manufacturers' Technical Specification Sheets for all equipment identified in the Frontage Roads Lighting Master Plan are included in "Part 7: Appendix B".
2. Fixture selection is manufacturer and product specific and may not be substituted. Where procurement of product is assigned to an exclusive supplier, the supplier and contact information is indicated on the Technical Manufacturers' Specification Sheet.
3. All fixtures selected and specified are UL and/or CUL listed. LED fixture selections are LM-80-08 and LM-79-08 tested (see Part 6:Appendix A for description of this test). Any modifications to the specification in the future will be listed and tested per these standards.
4. The Village Pedestrian Lantern (type P1) as presently specified and designed does not meet the full cutoff requirement of the Vail Outdoor Lighting Ordinance. The Frontage Roads Lighting Master Plan does not address re-design of this standard Vail product, although it is our understanding that efforts are underway to investigate modifications to the lantern design that will meet full cutoff criteria. Verify the status of the Village Lantern specification prior to implementation of the Frontage Roads Lighting Master Plan.

E. Controls System Criteria

1. The Frontage Roads Lighting Master Plan recommends both unitized (local at the fixture) and system approach to controlling the operations of the roadway lighting.
2. Unitized control is achieved with a multi-tap (350mA and 525mA) power supply integral with the LED street fixture. The benefit to this option is that on a fixture by fixture basis the light output can be adjusted to a higher or lower output to compensate for lumen depreciation over time and to set groups of fixtures for specific roadway conditions should that become desirable. With this control option, a multi-level control scheme can also be implemented wherein groups of lights can be switched between lower and higher output either automatically or manually. The multi-tap option is included in the Manufacturers' Technical Specifications for LED roadway fixture types P2, P3, P4, and P5, in "Part 7: Appendix B", as well as the wiring diagram for the 350mA and 525mA driver settings.
3. System control is achieved with a programmable solid-state relay panel that automatically turns groups of lights on and off based on a programmed schedule or as a manual function through network technology. The Frontage Roads Lighting Master Plan recommends the following characteristics and requirements for the system controls:
    a. The Relay Panel will be pre-assembled, UL/CSA listed, and separate from the electrical distribution equipment utilized to power the frontage road lighting. Manufacturer for the equipment will be approved by Town of Vail.

b. Relays will be low voltage lighting control relays, fully rated for 20A and suitable for all lamp types. Each relay will have a molded case containing terminals for both low voltage signal wiring and line voltage power wiring. Each relay shall have an integral means for manual operation. Relays will be capable of being automatically controlled in groups and simultaneously controlled by individual override. Relays shall have a built in status indicator that can be monitored by a networking technology. Relay status shall be accomplished by the same signal wiring as is used to carry the on/off signal.

c. Relay panels will have the capability to be networked to other relay panels and/or other programmable control systems supported by Town of Vail. The networking capabilities and preferences of Town of Vail will be coordinated with the networking capabilities of the specified Relay Panel.

d. Relay groups (lights that operate together on a unique relay) shall be approved by Town of Vail Public Works prior to installation of circuiting for roadway lighting systems. General parameters for lighting group development are:
   - Distinct luminaire types – roadway poles, Village Lanterns, and bollards – shall be grouped independent of each other.
   - Relay groups shall be limited to their distinct Lighting Zone as illustrated in the Zone Strategy diagrams, Figure 4.1 through 4.4 above.
   - Roadway lighting for intersections (poles positioned in the intersection and including the turn lanes) within a distinct Lighting Zone shall be grouped independent of the remainder of the roadway lighting in the Lighting Zone, unless otherwise approved by Town of Vail Public Works.

PART 5: Frontage Road Lighting Master Plan Approval Documentation

The Vail Frontage Road Master Lighting Plan as described herein is adopted by Resolution xxx, on xxx, 2010, by the Vail Town Council following a recommendation to approve by the Planning and Environmental Commission. Future amendments to this master plan must be approved by resolution or motion by the Town Council following a formal recommendation by the Planning and Environmental Commission. Implementation activities and ordinances will be approved in accordance with the Town of Vail Municipal Code.

PART 6: Appendix A

A. Standards, Studies, and Guidelines Referenced

1. IESNA RP-8-00/REAFFIRMED 2005 American National Standard Practice for Roadway Lighting
    - The Illuminating Engineering Society of North America (www.iesna.org) is a collegial national community with membership derived from diverse backgrounds including designers, manufacturing, contractors, distribution, utilities and energy services, government, and education.
    - The mission of IESNA is to improve the lighted environment through research and education. IESNA publications are developed through the consensus standards development process approved by the American National Standards Institute (ANSI). IESNA is not brand affiliated.
    - RP-8-00 is prepared by the Standard Practice Subcommittee of the IESNA Roadway Lighting Committee.
2. ANSI C136.16-2009 NEMA/ANSI Standard for Roadway and Area Lighting (www.nema.org/stds/C136.cfm)
    - American National Standards Institute (ANSI) and National Electrical Manufacturers Association (NEMA) are both organizations engaged in developing technical standards for product development, production, distribution, and utilization to impact safety, economics, and performance.
3. IDA Lighting Code Handbook V1.14 (www.darksky.org)
    - International Dark-Sky Association (IDA) is a 501(c) (3) nonprofit organization engaged in education about and advocacy for the preservation of the nighttime environment specifically through utilization of quality outdoor lighting. IDA is considered a leading authority concerning problems and solutions related to light pollution.
4. IESNA LM-80-08 Approved Method for the Electrical and Photometric Measurements of Solid State Lighting Products
    - Specifies procedures for measuring total luminous flux, electrical power, luminous efficacy, and chromaticity of SSL luminaires and replacement lamp products.
5. IESNA LM-79-08 Approved Method for Measuring Lumen Maintenance of LED Light Sources
    - Specifies procedures for determining lumen maintenance of LEDs and LED modules (but not luminaires) related to effective useful life of the product.
6. U.S. DOE Gateway Program: Demonstration Assessment of Light-Emitting Diode (LED) Roadway Lighting. (http://www1.eere.energy.gov/buildings/ssl/gatewaydemos.html)
    - DOE GATEWAY Demonstrations showcase high-performance LED products for general illumination in a variety of commercial and residential applications. Demonstration results provide real-world experience and data on state-of-the-art solid-state lighting (SSL) product performance and cost effectiveness. These results connect DOE technology procurement efforts with large-volume purchasers and provide buyers with reliable data on product performance
7. Lighting Research Center, Rennselaer Polytechnic Institute, "Mesopic Street Lighting Demonstration and Evaluation Final Report", by Peter Morante, published December 2008 (lighting.lrc.rpi.edu/researchAreas/pdf/GrotonFinalReport.pdf)

Standards and Guidelines applicable to Roadway Lighting and/or technologies specified within this master planning document that are forthcoming are listed as follows. Town of Vail is advised to review these documents as well as other technical papers generated in the future which may represent advancements in criteria and performance of roadway lighting systems.

- NEMA SSL-1 Driver Performance Standard for Solid State Lighting
- IESNA TM-21, Technical Memorandum regarding the method of estimation of LED Life
- IESNA LM-XX1, Approved method for the measurement of high power LEDs.

B. Similar LED Roadway Lighting Applications

Solid-state LED roadway lighting is a relatively new technology, gaining in effective performance and popularity. There are similar applications of LED roadway lighting installed nationwide by municipalities and the U.S.

Department of Energy to compare the LED and HPS sources for cost and quality of lighting. These applications are summarized below, and can be further reviewed by sourcing the web links identified.

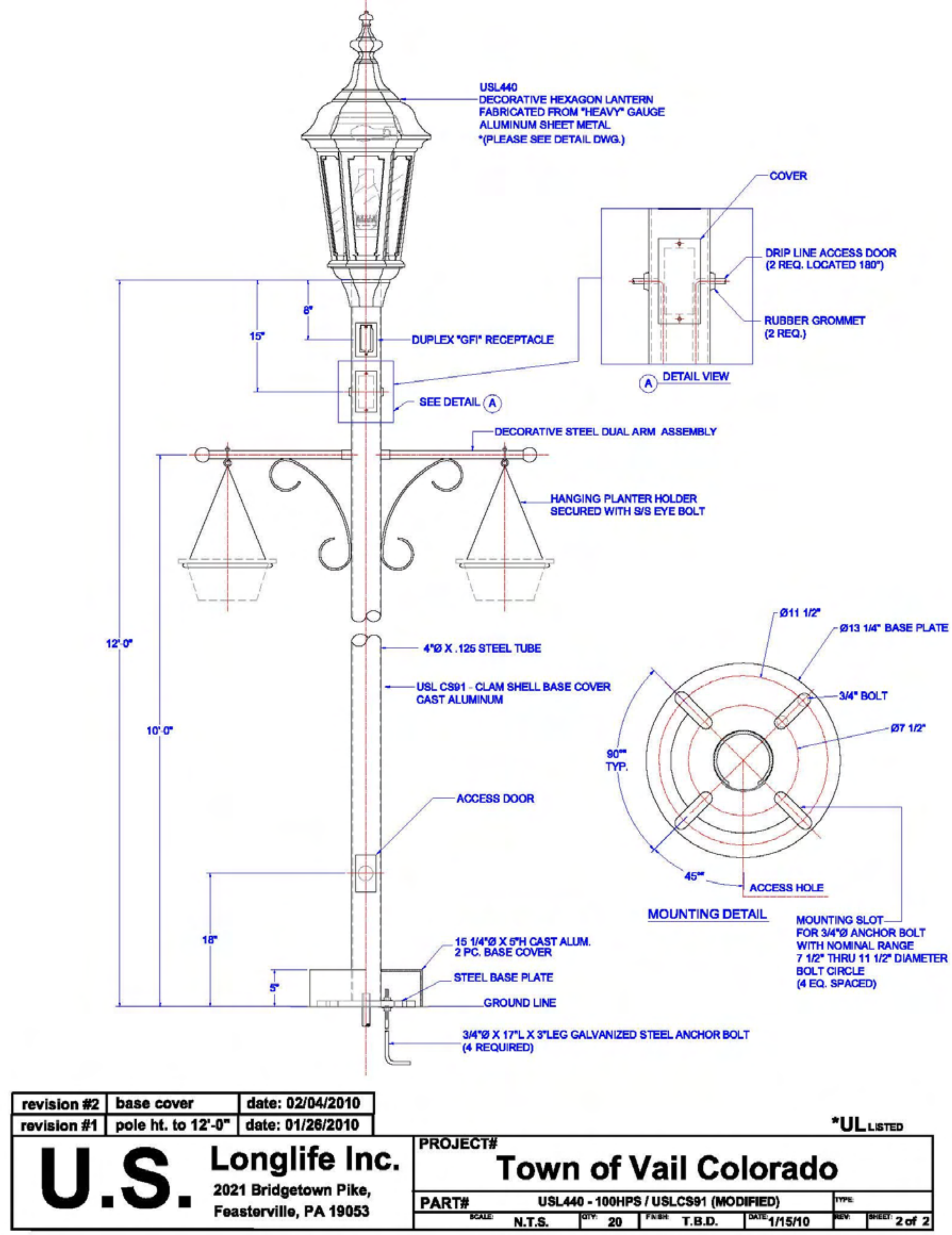
1. Ouray, Colorado:
   i. LED retrofit of low-pressure sodium street lighting on Main Street to 80LED, 6000K, 30'-0" poles. Installed 06/2009.
   ii. Has been well received by retailers, residents, municipality, and guests. 50% energy savings anticipated, with a 2 year payback.
   iii. Comments: "Nighttime sky more visible"; New lights are "more pleasing to the eye".
   iv. http://www.ledwaystreetlights.com/benefits-case-studies.html
2. Groton, Connecticut:
   i. Mesopic (night visual adaptation) Street Lighting Demonstration and Evaluation: study of white source (MH) versus yellow source (HPS), 25'-0" mounting height, residential neighborhood, 120'-140' spacing.
   ii. Based on survey including police personnel and residents with a 68% response, most respondents identified a noticeable improvement in security, visual clarity, aesthetic preference, natural look of vegetation for the white light source compared to the HPS yellow source.
   iii. Lighting.lrc.rpi.edu/researchAreas/pdf/**Groton**FinalReport.pdf
3. City of Ann Arbor, Michigan:
   i. Initial pedestrian pole retrofit (in 20070, followed by a 60LED replacement of roadway cobra-head lights
   ii. 4.4yr payback, 50-80% less energy.
   iii. Response from the community has been overwhelmingly position. 81 of 83 positive responses identified improvement in light quality, reduced light trespass (better control).
   iv. http://www.a2dda.org/dda_achievements/led_street_lights/
4. City of Greensburg, Kansas:
   i. Rural setting, replace all streetlighting (303 total fixtures) using 60LED and 80LED, completed Feb 2009.
   ii. Estimating 70% energy and maintenance savings
   iii. "Residents have all positive things to say about the LED fixtures. Quality of light on the roadways is greatly improved and people really like the sleek look of the fixtures." There is more night sky exposure.
   iv. http://www.ledwaystreetlights.com/benefits-case-studies.html
5. City of Anchorage, Alaska:
   i. Began in 2008 to replace HPS cobra heads. Anticipating 50% energy savings.
   ii. "We have conducted a conference and public survey that indicated that our residents overwhelmingly approve of the new white LED lighting."
   iii. http://www.ledwaystreetlights.com/benefits-case-studies.html
6. Lija Loop, Portland, OR:
   i. (DOE Gateway project) 100W HPS replaced with LED. Reduced horizontal photopic illuminance by 53% – this resulted in good payback and energy savings of 55%. 30' poles, 125' – 150' spacing. Cobra heads. 40% less light with the LED than the HPS.
   ii. Anticipating 20yr payback for retrofit, 7.6 yr payback for new installations.
   iii. 36% response to survey, 90% of respondents to survey (residents) either recognized an improvement in quality of light or no difference – improved visibility and coverage. Negative responses identified issues with brightness and glare, source appeared too blue.
   iv. http://www1.eere.energy.gov/buildings/ssl/gatewaydemos_results.html
7. City of San Fransisco, California:
   i. (DOE gateway project) Residential sunset District, replaced 100W HPS on 24'-34' poles with LED, 50%-70% energy savings over HPS (studied 4 different LED heads), 150'-200' spacing, 40% decrease in photopic illuminance.
   ii. Simple payback new installation 3.7 – 6.3 years
   iii. More uniform light – 30% better uniformity, and 30% less overall light. Lots of no opinion/do not know/ no change opinions which the district has interpolated as LED is an equal replacement to HPS. Good quantitative light performance resulted in positive customer perception of lighting performance.
   iv. http://www1.eere.energy.gov/buildings/ssl/gatewaydemos_results.html
8. City of Minneapolis, Minn, I-35 Bridge:

i. (DOE gateway project) Most comprehensive study of HPS and LED to date. Read reports available on website for further details.
ii. http://www1.eere.energy.gov/buildings/ssl/gatewaydemos_results.html

PART 7: Appendix B

7. Manufacturer's Technical Specification Sheets
    1. Included in this Appendix are the most current Technical Specifications as of the date of Master Plan approval for each product specified as part of the Frontage Roads Lighting Master Plan. Prior to implementation, all Technical Specifications will be verified with Manufacturer and newer editions of the Specification submitted to Town of Vail, identifying updates and modifications, for review.
    2. There will be no substitutions for specified products, or any options and components included in the Technical Specification for the product.
    3. Material suppliers, where listed, are single source unless otherwise approved by Town of Vail.

Type P1 Page 1 of 1	Notes: Banner Arms, Duplex Receptacle, and Irrigation Provisions are options to review with TOV
Supplier: U.S. Long Life Contact: Jack Mason, cupflyers@aol.com; 1-888-295-2677	



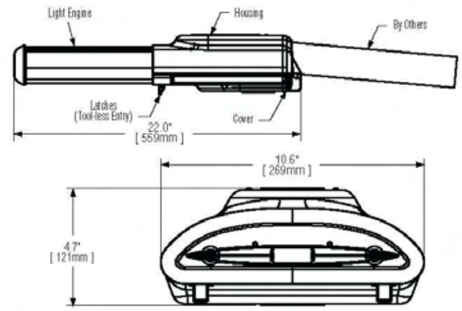
Type P2 Page 1 of 2	Notes:
Supplier: ANY Contact: N/A	

STR-LWY-4M-HT LEDway™ Streetlight – Type IV Medium

Rev. Date: 01/15/09

BetaLED Catalog #: STR - LWY - 4M - HT - 06 - C - UL - BK - 43K - 350 - SC

Reset



Notes:

1. Mounted on a 3'-0" Mast Arm (by US Long Life)
2. Multi-tap Driver (wired for 350mA initially)
3. Black finish
4. 4300K Color Temp
5. Door Safety Tether
6. No Backlight Control

Product	Family	Optic	Mounting	# of LEDs (x 10)	LED Series	Voltage	Color Options	Factory-Installed Options
STR	LWY	☐ 4M[1] ☐ 4MB[2]	HT[3]	☐ 04 ☐ 05 ☐ 06	C	☐ UL Universal 120–277V ☐ UH Universal 347–480V	☐ SV Silver[4] ☐ BK Black[4] ☐ BZ Bronze[4] ☐ PB Platinum Bronze[4] ☐ WH White[4]	Please type additional options in manually on the lines provided above. ☐ 350 350mA Drive Current[5] ☐ 43K 4300K Color Temperature[6] ☐ 700 700mA Drive Current[7] ☐ DIM 0–10V Dimming[8,9] ☐ F Fuse[10] ☐ HL Hi/Low (175/350/525, dual circuit input)[11-13] ☐ N No Quick Disconnect Harness or Leveling Bubble[14] ☐ PD Power Door[15,16] ☐ R NEMA Photocell Receptacle[10] ☐ SC Door Safety Tether[17]

Click here for Utility option.

For additional options, see IP66 spec sheet

Footnotes

1. IESNA Type IV Medium distribution
2. IESNA Type IV Medium distribution with backlight control
3. Horizontal tenon mount
4. Light engine portion of extrusion is not painted and will remain natural aluminum regardless of color selection
5. Driver operates at 350mA instead of the standard 525mA providing a lower lumen output and a longer life
6. Color temperature per fixture; minimum 70 CRI
7. Driver operates at 700mA instead of the standard 525mA providing a higher lumen output and a shorter life
8. Control by others
9. Please consult factory for availability
10. Not available with G option when V voltage is selected
11. Not available when V voltage is selected
12. Refer to multi level spec sheet for more information
13. Sensor not included
14. Standard product features unless N option is specified; door clips not included
15. All connections between door and fixture are shipped unconnected from the factory; door release spring included to open door automatically when the latches are released
16. Hinge retaining clips not included as part of this option
17. Stainless steel aircraft cable

LED PERFORMANCE SPECS

# of LEDs	Initial Delivered Lumens – Type IV Medium @ 6000K	B	U	G	Initial Delivered Lumens – Type IV Medium w/ Backlight Control @ 6000K	B	U	G	Initial Delivered Lumens – Type IV Medium @ 4300K	B	U	G	Initial Delivered Lumens – Type IV Medium w/ Backlight Control @ 4300K	B	U	G	System Watts 120–277V	Total Current @ 120V	Total Current @ 230V	Total Current @ 277V	System Watts 347–480V*	Total Current @ 347V	Total Current @ 480V	L_{70} Hours** @ 25° C (77° F)
		Rating***				Rating***				Rating***				Rating***										
350mA Fixture Operating at 25° C (77° F)																								
40	3,519 (04)	1	1	1	2,737 (04)	0	1	1	3,087 (04)	1	1	1	2,401 (04)	0	1	1	47	0.40	0.22	0.20	53	0.15	0.16	153,000
50	4,301 (05)	1	1	1	3,346 (05)	1	1	1	3,773 (05)	1	1	1	2,934 (05)	1	1	1	64	0.53	0.29	0.25	70	0.20	0.19	141,000
60	5,162 (06)	2	1	1	4,015 (06)	1	1	1	4,527 (06)	1	1	1	3,521 (06)	1	1	1	76	0.62	0.34	0.29	81	0.23	0.20	131,000
525mA (Standard) Fixture Operating at 25° C (77° F)																								
40	4,716 (04)	2	1	1	3,668 (04)	1	1	1	4,136 (04)	1	1	1	3,217 (04)	1	1	1	70	0.59	0.32	0.28	76	0.22	0.20	96,000
50	5,764 (05)	2	1	1	4,483 (05)	1	1	1	5,056 (05)	2	1	1	3,932 (05)	1	1	1	95	0.80	0.42	0.36	101	0.29	0.24	85,000
60	6,917 (06)	2	2	2	5,380 (06)	1	1	2	6,067 (06)	2	2	2	4,719 (06)	1	1	1	113	0.94	0.50	0.42	119	0.34	0.27	79,000
700mA Fixture Operating at 25° C (77° F)																								
40	5,772 (04)	2	1	1	4,489 (04)	1	1	1	5,062 (04)	2	1	1	3,937 (04)	1	1	1	98	0.83	0.44	0.37	104	0.30	0.24	65,000
50	7,054 (05)	2	2	2	5,487 (05)	1	1	2	6,187 (05)	2	2	2	4,812 (05)	1	1	1	124	1.04	0.55	0.46	131	0.38	0.30	56,000
60	8,465 (06)	2	2	2	6,584 (06)	1	2	2	7,425 (06)	2	2	2	5,775 (06)	1	2	2	146	1.23	0.64	0.54	154	0.44	0.34	50,000

* Utilizes magnetic step-down transformer

** For recommended lumen depreciation data see TD-13

*** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit www.iesna.org/PDF/Erratas/TM-15-07BugRatingsAddendum.pdf

Type P2 Page 2 of 2	Notes:
Supplier: ANY Contact: N/A	

STR-LWY-4M-HT LEDway™ Streetlight – Type IV Medium

Rev. Date: 01/15/09

General Description

Fixture housing is all aluminum construction. Standard fixture utilizes terminal block for power input suitable for #2–#14 AWG wire and operates at 525mA. Drive current is field switchable on 40, 50 and 60 LED units (50 & 60 LED units require two drivers). Fixture is designed to mount on 1.25" IP (1.675" O.D.) and/or 2" IP (2.375" O.D.) horizontal tenon and is adjustable +/- 5° to allow for fixture leveling (includes leveling bubble to aid in this process). Fixture carries a limited five year warranty.

Electrical

Modular design accommodates varied lighting output from high power, white, 6000K (+/- 500K per full fixture), minimum 70 CRI, long life LED sources. 120–277V 50/60 Hz, Class 1 LED drivers are standard. 347–480V 50/60 Hz option is available. LED drivers have power factor >90% and THD <20% at full load. Units provided with integral 9kV surge suppression protection standard. Quick disconnect harness suitable for mate and break under load provided on power feed to driver for ease of maintenance. Surge protection tested in accordance with IEEE C62.41.2 and ANSI standard 62.41.2.

Finish

Exclusive Colorfast DeltaGuard® finish features an E-Coat epoxy primer with an ultra-durable silver powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Bronze, black, white and platinum bronze powder topcoats are also available. The finish is covered by our 10 year limited warranty.

Fixture and finish are endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117.

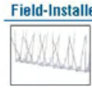
Testing & Compliance

UL listed in the U.S. and Canada for wet locations. Consult factory for CE Certified products. RoHS compliant. Meets CALTrans 611 Vibration Testing and GR-63-CORE Section 4.4.1/5.4.2 Earthquake Zone 4. International Dark-Sky Association approved.

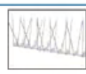
Patents

U.S. and international patents granted and pending. BetaLED is a division of Ruud Lighting, Inc. For a listing of Ruud Lighting, Inc. patents, visit www.uspto.gov.

Field-Installed Accessories

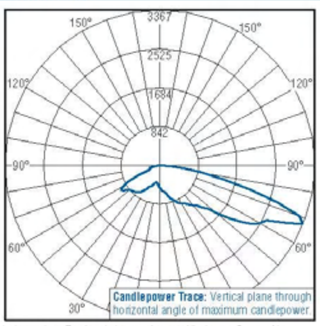


Bird Spikes for Light Engine
☐ XA-BRDSPK60

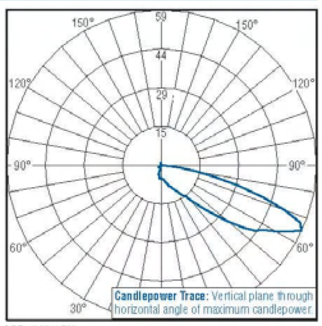


Bird Spikes Kit for Housing
☐ XA-BRDSPKHSG

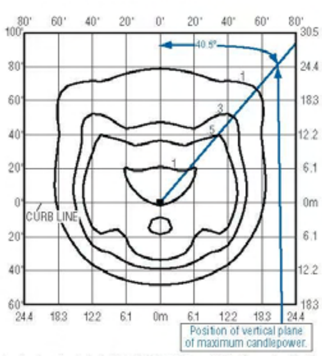
Photometrics



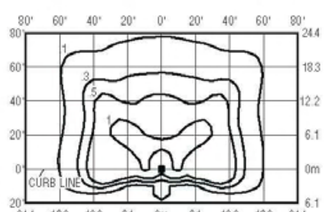
Independent Testing Laboratories certified test. Report No. ITL63175. Candlepower trace of 6000K, 40 LED Type IV Medium streetlight luminaire with 5,026 initial delivered lumens operating at 525mA. **All published luminaire photometric testing performed to IESNA LM-79-08 standards.**



PRELIMINARY
Candlepower trace of Type IV Medium LED luminaire with backlight control.



Isofootcandle plot of 6000K, 60 LED Type IV Medium streetlight luminaire at 25' A.F.G. Luminaire with 6,917 initial delivered lumens operating at 525mA. Initial FC at grade.



PRELIMINARY
Isofootcandle plot of 6000K, 60 LED Type IV Medium streetlight luminaire with backlight control at 25' A.F.G. Luminaire with 5,380 initial delivered lumens operating at 525mA. Initial FC at grade.

LEDway™ EPA & Weight Calculations

		Approximate Weight 120–277V*
40–60 LED fixture		16.0 lbs.
		EPA
Horizontal Tenon Mount		
1 fixture		0.685
		EPA
Round External Mount / Square Internal Mount Horizontal Tenons with Fixture(s)		
PT/PD-1H	Single	0.905
PT/PD-2H(90)	90° Twin	1.189
PT/PD-2H(180)	180° Twin	1.590
PT/PD-3H(90)	90° Triple	1.774
PT/PD-3H(120)	120° Triple	1.590
PT/PD-4H(90)	90° Quad	2.178

*Add 5 lbs. for transformer in 347–480V fixtures

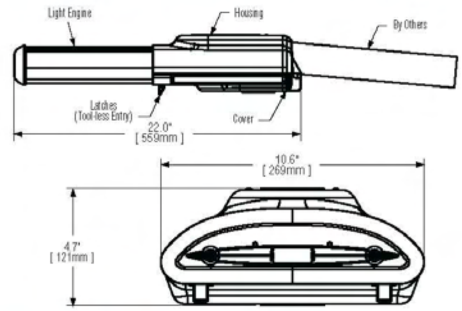
Type P3 Page 1 of 2	Notes:
Supplier: ANY Contact: N/A	

STR-LWY-3M-HT LEDway™ Streetlight – Type III Medium

Rev. Date: 01/15/09

BetaLED Catalog #: STR - LWY - 3MB - HT - 06 - C - UL - BK - 43K - 350 - SC

Reset



Notes:

1. Mounted on a 2'-0" Mast Arm (by US Long Life)
2. Multi-tap driver (wired for 350mA initially)
3. Black finish
4. 4300K Color Temp
5. Door Safety Tether
6. With Backlight Control

Product	Family	Optic	Mounting	# of LEDs (x 10)	LED Series	Voltage	Color Options	Factory-Installed Options
STR	LWY	☐ 3M[1] ☐ 3MB[2]	HT[3]	☐ 04 ☐ 05 ☐ 06	C	☐ UL Universal 120–277V ☐ UH Universal 347–480V	☐ SV Silver[4] ☐ BK Black[4] ☐ BZ Bronze[4] ☐ PB Platinum Bronze[4] ☐ WH White[4]	Please type additional options in manually on the lines provided above. ☐ 350 350mA Drive Current[5] ☐ 43K 4300K Color Temperature[6] ☐ 700 700mA Drive Current[7] ☐ DIM 0–10V Dimming[8,9] ☐ F Fuse[10] ☐ HL Hi/Low (175/350/525, dual circuit input)[11-13] ☐ N No Quick Disconnect Harness or Leveling Bubble[14] ☐ PD Power Door[15,16] ☐ R NEMA Photocell Receptacle[10] ☐ SC Door Safety Tether[17]

Click here for Utility option.

For additional options, see IP66 spec sheet.

Footnotes

1. IESNA Type III Medium distribution
2. IESNA Type III Medium distribution with backlight control
3. Horizontal tenon mount
4. Light engine portion of extrusion is not painted and will remain natural aluminum regardless of color selection
5. Driver operates at 350mA instead of the standard 525mA providing a lower lumen output and a longer life
6. Color temperature per fixture; minimum 70 CRI
7. Driver operates at 700mA instead of the standard 525mA providing a higher lumen output and a shorter life
8. Control by others
9. Please consult factory for availability
10. Not available with HL option when UH voltage is selected
11. Not available when UH voltage is selected
12. Refer to multi level spec sheet for more information
13. Sensor not included
14. Standard product features unless N option is specified; door clips not included
15. All connections between door and fixture are shipped unconnected from the factory; door release spring included to open door automatically when the latches are released
16. Hinge retaining clips not included as part of this option
17. Stainless steel aircraft cable

LED PERFORMANCE SPECS

# of LEDs	Initial Delivered Lumens – Type III Medium @ 6000K	B	U	G	Initial Delivered Lumens – Type III Medium w/ Backlight Control @ 6000K	B	U	G	Initial Delivered Lumens – Type III Medium @ 4300K	B	U	G	Initial Delivered Lumens – Type III Medium w/ Backlight Control @ 4300K	B	U	G	System Watts 120–277V	Total Current @ 120V	Total Current @ 230V	Total Current @ 277V	System Watts 347–480V*	Total Current @ 347V	Total Current @ 480V	L_{70} Hours** @ 25° C (77° F)
		Rating***				Rating***				Rating***				Rating***										
350mA Fixture Operating at 25° C (77° F)																								
40	3,476 (04)	1	1	1	2,259 (04)	0	1	1	3,049 (04)	1	1	1	2,287 (04)	0	1	1	47	0.40	0.22	0.20	53	0.15	0.16	153,000
50	4,248 (05)	2	2	2	3,186 (05)	0	1	1	3,726 (05)	2	2	2	2,795 (05)	0	1	1	64	0.53	0.29	0.25	70	0.20	0.19	141,000
60	5,098 (06)	2	2	2	3,823 (06)	1	2	1	4,472 (06)	2	2	2	3,354 (06)	0	1	1	76	0.62	0.34	0.29	81	0.23	0.20	131,000
525mA (Standard) Fixture Operating at 25° C (77° F)																								
40	4,658 (04)	2	2	2	3,493 (04)	0	1	1	4,085 (04)	2	2	2	3,064 (04)	0	1	1	70	0.59	0.32	0.28	76	0.22	0.20	96,000
50	5,693 (05)	2	2	2	4,270 (05)	1	2	1	4,993 (05)	2	2	2	3,745 (05)	1	2	1	95	0.80	0.42	0.36	101	0.29	0.24	85,000
60	6,831 (06)	2	2	2	5,123 (06)	1	2	2	5,992 (06)	2	2	2	4,494 (06)	1	2	1	113	0.94	0.50	0.42	119	0.34	0.27	79,000
700mA Fixture Operating at 25° C (77° F)																								
40	5,700 (04)	2	2	2	4,275 (04)	1	2	1	5,000 (04)	2	2	2	3,750 (04)	1	2	1	98	0.83	0.44	0.37	104	0.30	0.24	65,000
50	6,967 (05)	2	2	2	5,225 (05)	1	2	2	6,111 (05)	2	2	2	4,583 (05)	1	2	1	124	1.04	0.55	0.46	131	0.38	0.30	56,000
60	8,361 (06)	3	2	3	6,270 (06)	1	3	2	7,333 (06)	2	2	2	5,500 (06)	1	2	2	146	1.23	0.64	0.54	154	0.44	0.34	50,000

* Utilizes magnetic step-down transformer

** For recommended lumen depreciation data see TD-13

*** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit www.iesna.org/PDF/Erratas/TM-15-07BugRatingsAddendum.pdf

Made in the U.S.A. of U.S. and imported parts.
Meets Buy American requirements within the ARRA.

beta LED

Type P3 Page 2 of 2	Notes:
Supplier: ANY Contact: N/A	

STR-LWY-3M-HT LEDway™ Streetlight – Type III Medium

Rev. Date: 01/15/09

General Description

Fixture housing is all aluminum construction. Standard fixture utilizes terminal block for power input suitable for #2–#14 AWG wire and operates at 525mA. Drive current is field switchable on 40, 50 and 60 LED units (50 & 60 LED units require two drivers). Fixture is designed to mount on 1.25" IP (1.675" O.D.) and/or 2" IP (2.375" O.D.) horizontal tenon and is adjustable +/- 5° to allow for fixture leveling (includes leveling bubble to aid in this process). Fixture carries a limited five year warranty.

Electrical

Modular design accommodates varied lighting output from high power, white, 6000K (+/- 500K per full fixture), minimum 70 CRI, long life LED sources. 120–277V 50/60 Hz, Class 1 LED drivers are standard. 347–480V 50/60 Hz option is available. LED drivers have power factor >90% and THD <20% at full load. Units provided with integral 9kV surge suppression protection standard. Quick disconnect harness suitable for mate and break under load provided on power feed to driver for ease of maintenance. Surge protection tested in accordance with IEEE C62.41.2 and ANSI standard 62.41.2.

Finish

Exclusive Colorfast DeltaGuard® finish features an E-Coat epoxy primer with an ultra-durable silver powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Bronze, black, white and platinum bronze powder topcoats are also available. The finish is covered by our 10 year limited warranty.

Fixture and finish are endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117.

Testing & Compliance

UL listed in the U.S. and Canada for wet locations. Consult factory for CE Certified products. RoHS compliant. Meets CALTrans 611 Vibration Testing and GR-63-CORE Section 4.4.1/5.4.2 Earthquake Zone 4. International Dark-Sky Association approved.

Patents

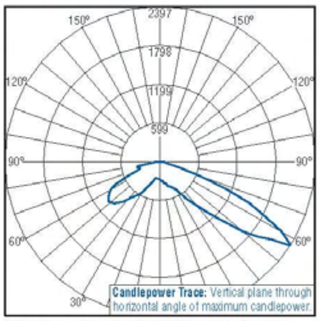
U.S. and international patents granted and pending. BetaLED is a division of Ruud Lighting, Inc. For a listing of Ruud Lighting, Inc. patents, visit www.uspto.gov.

Field-Installed Accessories

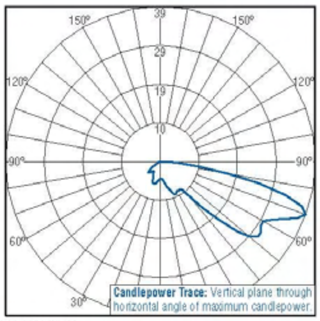
Bird Spikes for Light Engine
☐ XA-BRDSPK60

Bird Spikes Kit for Housing
☐ XA-BRDSPKHSG

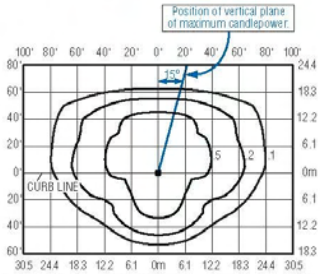
Photometrics



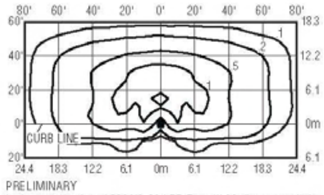
Independent Testing Laboratories certified test. Report No. ITL63266. Candlepower trace of 6000K, 40 LED Type III Medium streetlight luminaire with 4,696 initial delivered lumens operating at 525mA. **All published luminaire photometric testing performed to IESNA LM-79-08 standards.**



PRELIMINARY
Candlepower trace of Type III Medium LED luminaire with backlight control.



Isofootcandle plot of 6000K, 60 LED Type III Medium streetlight luminaire at 25' A.F.G. Luminaire with 6,831 initial delivered lumens operating at 525mA. Initial FC at grade.



PRELIMINARY
Isofootcandle plot of 6000K, 60 LED Type III Medium streetlight luminaire with backlight control at 25' A.F.G. Luminaire with 5,123 initial delivered lumens operating at 525mA. Initial FC at grade.

LEDway™ EPA & Weight Calculations

		Approximate Weight 120–277V*
40–60 LED fixture		16.0 lbs.
		EPA
Horizontal Tenon Mount		
1 fixture		0.685
		EPA
Round External Mount / Square Internal Mount Horizontal Tenons with Fixture(s)		
PT/PD-1H	Single	0.905
PT/PD-2H(90)	90° Twin	1.189
PT/PD-2H(180)	180° Twin	1.590
PT/PD-3H(90)	90° Triple	1.774
PT/PD-3H(120)	120° Triple	1.590
PT/PD-4H(90)	90° Quad	2.178

*Add 5 lbs. for transformer in 347–480V fixtures

Made in the U.S.A. of U.S. and imported parts.
Meets Buy American requirements within the ARRA.

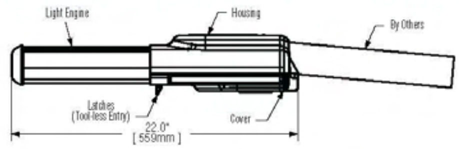
Type P4 Page 1 of 2	Notes:
Supplier: ANY Contact: N/A	

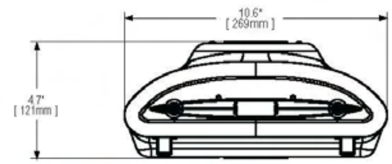
STR-LWY-3M-HT LEDway™ Streetlight – Type III Medium

Rev. Date: 01/15/09

BetaLED Catalog #: STR - LWY - 3MB - HT - 06 - C - UL - BK - 43K - 350 - SC

Reset





Notes:

1. Mounted on a 3'-0" Mast Arm (by US Long Life)
2. Multi-tap Driver (wired for 350mA initially)
3. Black finish
4. 4300K Color Temp
5. Door Safety Tether
6. NO Backlight Control

Product	Family	Optic	Mounting	# of LEDs (x 10)	LED Series	Voltage	Color Options	Factory-Installed Options
STR	LWY	☐ 3M[1] ☐ 3MB[2]	HT[3]	☐ 04 ☐ 05 ☐ 06	C	☐ UL Universal 120–277V ☐ UH Universal 347–480V	☐ SV Silver[4] ☐ BK Black[4] ☐ BZ Bronze[4] ☐ PB Platinum Bronze[4] ☐ WH White[4]	Please type additional options in manually on the lines provided above. ☐ 350 350mA Drive Current[5] ☐ 43K 4300K Color Temperature[6] ☐ 700 700mA Drive Current[7] ☐ DIM 0–10V Dimming[8,9] ☐ F Fuse[10] ☐ HL Hi/Low (175/350/525, dual circuit input)[11-13] ☐ N No Quick Disconnect Harness or Leveling Bubble[14] ☐ PD Power Door[15,16] ☐ R NEMA Photocell Receptacle[10] ☐ SC Door Safety Tether[17]

Click here for Utility option.

For additional options, see IP66 spec sheet.

Footnotes

1. IESNA Type III Medium distribution
2. IESNA Type III Medium distribution with backlight control
3. Horizontal tenon mount
4. Light engine portion of extrusion is not painted and will remain natural aluminum regardless of color selection
5. Driver operates at 350mA instead of the standard 525mA providing a lower lumen output and a longer life
6. Color temperature per fixture; minimum 70 CRI
7. Driver operates at 700mA instead of the standard 525mA providing a higher lumen output and a shorter life
8. Control by others
9. Please consult factory for availability
10. Not available with HL option when UH voltage is selected
11. Not available when UH voltage is selected
12. Refer to multi level spec sheet for more information
13. Sensor not included
14. Standard product features unless N option is specified; door clips not included
15. All connections between door and fixture are shipped unconnected from the factory; door release spring included to open door automatically when the latches are released
16. Hinge retaining clips not included as part of this option
17. Stainless steel aircraft cable

LED PERFORMANCE SPECS

# of LEDs	Initial Delivered Lumens – Type III Medium @ 6000K	B	U	G	Initial Delivered Lumens – Type III Medium w/ Backlight Control @ 6000K	B	U	G	Initial Delivered Lumens – Type III Medium @ 4300K	B	U	G	Initial Delivered Lumens – Type III Medium w/ Backlight Control @ 4300K	B	U	G	System Watts 120–277V	Total Current @ 120V	Total Current @ 230V	Total Current @ 277V	System Watts 347–480V*	Total Current @ 347V	Total Current @ 480V	L70 Hours** @ 25° C (77° F)
		Rating***				Rating***				Rating***				Rating***										
350mA Fixture Operating at 25° C (77° F)																								
40	3,476 (04)	1	1	1	2,259 (04)	0	1	1	3,049 (04)	1	1	1	2,287 (04)	0	1	1	47	0.40	0.22	0.20	53	0.15	0.16	153,000
50	4,248 (05)	2	2	2	3,186 (05)	0	1	1	3,726 (05)	2	2	2	2,795 (05)	0	1	1	64	0.53	0.29	0.25	70	0.20	0.19	141,000
60	5,098 (06)	2	2	2	3,823 (06)	1	2	1	4,472 (06)	2	2	2	3,354 (06)	0	1	1	76	0.62	0.34	0.29	81	0.23	0.20	131,000
525mA (Standard) Fixture Operating at 25° C (77° F)																								
40	4,658 (04)	2	2	2	3,493 (04)	0	1	1	4,085 (04)	2	2	2	3,064 (04)	0	1	1	70	0.59	0.32	0.28	76	0.22	0.20	96,000
50	5,693 (05)	2	2	2	4,270 (05)	1	2	1	4,993 (05)	2	2	2	3,745 (05)	1	2	1	95	0.80	0.42	0.36	101	0.29	0.24	85,000
60	6,831 (06)	2	2	2	5,123 (06)	1	2	2	5,992 (06)	2	2	2	4,494 (06)	1	2	1	113	0.94	0.50	0.42	119	0.34	0.27	79,000
700mA Fixture Operating at 25° C (77° F)																								
40	5,700 (04)	2	2	2	4,275 (04)	1	2	1	5,000 (04)	2	2	2	3,750 (04)	1	2	1	98	0.83	0.44	0.37	104	0.30	0.24	65,000
50	6,967 (05)	2	2	2	5,225 (05)	1	2	2	6,111 (05)	2	2	2	4,583 (05)	1	2	1	124	1.04	0.55	0.46	131	0.38	0.30	56,000
60	8,361 (06)	3	2	3	6,270 (06)	1	3	2	7,333 (06)	2	2	2	5,500 (06)	1	2	2	146	1.23	0.64	0.54	154	0.44	0.34	50,000

* Utilizes magnetic step-down transformer

** For recommended lumen depreciation data see TD-13

*** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit www.iesna.org/PDF/Erratas/TM-15-07BugRatingsAddendum.pdf

Made in the U.S.A. of U.S. and imported parts.
Meets Buy American requirements within the ARRA.

Type P4 Page 2 of 2	Notes:
Supplier: ANY Contact: N/A	

STR-LWY-3M-HT LEDway™ Streetlight – Type III Medium

Rev. Date: 01/15/09

General Description

Fixture housing is all aluminum construction. Standard fixture utilizes terminal block for power input suitable for #2–#14 AWG wire and operates at 525mA. Drive current is field switchable on 40, 50 and 60 LED units (50 & 60 LED units require two drivers). Fixture is designed to mount on 1.25" IP (1.675" O.D.) and/or 2" IP (2.375" O.D.) horizontal tenon and is adjustable +/- 5° to allow for fixture leveling (includes leveling bubble to aid in this process). Fixture carries a limited five year warranty.

Electrical

Modular design accommodates varied lighting output from high power, white, 6000K (+/- 500K per full fixture), minimum 70 CRI, long life LED sources. 120–277V 50/60 Hz, Class 1 LED drivers are standard. 347–480V 50/60 Hz option is available. LED drivers have power factor >90% and THD <20% at full load. Units provided with integral 9kV surge suppression protection standard. Quick disconnect harness suitable for mate and break under load provided on power feed to driver for ease of maintenance. Surge protection tested in accordance with IEEE C62.41.2 and ANSI standard 62.41.2.

Finish

Exclusive Colorfast DeltaGuard® finish features an E-Coat epoxy primer with an ultra-durable silver powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Bronze, black, white and platinum bronze powder topcoats are also available. The finish is covered by our 10 year limited warranty.

Fixture and finish are endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117.

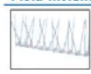
Testing & Compliance

UL listed in the U.S. and Canada for wet locations. Consult factory for CE Certified products. RoHS compliant. Meets CALTrans 611 Vibration Testing and GR-63-CORE Section 4.4.1/5.4.2 Earthquake Zone 4. International Dark-Sky Association approved.

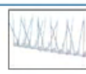
Patents

U.S. and international patents granted and pending. BetaLED is a division of Ruud Lighting, Inc. For a listing of Ruud Lighting, Inc. patents, visit www.uspto.gov.

Field-Installed Accessories

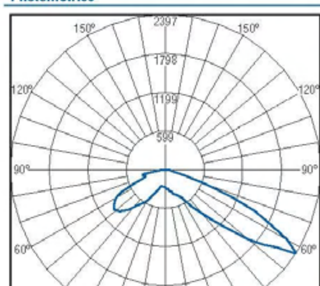


Bird Spikes for Light Engine
☐ XA-BRDSPK60



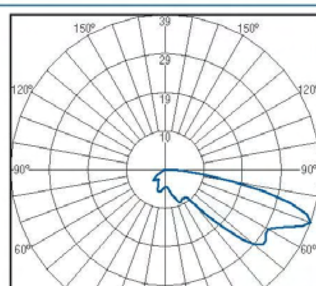
Bird Spikes Kit for Housing
☐ XA-BRDSPKHSG

Photometrics



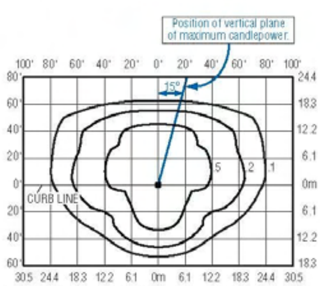
Candlepower Trace: Vertical plane through horizontal angle of maximum candlepower.

Independent Testing Laboratories certified test. Report No. ITL63266. Candlepower trace of 6000K, 40 LED Type III Medium streetlight luminaire with 4,696 initial delivered lumens operating at 525mA. **All published luminaire photometric testing performed to IESNA LM-79-08 standards.**

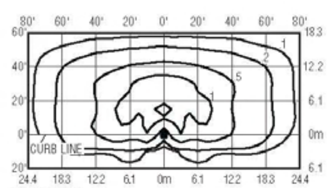


Candlepower Trace: Vertical plane through horizontal angle of maximum candlepower.

PRELIMINARY
Candlepower trace of Type III Medium LED luminaire with backlight control.



Isofootcandle plot of 6000K, 60 LED Type III Medium streetlight luminaire at 25' A.F.G. Luminaire with 6,831 initial delivered lumens operating at 525mA. Initial FC at grade.



PRELIMINARY
Isofootcandle plot of 6000K, 60 LED Type III Medium streetlight luminaire with backlight control at 25' A.F.G. Luminaire with 5,123 initial delivered lumens operating at 525mA. Initial FC at grade.

LEDway™ EPA & Weight Calculations

		Approximate Weight 120–277V*
40–60 LED fixture		16.0 lbs.
		EPA
Horizontal Tenon Mount		
1 fixture		0.685
		EPA
Round External Mount / Square Internal Mount Horizontal Tenons with Fixture(s)		
PT/PD-1H	Single	0.905
PT/PD-2H(90)	90° Twin	1.189
PT/PD-2H(180)	180° Twin	1.590
PT/PD-3H(90)	90° Triple	1.774
PT/PD-3H(120)	120° Triple	1.590
PT/PD-4H(90)	90° Quad	2.178

*Add 5 lbs. for transformer in 347–480V fixtures

Made in the U.S.A. of U.S. and imported parts.
Meets Buy American requirements within the ARRA.

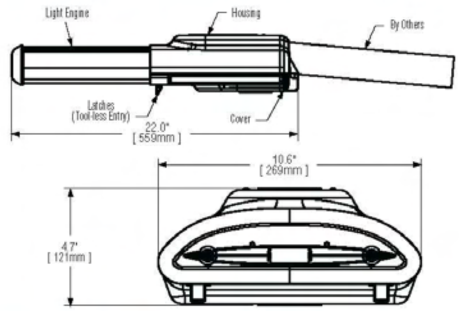
Type P5 Page 1 of 2	Notes:
Supplier: ANY Contact: N/A	

STR-LWY-3M-HT LEDway™ Streetlight – Type III Medium

Rev. Date: 01/15/09

BetaLED Catalog #: STR - LWY - 3MB - HT - 06 - C - UL - BK - 43K - 350 - SC

Reset



Notes:

1. Mounted on a 3'-0" Mast Arm (by US Long Life)
2. Multi-tap Driver (wired for 350mA initially)
3. Black finish
4. 4300K Color Temp
5. Door Safety Tether
6. With Backlight Control

Product	Family	Optic	Mounting	# of LEDs (x 10)	LED Series	Voltage	Color Options	Factory-Installed Options Please type additional options in manually on the lines provided above.
STR	LWY	☐ 3M[1] ☐ 3MB[2]	HT[3]	☐ 04 ☐ 05 ☐ 06	C	☐ UL Universal 120–277V ☐ UH Universal 347–480V	☐ SV Silver[4] ☐ BK Black[4] ☐ BZ Bronze[4] ☐ PB Platinum Bronze[4] ☐ WH White[4]	☐ 350 350mA Drive Current[5] ☐ 43K 4300K Color Temperature[6] ☐ 700 700mA Drive Current[7] ☐ DIM 0–10V Dimming[8,9] ☐ F Fuse[10] ☐ HL Hi/Low (175/350/525, dual circuit input)[11-13] ☐ N No Quick Disconnect Harness or Leveling Bubble[14] ☐ PD Power Door[15,16] ☐ R NEMA Photocell Receptacle[10] ☐ SC Door Safety Tether[17]

Click here for Utility option.

For additional options, see IP66 spec sheet.

Footnotes

1. IESNA Type III Medium distribution
2. IESNA Type III Medium distribution with backlight control
3. Horizontal tenon mount
4. Light engine portion of extrusion is not painted and will remain natural aluminum regardless of color selection
5. Driver operates at 350mA instead of the standard 525mA providing a lower lumen output and a longer life
6. Color temperature per fixture; minimum 70 CRI
7. Driver operates at 700mA instead of the standard 525mA providing a higher lumen output and a shorter life
8. Control by others
9. Please consult factory for availability
10. Not available with HL option when UH voltage is selected
11. Not available when UH voltage is selected
12. Refer to multi level spec sheet for more information
13. Sensor not included
14. Standard product features unless N option is specified; door clips not included
15. All connections between door and fixture are shipped unconnected from the factory; door release spring included to open door automatically when the latches are released
16. Hinge retaining clips not included as part of this option
17. Stainless steel aircraft cable

LED PERFORMANCE SPECS

# of LEDs	Initial Delivered Lumens – Type III Medium @ 6000K	B	U	G	Initial Delivered Lumens – Type III Medium w/ Backlight Control @ 6000K	B	U	G	Initial Delivered Lumens – Type III Medium @ 4300K	B	U	G	Initial Delivered Lumens – Type III Medium w/ Backlight Control @ 4300K	B	U	G	System Watts 120–277V	Total Current @ 120V	Total Current @ 230V	Total Current @ 277V	System Watts 347–480V*	Total Current @ 347V	Total Current @ 480V	L_{70} Hours** @ 25° C (77° F)
		Rating***				Rating***				Rating***				Rating***										
350mA Fixture Operating at 25° C (77° F)																								
40	3,476 (04)	1	1	1	2,259 (04)	0	1	1	3,049 (04)	1	1	1	2,287 (04)	0	1	1	47	0.40	0.22	0.20	53	0.15	0.16	153,000
50	4,248 (05)	2	2	2	3,186 (05)	0	1	1	3,726 (05)	2	2	2	2,795 (05)	0	1	1	64	0.53	0.29	0.25	70	0.20	0.19	141,000
60	5,098 (06)	2	2	2	3,823 (06)	1	2	1	4,472 (06)	2	2	2	3,354 (06)	0	1	1	76	0.62	0.34	0.29	81	0.23	0.20	131,000
525mA (Standard) Fixture Operating at 25° C (77° F)																								
40	4,658 (04)	2	2	2	3,493 (04)	0	1	1	4,085 (04)	2	2	2	3,064 (04)	0	1	1	70	0.59	0.32	0.28	76	0.22	0.20	96,000
50	5,693 (05)	2	2	2	4,270 (05)	1	2	1	4,993 (05)	2	2	2	3,745 (05)	1	2	1	95	0.80	0.42	0.36	101	0.29	0.24	85,000
60	6,831 (06)	2	2	2	5,123 (06)	1	2	2	5,992 (06)	2	2	2	4,494 (06)	1	2	1	113	0.94	0.50	0.42	119	0.34	0.27	79,000
700mA Fixture Operating at 25° C (77° F)																								
40	5,700 (04)	2	2	2	4,275 (04)	1	2	1	5,000 (04)	2	2	2	3,750 (04)	1	2	1	98	0.83	0.44	0.37	104	0.30	0.24	65,000
50	6,967 (05)	2	2	2	5,225 (05)	1	2	2	6,111 (05)	2	2	2	4,583 (05)	1	2	1	124	1.04	0.55	0.46	131	0.38	0.30	56,000
60	8,361 (06)	3	2	3	6,270 (06)	1	3	2	7,333 (06)	2	2	2	5,500 (06)	1	2	2	146	1.23	0.64	0.54	154	0.44	0.34	50,000

* Utilizes magnetic step-down transformer

** For recommended lumen depreciation data see TD-13

*** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit www.iesna.org/PDF/Erratas/TM-15-07BugRatingsAddendum.pdf

Made in the U.S.A. of U.S. and imported parts.
Meets Buy American requirements within the ARRA.

beta LED

Type P5 Page 2 of 2	Notes:
Supplier: ANY Contact: N/A	

STR-LWY-3M-HT LEDway™ Streetlight – Type III Medium

Rev. Date: 01/15/09

General Description

Fixture housing is all aluminum construction. Standard fixture utilizes terminal block for power input suitable for #2–#14 AWG wire and operates at 525mA. Drive current is field switchable on 40, 50 and 60 LED units (50 & 60 LED units require two drivers). Fixture is designed to mount on 1.25" IP (1.675" O.D.) and/or 2" IP (2.375" O.D.) horizontal tenon and is adjustable +/- 5° to allow for fixture leveling (includes leveling bubble to aid in this process). Fixture carries a limited five year warranty.

Electrical

Modular design accommodates varied lighting output from high power, white, 6000K (+/- 500K per full fixture), minimum 70 CRI, long life LED sources. 120–277V 50/60 Hz, Class 1 LED drivers are standard. 347–480V 50/60 Hz option is available. LED drivers have power factor >90% and THD <20% at full load. Units provided with integral 9kV surge suppression protection standard. Quick disconnect harness suitable for mate and break under load provided on power feed to driver for ease of maintenance. Surge protection tested in accordance with IEEE C62.41.2 and ANSI standard 62.41.2.

Finish

Exclusive Colorfast DeltaGuard® finish features an E-Coat epoxy primer with an ultra-durable silver powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Bronze, black, white and platinum bronze powder topcoats are also available. The finish is covered by our 10 year limited warranty.

Fixture and finish are endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117.

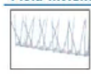
Testing & Compliance

UL listed in the U.S. and Canada for wet locations. Consult factory for CE Certified products. RoHS compliant. Meets CALTrans 611 Vibration Testing and GR-63-CORE Section 4.4.1/5.4.2 Earthquake Zone 4. International Dark-Sky Association approved.

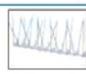
Patents

U.S. and international patents granted and pending. BetaLED is a division of Ruud Lighting, Inc. For a listing of Ruud Lighting, Inc. patents, visit www.uspto.gov.

Field-Installed Accessories

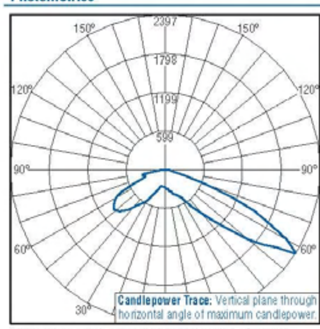


Bird Spikes for Light Engine
☐ XA-BRDSPK60

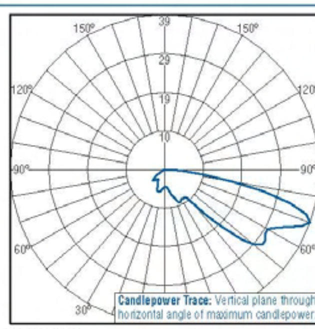


Bird Spikes Kit for Housing
☐ XA-BRDSPKHSG

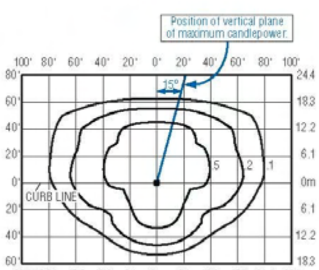
Photometrics



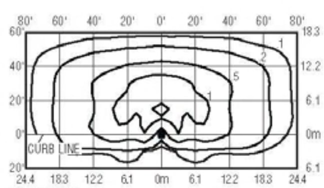
Independent Testing Laboratories certified test. Report No. ITL63266. Candlepower trace of 6000K, 40 LED Type III Medium streetlight luminaire with 4,696 initial delivered lumens operating at 525mA. **All published luminaire photometric testing performed to IESNA LM-79-08 standards.**



PRELIMINARY
Candlepower trace of Type III Medium LED luminaire with backlight control.



Isofootcandle plot of 6000K, 60 LED Type III Medium streetlight luminaire at 25' A.F.G. Luminaire with 6,831 initial delivered lumens operating at 525mA. Initial FC at grade.



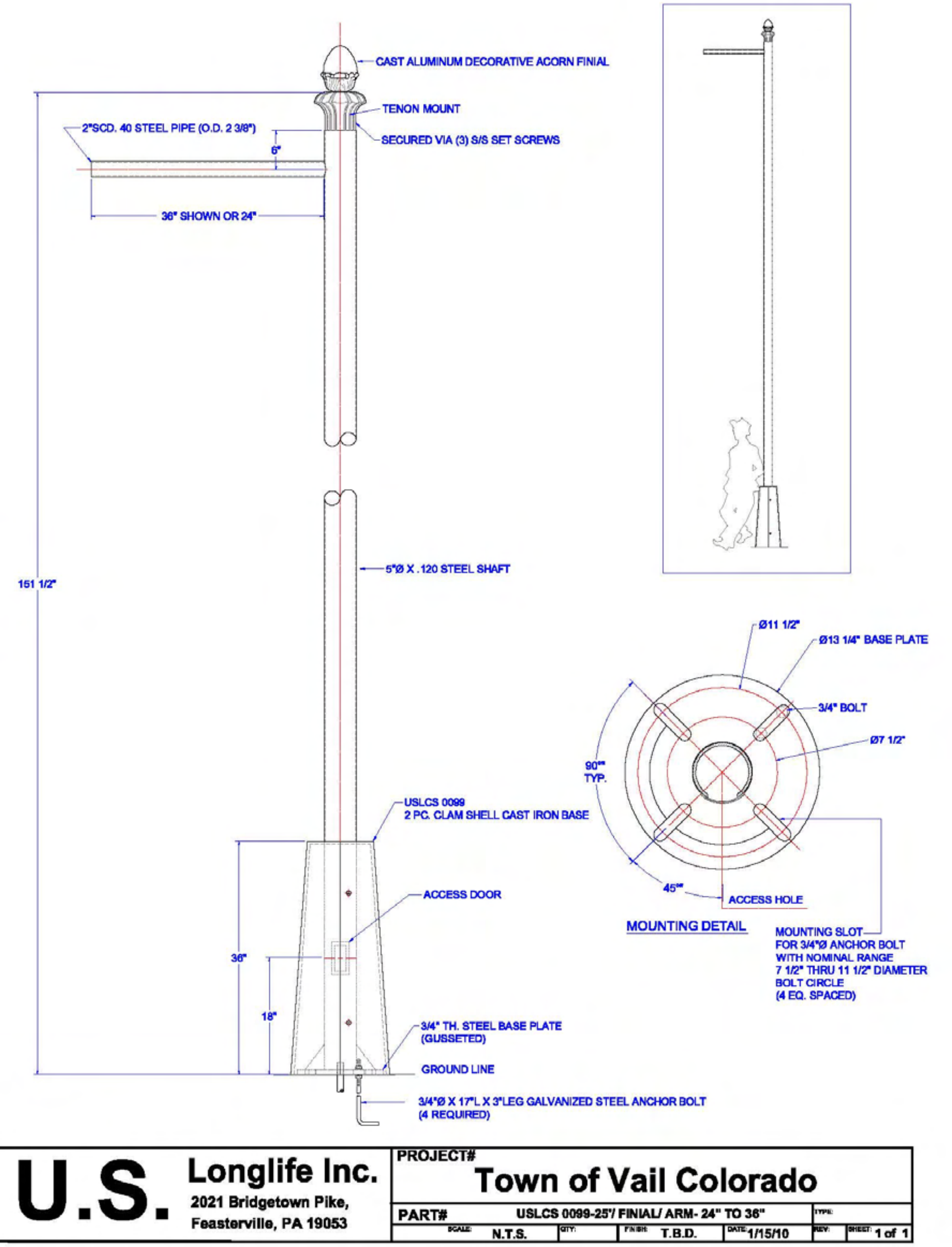
PRELIMINARY
Isofootcandle plot of 6000K, 60 LED Type III Medium streetlight luminaire with backlight control at 25' A.F.G. Luminaire with 5,123 initial delivered lumens operating at 525mA. Initial FC at grade.

LEDway™ EPA & Weight Calculations

		Approximate Weight 120–277V*
40–60 LED fixture		16.0 lbs.
		EPA
Horizontal Tenon Mount		
1 fixture		0.685
		EPA
Round External Mount / Square Internal Mount Horizontal Tenons with Fixture(s)		
PT/PD-1H	Single	0.905
PT/PD-2H(90)	90° Twin	1.189
PT/PD-2H(180)	180° Twin	1.590
PT/PD-3H(90)	90° Triple	1.774
PT/PD-3H(120)	120° Triple	1.590
PT/PD-4H(90)	90° Quad	2.178

*Add 5 lbs. for transformer in 347–480V fixtures

Type P2, P3, P4, P5 Pole and Mast Arm Page 1 of 1	Notes: Refer to P2, P3, P4, and P5 technical specs for length of mast arm
Supplier: U.S. LongLife Contact: Jack Mason, cupflyers@aol.com; 1-888-295-2677	



Type P2, P3, P4, P5 Multi-tap Driver Page 1 of 2	Notes:
Supplier: N/A Contact: N/A	

150W 3-Output LED Driver – CE366X01R0

Technical Specifications

Dimensions: ....9.5" x 2.3" x 1.6"
Weight: ....2.8 lbs.
Mounting: ....2 tabs on each end
Case Material: ....Steel
Packaging: ....Silicone potted unit
Input Voltage: ....120-277V ±10%
Input Frequency: ....50/60Hz ±5%
Input Current: ....1.9A max. at 120V; 0.9A max. at 230V
Active Power Factor Correction
Operating Temperature: ....-40°C ~ +80°C
Isolated Output
Rated Lifetime ....100,000 Hours
RoHS ....Yes

Output Power (W)	Output Voltage (Vdc)	Output Current (A)	Max. THD (%)	Power Factor at 120Vdc Output	Efficiency at 210Vdc Output	Line Regulation (%)	Load Regulation (%)
147	105 ~ 210	0.700	15	≥ 0.92	≥ 0.9	±2	±2
110		0.525					
74		0.350					

WIRING

INPUT		OUTPUT	
Black	Line	Red	Positive
White	Neutral	Orange	Negative 350mA
		Yellow	Negative 525mA
		Blue	Negative 700mA

Protection

Input High Voltage Surge ....Yes
Input Overload ....Yes
Output Short Circuit ....Self-limited with Auto Recovery
Output No-load ....Output Voltage Limited
Overheat ....Output Power is reduced with Auto Recovery

beta LED® A Division of RUUD LIGHTING

c UL us E333031 TÜV Rheinland Product Safety BAUART GEPRÜFT TYPE APPROVED CE

Type P2, P3, P4, P5 Multi-tap Driver
Page 2 of 2

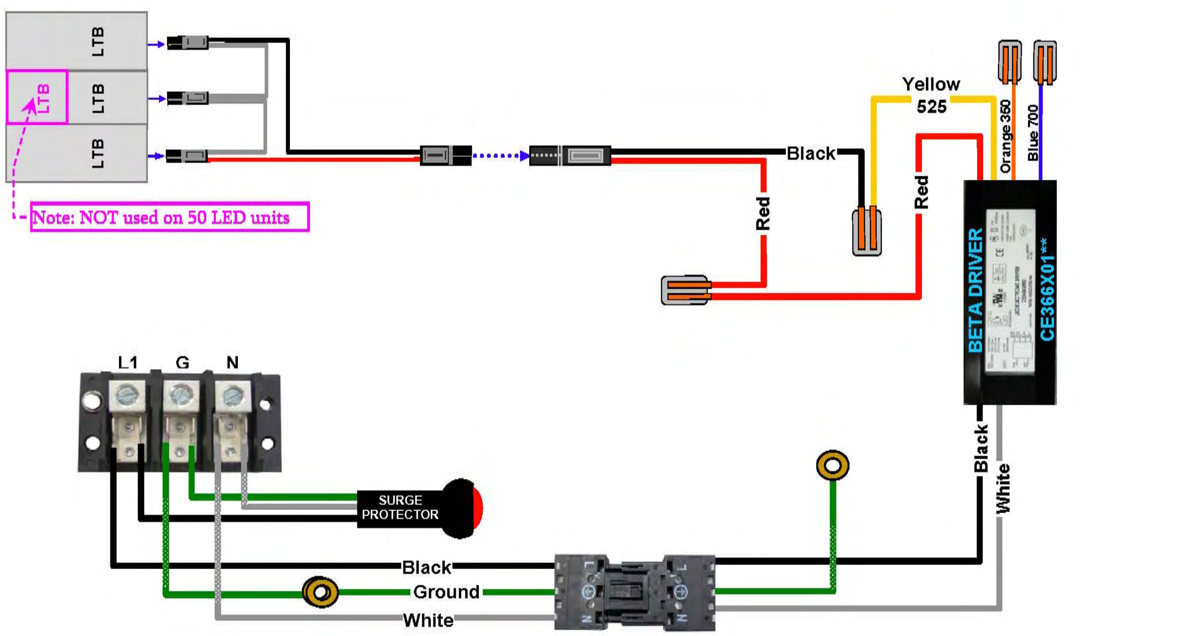
Notes: This represents the wiring diagram for the multi-tap ballast. Connect Red lead for 350mA, Orange lead for 525mA, and Blue lead for 700mA. Cap all unused leads.

Supplier: N/A
Contact: N/A

WIRING DIAGRAMS								
VOLTAGE(S)	OPTION(S)	ADV	DRIVER	LED'S	DETAILS	DOCUMENT	REV	DATE
U		♦	LED Electronic	50-60	525mA Drive Current 32V 10 LED, 64V 20 LED Series Boards	WIMF-LSL-WD-23	04	01/13/10

Notes: 1.) Terminal block and lead wires may be used.
2.) Lever nuts may be used, refer to BOM.

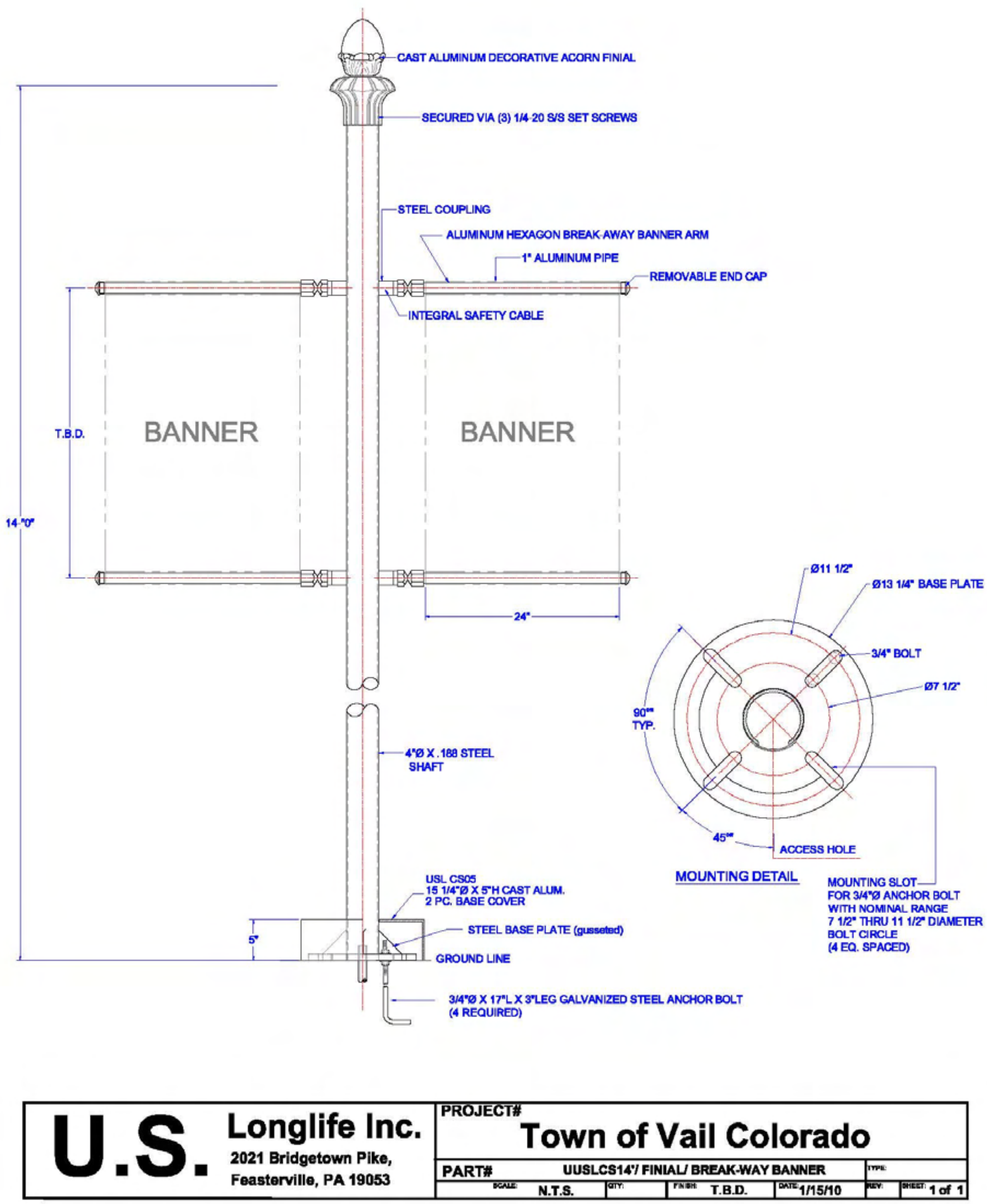
INDEX
WIRING



Type BA1
Page 1 of 1

Notes: Reference for future installation of banner arm poles by TOV. No BA1 pole locations shown.

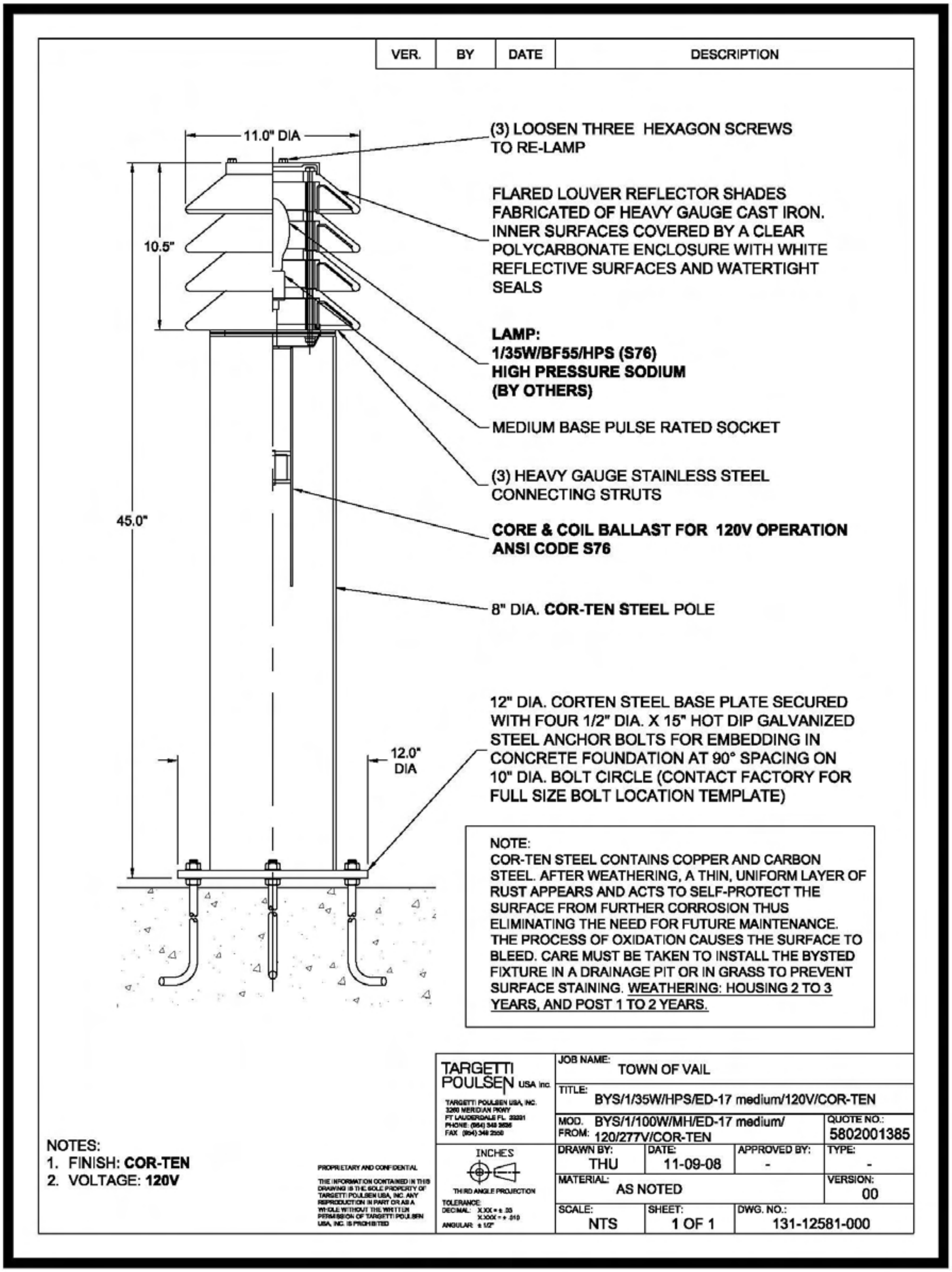
Supplier: U.S. Long Life
Contact: Jack Mason, cupflyers@aol.com; 1-888-295-2677



Type BL1

Notes:

Page 1 of 2	
Supplier: ANY Contact: N/A	



PART 8: Appendix c

A. Life Cycle Cost Analysis for five lamp sources studied follows on page 44, and is based on a sample layout for each luminaire/lamp source, from the Village roundabout to the Village parking garage. Target average illuminance and uniformity ratios are based on IESNA RP-8-00, adjusted for rural conditions in Town of Vail.
   1. Although the anticipated lamp life for the LED 350mA source would indicate 0 lamp burnouts annually, we have included a single lamp burnout as a “worst case” factor. Real life conditions are likely to result in improved maintenance costs for the LED 350mA source resulting from fewer lamp burnouts.

B. Life Cycle Cost Analysis for total LED 350mA roadway lighting system follows on page 45. This is an anaylsis of the legitimate roadway lighting system only, and does not include decorative lighting systems including the Village standard pedestrian lantern, the bike pathway bollard, and the non-illuminated banner arm pole.
   1. Although the anticipated lamp life for the LED 350mA source would indicate 0 lamp burnouts annually, we have included a single lamp burnout every 4 years (.25 avg burnout annually) as a “worst case” factor. Real life conditions are likely to result in improved maintenance costs for the LED 350mA source resulting from fewer lamp burnouts.

C. Details
   1. Figure 8.1 illustrates pole setback relative to roadway edge. This is an approximate setback and must be verified with actual field conditions including underground utility placement
   2. Figure 8.2 illustrates suggestion for placement of landscape material, particularly trees with mature height of crown at 20’-0” or less.

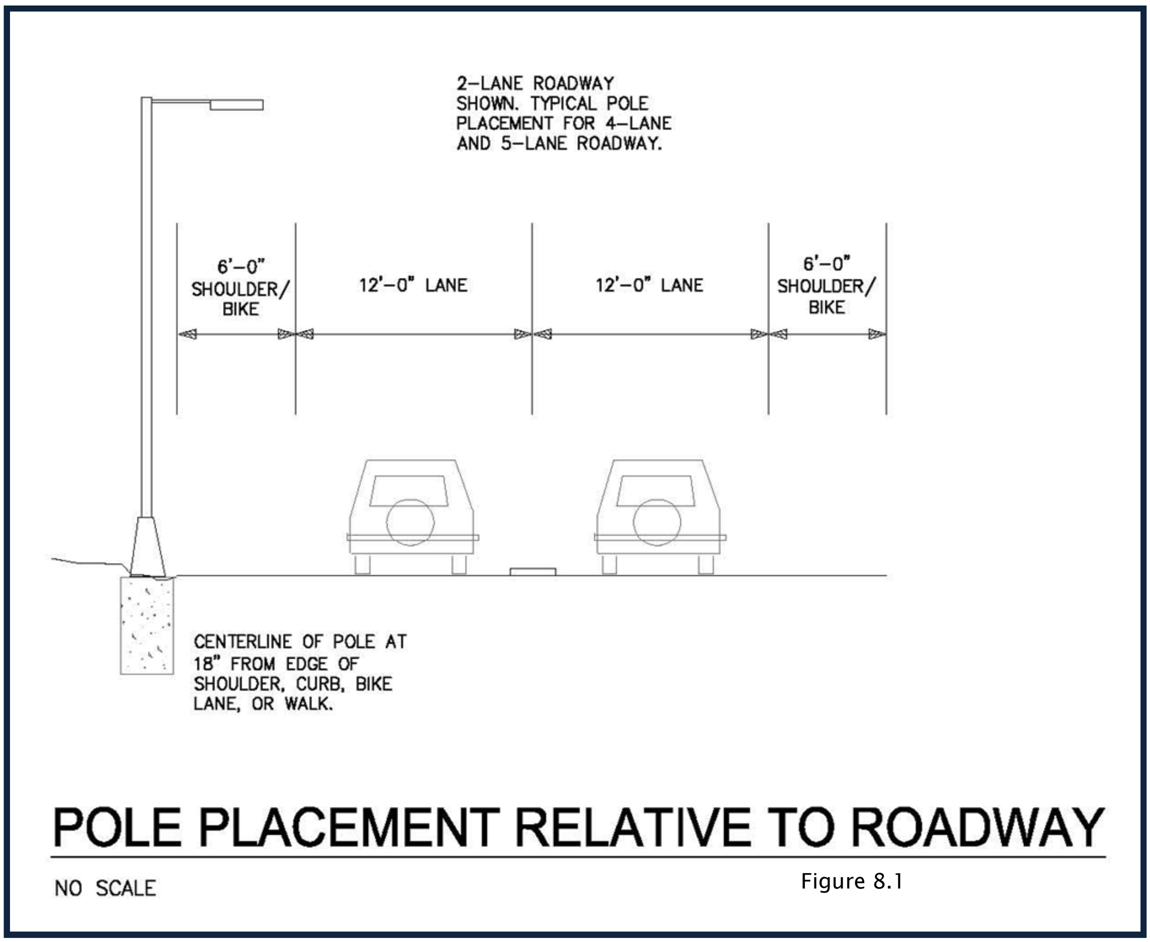
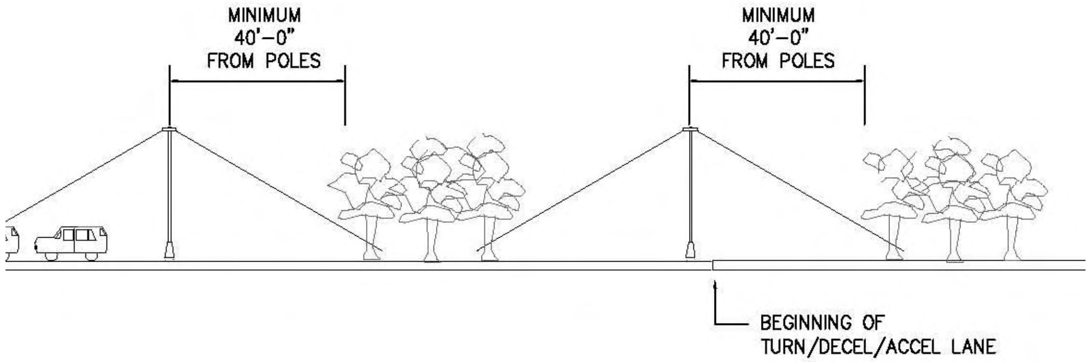
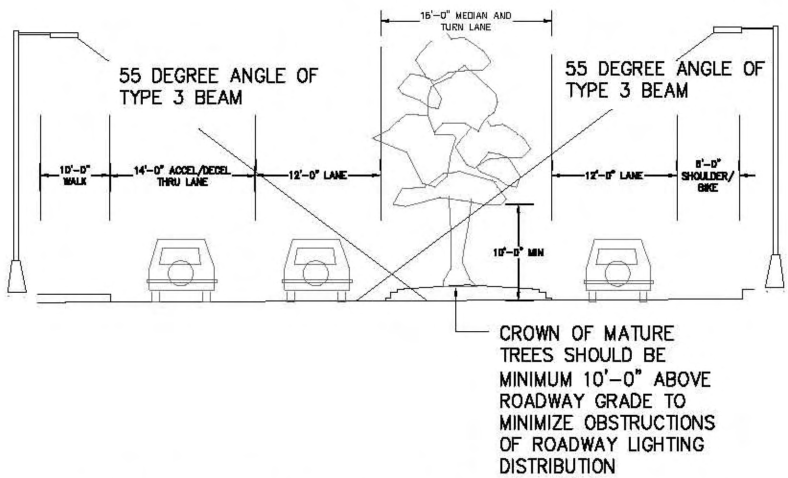


Figure 8.1



POLE PLACEMENT RELATIVE TO ROADWAY

NO SCALE



TREE PLACEMENT RELATIVE TO LIGHT POLES

NO SCALE

Figure 8.2

	6 BAR LED at stnd 525mA driver- 25' pole	100W HPS - 25' pole	100W MH - 25' pole	100W INDUCTION - 25'pole	3 LED @ 350mA driver
Luminaire Information	LED @ 525mA	HPS	MH	Induction	LED @ 350mA
Manufacturer	Beta 525 mA	US Architectural	US Architectural	US Lighting Tech	Beta 325mA
Model #	LEDway 100	Galaxy 400 HPS	Galaxy 400 MH	3 Bar LED T5	LEDway 102
Number of Luminaires	22	25	25	27	22
Lamps/Luminaire	1	1	1	1	1
System Watts/Luminaire	140	138	125	110	76
Luminaire Cost (including lamps)	$1,247.00	$1,167.00	$1,114.00	$535.00	$940.00
Installation Hours/Luminaire	3.3	3.3	3.3	3.3	3.3
Hourly Labor Installation Cost	$150.00	$150.00	$150.00	$150.00	$150.00
Installation Cost/Luminaire	$495.00	$495.00	$495.00	$495.00	$495.00
Cleaning Hours/Luminaire	3.3	3.3	3.3	3.3	3.3
Houlry Labor Cleaning Cost	$150.00	$150.00	$150.00	$150.00	$150.00
Cleaning Cost/Luminaire	$495.00	$495.00	$495.00	$495.00	$495.00
Lamp Information					
Lamp Manufacturer	Beta	GE	Philips		Beta
Lamp Model #	LED 4300k	LongLife Lucalox ED23.5	Ceramic Pulse Start	Induction Circline	LED
Lamp Watts	90	100	100	100	60
Lamp Life	75,000	40,000	24,000	100,000	131,000
Initial Lumens	8,988	9,200	9,000	8,500	4,472
Lamp Lumen Depreciation	0.95	0.80	0.75	0.85	0.95
Dirt Depreciation	0.90	0.90	0.90	0.90	0.90
Ballast Factor	1.00	1.00	1.00	1.00	1.00
Temperature Factor	1.10	1.00	1.00	1.00	1.10
Equipment Factor	1.00	1.00	1.00	1.00	1.00
Toal Light Loss Factor	0.94	0.72	0.68	0.77	0.94
Maintained Lumens	8,453	6,624	6,075	6,503	4,204
Cost/Lamp	$94.00	$35.00	$30.00	$100.00	$94.00
Relamp Labor Hours/Lamp	3.3	3.3	3.3	3.3	3.3
Hourly Labor Relamping Cost	$150.00	$150.00	$150.00	$150.00	$150.00
Relamp Labor Cost/Lamp	$495.00	$495.00	$495.00	$495.00	$495.00
Ballast Information					
Ballast Type	None	CWA	SCWA	None	None
Ballast Watts	0	38	49	4	0
Ballast Life, hrs	150,000	60,000	60,000	100,000	150,000
Ballast Factor	NA	1.00	1.00	NA	NA
Power Factor	1.00	0.90	0.85	1.00	1.00
Ballast Cost/Luminaire	$175.00	$120.00	$120.00	$0.00	$175.00
Reballast Labor Hours/Luminaire	3.3	3.3	3.3	3.3	3.3
Hourly Labor Reballasting Cost	$150.00	$150.00	$150.00	$150.00	$150.00
Reballast Cost/Luminaire	$495.00	$495.00	$495.00	$495.00	$150.00
Energy Consumption:					
Avg Weekday Operating Hours/Day	12	12	12	12	12
Avg Saturday Operating Hours	12	12	12	12	12
Avg Sunday Operating Hours	12	12	12	12	12
Annual Operating Hours	4,380	4,380	4,380	4,380	4,380
Total Lighting Load, KVA	3	4	4	3	2
Energy Unit Cost, $/KWH	0.04	0.04	0.04	0.04	0.04
Economic Analysis					
Initial Costs:					
Lighting Equipment Cost	$27,434	$29,175	$27,850	$14,445	$20,680
Lighting Installation Cost	$10,890	$12,375	$12,375	$13,365	$10,890
Wiring Unit Cost, $/KVA	$3,000	$3,000	$3,000	$3,000	$3,000
Wiring Cost	$9,240	$11,500	$11,029	$8,910	$5,016
Service/Distribuion Unit Cost, $/KVA	$3,000	$3,000	$3,000	$3,000	$3,000
Service/Distribution Cost	$9,240	$11,500	$11,029	$8,910	$5,016
Total Initial Cost	$56,804	$64,550	$62,284	$45,630	$41,602
Annual Energy Costs:	$540	$604	$548	$520	$293
Annual Maintenance Costs:					
Lamp Burnouts/Year	1	1	2	1	1
Annual Relamping Cost	$589	$530	$1,050	$595	$589
BalLast Failures/Year	0.00	0.00	0.00	0.00	0.00
Annual Reballasting Cost	$1	$1	$1	$1	$0
Annual Cleaning Cost	$495	$495	$990	$495	$495
Total Annual Maintenance Cost	$1,085	$1,026	$2,041	$1,091	$1,084
Total Life Cycle Cost:					
Useful Life of Lighting System, yrs	25	25	25	25	25
Inflation Factor	3%	3%	3%	3%	3%
Life Cycle Energy Cost	$28,246	$31,639	$28,659	$27,237	$15,333
Life Cycle Maintenance Costs	$56,776	$53,729	$106,858	$57,097	$56,752
Initial Cost	$56,804	$64,550	$62,284	$45,630	$41,602
Total Life Cycle Cost	$141,826	$149,918	$197,801	$129,965	$113,687
Amortized Annual Cost	$5,673	$5,997	$7,912	$5,199	$4,547
Cost Ratios:					
Life Cycle Energy Cost	20%	21%	14%	21%	13%
Life Cycle Maintenance Costs	40%	36%	54%	44%	50%
Initial Cost	40%	43%	31%	35%	37%
Total Life Cycle Cost	100%	100%	100%	100%	100%

	3 LED @ 350mA driver
Luminaire Information	LED @ 350mA
Manufacturer	Beta 325mA
Model #	LEDway 102
Number of Luminaires	187
Lamps/Luminaire	1
System Watts/Luminaire	76
Luminaire Cost (including lamps)	$940.00
Installation Hours/Luminaire	3.3
Hourly Labor Installation Cost	$150.00
Installation Cost/Luminaire	$495.00
Cleaning Hours/Luminaire	3.3
Houlry Labor Cleaning Cost	$150.00
Cleaning Cost/Luminaire	$495.00
Lamp Information	
Lamp Manufacturer	Beta
Lamp Model #	LED
Lamp Watts	60
Lamp Life	131,000
Initial Lumens	4,472
Lamp Lumen Depreciation	0.95
Dirt Depreciation	0.90
Ballast Factor	1.00
Temperature Factor	1.10
Equipment Factor	1.00
Toal Light Loss Factor	0.94
Maintained Lumens	4,204
Cost/Lamp	$94.00
Relamp Labor Hours/Lamp	3.3
Hourly Labor Relamping Cost	$150.00
Relamp Labor Cost/Lamp	$495.00
Ballast Information	
Ballast Type	None
Ballast Watts	0
Ballast Life, hrs	150,000
Ballast Factor	NA
Power Factor	1.00
Ballast Cost/Luminaire	$175.00
Reballast Labor Hours/Luminaire	3.3
Hourly Labor Reballasting Cost	$150.00
Reballast Cost/Luminaire	$150.00

Energy Consumption:

Avg Weekday Operating Hours/Day	12
Avg Saturday Operating Hours	12
Avg Sunday Operating Hours	12
Annual Operating Hours	4,380
Total Lighting Load, KVA	14
Energy Unit Cost, $/KWH	0.04

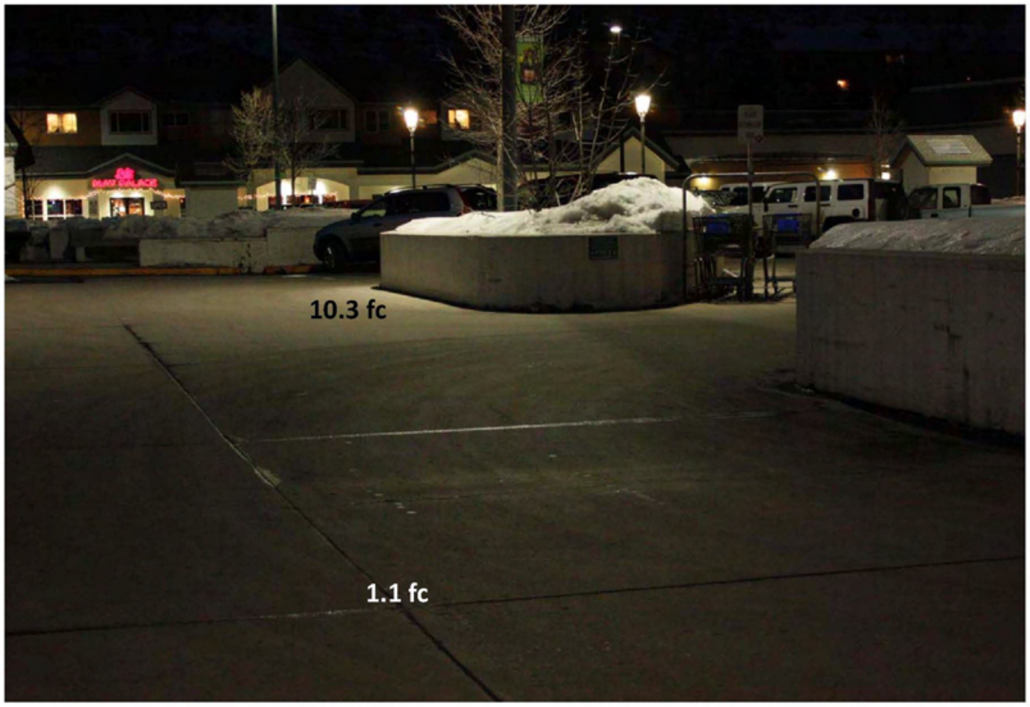
Economic Analysis

Initial Costs:		
	Lighting Equipment Cost	$175,780
	Lighting Installation Cost	$92,565
	Wiring Unit Cost, $/KVA	$3,000
	Wiring Cost	$42,636
	Service/Distribuion Unit Cost, $/KVA	$3,000
	Service/Distribution Cost	$42,636
	Total Initial Cost	$353,617
Annual Energy Costs:		$2,490
Annual Maintenance Costs:		
	Lamp Burnouts/Year	0.25
	Annual Relamping Cost	$147
	BalLast Failures/Year	0.00
	Annual Reballasting Cost	$0
	Annual Cleaning Cost	$495
	Total Annual Maintenance Cost	$642
Total Life Cycle Cost:		
	Useful Life of Lighting System, yrs	25
	Inflation Factor	3%
	Life Cycle Energy Cost	$130,335
	Life Cycle Maintenance Costs	$33,619
	Initial Cost	$353,617
	Total Life Cycle Cost	$517,571
	Amortized Annual Cost	$20,703
Cost Ratios:		
	Life Cycle Energy Cost	25%
	Life Cycle Maintenance Costs	6%
	Initial Cost	68%
	Total Life Cycle Cost	100%

PART 9: Appendix D

A. Photographs of Comparative Sites in Vail and metered footcandle measurements.

1. City Market
February 9, 2010



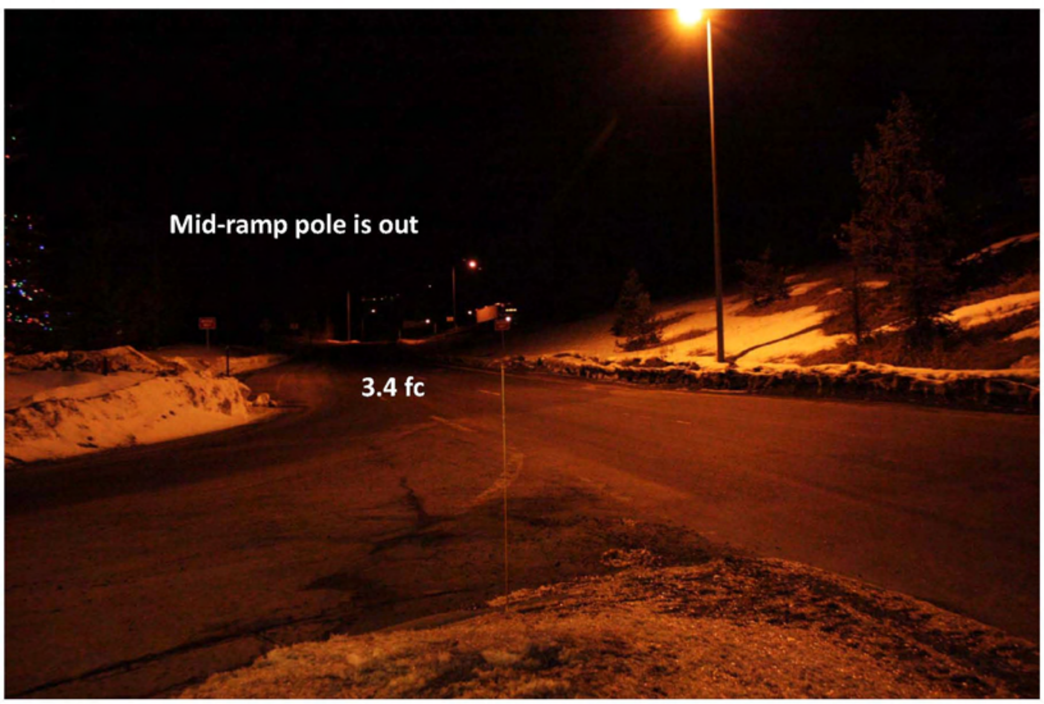
2. Safeway Parking
February 9, 2010

4. West Vail Roundabout

February 9, 2010

3. Off Ramp – West Vail Roundabout

February 9, 2010

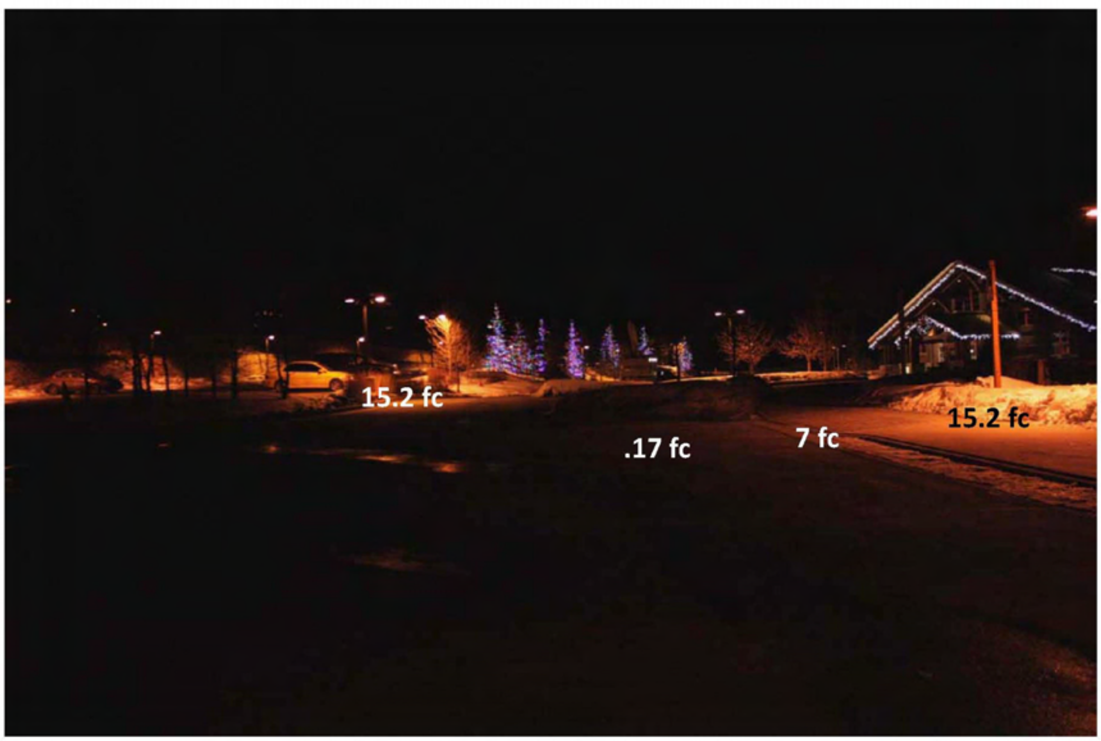


5. Matterhorn Dr. and Frontage Rd.

February 9, 2010

6. Donovan Park Lot

February 9, 2010

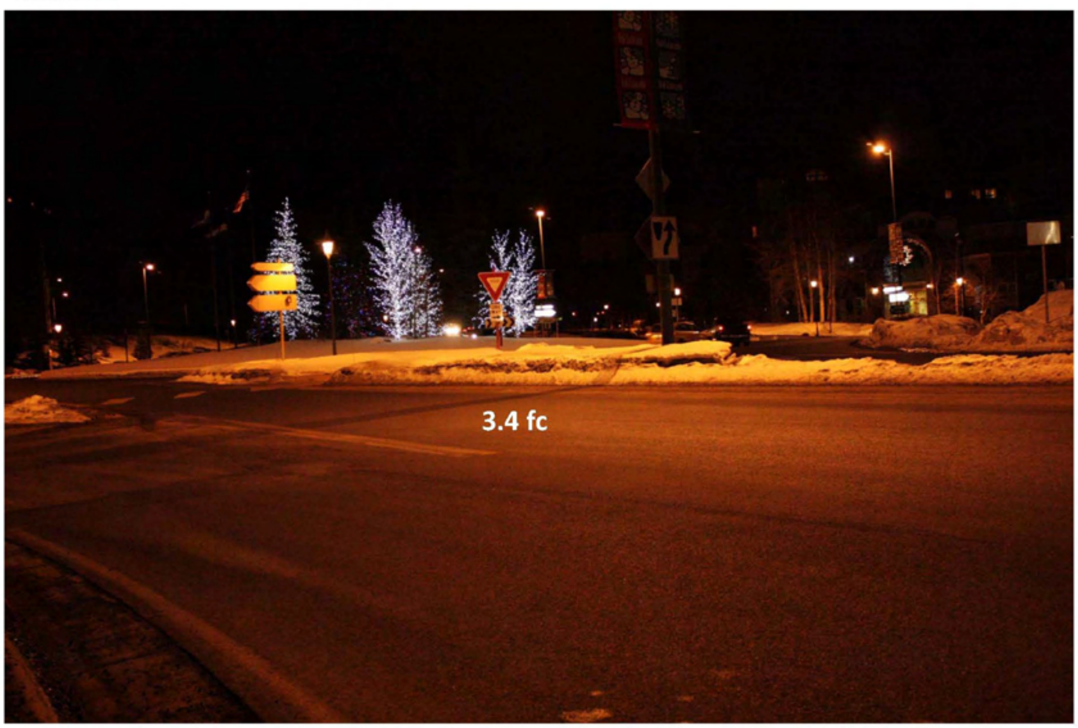


7. Village Turnabout – Pedestrian Crosswalk

February 9, 2010

8. Village Roundabout

February 9, 2010

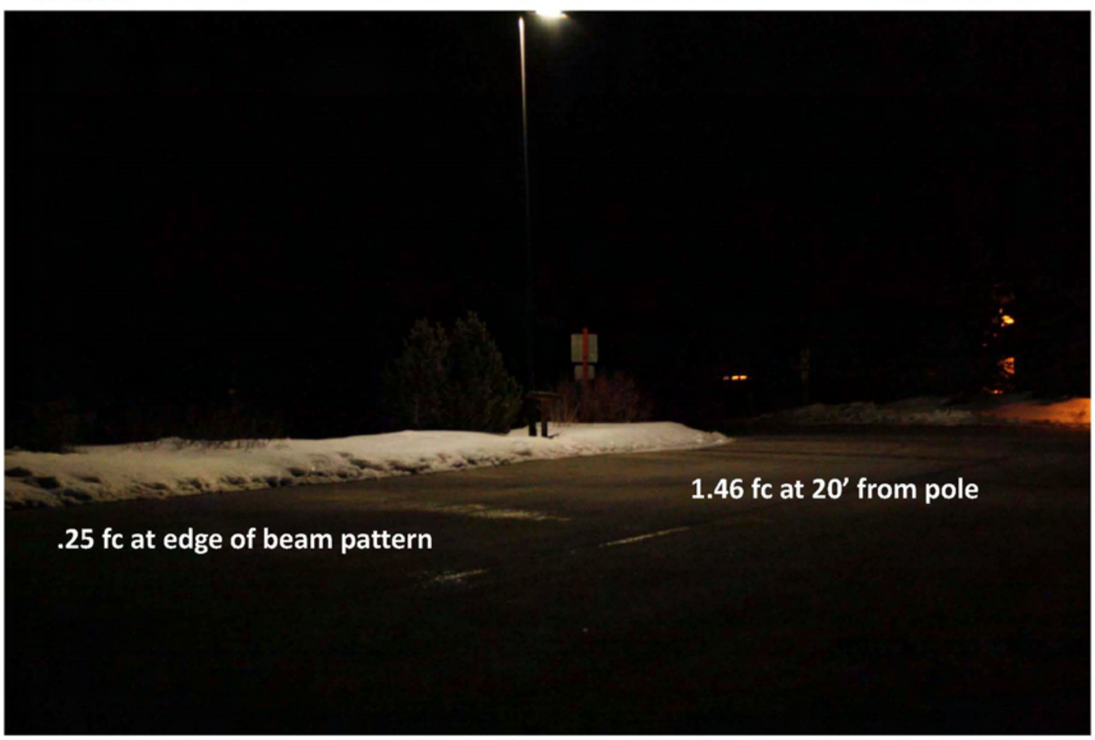


9. Village Roundabout I-70 Off Ramp

February 9, 2010

10. Ford Park Test Site

February 9, 2010



11. Ford Park Test Site
February 9, 2010

PART 10: Roadway Photometric Plans

A. Application Notes
   1. Photometric plans are a point by point study of illuminance (light incident on the horizontal roadway surface). Study is limited to the roadway and adjacent shoulders and bike paths.
   2. Backgrounds for the roadway have been provided by Town of Vail Public Works and incorporate future roadway configuration based on the Master Transportation Plan.
   3. Calculation programs used in the photometric study are AGI32, V1.9, and Visual V2.6 Professional Edition.
   4. IES files for calculation tools are the most current available in the industry, provided by product manufacturers.

B. Lighting Photometric Plans included are:
- PP-1 West Vail Part 1
- PP-2 West Vail Part 2
- PP-3 West Vail Part 3
- PP-4 Timber Ridge Part 1
- PP-5 Timber Ridge Part 2
- PP-6 Lionshead Part 1
- PP-7 Lionshead Part 2
- PP-8 Lionshead Part 3
- PP-9 Vail Village Part 1
- PP-10 Vail Village Part 2
- PP-11 Vail Village Part 3
- PP-12 Vail Village Part 4

C. Statistical Zones are identified on the photometric plans as “N-zone #” for North Frontage Road zones and “S-zone #” for South Frontage Road zones. Average footcandle (fc) and average/min footcandle (uniformity ration) represent the calculated values as compared to the target design values identified in Part 3 for medium, low, and intermitten intersection lighting zones. The high zones (proposed roundabouts at Simba Run) target the existing roundabout light levels.

D. The proposed re-alignment of the South Frontage Road at EverVail (east of the proposed Simba Run underpass) is shown as statistical zone 7-alt. The existing roadway configuration is shown as statistical zone 7.

North Frontage Road Statistical Zones:

STATISTICS

Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
N - zone 1 mid	+	0.6 fc	1.4 fc	0.1 fc	14.0:1	6.0:1
N - zone 2 inter	+	0.4 fc	1.7 fc	0.1 fc	17.0:1	4.0:1
N - zone 3 inter	+	0.6 fc	1.8 fc	0.1 fc	18.0:1	6.0:1
N - zone 6 inter	+	0.6 fc	1.8 fc	0.1 fc	18.0:1	6.0:1
N - zone 7 med	+	0.7 fc	2.7 fc	0.2 fc	13.5:1	3.5:1
N - zone 8 high	+	2.2 fc	9.0 fc	0.6 fc	15.0:1	3.7:1
N - zone 9 med	+	0.9 fc	5.0 fc	0.2 fc	25.0:1	4.5:1
N - zone 10 inter	+	0.6 fc	1.8 fc	0.2 fc	9.0:1	3.0:1
N - zone 11 inter	+	0.6 fc	1.8 fc	0.2 fc	9.0:1	3.0:1
N - zone 12 inter	+	0.7 fc	1.8 fc	0.2 fc	9.0:1	3.5:1

South Frontage Road Statistsical Zones:

STATISTICS

Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
S - zone 1 med	+	0.6 fc	1.8 fc	0.1 fc	18.0:1	6.0:1
S - zone 2 inter	+	0.7 fc	1.8 fc	0.3 fc	6.0:1	2.3:1
S - zone 3 inter	+	0.7 fc	1.7 fc	0.3 fc	5.7:1	2.3:1
S - zone 4 inter	+	0.4 fc	1.7 fc	0.1 fc	17.0:1	4.0:1
S - zone 5 med	+	0.7 fc	3.6 fc	0.2 fc	18.0:1	3.5:1
S - zone 6 high	+	1.9 fc	6.3 fc	0.4 fc	15.8:1	4.8:1
S - zone 7 low	+	0.5 fc	1.8 fc	0.1 fc	18.0:1	5.0:1
S - zone 7ALT med	+	0.8 fc	5.5 fc	0.0 fc	N / A	N / A
S - zone 8 med	+	0.8 fc	3.1 fc	0.2 fc	15.5:1	4.0:1
S - zone 9 high	+	1.3 fc	4.9 fc	0.2 fc	24.5:1	6.5:1
S - zone 10 med	+	0.7 fc	1.5 fc	0.2 fc	7.5:1	3.5:1
S - zone 11 inter	+	0.9 fc	4.1 fc	0.2 fc	20.5:1	4.5:1
S - zone 12 med	+	0.8 fc	4.8 fc	0.2 fc	24.0:1	4.0:1
S - zone 13 low	+	0.6 fc	4.6 fc	0.1 fc	46.0:1	6.0:1
S - zone 14 med	+	0.9 fc	8.7 fc	0.2 fc	43.5:1	4.5:1
S - zone 15 low	+	0.5 fc	1.8 fc	0.1 fc	18.0:1	5.0:1
S - zone 16 inter	+	0.7 fc	1.8 fc	0.2 fc	9.0:1	3.5:1