U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

HID vs. LED in an Area Lighting Application

LIGHTFAIR International

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FEMP Federal Energy Management Program

GATEWAY Demonstrations

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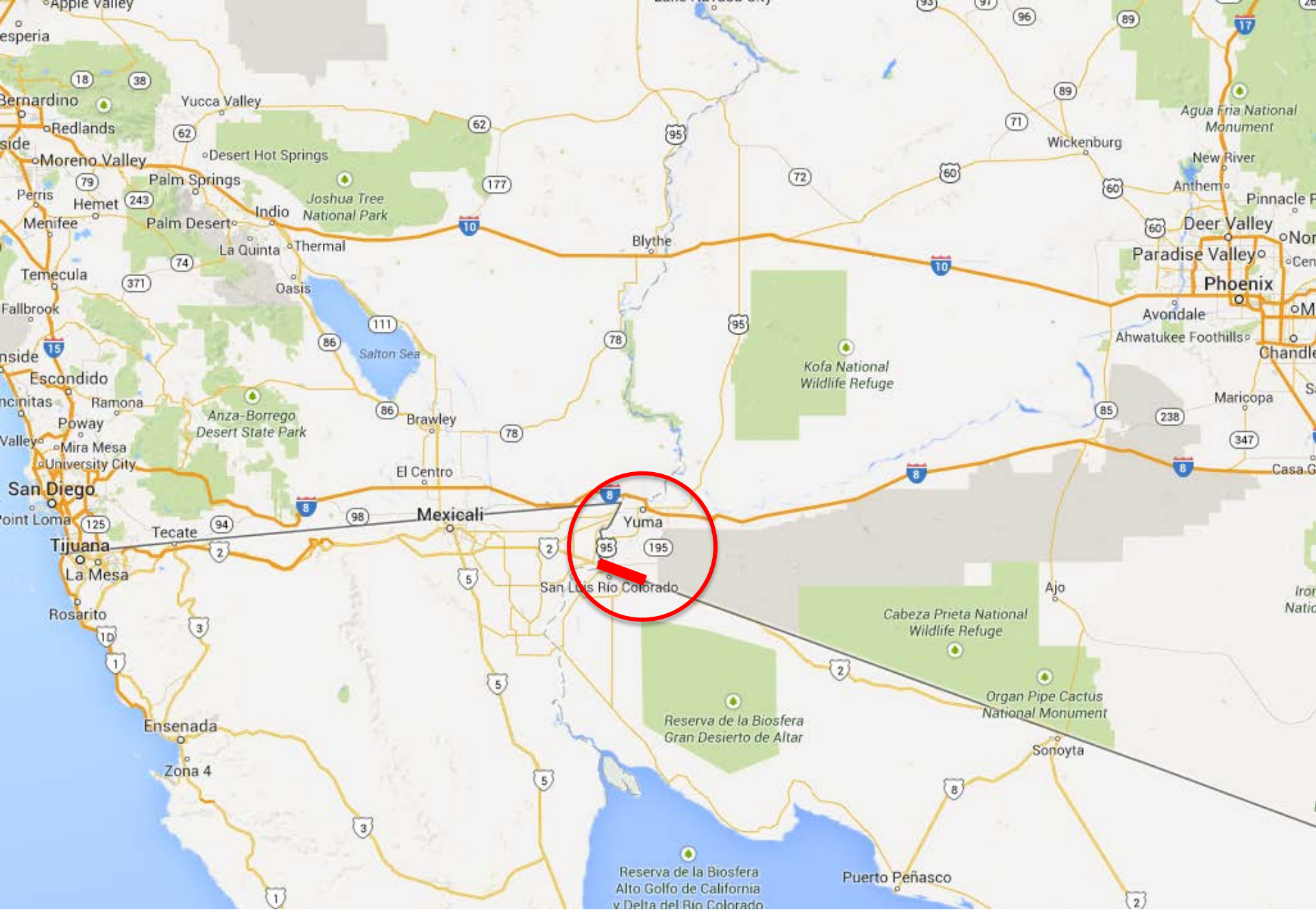
Apple Valley
esperia
Bernardino
Redlands
side
Yucca Valley
Moreno Valley
Desert Hot Springs
Palm Springs
Perris
Hemet
Menifee
Palm Desert
Indio
Joshua Tree National Park
La Quinta
Thermal
Temecula
Oasis
Fallbrook
Salton Sea
nside
Escondido
ncinitas
Ramona
Poway
Anza-Borrego Desert State Park
Mira Mesa
University City
San Diego
Point Loma
Tecate
Tijuana
La Mesa
Rosarito
Ensenada
Zona 4
Mexicali
El Centro
Brawley
Yuma
San Luis Rio Colorado
Blythe
Kofa National Wildlife Refuge
Wickenburg
Agua Fria National Monument
New River
Anthem
Pinnacle
Deer Valley
Paradise Valley
Phoenix
Avondale
Ahwatukee Foothills
Chandle
Maricopa
Casa G
Ajo
Cabeza Prieta National Wildlife Refuge
Organ Pipe Cactus National Monument
Sonoyta
Reserva de la Biosfera Gran Desierto de Altar
Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado
Puerto Peñasco

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Background - Existing Conditions

- Three 1000 W metal halide fixtures installed
- Two operating -1080 W total power
- 60 ft. height

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Background - Investment Grade Audit (IGA) Mock-up

- Two 412 W LED fixtures installed
- 40 ft. height

Measurement Methodology

- 15 x 15 ft. grid
- 10 in. above the ground
- 4 ft. and 8 ft. along the fence

Illuminance – HID

6	5	4	3	2	1	200	1	2	3	4	5	6	HID (lx)	
7.5	7.9	7.9	7.8	8.6	6.9	6.1	7.3	8.1	7.9	8.0	9.0	8.9	**7.8** Avg	Secondary Vertical Fence
7.2	7.7	8.0	7.7	8.6	6.6	6.3	6.8	7.7	8.2	8.1	8.3	8.6	**9.0** Max	
Secondary Fence													**6.1** Min	
6.0	6.6	7.3	6.5	7.6	5.7	6.2	5.5	6.5	6.7	6.7	6.5	7.1	**11.9** Avg	3 Rows Closest to Secondary Fence
8.1	9.1	11.1	10.9	10.8	9.8	20.3	9.1	9.4	10.4	10.6	9.6	9.2	**53.6** Max	
10.4	11.3	14.4	14.3	14.2	20.3	53.6	19.0	21.8	20.0	18.7	12.3	11.2	**5.5** Min	
13.1	13.7	18.5	17.2	19.5	39.9	80.2	29.9	28.0	25.9	20.8	14.4	13.0	**21.0** Avg	All Horizontal
14.1	17.5	24.8	20.9	27.4	35.6	87.0	37.9	33.2	29.4	24.1	16.9	15.4	**101.0** Max	
15.3	16.2	26.1	21.7	23.9	32.6	101	43.0	36.9	32.7	26.7	16.7	15.3	**5.5** Min	
14.8	15.0	21.8	19.9	22.2	32.2	89.0	43.5	30.7	26.4	22.2	15.4	14.5	**22.2** Avg	3 Rows Closest to Primary Fence
12.7	13.3	20.8	18.4	20.6	24.6	67.2	34.1	23.6	21.9	18.2	13.6	13.0	**89.0** Max	
11.0	11.2	15.2	12.4	14.6	16.4	23.9	17.9	17.3	17.5	15.2	12.5	11.9	**11.0** Min	
Primary Fence													**12.2** Avg	Primary Vertical Fence
8.9	8.9	11.2	11.1	11.2	12.3	18.0	13.8	14.2	14.8	12.3	10.3	9.5	**18.0** Max	
9.8	9.7	11.0	12.7	9.9	12.4	17.1	13.9	14.7	14.8	13.0	10.9	10.2	**8.9** Min	
6	5	4	3	2	1	200	1	2	3	4	5	6		

Illuminance – LED

6	5	4	3	2	1	204	1	2	3	4	5	6	LED (lx)	
4.3	4.3	4.6	5.0	5.7	6.5	6.7	6.7	6.1	5.2	4.6	5.6	4.8	**5.7** Avg	Secondary Vertical Fence
4.7	4.8	5.1	5.7	6.7	7.4	7.7	7.6	7.1	6.2	5.7	4.6	5.9	**7.7** Max	
Secondary Fence													**4.3** Min	
3.8	3.9	4.0	4.1	4.2	4.4	4.6	4.4	4.2	4.1	4.0	3.9	3.8	**8.4** Avg	3 Rows Closest to Secondary Fence
6.7	6.7	6.9	7.0	7.4	7.9	8.1	7.9	7.4	7.0	6.9	6.7	6.7	**15.4** Max	
13.5	13.5	13.0	13.3	14.1	15.2	15.4	15.2	14.1	13.3	13.0	13.5	13.5	**3.8** Min	
20.0	21.4	22.7	22.7	24.6	26.3	26.3	26.3	24.6	22.7	22.7	21.4	20.0	**22.0** Avg	All Horizontal
25.9	26.7	27.6	28.1	33.8	40.1	42.1	40.1	33.8	28.1	27.6	26.7	25.9	**45.5** Max	
27.7	29.6	29.7	31.7	34.2	37.5	45.5	37.5	34.2	31.7	29.7	29.6	27.7	**3.8** Min	
28.0	28.6	29.6	30.7	34.6	39.0	41.6	39.3	36.5	33.3	32.7	30.8	28.3	**28.5** Avg	3 Rows Closest to Primary Fence
27.1	27.7	27.9	27.9	28.8	30.2	30.2	30.7	30.7	29.1	30.8	29.9	27.3	**41.6** Max	
23.1	23.8	22.3	22.0	23.5	24.0	24.5	24.9	24.0	22.5	23.0	22.7	21.1	**21.1** Min	
Primary Fence													**29.3** Avg	Primary Vertical Fence
25.0	26.3	28.0	29.2	30.8	33.1	31.8	32.2	30.3	26.7	28.4	26.1	24.2	**36.8** Max	
21.4	23.6	27.8	32.5	33.7	36.5	36.8	36.5	34.5	32.0	28.8	23.4	21.5	**21.4** Min	
6	5	4	3	2	1	204	1	2	3	4	5	6		

Illuminance – HID vs. LED

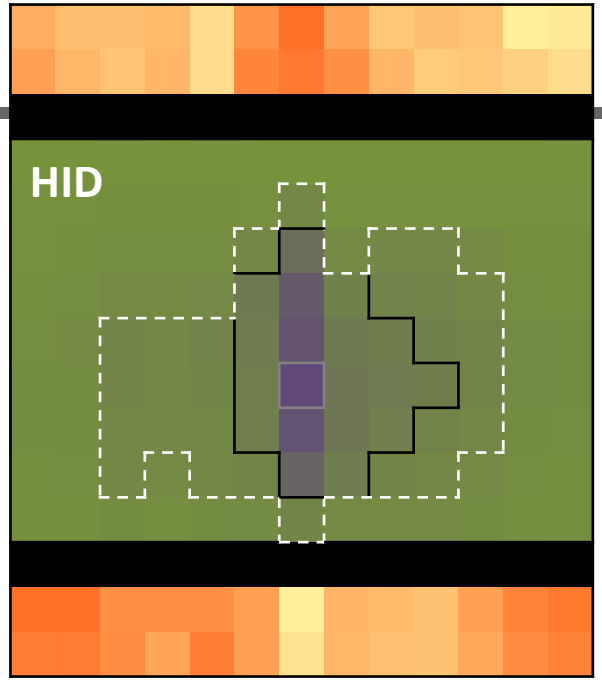
6	5	4	3	2	1	200	1	2	3	4	5	6
7.5	7.9	7.9	7.8	8.6	6.9	6.1	7.3	8.1	7.9	8.0	9.0	8.9
7.2	7.7	8.0	7.7	8.6	6.6	6.3	6.8	7.7	8.2	8.1	8.3	8.6
Secondary Fence												
6.0	6.6	7.3	6.5	7.6	5.7	6.2	5.5	6.5	6.7	6.7	6.5	7.1
8.1	9.1	11.1	10.9	10.8	9.8	20.3	9.1	9.4	10.4	10.6	9.6	9.2
10.4	11.3	14.4	14.3	14.2	20.3	53.6	19.0	21.8	20.0	18.7	12.3	11.2
13.1	13.7	18.5	17.2	19.5	39.9	80.2	29.9	28.0	25.9	20.8	14.4	13.0
14.1	17.5	24.8	20.9	27.4	35.6	87.0	37.9	33.2	29.4	24.1	16.9	15.4
15.3	16.2	26.1	21.7	23.9	32.6	101	43.0	36.9	32.7	26.7	16.7	15.3
14.8	15.0	21.8	19.9	22.2	32.2	89.0	43.5	30.7	26.4	22.2	15.4	14.5
12.7	13.3	20.8	18.4	20.6	24.6	67.2	34.1	23.6	21.9	18.2	13.6	13.0
11.0	11.2	15.2	12.4	14.6	16.4	23.9	17.9	17.3	17.5	15.2	12.5	11.9
Primary Fence												
8.9	8.9	11.2	11.1	11.2	12.3	18.0	13.8	14.2	14.8	12.3	10.3	9.5
9.8	9.7	11.0	12.7	9.9	12.4	17.1	13.9	14.7	14.8	13.0	10.9	10.2
6	5	4	3	2	1	200	1	2	3	4	5	6

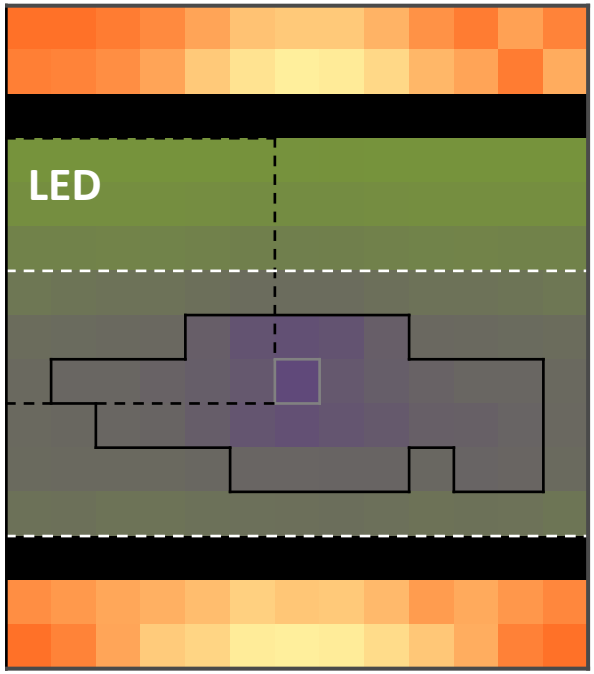
6	5	4	3	2	1	204	1	2	3	4	5	6
4.3	4.3	4.6	5.0	5.7	6.5	6.7	6.7	6.1	5.2	4.6	5.6	4.8
4.7	4.8	5.1	5.7	6.7	7.4	7.7	7.6	7.1	6.2	5.7	4.6	5.9
Secondary Fence												
3.8	3.9	4.0	4.1	4.2	4.4	4.6	4.4	4.2	4.1	4.0	3.9	3.8
6.7	6.7	6.9	7.0	7.4	7.9	8.1	7.9	7.4	7.0	6.9	6.7	6.7
13.5	13.5	13.0	13.3	14.1	15.2	15.4	15.2	14.1	13.3	13.0	13.5	13.5
20.0	21.4	22.7	22.7	24.6	26.3	26.3	26.3	24.6	22.7	22.7	21.4	20.0
25.9	26.7	27.6	28.1	33.8	40.1	42.1	40.1	33.8	28.1	27.6	26.7	25.9
27.7	29.6	29.7	31.7	34.2	37.5	45.5	37.5	34.2	31.7	29.7	29.6	27.7
28.0	28.6	29.6	30.7	34.6	39.0	41.6	39.3	36.5	33.3	32.7	30.8	28.3
27.1	27.7	27.9	27.9	28.8	30.2	30.2	30.7	30.7	29.1	30.8	29.9	27.3
23.1	23.8	22.3	22.0	23.5	24.0	24.5	24.9	24.0	22.5	23.0	22.7	21.1
Primary Fence												
25.0	26.3	28.0	29.2	30.8	33.1	31.8	32.2	30.3	26.7	28.4	26.1	24.2
21.4	23.6	27.8	32.5	33.7	36.5	36.8	36.5	34.5	32.0	28.8	23.4	21.5
6	5	4	3	2	1	204	1	2	3	4	5	6

Illuminance – HID vs. LED

Illuminance – HID vs. LED

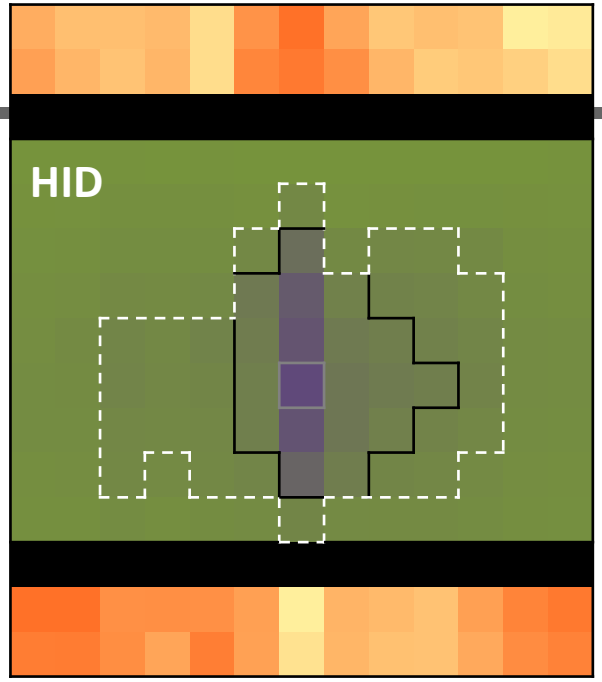
		Avg	Max	Min	Max/Min	Avg/Min	CV
Secondary Fence - Vert	HID	7.8	9.0	6.1	1.5	1.3	0.10
	LED	5.7	7.7	4.3	1.8	1.3	0.18
3 Rows Closest to Secondary Fence - Horiz	HID	11.9	53.6	5.5	9.7	2.2	0.69
	LED	8.4	15.4	3.8	4.1	2.2	0.50
All Horizontal	HID	21.0	101.0	5.5	18.4	3.8	0.79
	LED	22.5	45.5	3.8	12.0	5.9	0.50
3 Rows Closest to Primary Fence - Horiz	HID	22.2	89.0	11.0	8.1	2.0	0.68
	LED	28.5	41.6	21.1	2.0	1.4	0.18
Primary Fence - Vert	HID	12.2	18.0	8.9	2.0	1.4	0.20
	LED	29.3	36.8	21.4	1.7	1.4	0.16
Primary Corridor (7 Rows) - Horz	HID	24.6	101.0	10.4	9.7	2.4	0.70
	LED	26.7	45.5	13.0	3.5	2.1	0.28

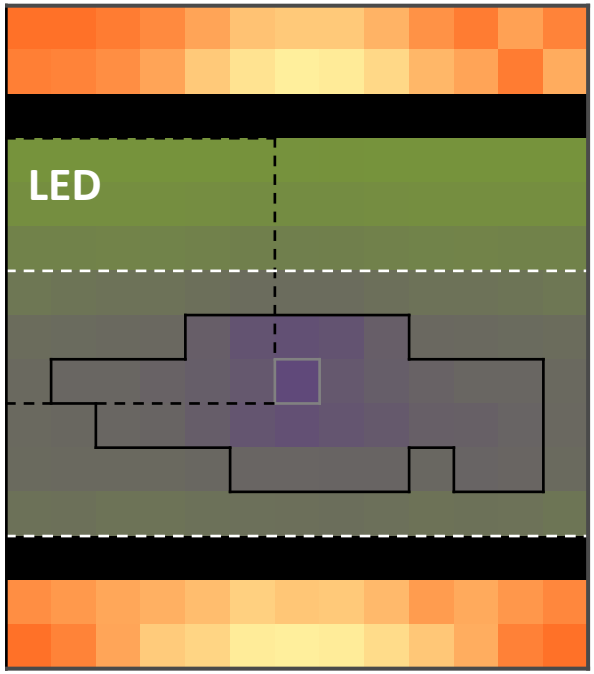




Illuminance – HID vs. LED

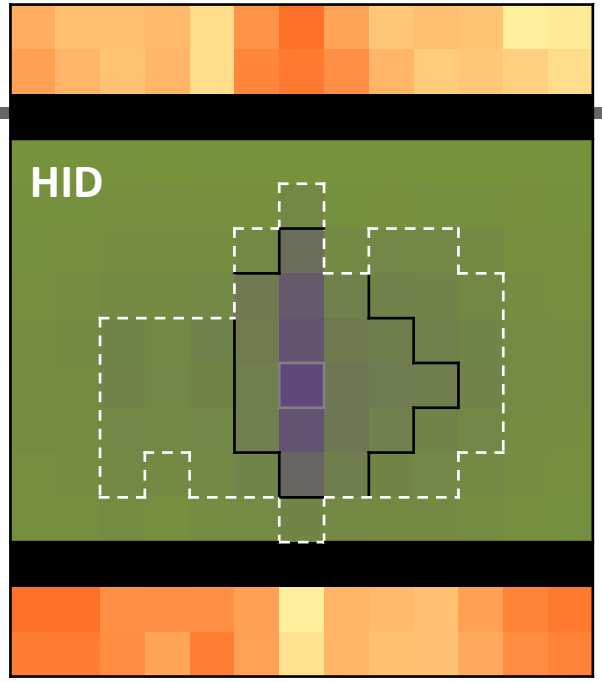
		Avg	Max	Min	Max/Min	Avg/Min	CV
Secondary Fence - Vert	HID	7.8	9.0	6.1	1.5	1.3	0.10
	LED	5.7	7.7	4.3	1.8	1.3	0.18
Primary Fence - Vert	HID	12.2	18.0	8.9	2.0	1.4	0.20
	LED	29.3	36.8	21.4	1.7	1.4	0.16

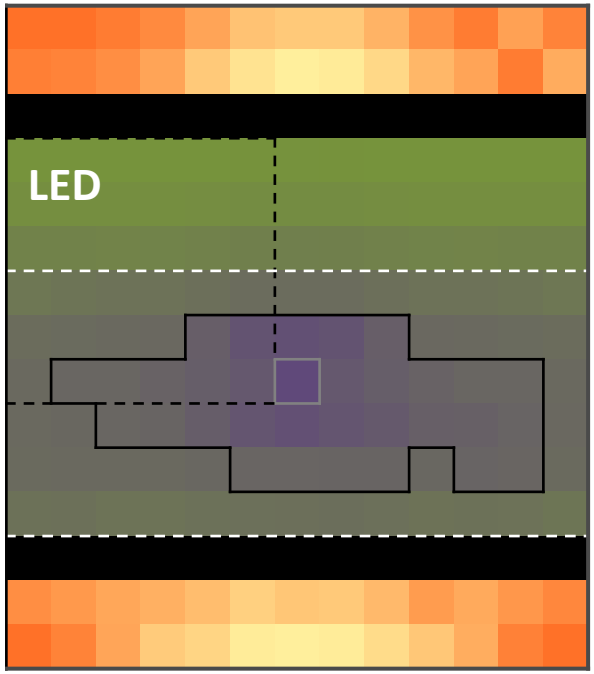




Illuminance – HID vs. LED

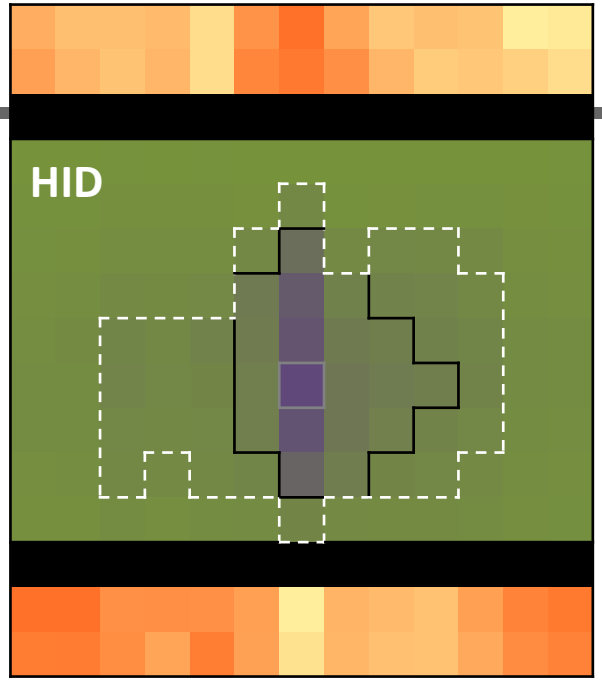
		Avg	Max	Min	Max/Min	Avg/Min	CV
3 Rows Closest to Secondary Fence - Horiz	HID	11.9	53.6	5.5	9.7	2.2	0.69
	LED	8.4	15.4	3.8	4.1	2.2	0.50
3 Rows Closest to Primary Fence - Horiz	HID	22.2	89.0	11.0	8.1	2.0	0.68
	LED	28.5	41.6	21.1	2.0	1.4	0.18

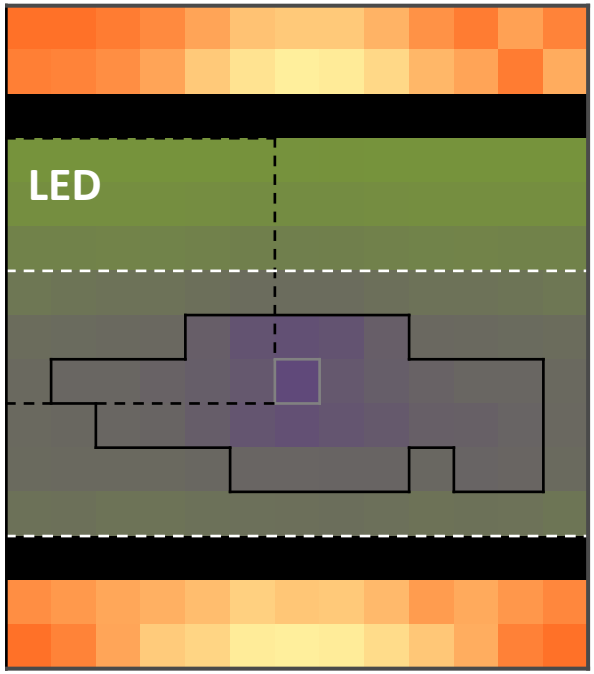




Illuminance – HID vs. LED

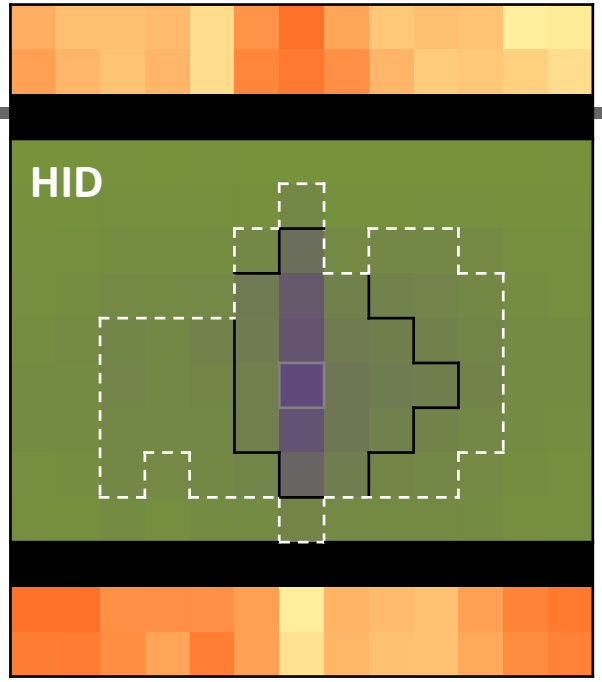
		Avg	Max	Min	Max/Min	Avg/Min	CV
All Horizontal	HID	21.0	101.0	5.5	18.4	3.8	0.79
	LED	22.5	45.5	3.8	12.0	5.9	0.50
Primary Corridor (7 Rows) - Horz	HID	24.6	101.0	10.4	9.7	2.4	0.70
	LED	26.7	45.5	13.0	3.5	2.1	0.28

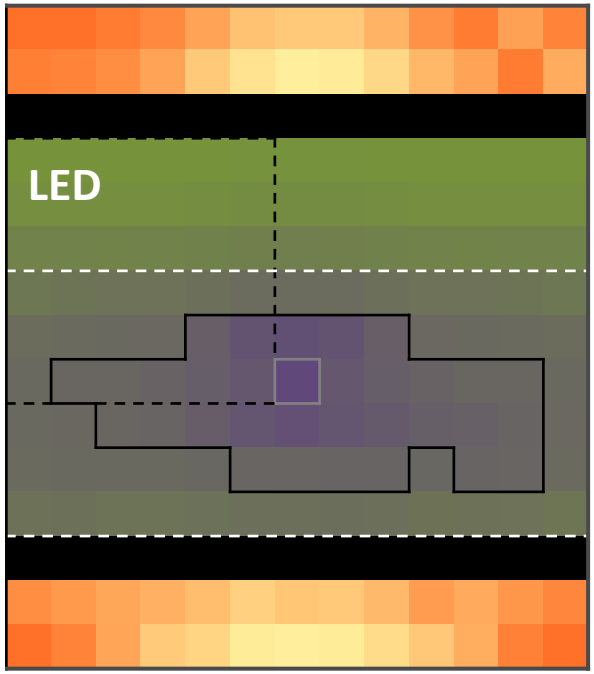




Illuminance – HID vs. LED

		Avg	Max	Min	Max/Min	Avg/Min	CV
Secondary Fence - Vert	HID	7.8	9.0	6.1	1.5	1.3	0.10
	LED	5.7	7.7	4.3	1.8	1.3	0.18
3 Rows Closest to Secondary Fence - Horiz	HID	11.9	53.6	5.5	9.7	2.2	0.69
	LED	8.4	15.4	3.8	4.1	2.2	0.50
All Horizontal	HID	21.0	101.0	5.5	18.4	3.8	0.79
	LED	22.5	45.5	3.8	12.0	5.9	0.50
3 Rows Closest to Primary Fence - Horiz	HID	22.2	89.0	11.0	8.1	2.0	0.68
	LED	28.5	41.6	21.1	2.0	1.4	0.18
Primary Fence - Vert	HID	12.2	18.0	8.9	2.0	1.4	0.20
	LED	29.3	36.8	21.4	1.7	1.4	0.16
Primary Corridor (7 Rows) - Horz	HID	24.6	101.0	10.4	9.7	2.4	0.70
	LED	26.7	45.5	13.0	3.5	2.1	0.28





Final LED Solution

- Two 315 W LED fixtures installed (rotated 90°)
- 70% energy savings
- 40 ft. height
- Wireless control system

Challenges

- Rapid change in technology
- High temperature environment
- Durability of fixtures

Conclusions

- 70% energy savings
- Reduction in light pollution
- Improved uniformity
- Decreased maintenance costs
- CV should be considered as a metric?