



Joshua Tree National Park International Dark Sky Park Application

June 2016



“Arch Rock by starlight”

Photo: Earl Merritt



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Bats prefer natural darkness

NPS Photo, Kristen Lalumiere

Executive Summary

This International Dark Sky Park application reveals Joshua Tree National Park's continuing commitment to preserve the night sky and provide a clear night sky for the Park's thousands of visitors to enjoy. Joshua Tree NP is confident that this document demonstrates the night sky quality at Joshua Tree, as well as the park's continuing commitment to the preservation and interpretation of natural nighttime darkness. We believe this application meets or exceeds all of the requirements of the IDA's International Dark Sky Park Program Guidelines (October 2015), and we urge the IDA Dark Sky Places Committee to support the nomination of Joshua Tree National Park to become the next International Dark Sky Park.

Part IV of this application provides a detailed description of Joshua Tree's sky quality, as well as a summary of factors supporting the park's designation at the bronze to silver tier level. Joshua Tree is fortunate to have some of the darkest skies in the southern California area. Although there are some impacts -from light pollution- along the southern and western boundaries of the park, the northern and eastern skies still offer an outstanding opportunity for night sky viewing. Some of these impacts are depicted in Part V for this application.

A sense of connection with the natural world permeates the park's Night Sky interpretive programs which include night sky talks, full moon walks, and telescope viewing; these are highlighted in Part VI of this application. Part VII includes a discussion of some of the key partnerships that enable the park to provide quality night sky experiences to its visitors.

Part VIII of this application documents a Lighting Management Plan created in November of 2015. Though the park continues its decades-long embrace of the night sky, the lighting inventory documented in Part IX of this application revealed shortcomings in Joshua Tree's own lighting management. Dan Duriscoe and Kate Magargal of the NPS Night Sky Team helped Joshua Tree with an exterior light inventory in 2008, and since the inventory, Joshua has retrofitted 98% of the Park's exterior lighting.

International Dark Sky Park Support Letters

Letter from Joshua Tree National Park Superintendent, David Smith



United States Department of the Interior
NATIONAL PARK SERVICE
Joshua Tree National Park
74485 National Park Drive
Twentynine Palms, California 92277



IN REPLY REFER TO:
9.C (JOTR-S))

Date: 6/28/2016

IDA Board of Directors
International Dark-Sky Association
3225 North First Avenue
Tucson, Arizona 85719

Dear IDA Board of Directors:

As the superintendent of Joshua Tree National Park, I strongly support the preservation of our dark night skies and this nomination for International Dark Sky Park designation. Even though our park is within proximity to the greater Los Angeles area and the Coachella Valley, Joshua Tree National Park still offers an amazing view of the night sky. Interestingly enough, this proximity to Los Angeles and Coachella Valley are what make Joshua Tree National Park an increasingly visited destination to observe the incredible astronomical displays of our galaxy.

The Organic Act of 1916 directs the NPS to protect three primary resources—historic and cultural objects, plant and animal life, and scenery. While scenery has been traditionally thought of as being distant vistas and habitable landscapes, it also includes the night sky. Currently, we are working with San Bernardino County and other non-governmental organizations to preserve and protect the night sky from light pollution. The collective efforts of our park staff, county government, local astronomy groups and conservation groups are working in concert to educate the true value of a dark sky park.

Unspoiled night lightscapes have natural, cultural, and scenic importance, and the NPS is charged with their protection. It is my personal commitment to ensure that the park will maintain conformance with the outdoor lighting guidelines included in this nomination package. The entire park staff is committed to maintaining a dark sky lightscape as an important element of the park environment.

Joshua Tree National Park is a prime candidate for your International Dark Sky Park designation. Please give this nomination your utmost consideration. As superintendent, I firmly believe that this designation will help solidify the ongoing efforts between community leaders, the county of San Bernardino and Joshua Tree National Park.

Sincerely,

David Smith
Park Superintendent

Letter from the IDA Chapter Leader, Tom O'Key (High Deserts Region, San Bernardino County, California)



Board of Directors

International Dark-Sky Association

3223 North First Avenue

Tucson, AZ 85719-2103

IDA Board of Directors,

February 19, 2016

As the International Dark-Sky Association's chapter leader for San Bernardino County, California - High Deserts Region, it is my sincere pleasure to be able to address this letter to you, today. Thank you for enabling me to submit it to you.

Joshua Tree National Park is a very special place. It has attained international recognition for having rare and valuable elements that are significant in all areas of interest and meaning across our Globe. From assorted scientific, recreational and spiritual values, all aspects of the humanities are met in Joshua Tree National Park. It is iconic land that stands as a stronghold and refuge for the appreciation of a diverse expanse of a fierce, yet fragile, ecological landscape.

Among the natural elements protected by our National Park Service, dark skies are one that our astronomy group is extremely happy to see as a priority. It is no surprise that the preservation of a natural dark sky matters to us, but, we know everyone agrees that it is one of the most important issues facing the National Park System. Joshua Tree National Park is a leader in this effort. Time and time again, Joshua Tree National Park has provided a starry night sky for everyone to enjoy.

Now, as we approach the 100th Anniversary of our National Park Service, Joshua Tree National Park has reached a milestone protecting dark night skies in their charge. They reach for heightened awareness among the overall institution they manage and bring outreach education to everyone who visits the Park. They work to share the concern for the dark sky cause in surrounding communities by creating awareness that urban areas must be supportive of the National Park's dark sky efforts.

The current rewriting of San Bernardino County's lighting ordinance continues and Joshua Tree National Park is represented on the committee and is acting as advisors in the effort to assure prudent measures are enacted to meet night sky criteria in harmony with the Park's natural and ecologically sensitive concerns.

A recent tour through the JTNP shows IDA dark sky approved applications of lighting in all areas where the needs for safety, utility, and enhanced needs meet standards that are listed in the inventory included in their application for dark sky status. The effort shows they will continue to follow the guidelines established by IDA requirements and these efforts are documented in their application, as well.

Thanks to the hard work of the Superintendent, Rangers, Scientists, and Staff, Joshua Tree National Park has diligently seen that the IDA standards are met and with this exciting achievement they are proclaiming success in meeting all goals needed to declare merits worthy the designation of a new "Dark Sky Park".

In conclusion, it is my true honor to ask the Board of Directors at IDA to accept Joshua Tree National Park's request and approve their application for status as a "Dark Sky Park"

Sincerely, Tom O'Key

IDA Chapter Leader – San Bernardino County California – High Deserts Region

I. Park Location and General Description

Joshua Tree National Park is located in Southern California, 140 miles east of Los Angeles, in the counties of San Bernardino and Riverside. It lies along the east/west trending Transverse Ranges of the Little San Bernardino Mountains. The south boundary follows the base of these mountains along the northern perimeter of the Coachella Valley and the Monument's north boundary is defined by the Morongo Basin. The north entrances to the park are located at the community of Joshua Tree and the city of Twentynine Palms. The south entrance is at Cottonwood Spring, 25 miles east of Indio.

The park boundary currently contains 772,676 acres in federal ownership and 19,834 acres of nonfederal lands. Of these lands, 595,370 acres are designated as wilderness—set aside for the preservation of natural, cultural, historic, and scenic resources, and 70,557 acres of potential wilderness. There are 9,080.43 acres of inholdings in the park with one full time, lived in residence and 5 other structures that are considered residences, used part time. The park lies within both San Bernardino and Riverside counties, and more than 18 million people live within a three-hour drive of the park.

The natural desert expanse of the park provides ideal conditions for campers, photographers, star gazers, naturalists, as well as anyone seeking space for quiet introspection, exploration, or outdoor learning. Dark night skies, a rich cultural history, and surreal geologic features add to the wonder of this vast wilderness in southern California. Visitors to Joshua Tree have access 24 hours a day, seven days a week, and 365 days a year, with limited supervision by law enforcement. Entrance fees are waived in the late evenings to early mornings, so visitors seeking a night time viewing of the star-filled sky often have free access to the Park.

The park contains two desert ecosystems; the Mojave and Colorado Deserts. Below 3,000 feet, the Colorado Desert encompasses the eastern part of the park and features natural gardens of creosote bush, ocotillo, and cholla cactus. The higher, moister, and slightly cooler Mojave Desert is the special habitat of the Joshua tree. In addition to Joshua tree woodlands, the western part of the park also includes some of the most interesting geologic displays found in California's deserts. Five fan palm oases also dot the park, indicating those few areas where water occurs naturally and wildlife abounds.

The compressed transition zone between the Mojave and Colorado Deserts makes it possible to cross from one desert to the other within less than 65 miles. The Park contains all or portions of numerous mountain ranges including the Little San Bernardino, Cottonwood, Hexie, Pinto, Coxcomb, and Eagle ranges. The eastern portion averages 2,000 feet above sea level while the western half is mostly above 4,000 feet.

Joshua Tree National Monument was established as a unit of the national park system by Presidential Proclamation No. 2193 on August 10, 1936 (50 Stat. 1760) because its "lands contain historic and prehistoric structures and have situated thereon various objects of historic and scientific interest...it appears that it would be in the public interest to reserve such lands as a national monument, to be known as the Joshua Tree National Monument." While the language in the presidential proclamation indicates a strong cultural resource emphasis, the legislative history reveals that another major reason for the establishment of the monument was preservation of the natural resources of the Colorado and Mojave Deserts. The natural resource preservation emphasis was so strong that the original name contemplated for the monument was Desert Plants National Park.

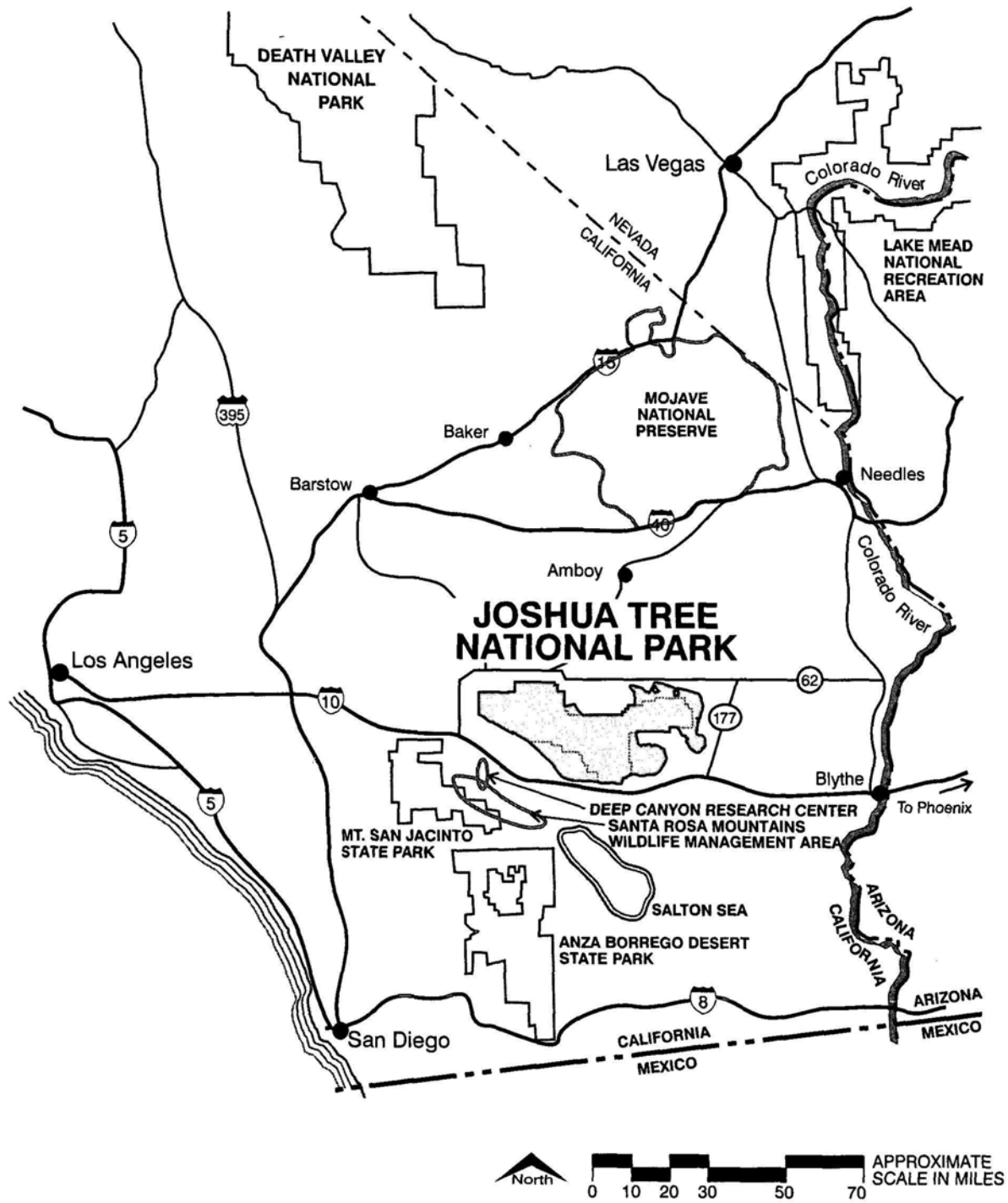


NOTE: Management of the land added to Joshua Tree National Monument by the national park legislation will be addressed in the wilderness and backcountry management plan.

VICINITY MAP

JOSHUA TREE NATIONAL PARK
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
DSC/Aug '93/156/20,014B

Figure 1. Vicinity Map, Joshua Tree National Park, United States Department of the Interior, National Park Service



North 0 10 20 30 50 70 APPROXIMATE SCALE IN MILES

NOTE: Management of the land added to Joshua Tree National Monument by the park legislation will be addressed in the wilderness and backcountry management plan.

REGION

JOSHUA TREE NATIONAL PARK
 UNITED STATES DEPARTMENT OF THE INTERIOR
 NATIONAL PARK SERVICE
 DSC/Dec. '94/156/20,043A

Figure 2. Region Map, Joshua Tree National Park, United States Department of the Interior, National Park Service

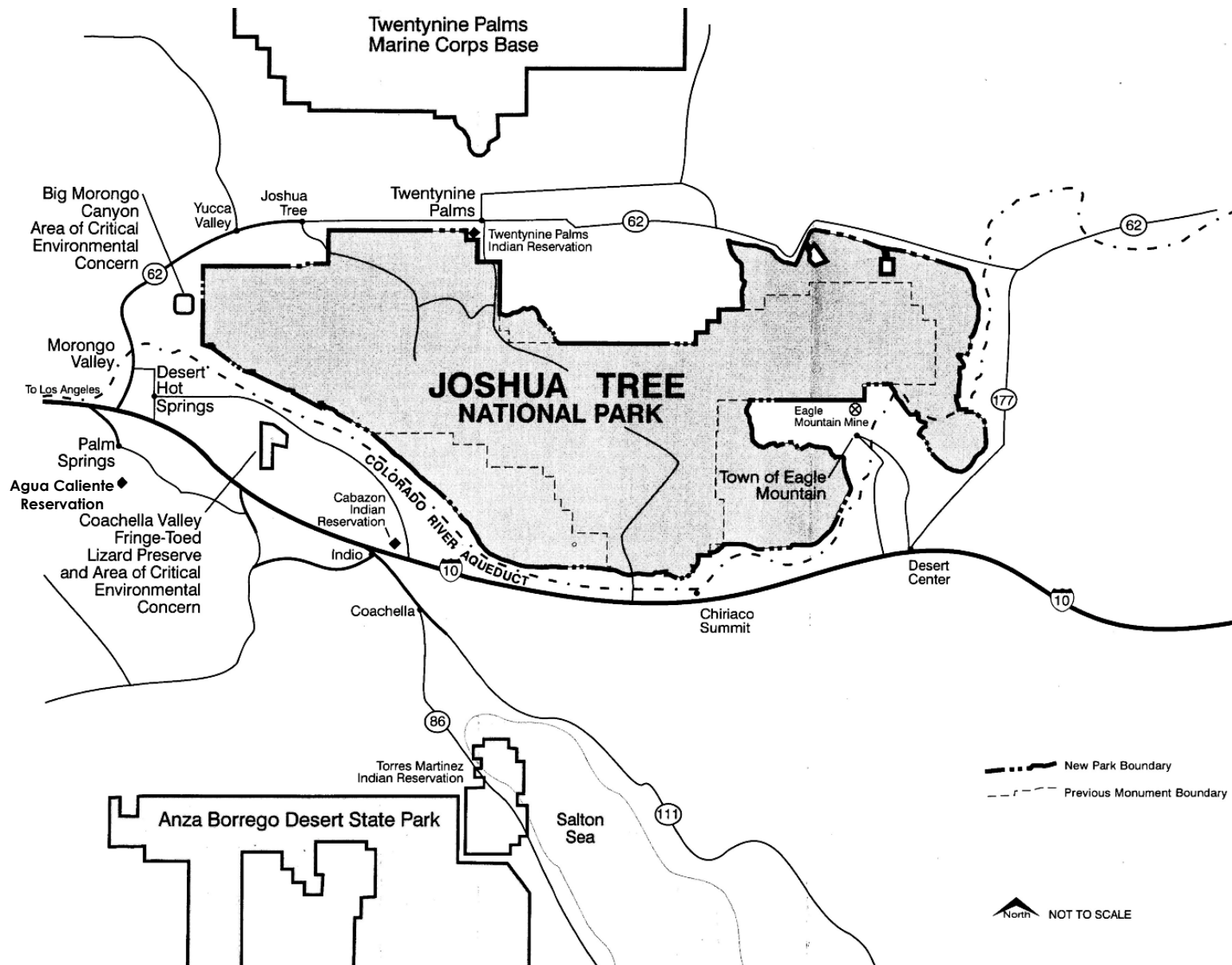


Figure 3. Local Map, Joshua Tree National Park, United States Department of the Interior, National Park Service

II. Park Resources and Significance

The proponents for the creation of Joshua Tree National Monument in the 1930s were driven by a sense of urgency to protect the area ahead of California's sprawling growth. However, since its creation urban development has reached the monument/park's borders. In the early years, everyone hoped that land status alone would provide significant protection for the resources. Indeed after its creation, the monument's boundary was an invisible, imaginary line in a sea of desert. If you fly over the area today, the park's boundaries are becoming increasingly visible due to developments such as housing tracts, roads, utility corridors, landfills, mining, military facilities, cities and agriculture. The park is becoming an ecological island.

Joshua Tree National Park is significant for the following reasons:

- The park is comprised of two biologically different desert environments, the Mojave and Colorado deserts, which merge within its boundaries to create an unusual ecological transition zone. Lush palm tree oases and historic springs draw attention to the importance of water in the desert environment.
- The Joshua tree, with its unusual shape and adaptation, is a perfect vehicle for understanding the interdependence of organisms living in the desert.
- Plants and animals have evolved to survive in the heat and drought. These adaptations produced an interesting array of life forms. Humans, from prehistoric times to present, also adapted to an environment with little water. People who have made this area their home have adapted and have provided a colorful and varied human history.
- The picturesque landscape features, including the mountain ranges, desert basins, and rock piles, all contribute to the significance of the park. The dynamic processes that formed in this area, including erosion and earthquakes, continue.

Natural Resources

Joshua Tree National Monument was originally set aside to preserve an ecologically dynamic component of the California Desert—much more than just the Joshua trees. The east-west Transverse ranges support examples of Mojave and Colorado Desert ecosystems. The elevations range from 6,000 feet to near sea level, which creates an unusual compressed transition zone between the two deserts.

Early proponents envisioned a representative segment of the two deserts that would be large enough to embrace a self-sustaining natural system. This system contains the visible and invisible biotic and abiotic components that link the elements. Living elements influence each other and are influenced by climate, fire, earthquakes, and other natural phenomena.



Mojave Desert with a Joshua Tree woodland

NPS photo

Cultural Resources

The geological and biological diversity of Joshua Tree area provided for early human subsistence. In the post Pleistocene, the climate was milder and wetter than it is now. The Pinto Basin was a braided river system 5,000 to 10,000 years ago. Along its banks lived the people of the Pinto Basin complex. Big game hunting was the predominant means of subsistence because the water and lush vegetation lured animals to the area. As the climate changed, the Pinto Basin slowly dried up and people left in search of water. They moved outside what is now the park to palm canyons of the lower valleys and to the cooler mountains and only returned to the area seasonally to trade, hunt, and harvest.

The park contains the early Pinto culture sites and traces of other prehistoric and historic American Indian cultures, as well as those of Euro-American gold mining, homesteading, and subsistence cattle ranching. The park is archeologically, ethnographically, and historically diverse. It exhibits a continuum of cultural adaptations and includes a significant collection of prehistoric and historic American Indian artifacts and late 19th century and early 20th century non-Indian artifacts. These artifacts document the park's importance to east-west migrations dating back to prehistoric times. The remnants of past human occupations illustrate the adaptations that different groups made to the arid desert environment.



Thunderstorm; Keys (Desert Queen) Ranch

NPS photo by Robb Hannawacker

Recreational Resources

The natural and cultural resources of the park provide outstanding recreational opportunities for the more than 1.6 million visitors that come to the area annually. Developed campgrounds allow for extended visits where visitors can explore Joshua Tree's many scenic and historic features. Campers can enjoy hiking, picnicking, interpretive programs, campfires and star gazing.

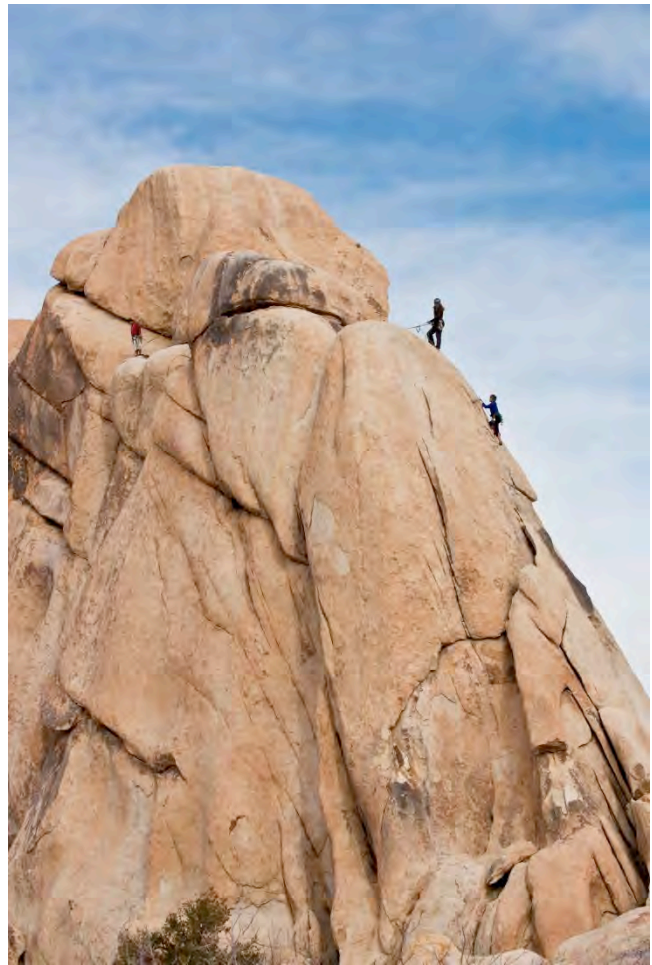


The wilderness provides an opportunity for solitude in nature and for primitive recreation such as hiking and backpacking. Clean air ensures an extensive visual range, and mountains, basins, canyons, massive boulders, rocky outcrops, desert plant life, and starry skies combine to make outstanding scenery.

Topographic relief and the associated change in air temperature encourage year-round visitor use. The park provides some of the most diverse desert wildflower displays in the southwestern United States. There is also a wide variety of wildlife, including coyotes, jackrabbits, desert tortoises, bighorn sheep, tarantulas, golden eagles, and roadrunners.

Opportunities to see, photograph, and study cultural resources also draw visitors. Old mines, ranches, and prehistoric rock art are all popular.

Massive boulders and rock outcrops provide some of the best rock climbing in the United States. Many families like to camp so they can scramble on the maze of boulders in the park. Skilled and novice technical rock climbers from around the world are attracted to the challenging climbing routes.



III. Night Sky Preservation Guidance

At the federal, state, and park level, a variety of laws, policies, plans and initiatives serve to guide Joshua Tree National Park in the protection of its dark night skies. These begin with the NPS Organic Act that established the U.S. National Park Service in 1916, to A Call to Action, the initiative to prepare the NPS for its centennial in 2016 and to provide leadership for the national parks into the next century. Goal #27 of that initiative, “Starry, Starry Night,” served as the impetus for Joshua Tree’s International Dark Sky Park application, as a way of fostering a dark sky cooperative in the Morongo Basin. Preserving dark night skies has been an important resource goal at the park since at least the early 1990s and is reflected in the parks management plans and other guiding documents.

National Park Service Organic Act

The 1916 NPS Organic Act created the U.S. National Park Service and still serves as the agency’s foundation for conservation. Among its purposes is scenic preservation, which includes dark sky resources and the mandate to keep them unimpaired for future generations.



“The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

NPS Management Policies 2006

This volume of NPS Management Policies is the basic Service-wide policy document of the U.S. National Park Service. It is designed to provide NPS management and staff with required and/or recommended actions to help manage parks and programs effectively.



4.1.4 Partnerships

“The Service will seek the cooperation of others in minimizing the impacts of influences originating outside parks by controlling noise and artificial lighting...”

4.10 Lightscape Management

“The Service will preserve, to the greatest extent possible, the natural lightscape of parks, which are natural resources and values that exist in the absence of human caused light...” “The stars, planets, and earth’s moon that are visible during clean nights influence humans and many other species of animals, such as birds that navigate by the stars or prey animals that reduce their activities during moonlit nights.”

9.3.1.4 Amphitheaters

“Artificial lighting must be carefully directed and kept to a minimum, with due regard for natural night sky conditions.”

9.3.2.1 Campgrounds

“Lighting will be energy efficient and shielded as much as possible so that visitors have the opportunity to experience the natural darkness and night skies.”

A Call to Action

U.S. National Park Service, 2011 (revised 2012)

A Call to Action is a strategic plan created to set a new direction for the U.S. National Park Service in its second century of stewardship and engagement. The plan is organized around broad themes and supported by specific goals and measurable actions. Each NPS park unit selects goals that strategically focus its efforts on actions that advance the NPS mission. Joshua Tree National Park is working toward achieving several Call to Action goals, including the following initiatives which advance the park’s commitment to preserving natural darkness in the nighttime sky:



Goal #27: “Starry, Starry Night”

“Lead the way in protecting natural darkness as a precious resource and create a model for dark sky protection by establishing America’s first Dark Sky Cooperative on the Colorado Plateau in collaboration with other federal agencies, partners, and local communities.”

Goal #38: “Enjoy the View”

“Protect clean, clear air and spectacular scenery now and for future generations. To do this we will lead collaborative efforts in 10 parks creating viewshed cooperatives with other federal agencies, tribes, and local partners to assess air pollutants and preserve treasured viewsheds and natural and cultural resources.”

Foundation Document

Joshua Tree National Park, January 2015

The Foundation document provides a formal statement of core missions, values, and resources significant and fundamental to the park.

Fundamental Resources and Values

Recreational opportunities and values: Current Conditions and Trends

- Passive uses, such as photography, night sky observing, and wildlife and nature appreciation, are being impacted by a large variety of sources (e.g. graffiti, overcrowding, external threats, etc.)

Night sky: Current Conditions and Trends

- The night sky is impacted by light pollution in most areas of the park. However the easterly and northerly skies are much less impacted.
- There is a “floating baseline” regarding the night sky. Baseline data is being currently being collected and will be used to establish trends related to development around the park and areas for improvement (e.g., working with developers, lighting suppliers, and local governments).
- Declining quality of night sky experience is resulting from urban development, both near and far. Without active efforts to mitigate the threats (urban development lighting), the trend of declining quality will likely continue.
- Park staff are currently working with San Bernardino County on promoting light pollution mitigation.
- James Ramos, The Supervisor of San Bernardino County 3rd district is working to implement an enforcement strategy.

Resource Stewardship Strategy

Joshua Tree National Park, 2014

The Resource stewardship Strategy serves as an analytic tool that distills management objectives from the qualitative statements of a park’s priority resources; identified current threats, opportunities and knowledge gaps; lays out sets of activities designed to meet management objectives; and compiles these activities into comprehensive strategies. Resource Stewardship Strategies are created with a 15-20 year time horizon, and help parks identify sets of reference conditions and condition targets for fundamental resources and values (FRV’s).

4.3 Comprehensive Strategy Timeline and Details

4.3.10a Comprehensive Strategy Details: Night Sky

Night Sky Objective #1: Decrease light pollution emanating from sources outside of park boundaries, as feasible

Night Sky Objective #2: Maintain natural darkness and minimize light pollution within park boundaries

IV. Sky Quality at Joshua Tree NP

Existing Night Sky Conditions

The existing night sky quality at Joshua Tree National Park falls within the Silver Tier for the International Dark Sky Parks criterial. Data was collected using both the Unihedron Sky Quality Meter and a Charged Couple Device (CCD) Camera (NPS Method). The sky brightness values collected with the Sky Quality Meter ranged from 20.87 to 21.58 magnitudes per square arcsecond. The mean all-sky brightness values collected with the CCD camera ranged from 20.23 to 21.4 magnitudes per square arcsecond. The brighter sky values were collected in areas of the Park near urban interfaces, such as Keys View, Black Rock Campground, and Hexahedron Mine. The darker sky values were collected from the interior and more eastern areas of the Park, such as Old Dale Road, Cottonwood Springs, and Pinto Wells.

Illuminance Measurements with a Unihedron Sky Quality Meter

The Unihedron Sky Quality Meter is a device used to measure luminance of the night sky as seen by human night vision. Luminance is the brightness of a surface, such as the night sky. Joshua Tree National Park has collected measurements from 13 sites within the Park boundary. The sky brightness values collected with the Sky Quality Meter range from 20.87 to 21.58 magnitudes per square arcsecond. The measurements can be seen below in the following table:



Figure 4. The Sky Quality Meter and the standard weatherproof housing.



Figure 5. The Sky Quality Meter (SQM-LE) with Ethernet Cable.

Table 1. Unihedron Sky Quality Meter data collected in Joshua Tree National Park on 12/14/2015 and 12/15/2015.

UT_datetime	Type	Bright-ness	Zenith	Conditions	Latitude	Longitude	Moon_alt	Moon_illum	Site description	User	Clear Sky Clock
12/15/2015 09:45	SQM-L	21.47	Up	Clear	33.9400	-115.4159	-64	17	Pinto Wells	JoshuaTreeNP	CSC
12/15/2015 09:22	SQM-L	21.48	Up	Clear	33.916	-115.4010	-61	17	Pinto Wells Gate	JoshuaTreeNP	CSC
12/15/2015 08:33	SQM-L	21.58	Up	Clear	33.7801	-115.463	-53	17	Big Wash Road	JoshuaTreeNP	CSC
12/15/2015 07:35	SQM-L	21.46	Up	Clear	33.7431	-115.8145	-41	16	Cottonwood Group Campsite 2	JoshuaTreeNP	CSC
12/15/2015 07:20	SQM-L	21.46	Up	Clear	33.8281	-115.7588	-38	16	Old Dale 2	JoshuaTreeNP	CSC
12/15/2015 06:49	SQM-L	21.42	Up	Clear	33.9454	-115.975	-32	16	Wilson Canyon 2	JoshuaTreeNP	CSC

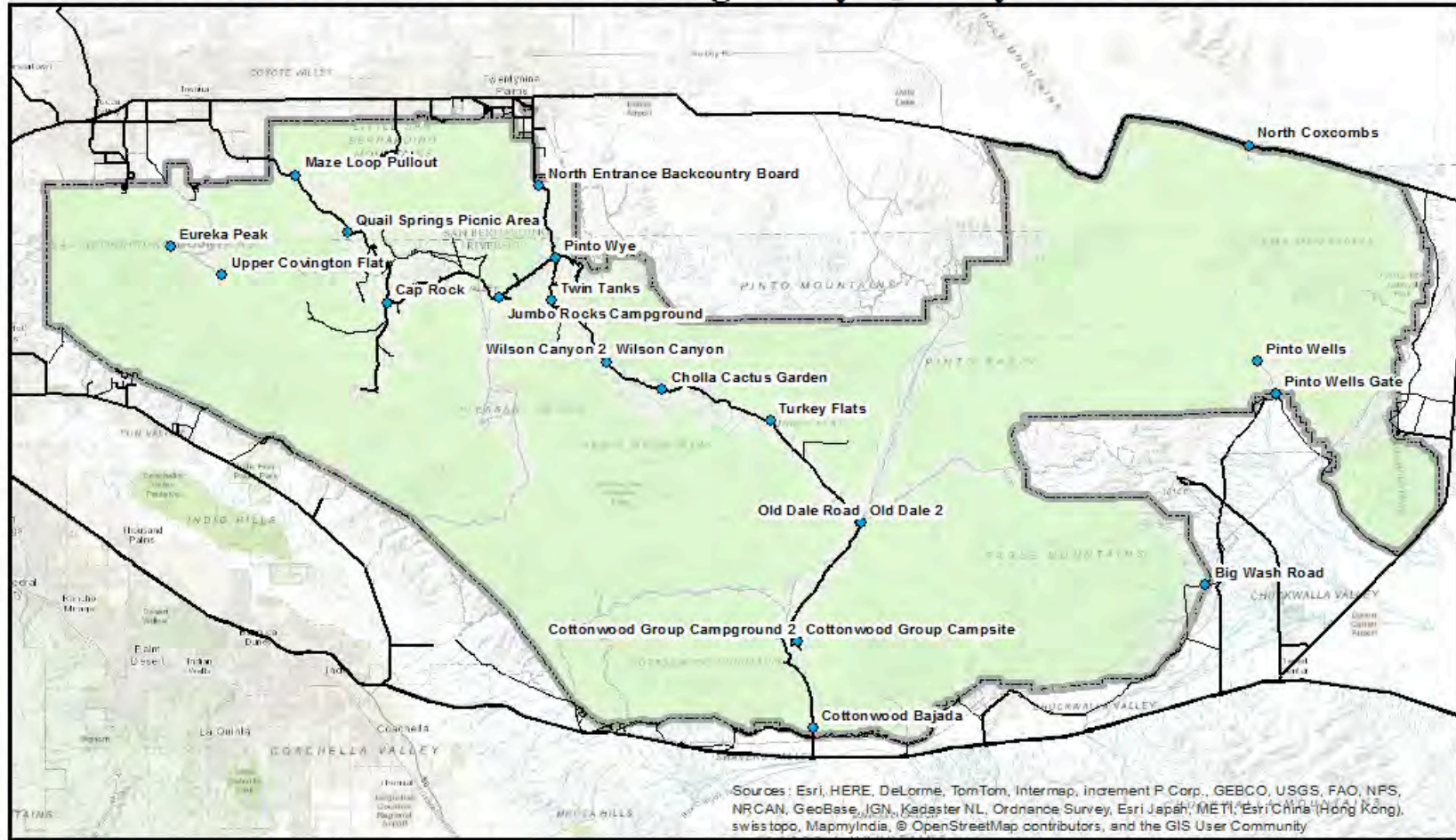
Table 2. Unihedron Sky Quality Meter data collected in Joshua Tree National Park on 11/09/2015 and 11/10/2015.

UT_datetime	Type	Brightness	Zenith	Conditions	Latitude	Longitude	Moon_alt	Moon_illum	Site description	User	Clear Sky Clock
11/10/2015 10:29	SQM -L	20.87	Up	clear	34.081	-116.242	-32	2	Maze Loop Pullout	JoshuaTreeNP	CSC
11/10/2015 10:18	SQM -L	20.91	Up	clear	34.0401	-116.198	-34	2	Quail Springs Picnic Area	JoshuaTreeNP	CSC
11/10/2015 10:08	SQM -L	20.94	Up	clear	33.9892	-116.164	-36	2	Cap Rock	JoshuaTreeNP	CSC
11/10/2015 9:55	SQM -L	20.98	Up	clear	33.9919	-116.068	-39	2	Jumbo Rocks	JoshuaTreeNP	CSC
11/10/2015 9:05	SQM -L	21.07	Up	clear	33.7432	-115.814	-48	2	Cottonwood Group Campground	JoshuaTreeNP	CSC
11/10/2015 8:52	SQM -L	21.09	Up	clear	33.6845	-115.802	-50	2	Cottonwood Bajada	JoshuaTreeNP	CSC
11/10/2015 8:30	SQM -L	21.14	Up	clear	33.8281	-115.759	-54	2	Old Dale Road	JoshuaTreeNP	CSC
11/10/2015 8:12	SQM -L	21.11	Up	clear	33.9017	-115.834	-57	2	Turkey Flats	JoshuaTreeNP	CSC
11/10/2015 7:56	SQM -L	21.1	Up	clear	33.9251	-115.928	-59	2	Cholla Cactus Garden	JoshuaTreeNP	CSC
11/10/2015 7:46	SQM -L	21.07	Up	clear	33.9452	-115.975	-60	2	Wilson Canyon	JoshuaTreeNP	CSC
11/10/2015 7:28	SQM -L	21.09	Up	clear	33.99	-116.023	-62	2	Twin Tanks	JoshuaTreeNP	CSC
11/10/2015 7:09	SQM -L	21.05	Up	clear	34.0203	-116.019	-64	2	Pinto Wye	JoshuaTreeNP	CSC
11/10/2015 7:07	SQM -L	21.04	Up	clear	34.0723	-116.033	-64	2	North Entrance Backcountry Board	JoshuaTreeNP	CSC

Table 3. Unihedron Sky Quality Meter data collected in Joshua Tree National Park on 08/29/2016 and 08/30/2016.

UT_datetime	Type	Brightness	Zenith	Conditions	Latitude	Longitude	Moon_alt	Moon_illum	Site description	User	Clear Sky Clock
2016-08-30 06:20:57	SQM-LE	21.61	Up	clear	34.0096	-115.42	-42	5	North Coxcombs	JoshuaTreeNP	CSC
2016-08-30 07:37:31	SQM-LE	21.82	Up	clear	34.0401	-116.198	-38	4	Pinto Wells	JoshuaTreeNP	CSC
2016-08-30 10:24:53	SQM-LE	21.53	Up	clear	34.0305	-116.35	-14	4	Eureka Peak	JoshuaTreeNP	CSC
2016-08-30 10:44:22	SQM-LE	21.51	Up	clear	34.0097	-116.306	-11	4	Upper Covington Flat	JoshuaTreeNP	CSC

Joshua Tree National Park: Night Sky Quality Meter Locations



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swiss topo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Legend

Site Locations	Roads	DIRT 4X4
Park Boundary	PAVED	DIRT 4x4
Wilderness	DIRT	DIRT4X4

0 5 10 20 30 Miles

1:425,005 **1 in = 7 miles**



Figure 6. Map of the Locations where sky brightness values were collection using the Unihedron Sky Quality Meter (SQM-LE).

NPS Method

Capturing the essence of a lightscape with numerical data is complex, but advances in technology have made possible an efficient and accurate method of measuring the impact of light pollution. The National Park Service has pioneered portable instrumentation and techniques for measuring conditions in parks and since 2001 has been testing and capturing data in nearly 100 national parks. The current state of the methodology features:

- rapid capturing the night sky in a high resolution mosaic,
- precise measurement of sky brightness and glare across the entire celestial hemisphere,
- identification of light pollution sources, and
- separation of natural and human-caused sky brightness.

The approach is designed to measure the night sky as the human eye sees it; in doing so, we can quantify aspects of the natural lightscape.

The heart of the system is a CCD camera (charged coupled device camera)—essentially a research-grade digital camera. It is attached to a robotic mount and laptop computer. The computer choreographs the entire system, pointing the camera to pre-determined areas of the sky and capturing a series of short exposures. These images are later individually calibrated and then stitched together to form a mosaic of the entire sky that can be displayed in either a panoramic or hemispheric (i.e., fish-eye) view. Data are calibrated to stars of known brightness, allowing absolute brightness measures to be extracted from the images. The camera uses a green filter, rejecting all other light from the infrared to the ultraviolet. This green or "V-band" filter approximates human night vision sensitivity. This process is known as astronomical photometry.

Data is displayed in various measures of sky brightness (luminance) as well as ground illuminance as a result of human-caused light.

A "Data Set" is one complete set of 45 images that cover the entire sky. Multiple data sets are often taken over the course of the night to detect changes in artificial sky glow from evening to early morning. The web report shows data from the best or most representative set only.



Figure 7. Camera attached to robotic mount and tripod.

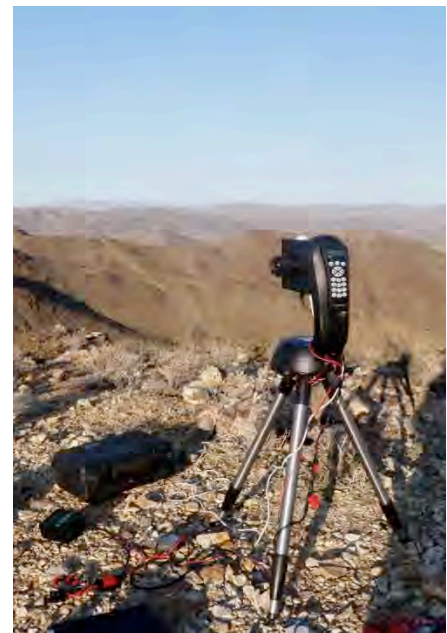


Figure 8. Camera attached to robotic mount and tripod.

The report contains three main sections:

1. A table showing general attributes of the data collection event and visual indicators of sky quality
2. Panoramic images of the entire sky shown in false color revealing calibrated sky brightness with links to the high resolution images
3. Photometric indicators of sky quality and the photic environment derived from the all-sky mosaics. Photometric units of measure used include SI units of luminance (candela per square meter) and illuminance (lux), as well as astronomical units of luminance (magnitudes per square arc second) and illuminance (magnitudes) in the V, or visual, band. SI units are linear, astronomical units are inverse logarithmic, that is, smaller values indicate brighter objects, and negative values are possible.

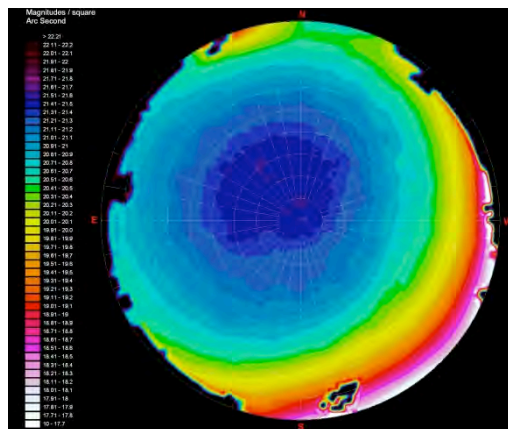


Figure 9. Mosaic of the entire sky stitched together from the 45 images shown in a hemispheric view. Data was collected from Keys View on 02/22/2006.

The NPS methods are unique in that a natural sky model is built for each all-sky observation and subtracted pixel-by-pixel revealing the estimated artificial sky glow. The indicator “Sky Quality Index” or SQI is derived from the artificial sky brightness only; therefore it is an index of light pollution from sky glow.

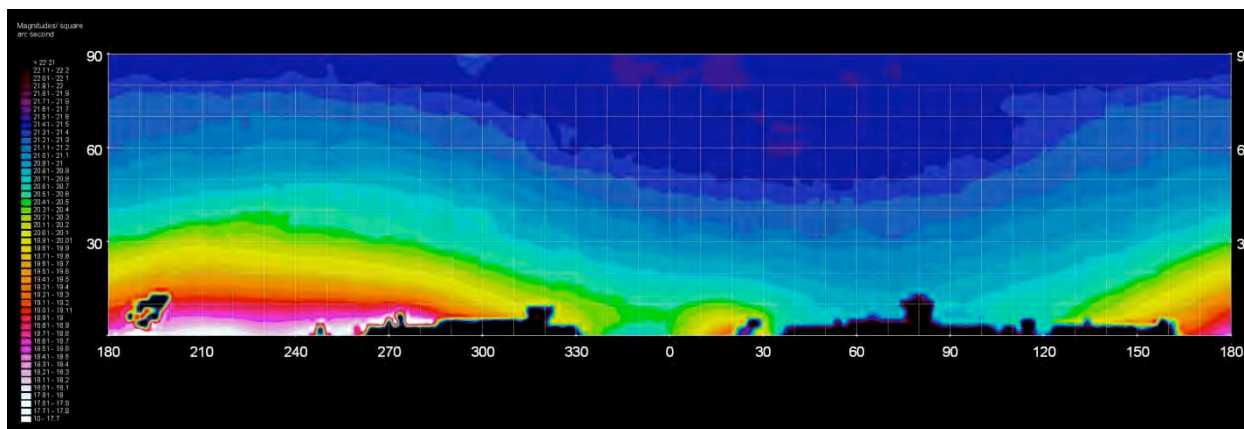


Figure 10. Mosaic of the entire sky stitched together from the 45 images shown in a panoramic view. Data was collected from Keys View on 02/22/2006.



Night Sky Quality Monitoring Report

Joshua Tree NP

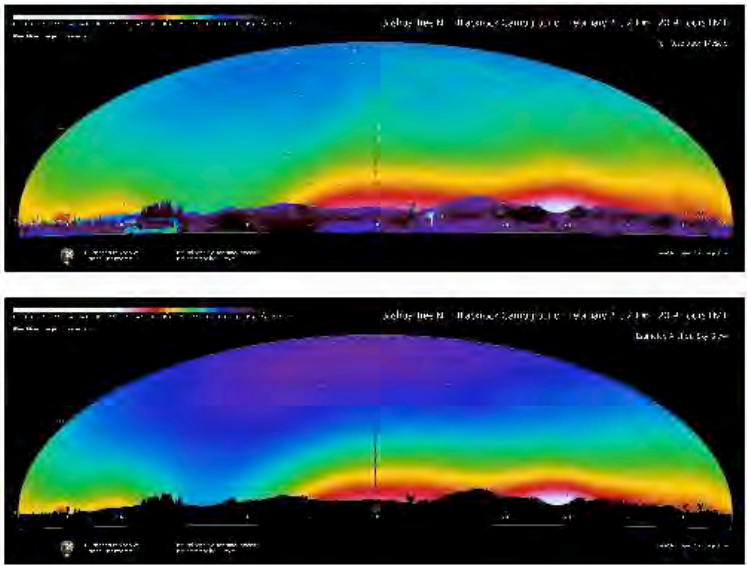
Blackrock Campground

21-Feb-2006

To effectively manage any resource, we need to know what we have and what we've lost. Light pollution, the brightness in the nighttime sky due to artificial light, effectively masks natural sources of light at night such as the stars and the Milky Way. The NPS has developed a system for measuring sky brightness to quantify the source and severity of light pollution. This system, developed with assistance from professional astronomers and the International Dark-Sky Association, uses a research-grade digital camera to capture the entire sky with a series of images. Data clearly show that almost every park, even remote national parks, are not immune from stray artificial light. Sky brightness is measured in astronomical magnitudes in the visual band or V-band, abbreviated as "mags". The V-band measures mostly green light, omitting purple through ultraviolet and orange through infrared. The magnitude scale is a logarithmic scale. A difference of 5 magnitudes corresponds to a 100x difference in brightness. Lower values (smaller or more negative) are brighter. Further information on astronomical magnitudes can be found on this Sky and Telescope webpage. Data images are shown in false color, with yellow, red, and white correspond to brighter sky and blue, purple and black corresponding to darker sky.

A more [detailed explanation](#) is available.

Data Set Attributes and Visual Indicators

Category	Details	Observed and Estimated Artificial Sky Brightness Mosaics
Park:	Joshua Tree NP	<p>Click on either image for a high resolution view</p> 
Site Name:	Blackrock Campground	
Longitude:	-116.39	
Latitude:	34.08	
Elevation (m):	1205	
Date (LMT):	21-Feb-2006	
Time (LMT Hours):	20.87	
Camera:	IMG 1	

Lens:	Nikon 1.8	NARRATIVE: Clear night, no clouds. Pronounced LP domes, only subtle detail in Perseus MW no zodiacal light, stars lost near horizon.			
Observers:	C Moore A Richman				
Air temp. (°C):	.0				
R. H. (%):	22.0				
Wind Speed (mph):	1				
Extinction Coeff. (mag/airmass):	0.20				
NELM:	6.4				
Bortle Class:	5				
Synthetic SQM:	20.88				
SQI All- sky:	44.				
SQI to Z.A. 70°:	53.				
Number of stars visible:	2430				
Photometric Indicators					
Indicator	Observed		Estimated Artificial		Light Pollution Ratio (Artificial/Natural)
Sky Luminance Measures					
Indicator	mag/ arcsec²	μcd/ m²	mag/ arcsec²	μcd/ m²	Light Pollution Ratio
Zenith	21.11	392	21.97	175	1.02
Mean all-sky	20.23	880	20.56	641	2.58
Brightest	17.28	13,166	17.30	12,881	75.33
Darkest	21.15	372	21.98	172	1.01
Median	20.57	633	21.07	400	1.60
Illuminance Measures					
Indicator	mags	milli-lux	mags	milli-lux	Light Pollution Ratio
Horizontal	-7.26	2.02	-6.77	1.30	1.63
Max Vertical	-7.15	1.84	-6.85	1.39	3.48

Night Sky Quality Monitoring Report



Joshua Tree NP

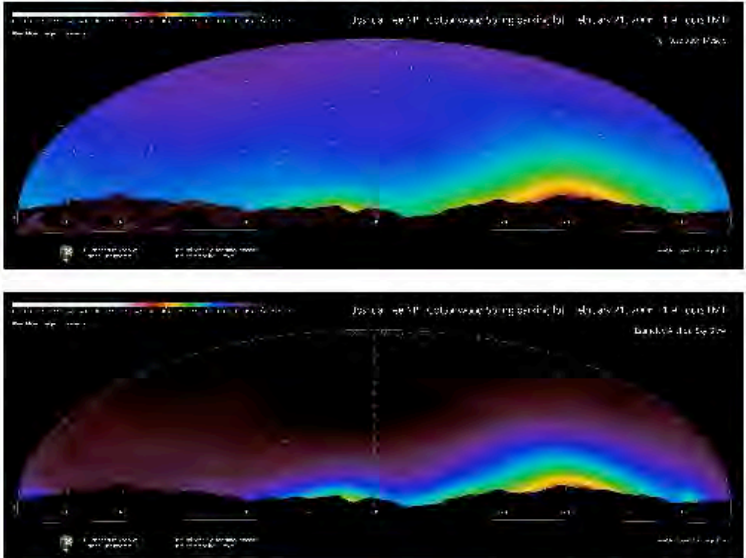
Cottonwood Spring parking lot

21-Feb-2006

To effectively manage any resource, we need to know what we have and what we've lost. Light pollution, the brightness in the nighttime sky due to artificial light, effectively masks natural sources of light at night such as the stars and the Milky Way. The NPS has developed a system for measuring sky brightness to quantify the source and severity of light pollution. This system, developed with assistance from professional astronomers and the International Dark-Sky Association, uses a research-grade digital camera to capture the entire sky with a series of images. Data clearly show that almost every park, even remote national parks, are not immune from stray artificial light. Sky brightness is measured in astronomical magnitudes in the visual band or V-band, abbreviated as "mags". The V-band measures mostly green light, omitting purple through ultraviolet and orange through infrared. The magnitude scale is a logarithmic scale. A difference of 5 magnitudes corresponds to a 100x difference in brightness. Lower values (smaller or more negative) are brighter. Further information on astronomical magnitudes can be found on this Sky and Telescope webpage. Data images are shown in false color, with yellow, red, and white corresponding to brighter sky and blue, purple and black corresponding to darker sky.

A more [detailed explanation](#) is available.

Data Set Attributes and Visual Indicators

Category	Details	Observed and Estimated Artificial Sky Brightness Mosaics
Park:	Joshua Tree NP	<p>Click on either image for a high resolution view --</p> 
Site Name:	Cottonwood Spring parking lot	
Longitude:	-115.81	
Latitude:	33.74	
Elevation (m):	915	
Date (LMT):	21-Feb-2006	
Time (LMT Hours):	1.86	
Camera:		

Lens:	Nikon 1.8	NARRATIVE: Clear night, lots of scintillation
Observers:	C Moore A Richman	
Air temp. (°C):	5.6	
R. H. (%):	19.0	
Wind Speed (mph):	6	
Extinction Coeff. (mag/airmass):	0.20	
NELM:	6.8	
Bortle Class:	3	
Synthetic SQM:	21.71	
SQI All- sky:	78.6	
SQI to Z.A. 70°:	85.5	
Number of stars visible:	3020	

Photometric Indicators

Indicator	Observed		Estimated Artificial		Light Pollution Ratio (Artificial/Natural)
Sky Luminance Measures					
Indicator	mag/arscec ²	μcd/ m ²	mag/arscec ²	μcd/ m ²	Light Pollution Ratio
Zenith	21.94	181	24.20	22	0.13
Mean all-sky	21.23	350	22.26	133	0.54
Brightest	19.12	2,409	19.26	2,116	12.37
Darkest	22.00	170	> 24.5	< 17	< 0.10
Median	21.45	283	22.96	70	0.28
Illuminance Measures					
Indicator	mags	milli-lux	mags	milli-lux	Light Pollution Ratio
Horizontal	-6.34	0.87	-4.97	0.25	0.31
Max Vertical	-6.14	0.72	-5.44	0.38	0.95

Night Sky Quality Monitoring Report

Joshua Tree NP

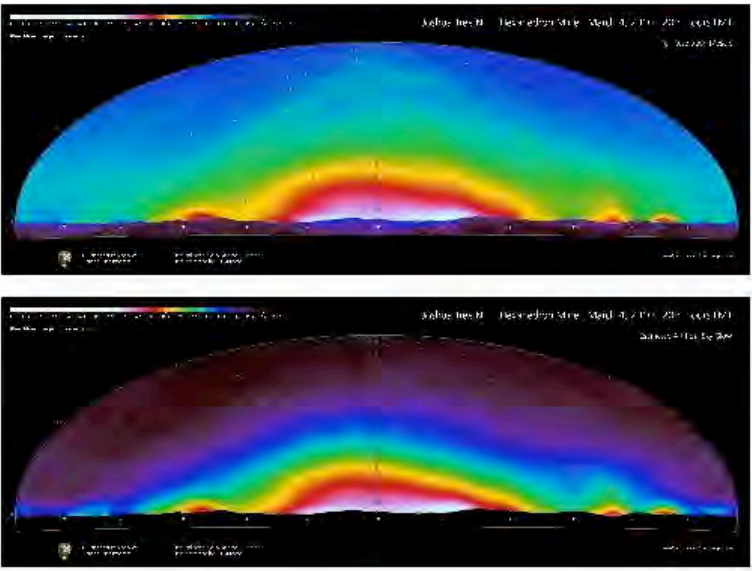
Hexahedron Mine

04-Mar-2010

To effectively manage any resource, we need to know what we have and what we've lost. Light pollution, the brightness in the nighttime sky due to artificial light, effectively masks natural sources of light at night such as the stars and the Milky Way. The NPS has developed a system for measuring sky brightness to quantify the source and severity of light pollution. This system, developed with assistance from professional astronomers and the International Dark-Sky Association, uses a research-grade digital camera to capture the entire sky with a series of images. Data clearly show that almost every park, even remote national parks, are not immune from stray artificial light. Sky brightness is measured in astronomical magnitudes in the visual band or V-band, abbreviated as "mags". The V-band measures mostly green light, omitting purple through ultraviolet and orange through infrared. The magnitude scale is a logarithmic scale. A difference of 5 magnitudes corresponds to a 100x difference in brightness. Lower values (smaller or more negative) are brighter. Further information on astronomical magnitudes can be found on this Sky and Telescope webpage. Data images are shown in false color, with yellow, red, and white corresponding to brighter sky and blue, purple and black corresponding to darker sky.

A more [detailed explanation](#) is available.

Data Set Attributes and Visual Indicators

Category	Details	Observed and Estimated Artificial Sky Brightness Mosaics
Park:	Joshua Tree NP	<p>Click on either image for a high resolution view</p> 
Site Name:	Hexahedron Mine	
Longitude:	-116.00	
Latitude:	33.93	
Elevation (m):	1199	
Date (LMT):	04-Mar-2010	
Time (LMT Hours):	20.36	
Camera:	Proline	

Lens:	Nikon 1.8	NARRATIVE: No Information Provided			
Observers:	S Manson B Jamison				
Air temp. (°C):	227.7				
R. H. (%):	32.0				
Wind Speed (mph):	3				
Extinction Coeff. (mag/airmass):	0.21				
NELM:					
Bortle Class:					
Synthetic SQM:	21.07				
SQI All- sky:	54.8				
SQI to Z.A. 70°:	68.7				
Number of stars visible:	2690				
Photometric Indicators					
Indicator	Observed		Estimated Artificial		Light Pollution Ratio (Artificial/Natural)
Sky Luminance Measures					
Indicator	mag/ arcsec²	μcd/ m²	mag/ arcsec²	μcd/ m²	Light Pollution Ratio
Zenith	21.30	328	23.19	57	0.33
Mean all-sky	20.28	840	20.81	509	2.05
Brightest	16.99	17,145	17.00	16,899	98.82
Darkest	21.40	296	23.28	52	0.31
Median	20.83	498	22.08	158	0.63
Illuminance Measures					
Indicator	mags	milli-lux	mags	milli-lux	Light Pollution Ratio
Horizontal	-7.09	1.74	-6.18	0.75	0.94
Max Vertical	-7.53	2.61	-7.24	2.00	5.00

Night Sky Quality Monitoring Report

Joshua Tree NP

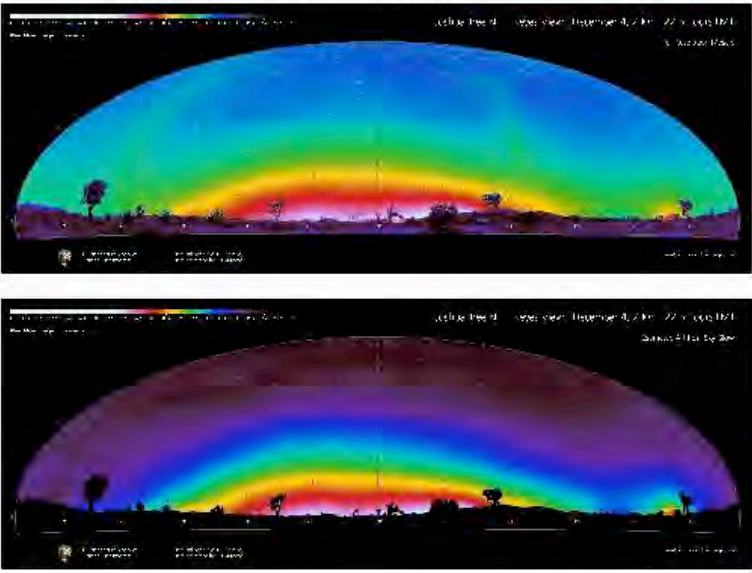
Keys View Weather Station

04-Dec-2005

To effectively manage any resource, we need to know what we have and what we've lost. Light pollution, the brightness in the nighttime sky due to artificial light, effectively masks natural sources of light at night such as the stars and the Milky Way. The NPS has developed a system for measuring sky brightness to quantify the source and severity of light pollution. This system, developed with assistance from professional astronomers and the International Dark-Sky Association, uses a research-grade digital camera to capture the entire sky with a series of images. Data clearly show that almost every park, even remote national parks, are not immune from stray artificial light. Sky brightness is measured in astronomical magnitudes in the visual band or V-band, abbreviated as "mags". The V-band measures mostly green light, omitting purple through ultraviolet and orange through infrared. The magnitude scale is a logarithmic scale. A difference of 5 magnitudes corresponds to a 100x difference in brightness. Lower values (smaller or more negative) are brighter. Further information on astronomical magnitudes can be found on this Sky and Telescope webpage. Data images are shown in false color, with yellow, red, and white corresponding to brighter sky and blue, purple and black corresponding to darker sky.

A more [detailed explanation](#) is available.

Data Set Attributes and Visual Indicators

Category	Details	Observed and Estimated Artificial Sky Brightness Mosaics
Park:	Joshua Tree NP	<p>Click on either image for a high resolution view</p> 
Site Name:	Keys View Weather Station	
Longitude:	-116.17	
Latitude:	33.93	
Elevation (m):	1524	
Date (LMT):	04-Dec-2005	
Time (LMT Hours):	22.46	
Camera:	SBIG 1	

Lens:	Nikon 1.8	NARRATIVE: Very windy, gusts to 25 mph. High clouds coming and going to south and west, maximum 10% cover, 3rd set most cloud-free. Direct lights from Indio and Coachella Valley strike the actual viewpoint. Site moved to near the weather station just east in saddle so that land blocks direct glare from lights in the valley. Sky very bright to southwest from light pollution, Milky Way barely visible to west, easily visible overhead and to east. Light from the sky illuminates land to fat crescent moonlight levels. View parking lot good for public and telescopes, but very bright compared to other locations in the park.
Observers:	D Duriscoe	
Air temp. (°C):	.1	
R. H. (%):	22.0	
Wind Speed (mph):	13	
Extinction Coeff. (mag/airmass):	0.13	
NELM:	6.7	
Bortle Class:	5	
Synthetic SQM:	21.06	
SQI All- sky:	54.1	
SQI to Z.A. 70°:	65.9	
Number of stars visible:	3150	

Photometric Indicators:

Indicator	Observed		Estimated Artificial		Light Pollution Ratio (Artificial/Natural)
Sky Luminance Measures					
Indicator	mag/ arcsec ²	μcd/ m ²	mag/ arcsec ²	μcd/ m ²	Light Pollution Ratio
Zenith	21.23	349	22.86	77	0.45
Mean all-sky	20.35	787	20.94	449	1.81
Brightest	17.35	12,266	17.38	11,900	69.59
Darkest	21.26	335	23.05	65	0.38
Median	20.80	511	22.03	165	0.66
Illuminance Measures					
Indicator	mags	milli-lux	mags	milli-lux	Light Pollution Ratio
Horizontal	-7.07	1.70	-6.15	0.73	0.92
Max Vertical	-7.33	2.16	-6.99	1.59	3.98



Night Sky Quality Monitoring Report

Joshua Tree NP

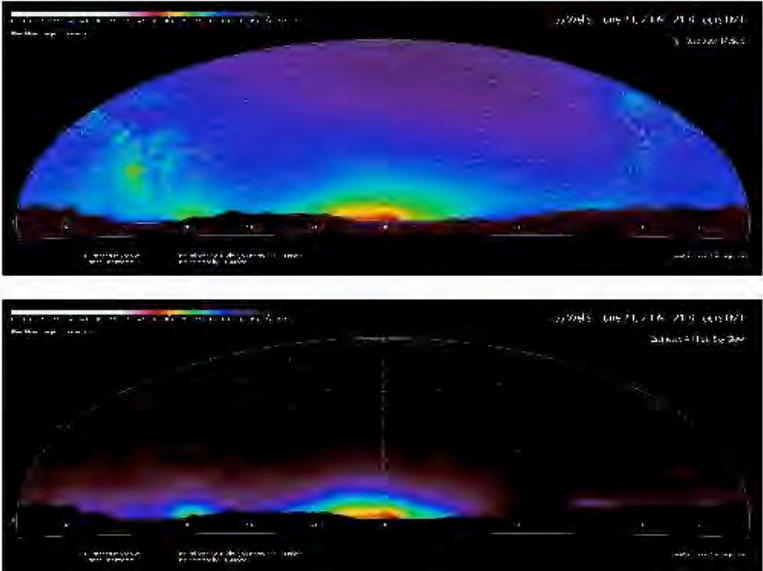
Pinto Wells

23-Jun-2009

To effectively manage any resource, we need to know what we have and what we've lost. Light pollution, the brightness in the nighttime sky due to artificial light, effectively masks natural sources of light at night such as the stars and the Milky Way. The NPS has developed a system for measuring sky brightness to quantify the source and severity of light pollution. This system, developed with assistance from professional astronomers and the International Dark-Sky Association, uses a research-grade digital camera to capture the entire sky with a series of images. Data clearly show that almost every park, even remote national parks, are not immune from stray artificial light. Sky brightness is measured in astronomical magnitudes in the visual band or V-band, abbreviated as "mags". The V-band measures mostly green light, omitting purple through ultraviolet and orange through infrared. The magnitude scale is a logarithmic scale. A difference of 5 magnitudes corresponds to a 100x difference in brightness. Lower values (smaller or more negative) are brighter. Further information on astronomical magnitudes can be found on this Sky and Telescope webpage. Data images are shown in false color, with yellow, red, and white corresponding to brighter sky and blue, purple and black corresponding to darker sky.

A more [detailed explanation](#) is available.

Data Set Attributes and Visual Indicators

Category	Details	Observed and Estimated Artificial Sky Brightness Mosaics
Park:	Joshua Tree NP	<p>Click on either image for a high resolution view</p> 
Site Name:	Pinto Wells	
Longitude:	-115.41	
Latitude:	33.94	
Elevation (m):	332	
Date (LMT):	23-Jun-2009	
Time (LMT Hours):	21.78	
Camera:	Proline	

Lens:	Nikon 1.8	NARRATIVE: Remote and dark, nice protected location. Seeing good transparency good. Toward the west a bright and conspicuous broad light dome from Indio/Palm Springs/Beaumont/Los Angeles is the most evident insult to an otherwise excellent night sky. Barely discernable small light dome from Brawley/El Centro/Mexicali due south, and a faint glow over the mountains north from Las Vegas. Very good location for observing despite dirt road and little room for set up.			
Observers:	L Sabala S Manson D Duriscoe				
Air temp. (°C):	33.1				
R. H. (%):	11.0				
Wind Speed (mph):	3				
Extinction Coeff. (mag/airmass):	0.19				
NELM:	7.1				
Bortle Class:	3				
Synthetic SQM:	21.84				
SQI All- sky:	90.6				
SQI to Z.A. 70°:	97.6				
Number of stars visible:	4040				
Photometric Indicators					
Indicator	Observed		Estimated Artificial		Light Pollution Ratio (Artificial/Natural)
Sky Luminance Measures					
Indicator	mag/arcsec²	μcd/ m²	mag/arcsec²	μcd/ m²	Light Pollution Ratio
Zenith	22.23	139	> 24.5	< 17	< 0.10
Mean all-sky	21.40	299	23.14	60	0.24
Brightest	18.94	2,841	19.02	2,651	15.50
Darkest	22.26	134	> 24.5	< 17	< 0.10
Median	21.51	266	24.30	20	0.08
Illuminance Measures					
Indicator	mags	milli-lux	mags	milli-lux	Light Pollution Ratio
Horizontal	-6.17	0.75	-3.67	0.07	0.09
Max Vertical	-5.93	0.60	-4.80	0.21	0.53

Figure 11. False color panoramic photo of sky brightness at Pinto Wells, Joshua Tree National Park. Cities that contribute to sky glow are labeled below the photo.

Figure 12. False color panoramic photo of sky brightness at Keys View, Joshua Tree National Park. Cities that contribute to sky glow are labeled below the photo.

Light Pollution Data
Collected at Hexihedron Mine
Joshua Tree National Park, CA

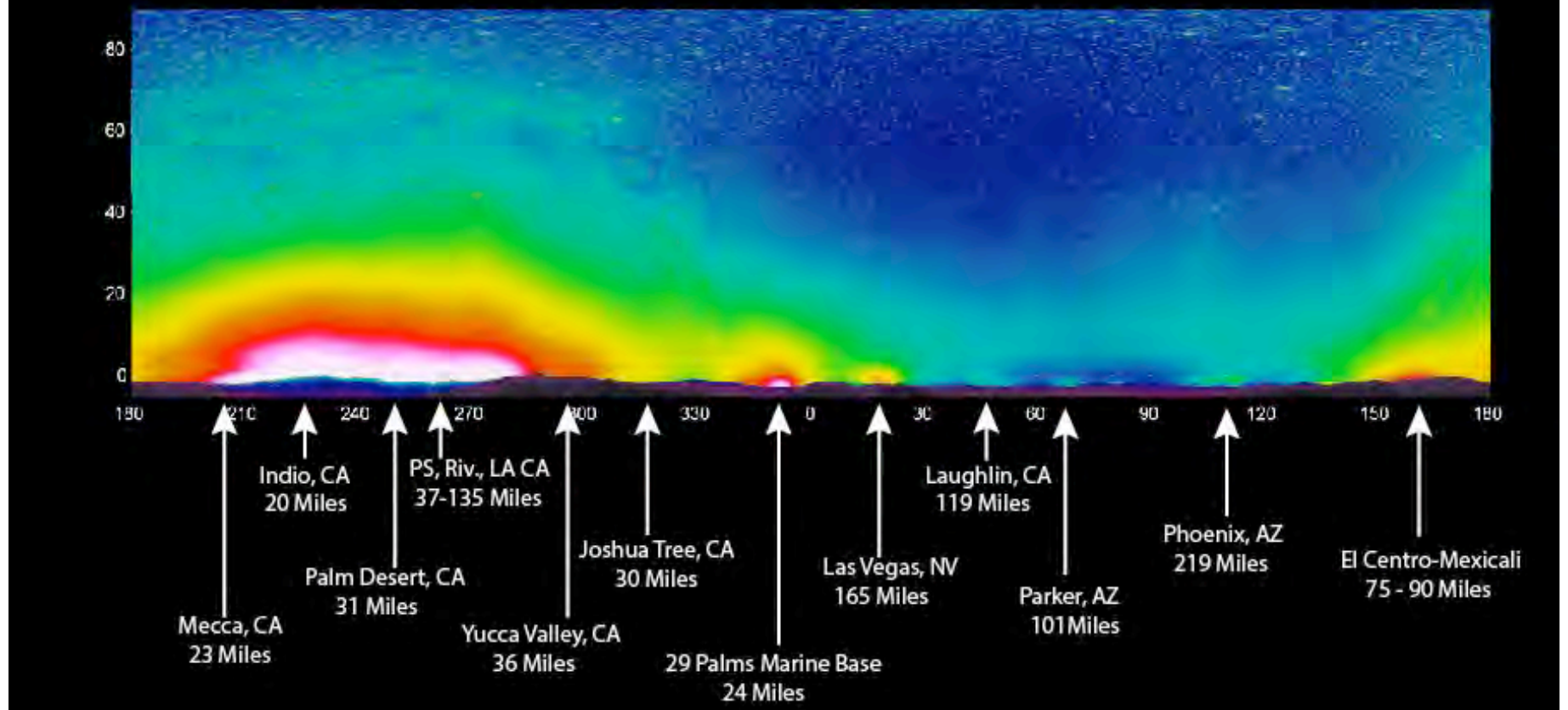


Figure 13. False color panoramic photo of sky brightness at Hexahedron Mine, Joshua Tree National Park. Cities that contribute to sky glow are labeled below the photo.

Continued Night Sky Monitoring

Monitoring of Joshua Tree's night sky began in 2005 and will continue in perpetuity by the Park's Resources Management and Physical Science staff. The Park will continue to track changes to the night sky quality using both illuminance measurements with the Sky Quality Meter and the NPS method with the CCD camera. Sites that have been visited in the past will be visited again, and new sites will be established for future monitoring. Park Interpretive staff will continue to educate the public about the night sky quality in the Park and the existing threat of degrading sky quality with urban development. Joshua Tree will also continue to work with partnering communities and agencies to improve lighting management policies as communities grow and darken the night sky within the park.



Figure 14. NPS Photo/Lian Law

V. Joshua Tree Astronomy

Joshua Tree National Park is a popular southern California location for amateur astronomy and stargazing, along with nearby Anza-Borrego Desert State Park. Joshua Tree is well known for its dark skies, which are largely free from southern California's extreme light pollution. The park's elevation and dry desert air, along with the relatively stable atmosphere in southern California, often make for excellent astronomical observing conditions. Joshua Tree's sky darkness ranges from a yellow (4.5) to a gray (2) rating on the Bortle Dark-Sky Scale (see Table 4 and Figure 15 below). Most light pollution comes from the southwestern boundary of the park where wilderness meets the urban development of the Coachella Valley. Dark skies can be found on the eastern side of the park, where very little development occurs around the park boundary.

Table 4. This table provides the description of the colors associated with the Bortle Scale that are used for mapping.

Color	Sky-Brightness	Sky Brightness mags/arc-sec ²	Bortle Scale	Description
Black	< 0.01	22.00 to 21.99	1	Gegenschein visible. Zodiacal light annoyingly bright. Rising Milky Way confuses some into thinking its dawn. Limiting magnitude 7.6 to 8.0 for people with exceptional vision. Users of large Dobsonian telescopes are <i>very</i> happy.
Dark Gray	0.01 to 0.11	21.99 to 21.89	2	Faint shadows cast by Milky Way visible on white objects. Clouds are black holes in the sky. No light domes. The milky way has faint extensions making it 50 degrees thick. Limiting magnitude 7.1 to 7.5.
Blue	0.11 to 0.33	21.89 to 21.69	3	Low light domes (10 to 15 degrees) on horizon. M33 easy with averted vision. M15 is naked eye. Milky way shows bulge into Ophiuchus. Limiting magnitude 6.6 to 7.0.
Green	0.33 to 1.0	21.69 to 21.25	4	Zodiacal light seen on best nights. Milky Way shows much dark lane structure with beginnings of faint bulge into Ophiuchus. M33 difficult even when above 50 degrees. Limiting magnitude about 6.2 to 6.5.
Yellow	1.0 to 3.0	21.25 to 20.49	4.5	Some dark lanes in Milky Way but no bulge into Ophiuchus. Washed out Milky Way visible near horizon. Zodiacal light very rare. Light domes up to 45 degrees. Limiting magnitude about 5.9 to 6.2.
Orange	3.0 to 9.0	20.49 to 19.50	5	Milky Way washed out at zenith and invisible at horizon. Many light domes. Clouds are brighter than sky. M31 easily visible. Limiting magnitude about 5.6 to 5.9.
Red	9.0 to 27.0	19.50 to 18.38	6 or 7	Milky Way at best very faint at zenith. M31 difficult and indistinct. Sky is grey up to 35 degrees. Limiting magnitude 5.0 to 5.5.
White	>27.0	<18.38	8 or 9	Entire sky is grayish or brighter. Familiar constellations are missing stars. Fainter constellations are absent. Limiting magnitude from 3 to 4. Telescopic visual observation is usually limited to the moon, planets, double stars and variable stars.

Joshua Tree National Park Light Pollution Map from ClearDarkSky.com

ClearDarkSky.com provides graphics and predications of night sky conditions around the globe. This map (Figure 15) from the World Atlas of the Artificial Night Sky Brightness shows light pollution in the vicinity of JTNP. The central cross marks the location of the Jumbo Rocks campground within the park. Since this map assumes an observer at sea level; an actual observer should see a slightly darker sky given that Joshua Tree’s elevation ranges from approximately 2,000-6,000 ft. Note the Las Vegas, NV corridor to the north; Los Angeles, CA to the west; San Diego, CA to the southwest; and the Palm Springs, CA corridor to the south; and the Mexicali, Mexico corridor to the southeast. Though the park has clear dark skies, light pollution from these communities is visible along the horizon.

“Light pollution limits the visibility of Milky Way to the unaided eye, the visibility of nebulae and galaxies seen in telescopes, and raises the noise on CCD astrophotographs. Only the observation of planets and double stars is unaffected. Low light pollution conditions, or dark skies, are one of the most important properties of a good astronomical observing site.” (Source: cleardarksky.com)

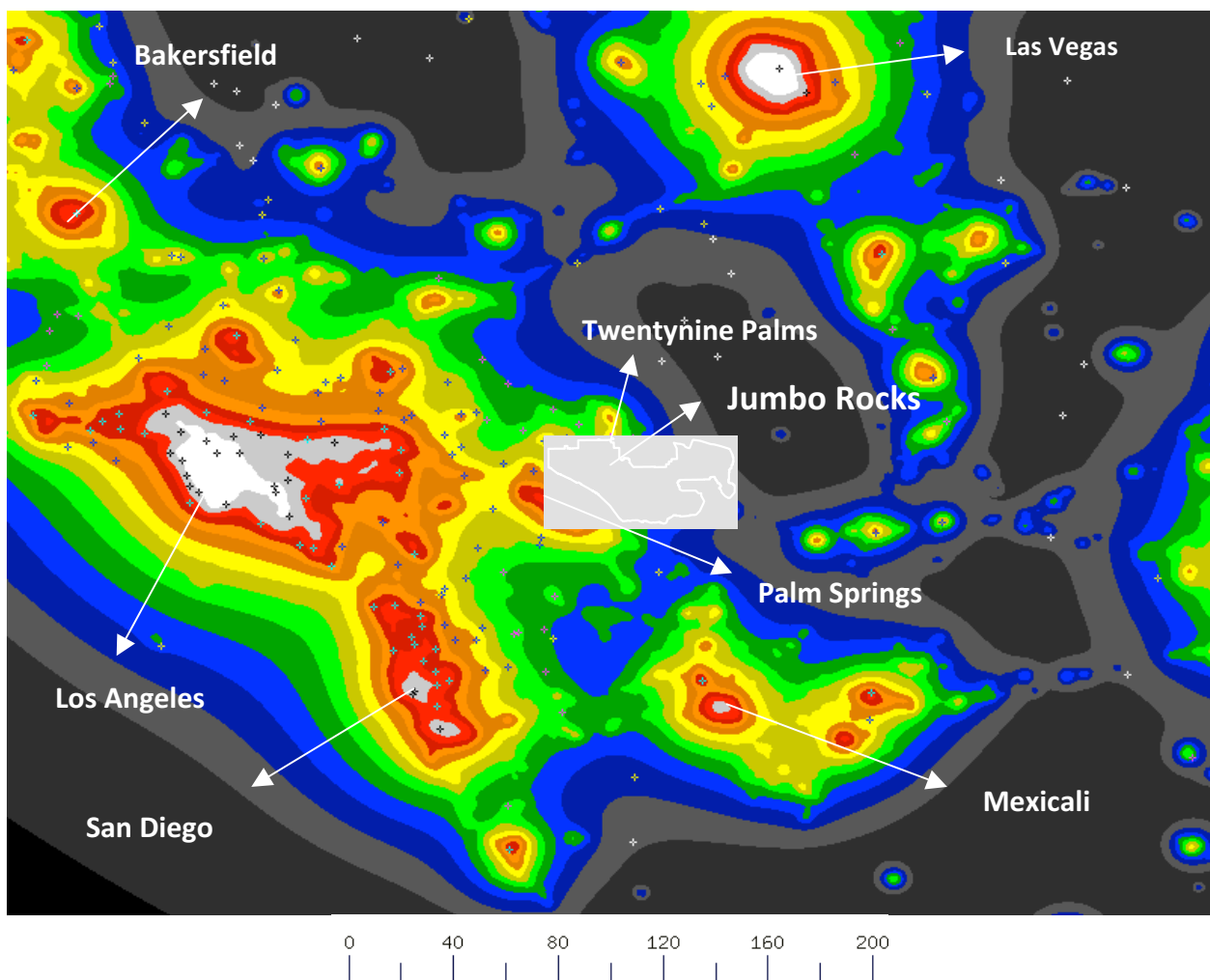


Figure 15. Light Pollution Map from ClearDarkSky.com. Image Credit: David Lorenz (University of Wisconsin-Madison). This map is a small excerpt (382mi east-to-west, by 346mi north-to-south) from the “Light Pollution Atlas 2006” by David Lorenz. David recalculated the “The World Atlas of the Artificial Night Sky Brightness” with newer data. The central cross marks the location of the Jumbo Rocks clear sky chart. Tiny crosses mark other charts. This map assumes an observer at sea level. A real observer should see a slightly darker sky.

Joshua Tree National Park Light Pollution Map from GoogleEarth.com

The maps below (Figures 16-19) were created in GoogleEarth using an edited image overlay created from artificial night sky brightness data for North America. Figures 16 and 18 were created from from “The night sky in the World” website (<http://www.lightpollution.it/dmsp/>). The overlay was downloaded as a kmz file from the University of Michigan (<http://umich.edu/~lowbrows/guide/google/269838-ArtificialNightSkyBrightnessforNorthAmerica.kmz>). Figures 17 & 19 were created from “The New World Atlas of Artificial Sky Brightness” website (<http://cires.colorado.edu/artificial-sky>). The overlay was downloaded as a kmz file from the GFZ German Research Centre for Geosciences (<http://pmd.gfz-potsdam.de/contact/showshort.php?id=escidoc:1541893&contactform>).

Figures 16 and 17 are an overview of surrounding artificial sky brightness within 150 miles around Joshua Tree National Park from 2006 and 2016 data respectively. Large metropolis areas, such as Los Angeles, Palms Springs, and San Diego impact the sky brightness of southern California. Figures 18 and 19 show a zoomed in view of the artificial sky brightness within and adjacent to Joshua Tree NP, and were created from 2006 and 2016 data respectively. Table 5 displays the Legend for Figures 17 & 19. Figures 17 and 19 were created from an Interactive Map that is based on data published on June 10, 2016 by a team of researchers led by Fabio Falchi and including NOAA’s Chris Elvidge and CIRES’ Kimberly Baugh.

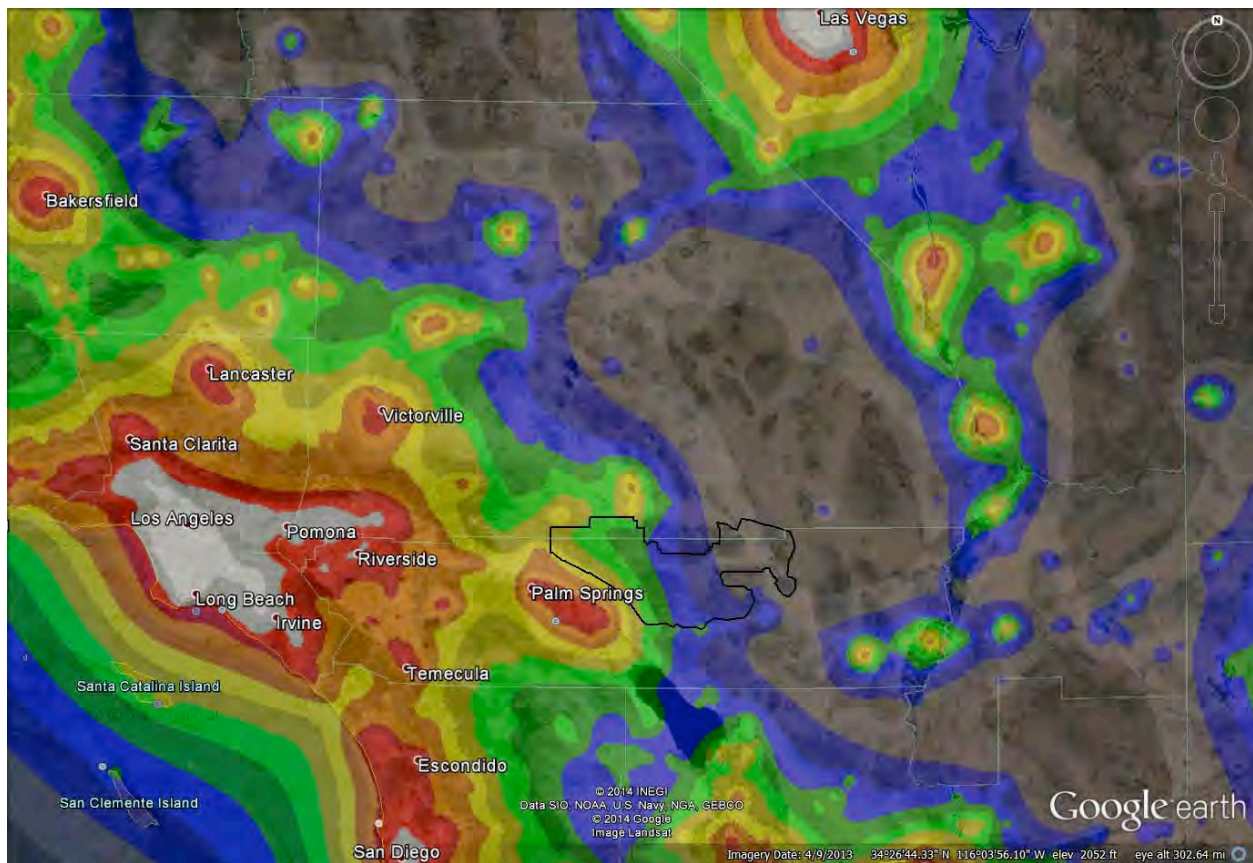


Figure 16. Light Pollutions map displayed in Google Earth. Artificial Night Sky Brightness for North America. Caused by exterior lights shining into the sky. <http://www.lightpollution.it/dmsp/> (2006)

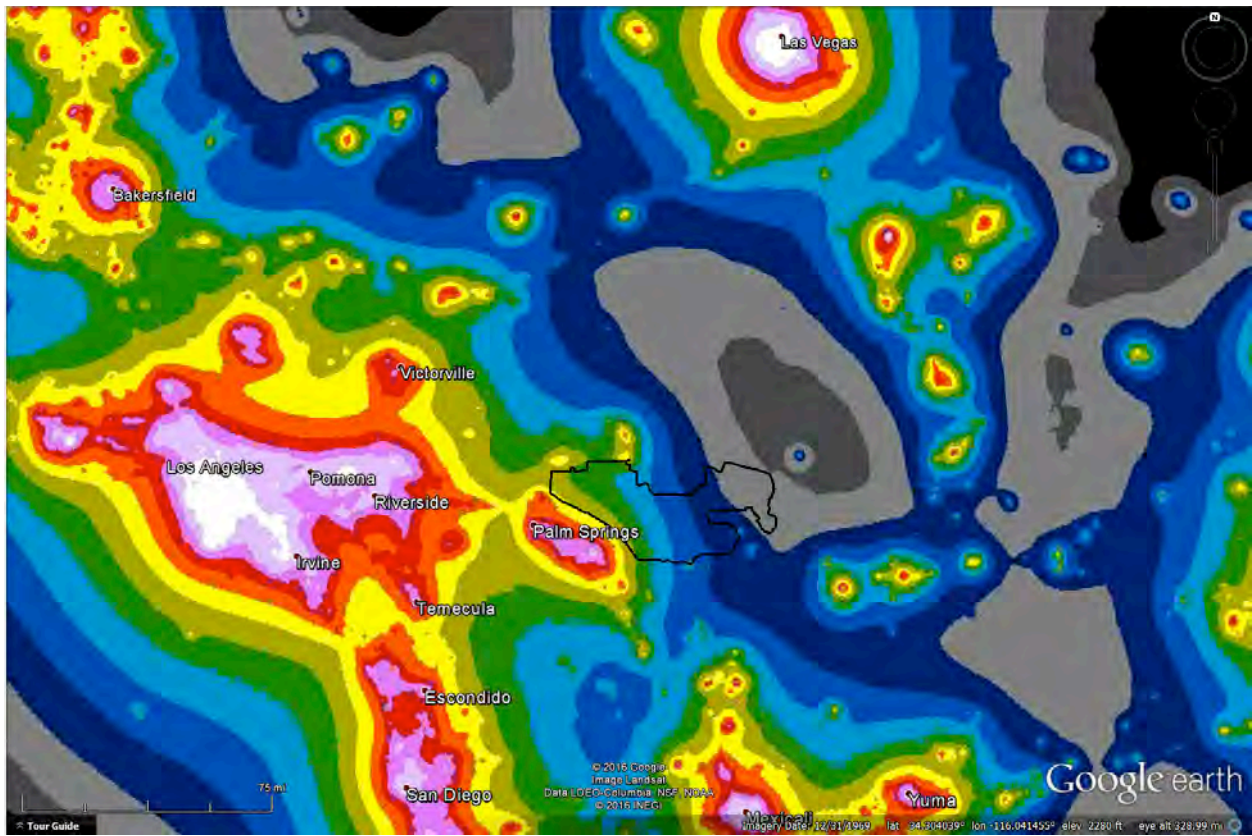


Figure 17. Light pollution map displayed in Google Earth from “The New World Atlas of Artificial Sky Brightness.” <http://cires.colorado.edu/artificial-sky>. (2016)

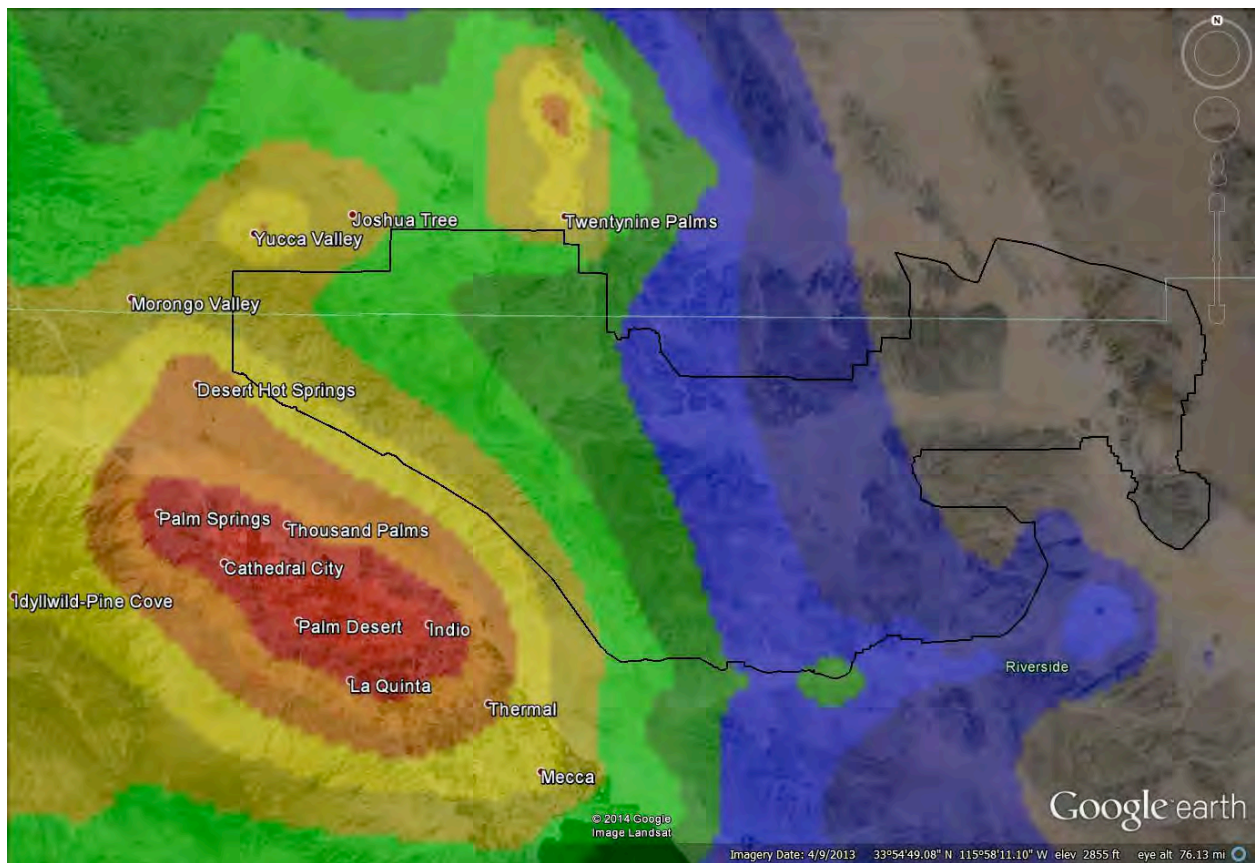


Figure 18. Light Pollution map displayed in Google Earth and zoomed in on Joshua Tree National Park. Artificial Night Sky Brightness for North America. Caused by exterior lights shining into the sky. <http://www.lightpollution.it/dmsp/> (2006)

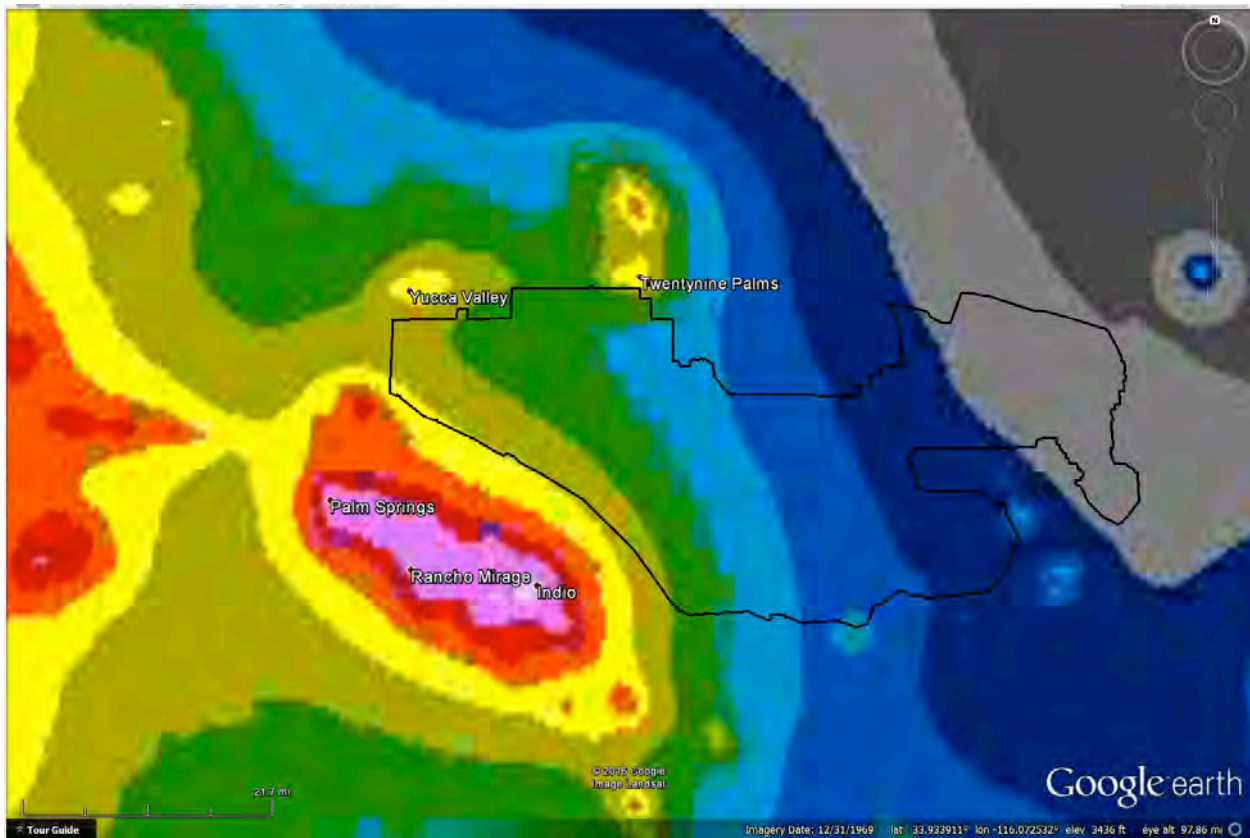


Figure 19. Light Pollution map displayed in Google Earth and zoomed in on Joshua Tree National Park from “The New World Atlas of Artificial Sky Brightness.” <http://cires.colorado.edu/artificial-sky>. (2016)

Table 5. Map Legend for Figures 18 & 19.

Ratio to natural brightness	Artificial brightness ($\mu\text{cd}/\text{m}^2$)	Approximate total brightness (mcd/m^2)	Color	
<0.01	<1.74	<0.176	Black	
0.01–0.02	1.74–3.48	0.176–0.177	Dark gray	
>0.02–0.04	>3.48–6.96	>0.177–0.181	Gray	
>0.04–0.08	>6.96–13.9	>0.181–0.188	Dark blue	
>0.08–0.16	>13.9–27.8	>0.188–0.202	Blue	
>0.16–0.32	>27.8–55.7	>0.202–0.230	Light blue	
>0.32–0.64	>55.7–111	>0.230–0.285	Dark green	
>0.64–1.28	>111–223	>0.285–0.397	Green	
>1.28–2.56	>223–445	>0.397–0.619	Yellow	
>2.56–5.12	>445–890	>0.619–1.065	Orange	
>5.12–10.2	>890–1780	1.07–1.96	Red	
>10.2–20.5	>1780–3560	>1.96–3.74	Magenta	
>20.5–41	>3560–7130	>3.74–7.30	Pink	
>41	>7130	>7.30	White	

VI. Interpretive and Educational Programs

Established Nighty Sky Programming

Since 2010, Joshua Tree National Park has been providing astronomy programming as part of the Park's official interpretation. Evening programs geared toward interpreting dark skies typically occur at least twice a month, all year round. During programs given at various locations in the Park, the public is invited to attend and enjoy the view of the night sky through Celestron computerized telescopes.

Established after dark programs include:

- Public telescope viewing (monthly, various days and dates)
- Full moon walks (occasional)
- Evening program astronomy (bi-monthly)
- Astronomy festival (Fall of 2015)

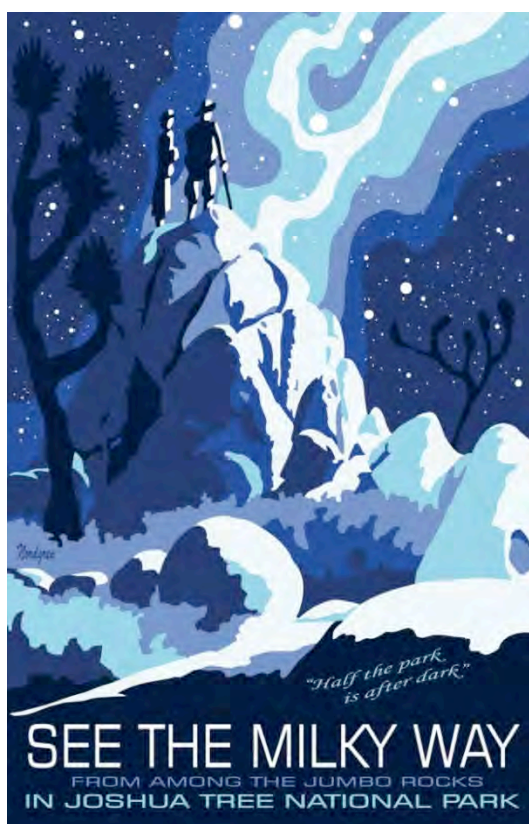


Figure 20. "See the Milky Way" poster art created by Tyler Nordgren in conjunction with the National Park Service.

Approximately 2,000 to 3,000 visitors participate in the night sky programs each year (Figure 15 shows an example of the typical night sky programs offered at Joshua Tree). Because of seating capacity and parking capacity, much of the public viewing is conducted at the Oasis Visitor Center, which attracts park visitors and city residents alike. With a close proximity to the Coachella Valley and Los Angeles area, many residents will drive to Joshua Tree National Park to view starry skies, watch meteor showers, and see the milky way, whether at a night sky program or just by themselves in the park.

Evening Campfire Programs

National Park Service
U.S. Department of the Interior
Joshua Tree National Park



for the week of January 10 - January 16, 2016

Ranger of the Lost Art

Friday, January 15 — 7:00 pm, Jumbo Rocks Campground Amphitheater

Between 1935 and 1943 the WPA's Federal Art Project printed over two million posters in 35,000 different designs to stir the public's imagination for education, theater, health, safety, and travel. Join Ranger Doug to learn about his reproductions of WPA National Park serigraphed posters.

Constellations and Culture: The Stars and You

Friday, January 15 — 7:00 pm, Cottonwood Campground Amphitheater

Join a ranger for a 45-minute program exploring the human connection to stars and their importance throughout time. Discover different stories told about the constellations, while enjoying the dark night skies protected in Joshua Tree National Park.

Joshua Tree National Park: A History

Friday, January 15 — 7:00 pm, Black Rock Visitor Center

Join retired Chief of Interpretation Joe Zarki for a 45-minute program to learn about the diverse history of Joshua Tree National Park.

Saturday Night Starlight

Saturday, January 16 — 7:00 pm, Jumbo Rocks Campground Amphitheater

Join a ranger for a 45-minute program on the value of our clear night skies and how we can all enjoy them.

Stories in the Stars

Saturday, January 16 — 7:00 pm, Cottonwood Campground Amphitheater

People have looked to the night sky for thousands of years for explanation and inspiration. Join a ranger for a 45-minute program as we explore some of the stories told about the stars and our place among them.

Ranger of the Lost Art

Saturday, January 16 — 7:00 pm, Black Rock Visitor Center

Between 1935 and 1943 the WPA's Federal Art Project printed over two million posters in 35,000 different designs to stir the public's imagination for education, theater, health, safety, and travel. Join Ranger Doug to learn about his reproductions of WPA National Park serigraphed posters.

Figure 21. Example of an Interpretive Program for a typical week in Joshua Tree National Park.

Beginning with two Celestron CPC 1100 GPS (XLT) telescopes, Joshua Tree has now expanded to include a new Celestron NexStar 8SE telescope. These, along with the very popular laser pointers and cell phone apps, give the public a great opportunity to enjoy the dark, star lit sky and learn ways to help protect it from light pollution.

In 2013, in conjunction with staff from Joshua Tree National Park Association, Celestron, and the American Park Network, as well as park employees and volunteers, Joshua Tree conducted a large night

sky event at the Oasis Visitor Center, with an attendance of about 200 members of the public. This event inspired Park staff to start planning an annual astronomy festival for the Fall.

2015 Night Sky Festival



The first ever, annual astronomy festival took place during the weekend of October 16-18, 2015 to kick off the start of the National Park Service's year of centennial celebrations. The event consisted of solar and night sky viewing, guest speakers, interpretive programs, ranger-led hikes, music, and model rocket building. There was a night sky photography class hosted by the Desert Institute, a women-in-science panel discussion, and a book & poster signing session with Tyler Nordgren. The festival brought together astronomers, scientists, cultural speakers, night-sky enthusiasts, artists, volunteers, junior rangers, and members of nearby communities to celebrate the night skies of Joshua Tree National Park.

Below is a list of some fun social media statistics in response to the 2015 Joshua Tree National Park Night Sky Festival, a table of visitor contacts made during the festival, and a preview of the festival brochure:

- **Snapchat** (usinterior account): Friday teaser: 1,700 views, Saturday story: 2,700 views
- **Twitter**: 230 tweets over Fri-Sat-Sun, total impressions = 150,523 (avg is 3-5 tweets per day, about 10,000 impressions)
- **Facebook**: 5 posts Fri-Sat-Sun, reach 55,000
- **Instagram**: 6 posts Fri-Sat-Sun, 5,007 hearts

Table 6. Visitor Contacts during Night Sky Festival

Night Sky Festival Visitor Contacts				
Location/Activity	Date			Totals
	10/16/2015	10/17/2015	10/18/2015	
Twin Tanks	26	70	0	96
Jumbo Rocks	92	120	0	212
Skies the Limit	45	192	0	237
Moon Rocks	0	211	0	211
Solar Scope	0	183	116	299
Night Life Hike	12	0	0	12
Cottonwood Viewing	12	80	0	92
Rocket Launch	10	0	0	10
Pepper Corn Hike	0	9	0	9
Woman in Science	0	40	0	40
Sailing on Tides Talk	0	37	0	37
Star's Above Talk	0	0	0	0
Boy Scout Hike	12	0	0	12
Dark Skies	0	35	0	35
Just 42	0	0	30	30
Cosmic Horizons	0	0	23	23
Junior Ranger Swear-in	0	0	6	6
Book Singing/Posters	0	9	0	9
Shuttle Count	16	86	0	102
Facilitated Diaglog	0	0	23	23
Closing Ceremonies	0	0	29	29
Night Song	0	24	0	24
Total Contacts	225	1096	175	1496
Jumbo Rocks Roving	67	30	0	97

The 2015 Night Sky Festival was made possible through partnerships with Sky's the Limit Observatory and Nature Center, the Joshua Tree National Park Association, the Desert Institute, Celestron, Dark Ranger Telescope Tours, Bryce Canyon National Park, and Grand Canyon National Park.



Figure 22. Cover of Night Sky Festival Brochure

SCHEDULE OF EVENTS

Friday, October 16, 2015



5:00 pm **Opening Remarks**
by Park Superintendent David Smith
*Sky's the Limit**



6:00 pm **Viewing the Vexing Void**
with Dark Ranger Kevin Poe
at *Sky's the Limit**

7:00 pm **Night Sky Evening Program**
Jumbo Rocks Campground Amphitheater



7:00 pm-10:00 pm **Night Sky Viewing**
multiple locations: *Sky's the Limit**, *Twin Tanks*,
and *Cottonwood Campground Amphitheater*

7:30 pm **Night Life: Nocturnal Animals of Joshua Tree**
hike with Wildlife Biologist Kristen Lalumiere
Note: space is limited and advance reservations are
required; call 760-367-5522 to sign up.

Saturday, October 17, 2015

9:00 am-12:00 noon **Model Rocket Building and Launching**
Sky's the Limit

Rocket kits and motors will be available for
purchase, first-come, first-served.

10:00 am-3:00 pm **Moon Rocks and Meteorites**
on display at the *Oasis Visitor Center*

10:00 am-3:00 pm **Safe Solar Viewing**
through the solar telescopes at the *Oasis Visitor Center*

12:00 noon-2:00 pm **Book & Poster Signing**
by Tyler Nordgren, author of *Stars Above, Earth Below*
Oasis Visitor Center

1:00 pm **Night Songs: Music for Twilight and Beyond**
with Jay Cravath, Cultural Director, Chemehuevi Tribe
Black Rock Nature Center

1:00 pm-10:00 pm **Night Sky Photography Class**
Note: This class is offered by the Desert Institute,
a park partner. Space is limited and pre-registration is
required. See <http://www.joshuatree.org/desert-institute/>

2:00 pm **"Earth as a Peppercorn" Ranger-led Hike**
Boy Scout Trail south trailhead, inside the West Entrance

3:00 pm **Women in Science Panel Discussion**
Black Rock Nature Center

4:00 pm **Sailing on Alien Tides:
Behind the Scenes of a NASA Europa Mission**
with Julie Rathbun
Black Rock Nature Center



6:00 pm—**Stars Above, Earth Below**
Astronomy in America's National Parks
with Tyler Nordgren
*Sky's the Limit**

7:00 pm **Night Sky Evening Program**
Jumbo Rocks Campground Amphitheater



7:00 pm-10:00 pm **Night Sky Viewing**
multiple locations: *Sky's the Limit**, *Twin Tanks*,
and *Cottonwood Campground Amphitheater*

Sunday, October 18, 2015

9:00 am-12:00 noon **Model Rocket Building & Launching**
Sky's the Limit

Rocket kits and motors will be available for
purchase, first-come, first-served.

10:00 am-3:00 pm **Safe Solar Viewing**
through the solar telescopes at the *Oasis Visitor Center*

11:00 am **"Earth as a Peppercorn" Ranger-led Hike**
Boy Scout Trail south trailhead, inside the West Entrance

1:00 pm **Just 42**
with Dark Ranger Kevin Poe
Black Rock Nature Center

2:00 pm **Dark Skies in Joshua Tree National Park**
with Stacy Manson
Black Rock Nature Center

3:00 pm **Cosmic Horizons**
with Angie Richman
Black Rock Nature Center

4:00 pm **Swearing-in of Night Sky Junior Rangers**
and
Closing Ceremonies
Black Rock Nature Center

Get your Junior Ranger Night Explorer activity books in
advance at park visitor centers, or download your own copy
online at <http://www.nature.nps.gov/night/youth.cfm>



**Ride the free shuttle to events
at Sky's the Limit**

Friday from 4:30 pm - 10:00 pm
and
Saturday from 5:00 pm - 10:00 pm

Due to limited parking at Sky's the Limit, we
strongly encourage visitors to park at the Oasis
Visitor Center and take the free shuttle to evening
events at Sky's the Limit. The shuttle will pick up
passengers approximately every 15 minutes.

Figure 23. Page 1 of Night Sky Festival Brochure

FEATURED PROGRAMS

"Viewing the Vexing Void" with Kevin Poe

6:00 pm Friday at *Sky's the Limit*

Space is REALLY big, which is scary, and VERY empty, which is terrifying! This is relevant when you consider the futility of space travel and the chance that life elsewhere might be friendly. But don't panic: the universe is also beautiful and intriguing.

"Night Songs: Music for Twilight and Beyond" with Jay Cravath

1:00 pm Saturday at *Black Rock Nature Center*

Dr. Cravath will perform night songs during this event. Using guitar, harmonica and dulcimer, the Chemehuevi Tribe's Cultural Director will include lullabies, love songs and even a couple pieces from Stephen Sondheim's musical: "A Little Night Music." Oh, and be prepared to sing along on a few.

"Sailing on Alien tides: Behind the Scenes of a NASA Europa Mission" with Julie Rathbun

4:00 pm Saturday at *Black Rock Nature Center*

Europa is one of the 4 major Galilean satellites of Jupiter. It's about the size of the Earth's moon and is covered in ice. There is strong evidence of a global ocean beneath Europa's icy crust that is moved by tidal energy, making this moon one of the best known spots for potential alien life.

"Stars Above, Earth Below: Astronomy in America's National Parks" with Tyler Nordgren

6:00 pm Saturday at *Sky's the Limit*

Nearly 60% of Americans cannot see the Milky Way from their house. For visitors to America's national parks, a sky full of stars is now as rare as the glaciers and grizzly bears that brought them there in the first place. National parks are our window to the Universe.

"Just 42" with Kevin Poe

1:00 pm Sunday at *Black Rock Nature Center*

Astronomy math is hard, but the science itself is much simpler. If you exclude Earth, there are only 42 things you need to know to understand the rest of the universe! Get a semester's worth of astronomy in a single afternoon.

"Dark Skies in Joshua Tree National Park" with Stacy Manson

2:00 pm Sunday at *Black Rock Nature Center*

Joshua Tree is one of the best escapes in south California to view the natural night sky. But light pollution is an ever growing threat on the horizon. How do we measure dark skies in Joshua Tree? How does light pollution impact the park? Immediately following Ranger Stacy's presentation, join Park Ranger Sara Sutton for a conversation about dark skies and your own personal experiences with them.

"Cosmic Horizons" with Angie Richman

3:00 pm Sunday at *Black Rock Nature Center*

From a little kid on a trampoline in the backyard to astronomers like Galileo and Hubble, we have all been inspired by a night sky full of stars. Let's take a walk through human history to see how the cosmos shaped our world and what might be on the cosmic horizon.



Figure 24. Page 2 of Night Sky Festival Brochure

Bring Along: 

Leave Behind: 

Only bring **red lights**. No white lights. Keep your cell phones off and tucked away. This is very important for protecting your night vision. You can make a regular flashlight into a red light by covering it with red cellophane, tape, red fabric, red construction paper, etc. Most outdoor stores sell red lights and red headlamps. Seating is limited at Sky's the Limit; bring a lawn chair or blanket for your comfort. There is no water at most event locations. Please plan ahead by bringing what you need, but do not eat or drink around the telescopes. They are fragile. Be careful not to bump or jostle the telescopes. A scope operator can adjust the view for you. Bring extra layers of warm clothes. Temperatures drop quickly in the evening.

FEATURED SPEAKERS



Dr. Jay Cravath

Composer, Writer, and Cultural Director of the Chemehuevi Indian Tribe

Dr. Jay Cravath's programs involve discussions, stories, musical performance and dance. His publications include *North American Indian Music*, *The Mohave Book for Little Ones*, and *The Chemehuevi Book for Little Ones*. Having been on the Arizona Humanities Council Speakers Bureau since 1992, he has performed at festivals, libraries and museums.



Dr. Tyler Nordgren

Author, Artist, and Professor of Physics and Astronomy at the University of Redlands

Dr. Tyler Nordgren is a Professor of Physics and Astronomy at the University of Redlands. He has helped design "Marsdials," one which landed on Mars and the other that is onboard NASA's newest rover, Curiosity. His book *Stars Above, Earth Below: A Guide to Astronomy in the National Parks* was funded by the Planetary Society. In 2011, Dr. Nordgren was elected to the Board of Directors of the International Dark-Sky Association.



Kevin Poe

Dark Ranger

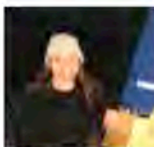
Kevin Poe has degrees in Forestry and Recreation and Resource Management from Utah State University. He has more than 18 years of astronomy experience and has led telescope and astronomy programs in Bryce Canyon and other national parks throughout the country.



Dr. Julie Rathbun

Professor of Physics, University of Redlands; Senior Scientist, Planetary Science Institute

Dr. Julie Rathbun earned her PhD in astronomy from Cornell University in 1999 and has worked as an astronomer at Lowell Observatory. Her research focuses on moons in the outer solar system, with the moons of Jupiter as her favorites. She is currently a member of the steering committee for NASA's Outer Planets Assessment Group.



Angie Richman

Astronomy and Climate Change Consultant

Angie Richman received a BA in Astrophysics from the University of New Mexico with a minor in Archeology, emphasizing Cultural Astronomy. She worked for the National Park Service for over 15 years, most recently as the Communication Specialist for the Climate Change Response Program. As a ranger, her programs are infused with astronomy, a personal sense of place within the universe, and love of a starry sky.

Thank You to Our Partners Joshua Tree National Park would like to thank our guest speakers, Sky's the Limit, the Joshua Tree National Park Association, the Desert Institute, Celestron, Dark Ranger Telescope Tours, Riverside Astronomical Society, San Bernardino Valley Amateur Astronomers, the Astronomical Society of the Desert, and Grand Canyon National Park.



**FIND YOUR
PARK**

The National Park Service, steward of Joshua Tree National Park and over 400 other park sites around the country, celebrates its 100th birthday in 2016. The 2015 Joshua Tree National Park Night Sky Festival kicks off our celebration of the NPS Centennial by bringing together astronomers, scientists, cultural speakers, night-sky enthusiasts, artists, volunteers, junior rangers, and members of nearby communities to celebrate the night skies of Joshua Tree National Park.

Figure 25. Last Page of Night Sky Festival Brochure

Stargazing

<http://www.nps.gov/jotr/planyourvisit/stargazing.htm>

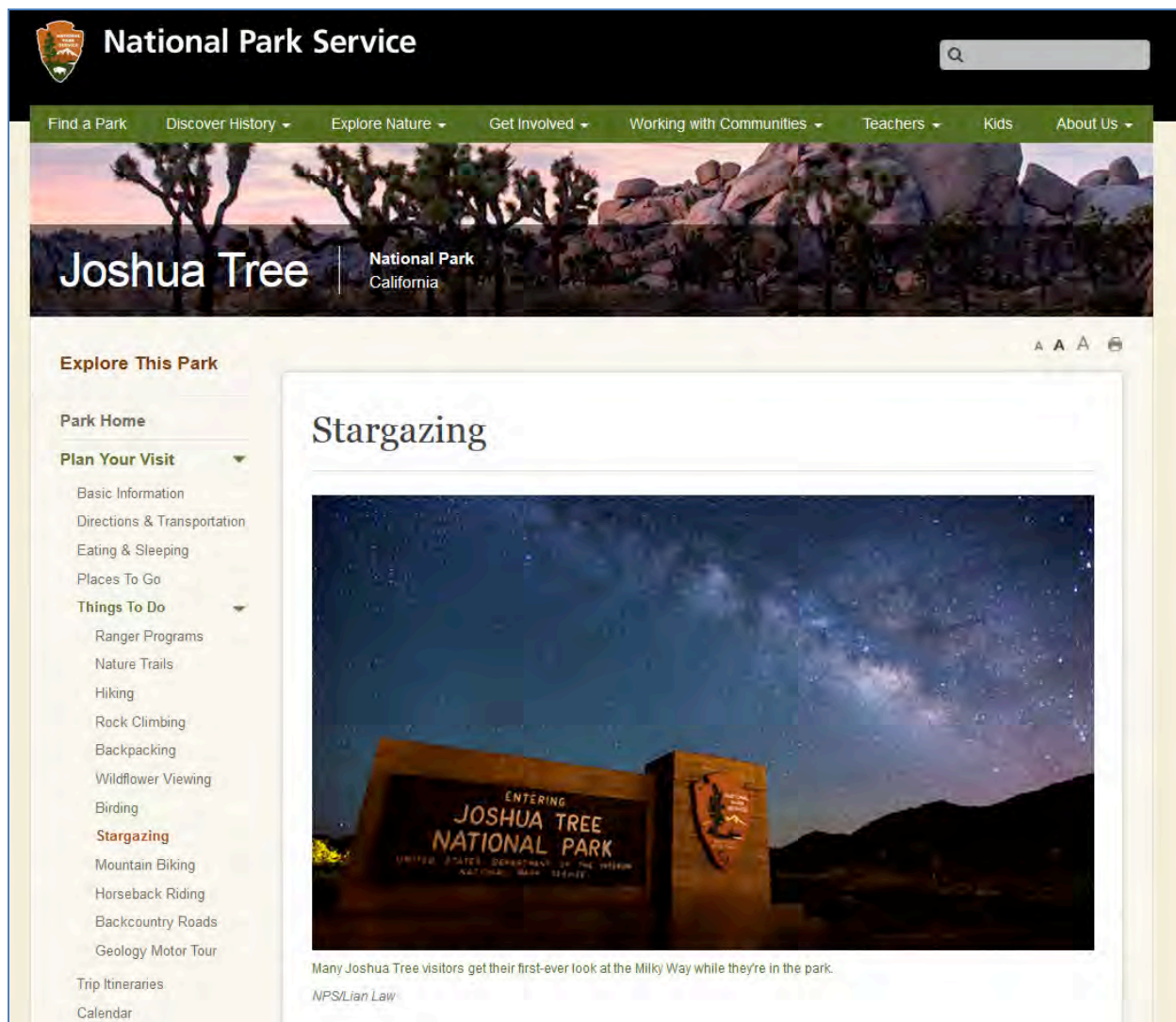


Figure 26. Joshua Tree Stargazing website page.

The night sky is a glittering dome peppered with stars, planets, and passing meteors—but most people no longer get to see it. In urban and suburban settings, artificial lighting and atmospheric pollutants wash out the light of the stars. This is a serious loss. For millennia, our ancestors experienced a dark night sky. Cultures around the world told stories about the constellations and used the stars as a calendar. Only for the past few generations have humans been denied the chance to stand in awe of the heavens. Boasting some of the darkest nights in Southern California, Joshua Tree National Park offers many visitors the chance to admire the Milky Way for the first time in their lives.

In October 2015, we're celebrating our beautiful dark skies at our first [Night Sky Festival](#). Come join us!

The Night Sky by Season

Winter

The winter solstice is the shortest day of the year—and the longest night. In Joshua Tree, sunset in December can be as early as 4:30 pm, with full dark falling by 5:00 pm. Campers in the national park at this time of year have plenty of opportunity to stargaze before going to bed for the night.

Winter's most famous constellation is almost certainly **Orion**, the Hunter. The three stars that make up Orion's belt are easily seen in the southern sky. Below Orion's belt, three faint stars make up the great hunter's sword. Use binoculars or a telescope to look at the Orion Nebula, a vast stellar cloud of dust and gas that appears in the sword.

If you follow the line of Orion's belt down and to the left, you'll come to **Sirius**, the brightest star in the night sky. Sirius is also known as the Dog Star and lies in the constellation Canis Major, the Great Dog. Other prominent winter constellations include **Gemini** and **Taurus**. Gemini, the Twins, features the bright stars Castor and Pollux marking the heads of the two brothers, who stand in the heavens with their arms about each other's shoulders. From the eye of V-shaped Taurus (the Bull) winks the red giant Aldebaran.

Spring

On the vernal equinox, or the first day of spring, day and night are of equal length. At this time of year, the brilliant star **Arcturus** appears in the eastern sky at dusk. You can find Arcturus by following the arc of the handle of the Big Dipper (remember: "Arc to Arcturus").

Looking high in the sky to the south, you may find the sickle-shaped head of **Leo**, the Lion. Bright Regulus is Leo's front paw.

Summer

Summer starts on the solstice in late June, when we have the longest day and the shortest night of the year.

The **Milky Way** is at its best on a moonless summer night. At this time of year, we are looking inward toward the center of our galaxy when we gaze upward into the night sky. The galactic center, where the band of the Milky Way appears brightest in the sky, is located in the constellation Sagittarius.

The Milky Way runs through the center of the **Summer Triangle**, which is not a constellation but an asterism. Its three bright and easily observed stars are in the east at dusk and wheel overhead through the night. Each of these three stars is the brightest star in its constellation: brilliant Vega in Lyra (the Lyre), Altair in Aquila (the Eagle), and Deneb in Cygnus (the Swan).

The **Perseid Meteor Shower** in mid-August is one of the most consistently reliable meteor showers each year.

Fall

At the autumnal equinox, day and night are again of equal length. Around this time—the beginning of autumn—the **Great Square of Pegasus** rises in the northeastern sky at dusk. Four stars of roughly equal

brightness make up the Great Square. If you don't see it right away, find Polaris, the North Star. Draw a line from Polaris past the W shape of Cassiopeia, and it will bring your eye to the Great Square. The Great Square is oriented more like a diamond, and you can use it to find the Andromeda Galaxy. Home plate is the star at the bottom of the Great Square, with first base to the right, second base at the top, and third base to the left. On moonless nights, the **Andromeda Galaxy** is visible to the naked eye as a fuzzy patch off in the stands on the third base side of the field, about as far back from third base as between first and third. Use binoculars or a telescope to get a better view of this spiral galaxy.

Lightscape & Night Sky

<http://www.nps.gov/jotr/learn/nature/lightscape-and-night-sky.htm>

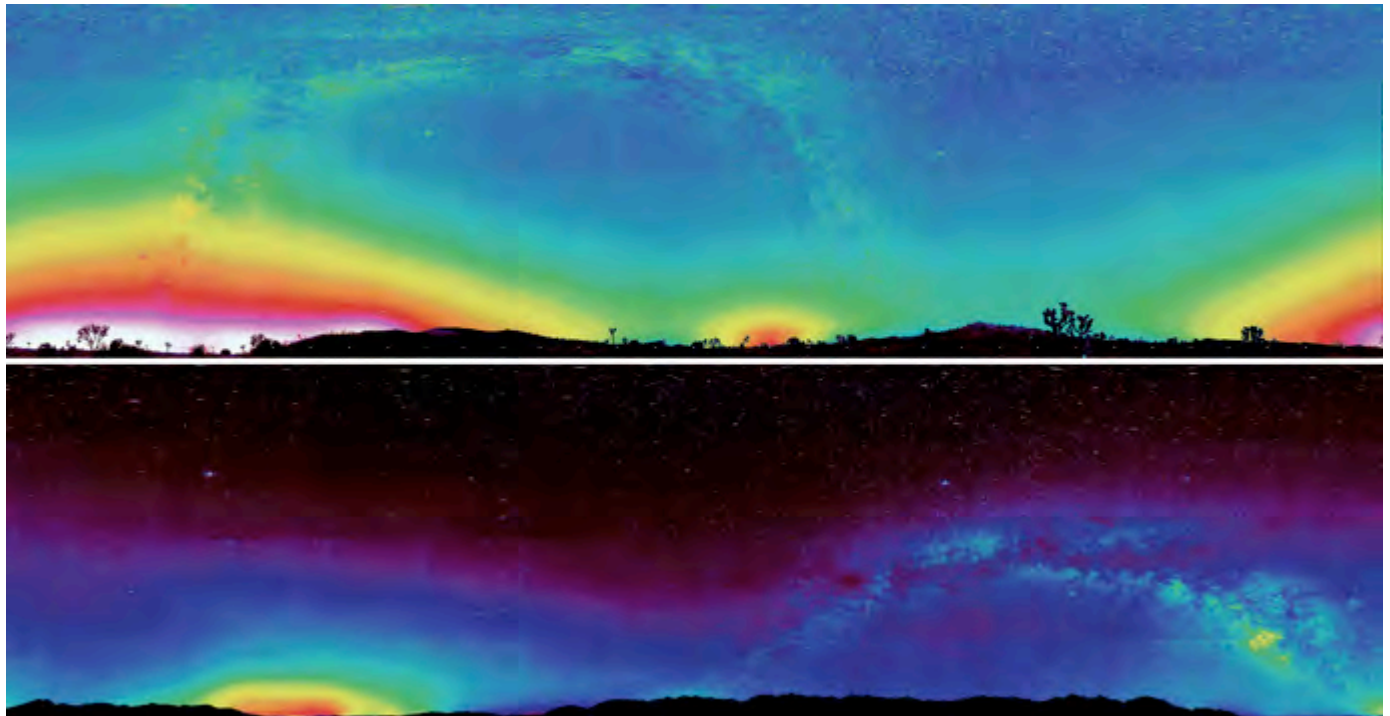


Figure 27. Two false color images from the park's light pollution study. Top: Large light domes from nearby cities impair views of the night sky from Keys View. Bottom: Pinto Wells, in the remote eastern part of the park, is far less impacted by light pollution.

NPS

Today, more than half of the world's population lives in cities, where few stars are visible. Here in the United States, vast swaths of the nation remain dark at night, but 99 percent of people live in places where artificial light obscures the stars and planets. No wonder visitors to Joshua Tree National Park are awed and astounded when they get their first glimpse of the night sky.

Joshua Tree's location far from city lights contributes to our phenomenal views of the dark night sky. But the desert environment contributes, as well. In their book *The Deserts of the Southwest*, Peggy and Lane Larson describe how the desert environment naturally provides for exceptional views. "Little obstructs the extensive view of the sky dome, which in the clear, arid atmosphere appears bluer by day and more brightly star-studded by night than do the skies over many moister regions."

Increases in both light and air pollution pose a threat to night sky viewing in Joshua Tree National Park. Data collected by the Earth Observation Group and NOAA National Geophysical Data Center document

medium to high levels of light pollution that infringe on the night skies of Joshua Tree National Park. Most of the light pollution comes from poorly regulated artificial lighting in Los Angeles, Las Vegas, and the Coachella Valley. Luke Sabala, Chief Physical Scientist at Joshua Tree National Park, and Stacy Manson, Physical Science Technician, have been collecting data to document light pollution within the park.

"Collecting information on light pollution is important because stargazing is such a popular visitor activity. Joshua Tree is in the process of applying to become recognized as an International Dark Sky Place, and a measurement of sky quality is crucial in receiving designation," says Manson. Ongoing research also provides the information needed to educate the community on the dramatic amounts of light pollution within the Southern California region. Joshua Tree National Park is committed to the protection and preservation of the desert ecosystem, and a dark night sky is a core part of the desert experience.

Night sky preservation is unique in that the resource cannot be lost permanently. Even in the face of new development approaching the park boundary, the loss of night sky views is both reversible and preventable. An obscured night sky is only temporary. Communities and concerned citizens can prevent and even reverse light pollution by insisting on night-sky friendly light fixtures.

VII. Partnerships and Community Outreach

Morongo Basin Dark Night Sky Alliance

The Morongo Basin Dark Night Sky Alliance is a project created by a collection of businesses, citizens, and elected officials throughout the Morongo Basin that recognize that protecting dark skies is important and cost-effective. The alliance includes representatives from the following organizations:



- Andromeda Society
- International Dark Skies Association
- Joshua Tree Community Association
- Joshua Tree National Park
- Marine Corps Air Ground Combat Center
- Morongo Basin Conservation Association
- Morongo Basin Open Space Group
- National Parks Conservation Association
- James Ramos (Supervisor, 3rd District, County of San Bernardino)
- Sky's the Limit
- Southern California Desert Video Astronomers

The alliance shares information at community meetings and with community organizations, presents information at public events, and works to improve the San Bernardino County Lighting Ordinance. Members of the alliance also write articles for newspapers and periodicals on why dark skies are important and what we can do to make a difference. Flyers, brochures and stickers that highlight the importance of dark skies are distributed at public events. The alliance helps to bring astronomy and dark-sky programs to local communities. Local businesses are informed about the alliance and assisted in supporting dark night skies.

Accomplishments

- San Bernardino County Lighting Ordinance
 - Lighting for new construction must be shielded so that it doesn't stray onto adjacent properties and public areas
 - Existing lighting that strays onto adjacent properties and public areas must be shielded, filtered, redirected, replaced with a less intense light source or removed
 - Half of the lights in a parking lot or other open commercial lot must be turned off between 10 PM and sunrise
 - Recreation facilities may not be lit for private use between 11 PM and dawn, and such facilities may not be lit unless in use
- Marine Corps Air Ground Combat Center
 - Night-lighting has been cut by 60 percent

VIII. JOTR Outdoor Lighting Management Plan

Joshua Tree National Park Outdoor Lighting Management Plan



NPS Photograph by: Lian Law



Prepared by:


Luke Sabala, Physical Science Branch Chief

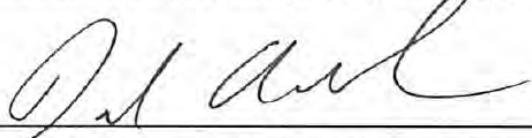
Stacy Manson, Physical Science Technician

Joshua Tree National Park Outdoor Lighting Management Plan

March 2016

Recommended by:  3/23/16
Branch Chief Physical Scientist, Joshua Tree National Park Date

Recommended by:  3/23/16
Chief of Resources Management, Joshua Tree National Park Date

Approved by:  3/23/16
Superintendent, Joshua Tree National Park Date

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Plan Objectives

The objectives of this lighting management plan are to provide Joshua Tree National Park a planning strategy and best management practices for outdoor lighting. An important consideration in this document was balancing the need for safety with the sensitivity of the Park's nocturnal environment. The guideline focuses on "off the shelf" solutions, though development of new technologies like LEDs will soon allow parks to more precisely manage outdoor lights; however, for now only mainstream technologies have been included in this document. Simplicity of understanding and implementation of these guidelines were given greater weights than the details of lighting design, visibility research, and energy efficiency.

- Curtail and reverse the degradation of the nighttime visual environment and the night sky, including casual observation, astronomy, and air quality related values.
- Minimize glare, light trespass, obtrusive light, and artificial sky glow by limiting outdoor lighting that is misdirected, excessive, or unnecessary.
- Insure —good neighbor lighting by minimizing light trespass.
- Help minimize suspected health risks to humans from adverse exposure to light at night.
- Help protect natural ecosystems from the damaging effects of night lighting.
- Permit reasonable and rational use of outdoor lighting for nighttime safety, utility, security, and productivity.
- Help to conserve energy and resources.
- Minimize maintenance and operating costs
- Provide some flexibility for architectural and artistic lighting within the above constraints

Scope

This plan is intended to address outdoor lighting within Park boundaries, including developed areas, and exceeds the San Bernardino County Code of Ordinances on Glare and Outdoor Lighting (Chapter 83.07). This plan omits transportation right of ways where state and federal transportation codes may supersede park authority.

Complex facilities and lighting situations may require more guidance than is found here. In those cases, reviewing additional guidelines and consultation with lighting engineers and the NPS Night Sky Team is encouraged.

Purpose and Need

The protection of the natural environment is an integral component to the mission of Joshua Tree National Park. In and around areas of human occupation, modifications to this environment take place and there is a potential for environmental pollution. While safeguards to prevent water, air, and noise pollution have been in place for many decades at most facilities in national parks, attention to the preservation of a natural nocturnal environment with regard to artificial light pollution (or photopollution) is not commonly emphasized as much as the other factors. In an area with minimal vegetation such as Joshua Tree's Mojave and Colorado deserts, excessive or stray light may have far reaching impacts upon the land and not be merely confined to the immediate area of its use. These guidelines are intended as a tool for facility and land managers to accomplish visitor enjoyment and environmental preservation objectives with regard to permanently installed outdoor lighting. Minimizing sky glow, glare and visual clutter is essential in maintaining a natural nocturnal lightscape, and sets an important example for park visitors and neighboring communities.

2006 Management Policies

The 2006 NPS Management Policies (slightly modified from the 2001 version) direct the NPS to conserve natural lightscapes. Protection of natural darkness is not only a visitor resource and scenic value; it has important connection to cultural landscapes, ecological integrity, operational efficiency, and sustainability.

4.10 Lightscape Management

The Service will preserve, to the greatest extent possible, the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light. The absence of light in areas such as caves and at the bottom of deep bodies of water influences biological processes and the evolution of species, such as the blind cave fish. The phosphorescence of waves on dark nights helps hatchling sea turtles orient to the ocean. The stars, planets, and earth's moon that are visible during clear nights influence humans and many other species of animals, such as birds that navigate by the stars or prey animals that reduce their activities during moonlit nights.

Improper outdoor lighting can impede the view and visitor enjoyment of a natural dark night sky. Recognizing the roles that light and dark periods and darkness play in natural resource processes and the evolution of species, the Service will protect natural darkness and other components of the natural lightscape in parks. To prevent the loss of dark conditions and of natural night skies, the Service will minimize light that emanates from park facilities, and also seek the cooperation of park visitors, neighbors, and local government agencies to prevent or minimize the intrusion of artificial light into the night scene of the ecosystems of parks. The Service will not use artificial lighting in areas such as sea turtle nesting locations where the presence of the artificial lighting will disrupt a park's dark-dependent natural resource components.

The Service will:

- restrict the use of artificial lighting in parks to those areas where security, basic human safety, and specific cultural resource requirements must be met;
- use minimal-impact lighting techniques;

- shield the use of artificial lighting where necessary to prevent the disruption of the night sky, natural cave processes, physiological processes of living organisms, and similar natural processes.

The decision about whether or not to install artificial lighting in particular circumstances is left to the discretion of the superintendent and is made through the planning process.

Outdoor Lighting

Joshua Tree National Park is a popular outdoor recreation destination. Many thousands of visitors seek out the dry, warm climate, and will be active at night, especially in and around developed areas. While the park is primarily a wild area (and its visitors want it to remain so), the safety of humans occupying developed sites is of paramount importance. Therefore, zones of concentrated human use, and especially those areas open to the visiting public, will be illuminated to a level sufficient to ensure their safety. Lighting serves both objective and subjective human needs. Objectively, light is used to provide adequate visual perception in low light. Additionally, the eye cannot easily transition from a bright environment (such as indoors) to a dark environment (such as outdoors at night). Thus outdoor lighting at Joshua Tree is needed to provide a minimal illumination level and ease high contrast transitions.

Human Needs

It is not unreasonable to expect a visitor to carry their own source of illumination when travelling at night by foot. However, visitors to developed areas should be provided enough light to navigate safely from their vehicle to the building doorway or destination of interest. These developed areas are defined by a zone plan for the park, and within them every effort will be made to provide adequate illumination for way finding and navigation via foot. However, visitors will also be advised that their ability to negotiate obstacles at night will be greatly assisted by carrying a flashlight, even a small “keychain” type.

Safety must not be confused with convenience. Just when the boundary is crossed from essential outdoor lighting for safety purposes to inessential outdoor lighting provided for the convenience of humans may in part be subjective. Lighting which enhances outdoor recreational activities in developed areas of Joshua Tree is appropriate. However, any outdoor light must be evaluated as to its necessity based upon the protection of natural and cultural resource values within Joshua Tree. For example, it may be convenient to provide 100 lux of white light in a parking lot that allows excellent color rendition of people and objects and allows one to read a map or similar document by the ambient light alone. Nonetheless, a fully shielded yellow light of 2 lux



intensity will easily meet the safety requirements while drastically mitigating resource impacts.

Security

Safety must also not be confused with security. So-called “security lighting” is effective in preventing crime mainly if it enables people to notice criminal activity as it's taking place, and if it doesn't help criminals to see what they're doing. Therefore, bright, glaring dusk-to-dawn floodlights may fail on both counts if there is no one on patrol at night or they create high contrast shadow areas within which perpetrators of crime may hide from detection while surveying targets using the lighting provided.

While an outdoor light may provide a “feeling” of security to a pedestrian striking out in darkness from the lit interior of a building or vehicle, the actual amount of protection from potential threats will depend on the quality and uniformity of the light and even more on the presence of other safety-enhancing conditions such as the presence of other visitors or park personnel. Ideally, this type of lighting would be controlled by the user, and switched off when they leave the area, or by the use of motion sensors. In either case, dusk-to-dawn lighting is inappropriate for security purposes if no one is present to take advantage of it.

Accessibility Standards

It is a requirement to provide accessible routes which meet standards set by the Americans with Disabilities Act (ADA). However, the ADA does not give guidelines on appropriate lighting levels for accessible routes. Lighting on accessible routes should follow the general guidelines stated here. In order to accommodate people with impaired vision, lighting should maintain a continuous illumination, minimize glare, and not create a spotty effect.

Problems with Light

Light is not innocuous. It is an alteration of our environment like so many other human constructions, but it has received little attention as a significant environment change until recently. As seen from the many images of the Earth from space, outdoor lights have sprung up throughout most of the globe. The simple fact that light is visible from space, directly overhead shows how easily this human tool leaks out into the natural environment.

Light Pollution

The upward spill of light is often called light pollution. Dust, water vapor and other particles will scatter and reflect light that is emitted into the atmosphere creating sky glow. Light that escapes directly upward into the night sky is a major contributor to the loss of the dark night sky. Even light from a few fixtures can create an unnatural glow over a wide area. Light from cities has been documented by the NPS as being visible from over 200 miles away. Even a lone streetlight in the countryside can be seen for tens of miles if it is unshielded or of excessive intensity. Direct uplight is controlled by using fully shielded (sometimes called full cut-off)



fixtures. This is thought to reduce the overall uplight component to less than 25% of its former value. The reflected light component is controlled by using the minimal illumination level necessary.

Light pollution is not only an annoying modification to the natural environment; it is harmful to many animal species and may significantly alter human behavior, or cause harmful long-term effects to human health. Many people visit national parks seeking peace and quiet, especially at night. Campgrounds have noise curfews which are socially accepted. A light curfew or dusk to dawn light intensity that is low enough to not interfere with natural dark conditions should be expected as well. Minimizing sky glow is essential in maintaining a natural nocturnal lightscape, and sets an important example for park visitors and neighboring communities.

Light Trespass and Glare

Light that shines sideways (horizontally) from a fixture is not only a significant source of light pollution, but it is more apt to trespass into areas where light is not wanted. The surface of an electric lamp or lens of a luminaire has a very high intrinsic brightness per unit area. Such a brilliant source of light can be seen for tens of miles at night if it is unshielded from view. This brings about glare and light trespass, which is the illumination of the land or sky away from the intended task. Glare can cause minor discomfort, or it can completely disable the eye's ability to see properly. Even when present in low levels, it will cause the pupil to constrict down, diminishing the remaining light in the visual field. Glare should be minimized in all circumstances to both improve the lighting quality and to minimize light trespass.



Joshua Tree National Park will eliminate all such situations of light trespass and glare to the extent possible on permanent outdoor light fixtures through shielding, reduction in lamp intensity to below 250 lumens, or removal of the luminaire. Figure 1a-b shows examples of light fixtures that contribute to light trespass and glare, whereas Figure 2a-b shows full cut-off fixtures appropriate for Joshua Tree.

When luminaires on tall poles are employed, some glare is inevitable, but light trespass can still be contained

to some extent with proper shielding. For this reason, the use of tall poles is discouraged in the park. While not as economic to install, a greater number of shorter poles fitted with lower intensity luminaires will result in a more sensitive installation for area illumination. Note that lights which are temporary in nature (such as sports fields or yard lights) are not exempt from this guideline. Unshielded lights which may be seen from the wilderness are particularly egregious.



Figure 1a-b. Unshielded fixtures resulting in glare and light trespass.



Figure 2a-b. Full cutoff fixtures fitted with low intensity lamps

Ecological and Health Impacts

Every year there is more research suggesting that artificial light is affecting the natural environment and the biological rhythms of both plants and animals that are critical to native habitat and natural evolution. Effects of artificial light on wildlife can cause avoidance or attraction behavior with diverse and significant consequences that not only affect the species themselves but those on which they prey and those that prey on them. Research to date has concentrated on the effects of artificial light on birds and insects, but there is evidence that light affects larger animals. Mammals that travel long distances to find food or mates, such as mountain lions, may avoid links between natural areas if the areas emit artificial light.

Because the scientific literature is relatively sparse on this topic, there is frequently no species specific information available. However, there are some generalities that are useful guides. Nocturnal predators are particularly affected by artificial light, either positively or negatively, which can have resultant impacts on their prey species. Birds, many of which migrate at night, are particularly prone to disorientation by artificial lights. Certain biomes are believed to be more sensitive. These include wetland and ponds, shorelines, alpine areas, and open country such as deserts and prairie. The NPS is currently working with researchers to provide lighting guidance as it relates to wildlife including protecting sea turtle habitat at Cape Hatteras.

Finally, humans are animals too, and there is a solid body of research potentially linking artificial light at

night to certain health problems.

Sustainable Facilities Management

Outdoor lighting is the last appliance that has received so little energy efficiency scrutiny. Though the different types of lamps are well studied (for example a 4x energy savings is realized by replacing a traditional light bulb with a compact fluorescent), the question of what type of fixture, how much light, and if an area should be lit at all has not seen much discourse. It is estimated that the portion of light that shines upward and creates light pollution represents \$2 to \$5 Billion annually in the US. Thus, saving our night skies can have tremendous economic and energy benefits.

Designing for Efficiency

The basic tenants of efficiency are to use light only when and where it is needed, and if needed, use the minimum amount to achieve needed visibility using the most efficient light source that meets the task requirement. Lamp technology has evolved much, and efficiencies can be improved 2x-5x (i.e. reducing energy use 50% to 80%) by using modern lamp types. Reducing light levels are a viable solution if illumination can be reduced while still meeting the task, yielding proportional efficiency gains. Full shielding directs light that would go into space downward, further improving efficiency; concurrent elimination of glare usually allows lower illumination levels as well. And finally smart technologies, from the very basic timer or motion sensor, to elaborate computer controlled lighting and LED lamps can further improve efficiencies.

Maintenance Cost

What is energy efficient is almost always cost efficient. But another aspect of cost reduction is maintainability. Lighting design should include workload estimates related to upkeep. Capital cost should be compared with energy efficiency and maintenance intervals to get a true picture of the cost of lighting. All too often, lighting choices are made based only on fixture cost. A \$40 yardblaster light can be purchased at a hardware outlet, compared to a high end fixture with sophisticated optics and shielding materials (or luminaire as they are often called) costing \$400. However, if the yardblaster is 175 watts and the full cut-off luminaire is 18 watts, the capital cost will be offset by energy savings in 4 years. Over a 20-year fixture lifetime, the difference becomes \$1,200.

A similar comparison can be made with lamp lifetimes. A typical incandescent lamp will last about 1,000 hours or less, compared to 10,000 hours for a compact fluorescent lamp (CFL), and 50,000 to 100,000 hours for LED lamps. The old fashioned light bulb will be changed 6 or 7 times before the CFL burns out, more than making up for its higher initial cost.

Design

Lighting is an important element in architecture and landscapes. It can emphasize spaces, highlight the landscape, and serve purposes beyond the basic need for visibility. Design issues can include pole height and pole spacing, fixture appearance, illumination pattern, light level, or light color to name a few. With design and implementation, the use of the appropriate light intensity, color, and duration for a particular task will achieve the objectives of both human safety and resource protection.

In 2008 Joshua Tree National Park conducted a lighting inventory to determine which outdoor lights do not meet IDA standards. In 2010, 98% of the lights were upgraded to meet the IDA standards. Currently

there are no retrofits planned for the next several years, but any future upgrades will be designed to meet IDA standards.

Lamp Color

One element that receives much attention is the color of the light. Different lamp technologies, such as High Pressure Sodium (HPS) or Low Pressure Sodium (LPS) produce yellow light. This monochromatic or color biased light cannot render colors properly (these are often described as having a low color rendering index). Many feel that this light has an industrial character. Research indicates that less light is needed (and therefore less energy) for the human eye to see efficiently with a white (blue/green) light source than with a more yellow light source. However, HPS and LPS lights are more efficient than white light sources such as Metal Halide (MH), Mercury Vapor (MV), or even Compact Fluorescent Lamps (CFL), producing more lumens per watt. They are also believed to be less impacting to nocturnal wildlife. For example, LPS is often used on turtle nesting beaches with good success. Additionally, the yellow lights scatter much less in the atmosphere and are 2.5x (HPS) to 5x (LPS) less interfering with human night vision than white light. This is an important factor in maintaining dark night skies.

The color rendering abilities and improved visibility of white lights are at odds with their lower energy efficiency, wildlife impact, and night sky impact, causing frequent professional disagreement. The bias of this guideline is to use yellow lights sources as a default when available unless the need for better color rendition is demonstrated.

Historic Integrity

Historic structure and cultural landscapes have particular lighting needs that may not be addressed in this document. Both the light fixtures themselves and the character of the light they produce are of concern. Often there is too much emphasis on selecting fixtures that look of the appropriate period, while the nighttime scene is neglected but just as important to the historic integrity.

Lighting Guidelines

Approaches

There are several ways to define lighting. They can be divided into two categories— prescriptive where the type, size, lamp, etc. of the light is defined, or performance where the resultant illumination levels are defined (see Table 1). The latter is more accurate, but requires computer modeling and photometric data on each light fixture. Because so many of the fixtures used in parks are low cost without photometric or custom designs, and lighting expertise to run computer models is rare, a prescriptive approach is taken here. There are several aspects of lighting design that can be controlled and defined. The designs chosen to be prescribed in this guideline are limited for simplicity.

Table 7. Two categories defining lighting.

Prescriptive Parameters	Performance Parameters
Lumens	Illumination (minimum, avg, max)
Kelvins	Color temperature
Watts	Glare or Glare Ration
Power density	Uniformity (average:minimum)
Lumen density	Uplight and light distribution
Pole spacing	Spill light/light trespass
Pole height	Transition
Fixture shielding and aiming	Down-directed less than 45 degrees of nadir

Table 8. Outdoor lighting zones.

Zone	Description	Typical task	Maximum intensity of task areas	Maximum intensity at zone boundary	Maximum fixture brightness (lumens)	Maximum fixture color temperature (kelvins)
0	Wilderness & undeveloped land	Backcountry hiking and camping	0	0	0	0
1	Entrance Stations, Recreation Sites, parking lots	Developed Camping Rest Room Exterior, Dusk to Dawn fee collection areas, pathway illumination, certain high use parking lots	5	0.01	1,500	<4,000
2	Fuel, Maintenance Yard	Fueling station, equipment delivery	50	2	5,000	<4,000
4	Emergency Services or Loading Dock area	Fire Station Exterior, Warehouse Loading Dock	50	6	5,000	<4,000

*Maximum intensity is illuminance in lux

Zones

Joshua Tree National Park embraces the concept of restricting the use of light and its maximum intensity

based upon the location within the park as it relates to land use and human development (see Table 2). Lighting zones are defined based upon the following guide for permanently mounted fixtures (after IENSA RP-33). The listed “maximum intensity at zone boundary” is an important concept. It defines the allowable “light trespass”, or vertical artificial illumination at that point on the land. Such illumination may result from direct glare OR reflected light. This is particularly important at the Zone 1 boundary, beyond which lies Zone 0 (Wilderness). The preservation of wilderness values is of paramount importance in Joshua Tree National Park, including solitude, natural quiet, and a natural dark environment at night.

Note that roadways are NOT considered Zone 1 by default; the vast majority of roads are in Zone 0. Roadway lighting is *strongly discouraged*. In fact, at this time there is NO roadway lighting in the park at all. For any future development, modifications or retrofitting, a lighting zone map will be drafted specifically outlining the boundaries of each zone. “Use of lighting controls” means that lights of an intensity greater than 1,000 lumens MUST be controlled by a manual switch, timer, or motion sensor in addition to or instead of a simple “dusk to dawn” photocell.

Lighting zones must grade from bright to dark incrementally to meet the maximum illuminance at zone boundary requirements. Incompatible uses must be avoided or mitigated (such as a 24 hour gas station bordering a wilderness area) with screening by vegetation, walls, or earth berms, where possible.

Lighting Applicability

Where there is an expectation by the visitor or employee of darkness and people are generally prepared for darkness (either through dark adaptation or carrying their own flashlight), lights should not be installed.

Lights should be installed as an illumination transition on commonly used building egress points, where outdoor work may be done at night, where critical information is posted, to draw nighttime visitors to important information or safety point (such as a phone booth or visitor center entrance), where there is a demonstrated need for protection of assets, where there is an identified safety hazard, or where facilities are commonly used at night (such as a laundry room in residence area).

When choosing whether to light an area, it is important to consider the cumulative effect of the action as well as if the illumination will be successful in its desired function. It is also important to consider illumination transitions; an isolated light may effectively light a small area but will render the surrounding dark area less visible.

Security lighting where no patrols exist (such as a remote storage yard or parking areas) is often counterproductive, inviting crime without the opportunity to intercede.

Lighting Requirements

Exterior Lighting

All permanent exterior lighting shall be fully shielded, use the proper illumination level, and must be less than 4,000 kelvins in color temperature. When fixtures are articulating, such as PAR floodlamps, they should have directional shields, should be aimed within 45 degrees of downward, and should not illuminate areas outside the intended target.

Special Use Lighting

Unshielded and partially shielded fixtures are permitted for low voltage LED pathway lights, under-canopy lights at phone booths, and other guidance lighting provided they are ≤ 7 watts each.

Lighting Controls

Lighting controls include manual switches, photo-switches, dimmers, timers, motion or presence detectors, and any other device which may be used to control a light's operation or intensity. Intelligent use of lighting controls will result in energy conservation and mitigation of light pollution. However, controls will not be used as a substitute for replacing an unshielded light fixture that produces glare or light trespass.

The use of a photo-switch, which uses a photocell to determine the ambient light level and automatically activates a light when it drops below a threshold, is one of the most common outdoor lighting controls. While allowing the convenience of automated activation of outdoor lights, it should be used in combination with other controls to avoid obligatory "dusk to dawn" operation. All outdoor lights within Joshua Tree National Park will be fitted with a user-accessible manual override switch or other control so they may be turned off, if desired.

Motion or presence detectors mitigate light pollution and save energy by automatically activating lights when an object is detected in proximity to the detector location. While these controls are ideal in certain situations, such as security lighting, great care must be taken with the location of the sensor and adjusting its sensitivity. They should not be used near roadways where passing cars will trigger them or in areas frequented by large wild animals, such as coyotes. They also should not trigger for passing pedestrians who are not using the area needing light. Motion sensors are not maintenance-free and must be frequently checked for proper operation.

Timers provide an excellent solution to outdoor lighting control in situations with public access. Lights are often needed only in the evening hours, when the vast majority of visitors are active as compared to late night and early morning. A light curfew may be implemented using a timer. An elegant solution for some applications uses a timer combined with a dimming circuit, where after the curfew lights are dimmed to a minimal level, allowing the facility to still be seen from a distance for those seeking a telephone or information on how to obtain emergency services. Solid-state devices are available which contain an astronomical clock, eliminating the need for photo-switches.

Prescriptions

Maximum Lamp Lumens

The maximum allowable lamp output is 5,000 lumens (except for emergency lighting). In most cases, 500-1,500 lumens will be sufficient. See Table 3 below for the recommended lighting for specific areas.

Table 9. Recommended Lighting for Specific Types of Areas

Type of Area	Maximum Lamp Lumens	Recommended Light Types	Recommended Illuminated Area	Recommended Duty Cycle
Pedestrian Walkways	1,000	Low voltage LED guidance lighting or very low lumen fully shielded lamps. Higher illumination steps or uneven ground.	Pathway and area immediately adjacent to path.	Timer for operation during frequently used times.
Building Egress Points (Public and Staff Buildings)	1,500	CFL 500-1500 lumens. Forward throw fully shielded fixture.	Egress point and surrounding approach. Transition from lit to dark area should be gradual reduction in illumination with no hard shadows.	All night operation at critical safety, frequently used, and visitor contact points. Motion sensors or user accessible switches for other tasks.
Parking Lots	5,000	Not generally recommended. If required, light with LPS or HPS lamps of 3500-5000 lumens (depending on pole height).	Portion of parking lot used at night.	Switched with timers to prevent all-night operation.
Safety and Work Areas (Loading Dock, etc.)	5,000	CFL of 1200-3000 lumens for most applications. Fully shielded lights.	Only immediate work area.	User controlled switches or power-interrupt sensor.

***Note:** see Table 4 – Lamp Characteristic below for conversion to Watts.

Lamp Selections

The standard lamp shall be a cold-start compact fluorescent lamp (CFL), ideal for its high energy efficiency and range of wattages. These should produce less disruption to the nocturnal species and human experience of the night than a 70-watt High Pressure Sodium (HPS) lamp, provided the CFL lamps are 26 watts or less. Incandescent lamps may be used with motion sensor lights. Lighting requiring more than 2,000 lumens should use HPS lighting.

Lamp Characteristics

Lamp types should be carefully chosen. Proper lumen output, efficiency, color temperature, and spectral characteristics should be key elements in the decision. Other factors to consider should be lamp life, lamp available and cost, aesthetics, and appropriateness. The lamp color should be very warm, warm, or warm white (1,000K, 2,700K, and 3,000K respectively). Avoid purchasing clear colored lamps and pay attention to the color temperature.

The following are allowed under these guidelines when specifically permitted (see Table 4).

Table 10. Typical lamp characteristics

Lamp	Watts	Lumens (initial output)	Lumens/watt (efficiency)	Lifetime (hours)	Color Rendering	Correlated Color Temperature
A-Lamp Incandescent	40	500	12	1,000	100	2,800
	60	850	15	1,000	100	2,800
	100	1,600	16	1,000	100	2,800
Compact Fluorescent	7	400	57	10,000	85	2,700
	13	775	60	10,000	85	2,700
	23	1,400	60	10,000	85	2,700
	26	1,650	65	10,000	85	2,700
	42	2,800	65	10,000	85	2,700
Metal Halide	39	2,800	72	6,000	85	3,000
	50	3,700	75	6,000	85	3,000
	100	7,500	75	6,000	85	3,000
	150	10,500	70	6,000	85	3,000
High Pressure Sodium	35	2,200	50	24,000	40	2,000
	50	3,700	60	24,000	40	2,000
	70	6,200	75	24,000	40	2,000
	100	8,000	80	24,000	40	2,000
	150	14,500	85	24,000	40	2,000
Low Pressure Sodium	18	3,800	150	18,000	0	1,700
	35	6,800	150	18,000	0	1,700
	90	15,300	150	18,000	0	1,700

*Note: high color rendering combined with total brightness typically results in higher impact to nocturnal environment.

Decorative Lighting

Decorative lighting is here defined as any light that uses an unshielded fixture (such as globes, lanterns, or bare bulbs). That is, the fixture itself is intended to be attractive or an enhancement to the visual scene. Decorative lighting is strongly discouraged. If decorative lighting must be used the illuminating lamp used within the fixture must not exceed 250 lumens. The use of yellow light or warm (incandescent) lamp is strongly encouraged, and the lights must use intelligent controls (not be on dusk to dawn by default).

Security Lighting

Light may be used as a deterrent to crime, either burglary or violent attacks on people, but its use in a park setting should include a presence detection system (motion sensor or other device) to activate the lights. The concept of deterrence is primarily based upon illumination of the area that is sufficient for the perpetrator to be identified by a witness or seen by law enforcement personnel or surveillance cameras from a distance. Research has shown that about 10 lux of vertical illumination is required for most people to be able to recognize another person's face, though it is not clear that simple recognition allows identification of true hazards. But 10 lux is an enormous amount of light in the dark surroundings of Joshua Tree National Park. One lux is equal to one lumen per square meter, and takes into account the area over which lumens are spread.

The installation of dusk-to-dawn light to achieve 10 lux of vertical illumination in an area such as at Pinto Wye or the Lost Horse Ranger Station would bring about an unacceptable impact to the natural lightscape surrounding the facility. Lower intensity pathway lighting and/or building illumination may be installed to maintain hazard identification. If necessary, brighter "security lights" could be installed if triggered by a motion sensor. These lights should be on a timer to provide automatic activation after the facility is normally closed. They should always include a user-accessible manual switch. Ideally, an alarm, camera surveillance system, and/or night patrol guard should accompany such lighting systems.

Other Situations

Sign Lighting

Internally illuminated signs should be light lettering on a dark background and should not be lit after the related facility has ceased operation for the night. Externally illuminated signs should be lit from the top downward with fully shielded or partially shielded fixtures and should use the minimum amount of light necessary. No specific guidelines are established in this interim guideline, however it is recommended that sign lighting only be employed where it is clearly necessary and that luminance be limited to approximately 1,000 lumens or less per side per modest size sign, depending on viewing distance and ambient light level.

Flag Lighting

The preferred practice for staffed federal facilities is to raise and lower the American flag daily at staffed federal facilities. There are only a handful of federal sites where flags are intended to fly all night, such as the Tomb of the Unknown Soldier. There is a growing misconception that flags should be up all night and should be lit. At active federal sites there is little excuse to not honor the flag daily by its raising and lowering. The Patriot Act of 1976 requires nighttime flags to be lit, but does not in any way indicate patriotic preference for leaving the flag up during darkness. Recently some top-down lighting solutions for flags have come to market. This will allow full compliance of flat lighting if there is such a need.

Spill of Interior Lights through Windows

In Zone 1 areas such as campgrounds, interior lights must be evaluated for light trespass if bright light escapes through windows or open doors. Interior lighting levels are particularly incompatible with outdoor nighttime vision, and when illuminated interior spaces are visible from outdoors visibility can be compromised and impacts on the nighttime environments severe. These situations must be mitigated with proper shielding of the interior fixtures, minimal interior illumination levels, and where appropriate window coverings. It is recommended that the visitor centers at Black Rock, Indian Cove, and Cottonwood run in total darkness at nighttime. If necessary, security lighting that is triggered by motion could be utilized.

Exempt lighting

- 1) Where OSHA states that specific lighting levels are necessary for work situations these are considered exempt from the Lighting Management Plan. However, although the lighting levels for the actual work environment must meet OSHA requirements all measures outlined in this document must be taken to exercise best energy practices and shield the light from the surrounding environment.
- 2) Emergency lighting is exempt from these controls provided it is not used for routine maintenance or scheduled functions. Typically, emergency lighting is used once a year or less and is necessary for human safety in emergency or unforeseen circumstances.
- 3) Traffic safety warning lights and speed indicators are NOT automatically exempt but should be considered on a case by case basis.
- 4) Holiday lighting is exempt, provided it is only in operation during the holiday period.

IX. Dark Sky Park Designation Request

Silver Tier

Joshua Tree National Park is requesting a Silver Tier designation as a Dark Night Sky Park. Though Joshua Tree has a varying degree of sky quality from its western borders to its eastern edge, the majority of Park visitors camp in areas of the Park that display Silver Tier qualities. When sky conditions are good in the Park, light domes do not stretch to the zenith, the Milky Way is visible in both summer and winter, and there is little to no point light sources and glary lights. For being located in Southern California, Joshua Tree's nighttime lightscapes are exemplary and people come from all over the world to capture the whimsical Joshua tree or the unique rock formation, Arch Rock, with the Milky Way in the background.



Figure 28. A starry Sky in Joshua Tree. NPS Photo/Lian Law

According to the World Atlas of the Artificial Night Sky Brightness, Joshua Tree National Park falls within a range of 20.49 to 21.99 magnitudes per square arcseconds (MPSA) for sky brightness. The sky brightness at campgrounds in the Park fall within a range of 21.25 to 21.89 MPSA based on the World Atlas data, which falls within the Silver to Gold Tiers.

Data collected with a Unihedron Sky Quality Meter (SQM) at Joshua Tree shows a range from 20.25 to 21.24 MPSA, where the majority of data collected fell between 21 to 21.61 MPSA. The data collected with the SQM is dependent on sky conditions and may be impacted by user error. Data collected from Pinto Wells showed a range from 20.25 to 22.24, which is an extreme range that may have been

affected by atmospheric conditions. More SQM data is needed to have a better average of night sky quality throughout the Park, and Joshua Tree is committed to ongoing data collection in perpetuity.

The western edge of the Park is most impacted by light pollution, and data collected using the NPS method shows an average mean all-sky brightness of 20.23 at Black Rock, 20.28 at Hexahedron Mine, and 20.35 at Key's View, which all fall within the bronze tier. But data collected from Pinto Wells and Cottonwood fall within the silver tier with mean all-sky brightness values of 21.4 and 21.23 respectively. Joshua Tree's night sky camera and laptop have been updated with proper software and protocols, and collection at previous and new sites will continue in perpetuity.

There is a real threat to the quality of the night sky in the Park with increasing urban development near the Park's border. According to data released from California DOF web site E1 report in 2013, Coachella, Desert Hot Springs, and Indio have all increase in population from 2005 to 2013 (38.2%, 42.7%, and 22.3%). If these trends continue, light pollution from the Coachella Valley will continue to increase as well. Joshua Tree quality currently averages in the silver tier, but could be reduced to the bronze tier or less.

In order to combat increasing light pollution, Joshua Tree National Park is working with San Bernardino County to enforce lighting ordinances. If San Bernardino County is successful in enforcing its lighting ordinances, the quality of night sky could improve. Also, if San Bernardino County is successful, there could be a real push to enforce lighting ordinances in Riverside and other Southern California counties. If cities in Southern California adhere to lighting ordinances, light pollution in Joshua Tree National Park could be drastically reduced. Joshua Tree National Park is committed to working with its neighbors to improve night sky quality.



“I have loved the stars
too fondly to be fearful
of the night”

-Sarah Williams



Appendix I

Glossary

Fully shielded – a fixture that throws light downward only and in which the lamp itself is shielded so that it cannot be seen except from under the fixture

Full cut-off – a fixture that is fully shielded and has virtually no part (or a negligible amount) of the fixture lit below the horizontal

Cut-off – is a fixture that shields upward light causing light to shine both downward and sideways only

Luminance – is the quantity of light reflected or emitted toward an observer, i.e., the light an observer sees

Illuminance – is a measure of light in either foot-candles (imperial) or lux (metric). Technically described as flux density per unit area

Brightness – is a subjective sensation to measured luminance

Glare –

- **Disability Glare** (veiling luminance) – is stray light scattered within the eye reducing the contrast of the image.
- **Discomfort Glare** – is high contrast or non-uniform distribution of luminance in the field of view.
- **Nuisance or annoyance glare** – is not quantified but is basically annoying light such as “the light shining in the window”

Visual Adaptation to Light –

- **Photopic Vision** – is the eye’s response at high light levels when cones are used to determine color and to focus on objects
- **Scotopic Vision** – is the eye’s response at low light levels such as moon-light when rods are used. Peripheral vision is strong and everything appears in shades of gray
- **Mesopic Vision** – is a combination of photopic and scotopic Vision

- All definitions “Lighting for exterior environments” IESNA

Appendix II

Light Inventory (2016 Update)

On July 7 through July 10, 2008, Dan Duriscoe and Kate Magargal of the National Park Service Night Sky Team conducted an inventory of outdoor lighting at Joshua Tree National Park. The results of their inventory and recommendation are presented below.

This inventory was partially updated on September 15, 2016. The updated inventory included the light fixtures -visually accounted for- that are installed on infrastructure located *within the interior* of the park boundary. The 2008 inventory came with recommendations for retrofitting light fixtures within the park and at our facilities located exterior to the park boundary. In 2010 a campaign to change out or retrofit noncompliant lights was implemented at facilities managed or owned by the NPS (including the headquarters at Twentynine Palms.)

It is a fact that more than 80 percent of the light fixtures have been replaced with night sky friendly light fixtures and bulbs located within the interior of the park. Additionally, the lack of electricity within the interior of the park helps maintain our goal to preserve the night sky quality at Joshua Tree National Park. There no future plans to bring electricity onto the park or to develop infrastructure in new locations of the park that would include electricity. A few fixtures located on the boundary have not been replaced due to conflicts and use. For example the Black Rock fire center is located just on the edge of the park boundary and is managed by the BLM. The park service is striving to educate and replace the all the light fixtures in all the locations where we are noncompliant (including non-federally owned structures and buildings outside the boundary). In areas where the fixtures were not removed or replaced the fixtures have either been rendered inoperable or are no longer used.

At this time, a complete updated inventory is planned during our fiscal year 2017. However, a complete inventory of interior (within park boundary) light fixtures was completed in September 2016. Please see Table 11, below for a current updated status of lights visually accounted for (inventoried) in September 2016.



Outdoor Lighting Technology Inventory and Review

Joshua Tree National Park

July 28, 2008

Updated 2016

Dan Duriscoe

Kate Magargal

NPS Night Sky Program

Summary

Park	Joshua Tree National Park	Area Name Acres	All areas
Date of visit	July 7-10, 2008		789,866
Report date	31-Jul-08		
Contact #1	Paul DePrey	Reviewer 1	Dan Duriscoe
Contact #2	Luke Sabala	Reviewer 2	Kate Magargal

Existing Conditions:

Joshua Tree National Park contains a variety of light fixtures with technologies ranging from the 60's to the present. Some custom light fixtures exist as well. Most present fixtures are in need of retrofitting and some for removal.

Retrofit Objectives:

The recommendations contained herein are intended to minimize the amount of light produced artificially from within the park and park facilities. This effort is primarily to reduce the park's impact on the natural lightscape. Attention has also been paid to visitor and employee safety in areas where appropriate.

In most cases a one to one fixture retrofit or removal is recommended, however, in some cases a redesign of the lighting plan for the area would be more desirable. Considerable energy savings may be realized by merely replacing the large number of incandescents and halogens found here with lower power consuming lamps.

	Existing Conditions	Recommended
Total lumens	265396	166830
lamp hours/day	1292	758
energy useage (kWh)	19,618	2386
energy cost (0.14/KWh)	\$2,747	\$334
# of lights	267	234
# conforming		

Estimated cost of retrofits: \$14,628.32

Estimated years until cost offset: 6.06

Park Headquarters, Oasis of Mara



Park Headquarters area map

Outdoor lighting at the Visitor Center presents the most significant challenge of any facility in the park. While discussion with park personnel indicated that the area receives little or no public use after dark, significant improvements to employee safety may be achieved while reducing light trespass and glare. Particularly egregious are the walkway/parking lot lights (56-78). The simplest retrofit for these is a shield or louvre fastened over or in place of the diffusing shields now installed (see photo). Using a much lower lumen lamp in each fixture is another option.



Sidewalk illuminating pathway light

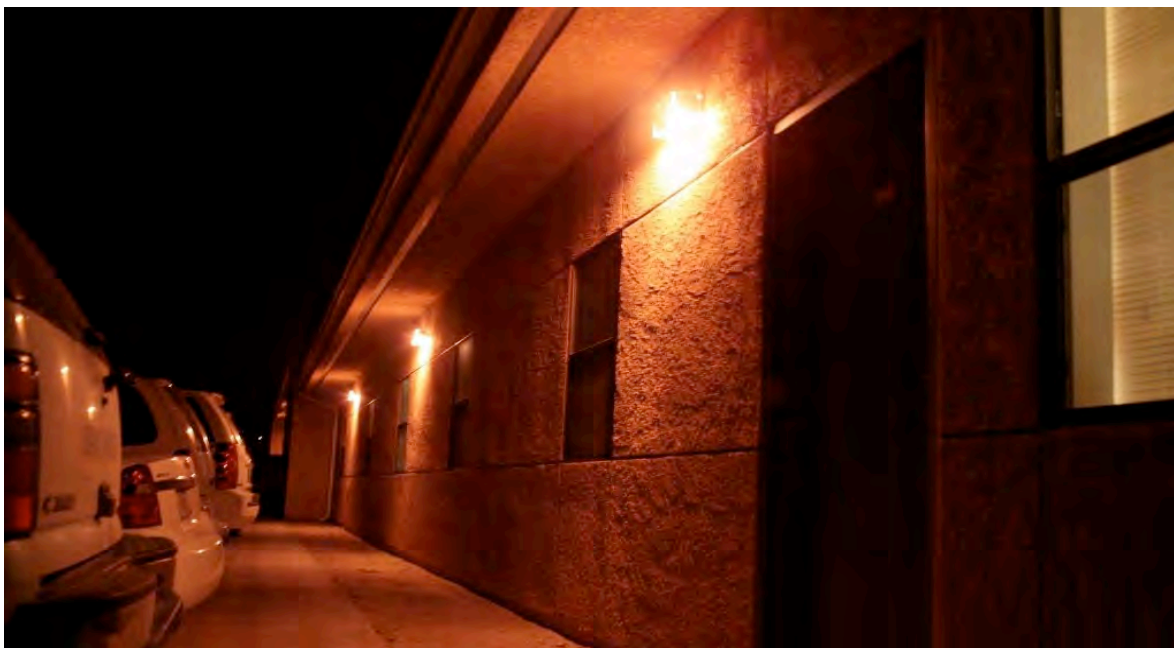
This array of lights facing the parking lot, while providing some measure of illumination of parked cars and the parking lot area for those walking toward the lot, severely inhibits visibility to those walking from the lot to the buildings. The glare and low angle light masks the curb at the sidewalk/parking area junction, creating a tripping hazard (see photo).



Sidewalk and parking lot, Headquarters



Other illuminated areas at headquarters can generally be improved by simple retrofits of existing luminaires. The Park Nursery has only one light, an old mercury-vapor "barn light" that should be removed. A decision to provide replacement illumination for this area must be made. We did not address a new design for this large outdoor area. We were informed that a new employee parking lot is planned, near the maintenance admin and visitor protection buildings. This area is currently (poorly) illuminated by wall mounted fixtures on buildings. Similar to the visitor center parking lot, low level area illumination may need to be designed for this area requiring pole fixtures. We recommend that ALL fixtures attached to walls be fully shielded and areas more than 3 or 4 times the mounting height horizontally away from the fixture not be directly illuminated by the fixture. Sometimes with light colored walls, refelected light off the wall provides sufficient illumination of these areas. However, higher lumen output lamps should not be used in an attempt to create this effect (see photo).



Employee and Official Vehicle parking near Visitor Protection offices

Black Rock Area



Blackrock area map

Most of the outdoor lights in this area are at the interagency fire center. This fairly new complex of buildings is for the most part appropriately lit, however considerable energy savings can be achieved by replacing existing incandescent lamps with CFLs. Some area lighting near the fire station bay doors is currently accomplished with sideways-pointed halogen flood lights mounted on the walls. We do not recommend these unless they are pointed straight down, even if they are motion sensed, especially in this instance where light trespass extends to the wilderness area adjacent when the lights are in use. The GB2000 provides a servicable retrofit, but it will not provide the intensity on the ground that the halogens do, particularly beyond 3 x mounting height distances from the wall. Another GB2000 could be installed on the outdoor arbor dining structure to cover the area better, but its mounting height without the addition of a pole would be too low to be effective. If this entire area must be illuminated, consider installing a pole near or attached to the arbor extending the mounting height to about 14 feet. (see photos).



Wall mounted flood light on fire station



Arbor area opposite fire station

The parking area west of the offices is currently illuminated only by unshielded flood lights attached to the buildings. We recommend these be replaced with either a GB1,000 or GB2000, depending on the level of illumination desired. In this area near wilderness, we would prefer to see the GB1,000 with no more than a 13 watt CFL. This application will definitely not illuminate the entire parking area, but will adequately illuminate the area nearest the entry doors. If the entire parking area is often filled with cars at night, additional poles may be required to provide adequate safety.

The "Jellystone" campground nature center provides an opportunity for creative lighting design of the entry way and signs. While an excellent effort has produced custom made shields for tube fluorescents now installed, flush mount shielded canopy lights may provide better illumination of the stairs, especially when combined with reflective paint on the stair edges. A pole-mounted parking lot flood light should be removed or replaced with a fully shielded fixture (see photo).



Pole mounted floodlight in Nature Center parking area

Cottonwood Area



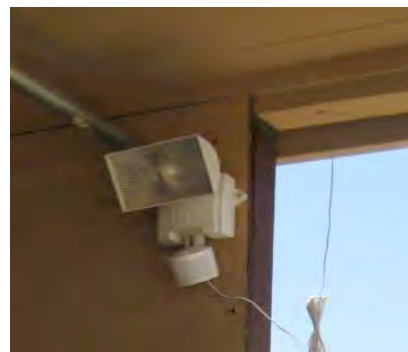
Cottonwood maintenance and housing area map



Cottonwood Visitor Center area map

In the Cottonwood area we found some "portable" floodlights with small solar panels and integrated battery installed in various locations. Some of them appear to be no longer working, probably because the battery has failed. The use of this type of light comes with it a maintenance burden related to batteries. High (and low) outdoor temperatures can shorten battery life. These installations use a flood light, with a halogen lamp (consumes a lot of power for the lumens provided--see photo).

Solar powered flood light of the type found at Cottonwood. Note the wire from the roof where the solar panel is located and the motion sensor; the metal conduit on the canopy does not provide power to this fixture. Battery is in white plastic case.



While providing a creative solution to outdoor lighting for this remote area, these unshielded flood lights produce glare and light trespass. A custom solution from a vendor like Holly Solar using LED lamps would probably provide better quality and quantity of light, although they will be expensive. The other alternative is to modify each building's electrical configuration and provide 120 volt power in outdoor conduit to the locations where these fixtures are used. This would be labor intensive, but would allow a greater flexibility in the type of light fixtures that could be used.

Some 120 volt flood lights were found at the Cottonwood Visitor Center that appear to have been disconnected (lights 213 and 214). They were intended to illuminate the area around the park map and provide nighttime motorists with information when the visitor center is closed. This is an important function, and some sort of pilot illumination that is on all night is normally required to guide motorists to the display. A re-design using an independent power source (solar collector and batteries) is once again quite possible here (see photo).



Disconnected canopy lights at Cottonwood Visitor Center. Information and map to the left where foreground flood is pointed.

Entrance Stations



West Entrance Station Map



Both the west and north entrance stations have some façade lighting installed using halogen floods (see photo). Unfortunately we did not examine these at night to determine if they were actually functioning, but each uses uplight from areas on either side of the building. We do not recommend this type of lighting, and recommend they be removed. Safety for motorists at night can be adequately addressed by much lower intensity marker lighting or reflectors on the building. Both entrance stations also employ unshielded or partially shielded lights at the windows, we recommend these be replaced with fully shielded fixtures (see photo).



Upward pointing halogen flood at west entrance



Partially shielded window illumination at west entrance



Façade light at north entrance



Halogen flood aimed downward at north entrance, a fully shielded fixture

Other Ranger and Visitor Contact Stations



Lost Horse Ranger Station Map



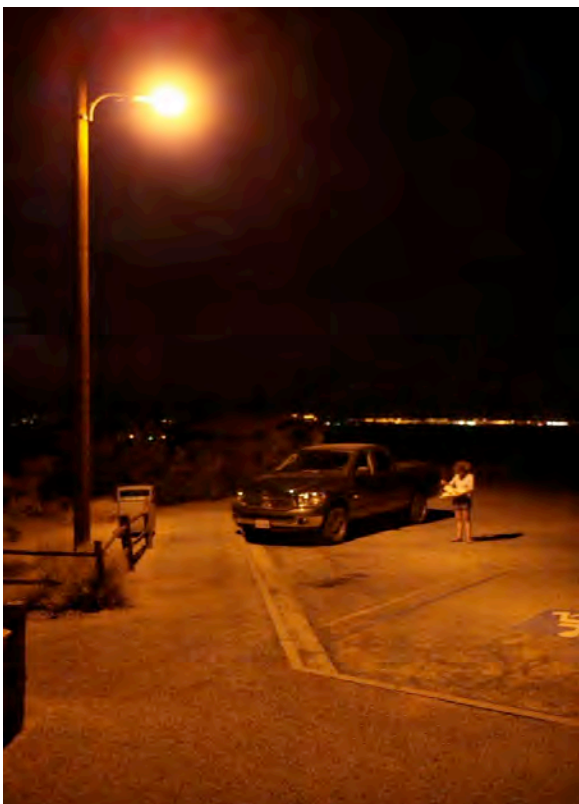
Indian Cove Ranger Station Map



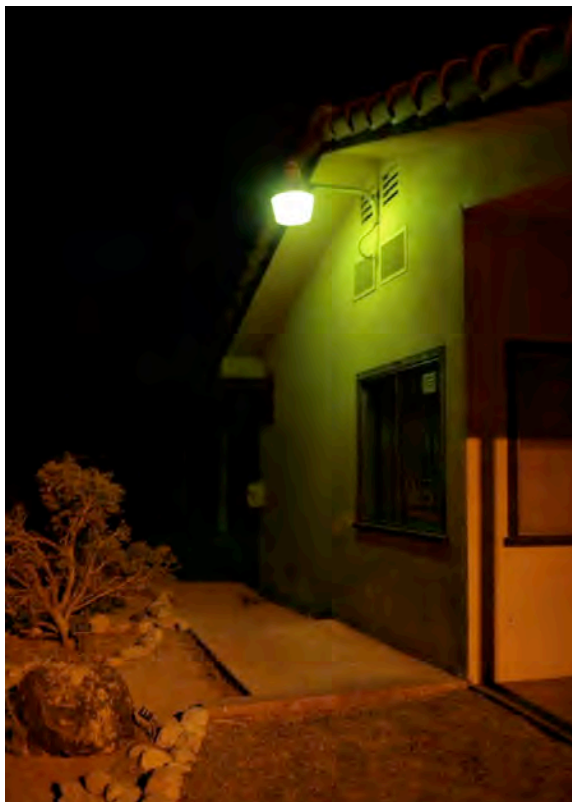
Joshua Tree Visitor Center and Park Rock Café

Lost Horse presents a challenge of remote power. LED fixtures may be ideal here, both from an energy conservation perspective and because of its very dark surroundings calling for low light levels. Currently incandescents are installed.

Indian Cove Ranger Station has a very bright pole mounted area light that appears to be on all night (light number 240). A brightness reading of 5 footcandles was measured directly under it, five times the recommended maximum brightness for this type of light. Replacing the head with a lower wattage fully shielded type and placing the light on intelligent controls are recommended (see photo). Also, an older "barn light" is installed on the building wall, apparently a mercury vapor lamp that is long past its prime is consuming a lot of energy for the lumen output (light number 241, see photo). We recommend this fixture be replaced with a GB1,000 with intelligent controls.



Excessively bright pole mounted light



Mercury vapor lamp on rangerstation

A lot can be done with the Joshua Tree visitor contact station and Park Rock Café. Nearly all outdoor lights currently installed are unshielded. The halogen flood "security" lights on the arbor are manually controlled by a switch inside the café. This installation is OK only if they are used for scheduled outdoor activities, such as dining. If so, the fixtures should be replaced with something of more appropriate intensity. If they are intended for security only, they should be aimed downward and placed on a motion sensor (see photo). This in-town location associated with lots of visitor contacts is an ideal place to show off appropriate lighting design and conduct education outreach on the subject of light pollution.

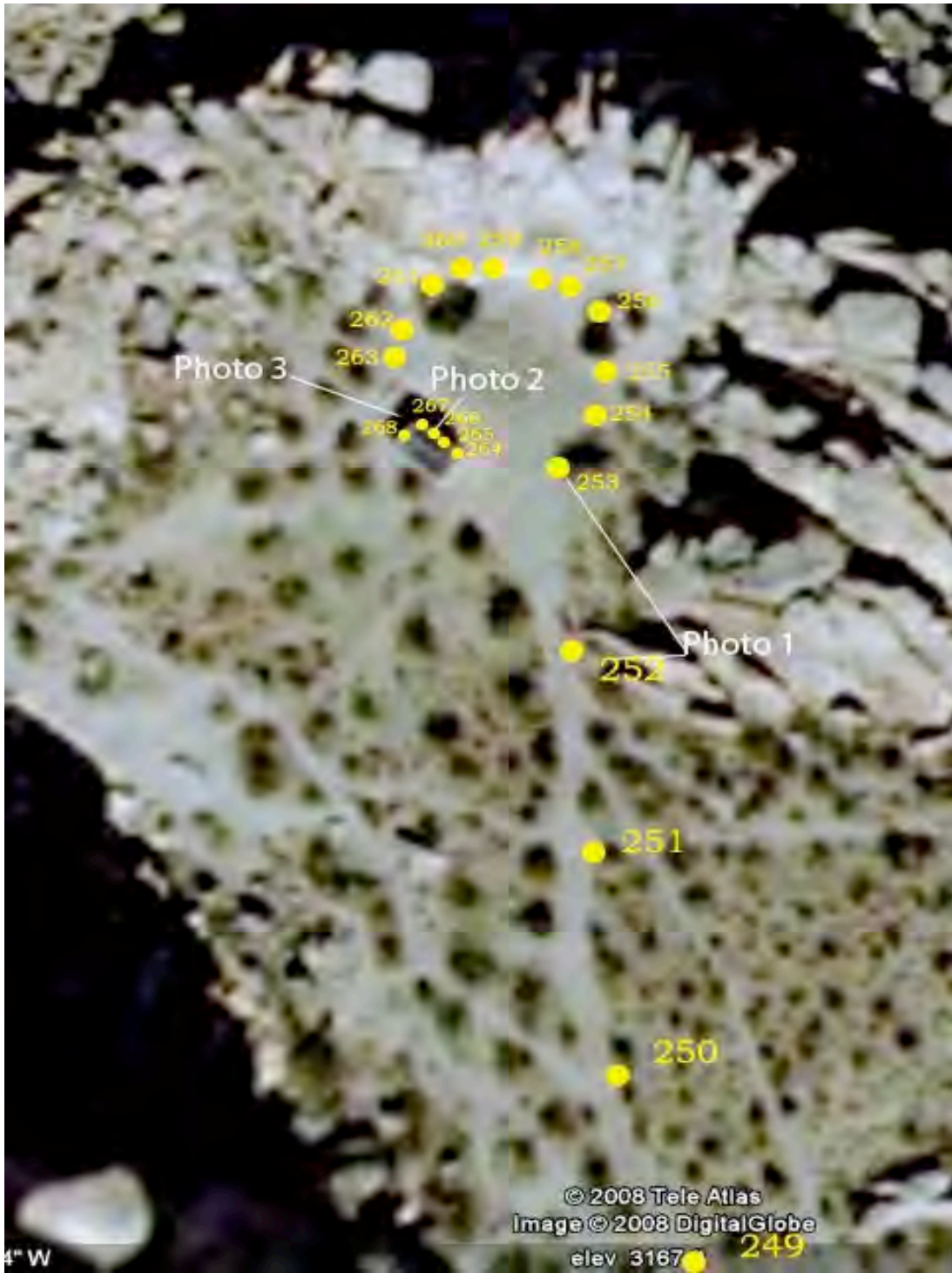


Unshielded flood under the arbor, and a general view of the dining area, Park Rock Café

Campground Amphitheaters



Cottonwood CG Amphiteater Map



Indian Cove Amphitheater Map



Jumbo Rocks Campground Amphiteater Map

The three amphitheaters in the park are beautifully done in terms of facilities management, and the outdoor lights are no exception. Custom pathway lights carved out of native stone and using low voltage "headlight" lamps give this park a unique place in the world of outdoor lighting (see photos). Stage lighting consists of small floods aimed downward (see photo). A few wall mounted fixtures should be replaced with fully shielded types, and incandescents could be replaced with lower power consuming lamps to save on the remotely collected energy at each site. This is particularly important since the projector systems undoubtedly use a lot of power and having enough battery power to last through the presentation is a must.



Jumbo Rocks pathway light



Cottonwood pathwaylight



Jumbo Rocks Stage lighting



Cottonwood Stage lighting



Indian Cove Stage lighting, should be pointed down

Pinto Wye Area



Pinto Wye Maintenance Yard Map



These areas are generally hidden from public view, and have little if any nighttime use by park employees. Nevertheless, outdoor light should still conform to the lighting guidelines, and many retrofits are recommended. This area may be considered low priority for retrofits since the currently installed lights are very rarely used.

Existing Outdoor Lighting Inventory

Table 11. Lighting Inventory

Existing Outdoor Lighting Inventory				Joshua Tree National Park											
General	Location			Existing Light Information										Recommended	2016 Inventory
												Hours/	Notes		
1	Black Rock	Black Rock Nature Center	16854	Area security	Timer	Canopy_Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	64	3500	4	home made shield added	Remove	Compliant
2	Black Rock	Black Rock Nature Center	16854	Building_Egress	Timer	Canopy_Partial	Wall	Wall_Other	Incandescent_Halogen	25	189	4		Remove	Compliant
3	Black Rock	Black Rock Nature Center	16854	Building_Egress	Timer	Canopy_Partial	Wall	Wall_Other	Incandescent_Halogen	25	189	4		Remove	Compliant
4	Black Rock	Black Rock Nature Center	16854	Area security	Switch	Canopy_Partial	Canopy_Soffit	Canopy_Drop_Lens	Comp_Fluorescent	15	850	12	home made shield added	Remove	Compliant
5	Black Rock	Black Rock Nature Center	16854	Task	Switch	Canopy_Partial	Canopy_Soffit	Canopy_Drop_Lens	Comp_Fluorescent	26	0	12	Poor info board design	Replace	Compliant
6	Black Rock	Black Rock Nature Center	16854	Area security	Timer	Canopy_Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	4	lantern style	Remove	Compliant
7	Black Rock	Black Rock Nature Center	16854	Area security	Switch	Canopy_Partial	Canopy_Soffit	Canopy_Drop_Lens	None	0	0	12	empty socket/flood style fixture	Remove	Inoperable
8	Black Rock	Black Rock Nature Center	16854	Area security	Switch	Canopy_Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	64	3500	12	home made shield added, picnic/employee break area	Remove	Inoperable
9	Black Rock	Black Rock Nature Center	16854	Building_Egress	Switch	Canopy_Partial	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	4	accessible entrance	Replace	Compliant
10	Black Rock	Black Rock Nature Center Parking Lot	16854	Area security	Switch	Partial	Pole	Pole_Security	T_Fluorescent	0	0	0	~14' mounting height	Remove	Compliant/Removed
11	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
12	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
13	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
14	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
15	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
16	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
17	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
18	Black Rock	Black Rock Fire Dorm	28516	Area security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	65	740	3		Replace Lamp	Compliant
19	Black Rock	Black Rock Fire Dorm	28516	Pathway_Illumination	Photocell	Full	Wall	Wall_Other	Incandescent_Halogen	15	112	12	mounted on wall near ground with louvres	Replace Lamp	Inoperable
20	Black Rock	Black Rock Fire Dorm	28516	Pathway_Illumination	Photocell	Full	Wall	Wall_Other	Incandescent_Halogen	15	112	12	mounted on wall near ground with louvres	Replace Lamp	Inoperable
21	Black Rock	Black Rock Fire Dorm	28516	Pathway_Illumination	Photocell	Full	Wall	Wall_Other	Incandescent_Halogen	15	112	12	mounted on wall near ground with louvres	Replace Lamp	Inoperable
22	Black Rock	Black Rock Fire Dorm	28516	Pathway_Illumination	Photocell	Full	Wall	Wall_Other	Incandescent_Halogen	15	112	12	mounted on wall near ground with louvres	Replace Lamp	Inoperable
23	Black Rock	Black Rock Fire Dorm	28516	Pathway_Illumination	Photocell	Full	Wall	Wall_Other	Incandescent_Halogen	15	112	12	mounted on wall near ground with louvres	Replace Lamp	Inoperable
24	Black Rock	Black Rock Fire Dorm	28516	Pathway_Illumination	Photocell	Full	Wall	Wall_Other	Incandescent_Halogen	15	112	12	mounted on wall near ground with louvres	Replace Lamp	Inoperable
25	Black Rock	Black Rock Fire Dorm	28516	Pathway_Illumination	Photocell	Full	Wall	Wall_Other	Incandescent_Halogen	15	112	12	mounted on wall near ground with louvres	Replace Lamp	Inoperable

Non-

26	Black Rock	Black Rock Fire Dorm	28516	Building_Egress	S+M	Partial	Wall	Fixed_Flood	Incandescent_Halogen	300	5350	2	2016 Inventory: This light is not used by staff or is seldom used	Replace	Noncompliant
27	Black Rock	Black Rock Fire Dorm	28516	Building_Egress	S+M	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	2		Replace	Compliant
28	Black Rock	Black Rock Fire Dorm	28516	Building_Egress	Switch	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	2		Replace	Compliant
29	Black Rock	Black Rock Fire Dorm	28516	Building_Egress	S	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	2		Replace	Compliant
30	Black Rock	Black Rock Fire Dorm	28516	Building_Egress	S	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	2		Replace	Compliant
31	Black Rock	Black Rock Fire Dorm	28516	Building_Egress	S	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	2		Replace	Compliant
32	Black Rock	Black Rock Fire Dorm	28516	Area_security	S+M	Partial	Wall	Wall_Unshielded	Incandescent_Halogen	150	2430	2		Replace	Compliant
33	Black Rock	Black Rock Fire Dorm	28516	Area_security	S+M	Partial	Wall	Wall_Unshielded	Incandescent_Halogen	150	2430	2		Replace	Compliant
34	Black Rock	Black Rock Fire Dorm	28516	Area_security	S+M	None	Wall	Fixed_Flood	Incandescent_Halogen	180	0	3	2016 Inventory: This light is not used by staff or is seldom used	Replace	Noncompliant
35	Black Rock	Black Rock Fire Dorm	28516	Building_Egress	S+M	Partial	Wall	Fixed_Flood	Incandescent_Halogen	300	5350	2	2016 Inventory: This light is not used by staff or is seldom used	Replace	Noncompliant
36	Headquarters	Oasis of Mara VC	16812	Area_security	S+T	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	24	0	12	low priority for night skies, high visibility to public, 8.5 ft. height	Replace	Not within park boundary
37	Headquarters	Oasis of Mara VC	16812	Area_security	S+T	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	24	0	12	low priority for night skies, high visibility to public, 8.5 ft. height	Replace	Not within park boundary
38	Headquarters	Oasis of Mara VC	16812	Area_security	S+T	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	24	0	12	low priority for night skies, high visibility to public, 8.5 ft. height	Replace	Not within park boundary
39	Headquarters	Oasis of Mara VC	16812	Area_security	S+T	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	24	0	12	low priority for night skies, high visibility to public, 8.5 ft. height	Replace	Not within park boundary
40	Headquarters	Oasis of Mara VC	16812	Area_security	S+T	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	24	0	12	low priority for night skies, high visibility to public, 8.5 ft. height	Replace	Not within park boundary
41	Headquarters	Oasis of Mara VC	16812	Task	S+T	Partial	Wall	Wall_Cutoff	T_Fluorescent	64	3500	12	glarey and too bright	Replace	Not within park boundary
42	Headquarters	Oasis of Mara VC	16812	Area_security	S+T	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	24	0	12	low priority for night skies, high visibility to public	Replace	Not within park boundary
43	Headquarters	Oasis of Mara VC	16812	Building_Egress	S	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	60	740	12	store entrance	Replace Lamp	Not within park boundary
44	Headquarters	Oasis of Mara VC	16812	Building_Egress	S	Partial	Wall	Wall_Cutoff	T_Fluorescent	32	0	2	breezeway	remove	Not within park boundary
45	Headquarters	HQ Admin Bldg	16811	Building_Egress	S	None	Wall	Wall_Unshielded	Comp_Fluorescent	13	750	1	Admin Office VC side	Replace	Not within park boundary
46	Headquarters	HQ Admin Bldg	16811	Building_Egress	S	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	1	Admin office employee side	Replace	Not within park boundary
47	Headquarters	HQ Admin Bldg	16811	Building_Egress	Photocell	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	15	0	12	also illuminates pathway	Replace	Not within park boundary
48	Headquarters	HQ Admin Bldg	16811	Area_security	Photocell	Partial	Canopy_Soffit	Canopy_Drop_Lens	T_Fluorescent	64	3500	12	center of pathway between admin offices	Remove	Not within park boundary
49	Headquarters	Oasis of Mara VC	16812	Building_Egress	S+T	Full	Canopy_Soffit	Canopy_Recessed	Comp_Fluorescent	15	850	12		Replace Lamp	Not within park boundary
50	Headquarters	Oasis of Mara VC	16812	Architectural_Facade	S	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1		Remove	Not within park boundary
51	Headquarters	Oasis of Mara VC	16812	Architectural_Facade	S	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1		Remove	Not within park boundary
52	Headquarters	Oasis of Mara VC	16812	Architectural_Facade	S	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1		Remove	Not within park boundary
53	Headquarters	Oasis of Mara VC	16812	Architectural_Facade	S	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1		Remove	Not within park boundary
54	Headquarters	Oasis of Mara VC	16812	Architectural_Facade	S	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1		Remove	Not within park boundary

84	Headquarters	HQ Protection Offices	16813	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12	attempting to illuminate parking lot area	Replace	Not within park boundary
85	Headquarters	HQ Protection Offices	16813	Building_Egress	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12		Replace	Not within park boundary
86	Headquarters	HQ Protection Offices	16813	Building_Egress	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	60	740	1		Replace Lamp	Not within park boundary
87	Headquarters	HQ Protection Offices	16813	Building_Egress	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	60	740	1	main entrance	Keep	Not within park boundary
88	Headquarters	Facilities Operations Bldg	16813	Building_Egress	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	60	740	1	main entrance	Keep	Not within park boundary
89	Headquarters	HQ Protection Offices	16813	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12	on outer wall near main entrance	Remove	Not within park boundary
90	Headquarters	Facilities Operations Bldg	90570	Building_Egress	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1	in doorway	Replace Lamp	Not within park boundary
91	Headquarters	Facilities Operations Bldg	90570	Building_Egress	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	75	990	12		Remove	Not within park boundary
92	Headquarters	Facilities Operations Bldg	90570	Building_Egress	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12		Replace	Not within park boundary
93	Headquarters	#REF!	90570	Building_Egress	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12		Replace	Not within park boundary
94	Headquarters	Facilities Operations Bldg	90570	Building_Egress	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12		Replace	Not within park boundary
95	Headquarters	Facilities Operations Bldg	90570	Building_Egress	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1	entrance from parking lot	Replace Lamp	Not within park boundary
96	Headquarters	Facilities Operations Bldg	90570	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12		Remove	Not within park boundary
97	Headquarters	Facilities Operations Bldg	90570	Building_Egress	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1		Replace Lamp	Not within park boundary
98	Headquarters	Facilities Operations Bldg	90570	Building_Egress	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	75	990	1		Replace Lamp	Not within park boundary
99	Headquarters	Facilities Operations Bldg	90570	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	60	740	12		Remove	Not within park boundary
100	Black Rock	Black Rock Maint Shop/Office	16856	Building_Egress	Switch	Partial	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	1		Replace	Compliant
101	Black Rock	Black Rock Maint Shop/Office	16856	Building_Egress	Switch	None	Wall	Wall_Other	Incandescent_Halogen	75	990	1		Replace	Compliant
102	Black Rock	Black Rock Maint Shop/Office	16856	Building_Egress	Switch	None	Wall	Wall_Other	Incandescent_Halogen	75	990	1		Replace	Compliant
103	Black Rock	Black Rock Employee Housing	16865	Building_Egress	Switch	None	Wall	Wall_Other	Incandescent_Halogen	75	990	1		Replace	Compliant
104	Black Rock	Black Rock Employee Housing	16865	Area_security	Switch	None	Wall	Wall_Unshielded	None	0	0	1		Replace	Noncompliant
105	Black Rock	Black Rock Employee Housing	16865	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	1		Replace	Compliant
106	Black Rock	Black Rock Employee Housing	16865	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	1		Replace	Compliant
107	Black Rock	Black Rock Educatoin Office/Restroom	16869	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	1		Replace	Compliant
108	Black Rock	Black Rock Educatoin Office/Restroom	16869	Building_Egress	S+P	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	1		Replace	Compliant
109	Black Rock	Black Rock Educatoin Office/Restroom	16869	Building_Egress	S+P	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	1		Replace	Compliant
110	Black Rock	Black Rock Comfort Station 1	17227	Building_Egress	S+P	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	12		Replace	Compliant
111	Black Rock	Black Rock Comfort Station 1	17227	Building_Egress	S+P	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	12		Replace	Compliant
112	Black Rock	Black Rock Comfort Station 2	17228	Building_Egress	S+M	None	Wall	Wall_Unshielded	Incandescent_Halogen	200	0	1		Replace	Compliant

113	Black Rock	Black Rock Comfort Station 2	17228	Building_Egress	S+P	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	12		Replace	Compliant
114	Black Rock	Black Rock Comfort Station 2	17228	Building_Egress	S+P	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	12		Replace	Compliant
115	Black Rock	Black Rock Comfort Station 2	17228	Building_Egress	S+M	None	Wall	Wall_Unshielded	Incandescent_Halogen	200	0	1		Replace	Compliant
116	Black Rock	Black Rock Comfort Station 3	17226	Building_Egress	S+P	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	60	740	12		Replace Lamp/Control	Compliant
117	Black Rock	Black Rock Comfort Station 3	17226	Building_Egress	S+P	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	60	740	12	replace diffuser to be flush with canopy	Replace Lamp/Diffuser/Control	Compliant
118	Black Rock	Black Rock Comfort Station 3	17226	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	1		Replace	Compliant
119	Joshua Tree	Joshua Tree VC	106703	Area_security	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
120	Joshua Tree	Joshua Tree VC	106703	Area_security	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
121	Joshua Tree	Joshua Tree VC	106703	Pathway_Illumination	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
122	Joshua Tree	Joshua Tree VC	106703	Building_Egress	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
123	Joshua Tree	Joshua Tree VC	106703	Building_Egress	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
124	Joshua Tree	Joshua Tree VC	106703	Area_security	Switch	Partial	Wall	Wall_Other	Incandescent_Halogen	150	2430	1		remove	Not a federal building
125	Joshua Tree	Joshua Tree VC	106703	Area_security	Switch	Partial	Wall	Wall_Other	Incandescent_Halogen	150	2430	1		remove	Not a federal building
126	Joshua Tree	Joshua Tree VC	106703	Area_security	Switch	Partial	Wall	Wall_Other	Incandescent_Halogen	150	2430	1		remove	Not a federal building
127	Joshua Tree	Joshua Tree VC	106703	Area_security	Switch	Partial	Wall	Wall_Other	Incandescent_Halogen	150	2430	1		remove	Not a federal building
128	Joshua Tree	Joshua Tree VC	106703	Area_security	Switch	Partial	Wall	Wall_Other	Incandescent_Halogen	150	2430	1		remove	Not a federal building
129	Joshua Tree	Joshua Tree VC	106703	Building_Egress	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
130	Joshua Tree	Joshua Tree VC	106703	Building_Egress	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
131	Joshua Tree	Joshua Tree VC	106703	Sign_Flag	Photocell	Full	Wall	Wall_Cutoff	Incandescent_Halogen	75	990	12		None	Not a federal building
132	Joshua Tree	Joshua Tree VC	106703	Building_Egress	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	12		Replace	Not a federal building
133	Joshua Tree	Joshua Tree VC Sculpture Garden	106703	Area_security	Switch	Partial	Wall	Wall_Other	Incandescent_Halogen	150	2430	1		Replace	Not a federal building
134	West Entrance	West Entrance Fee Office/Restrooms	17062	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	40	441	12		Replace	Compliant
135	West Entrance	West Entrance Fee Office/Restrooms	17062	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	40	441	12		Replace	Compliant
136	West Entrance	West Entrance Fee Office/Restrooms	17062	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	40	441	12		Replace	Compliant
137	West Entrance	West Entrance Fee Office/Restrooms	17062	Building_Egress	Switch	Partial	Wall	Wall_Other	Incandescent_Halogen	40	441	24		Replace	Noncompliant
138	West Entrance	West Entrance Fee Office/Restrooms	17062	Area_security	S+M	Full	Wall	Wall_Other	Incandescent_Halogen	150	2430	1		None	Compliant
139	West Entrance	West Entrance Fee Station	17059	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	40	441	12		Replace	Compliant
140	West Entrance	West Entrance Fee Station	17059	Building_Egress	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	40	441	12		Remove	Noncompliant
141	West Entrance	West Entrance Fee Station	17059	Area_security	Photocell	Partial	Wall	Wall_Other	Incandescent_Halogen	40	441	12		Replace	Compliant

142	West Entrance	West Entrance Fee Station	17059	Architectural Facade	P+S	None	Wall	Wall Unshielded	Incandescent Halogen	150	2430	1	don't know useage (guessed 1 hr/day)	Remove	Noncompliant
143	West Entrance	West Entrance Fee Station	17059	Architectural Facade	P+S	None	Wall	Wall Unshielded	Incandescent Halogen	150	2430	1	don't know useage (guessed 1 hr/day)	Remove	Noncompliant
144	West Entrance	West Entrance Fee Station	17059	Architectural Facade	P+S	None	Canopy Soffit	Wall Unshielded	Incandescent Halogen	150	2430	1	don't know useage (guessed 1 hr/day)	Remove	Noncompliant
145	West Entrance	West Entrance Fee Station	17059	Architectural Facade	P+S	None	Wall	Wall Unshielded	Incandescent Halogen	150	2430	1	don't know useage (guessed 1 hr/day)	Remove	Noncompliant
146	West Entrance	West Entrance Fee Station	17059	Architectural Facade	P+S	None	Wall	Wall Unshielded	Incandescent Halogen	150	2430	1	don't know useage (guessed 1 hr/day)	Remove	Noncompliant
147	West Entrance	West Entrance Fee Station	17059	Architectural Facade	P+S	None	Canopy Soffit	Wall Unshielded	Incandescent Halogen	150	2430	1	don't know useage (guessed 1 hr/day)	Remove	Noncompliant
148	Lost Horse RS	Lost Horse RS	16936	Building Egress	Switch	None	Wall	Wall Unshielded	Incandescent Halogen	60	740	1		Replace	Compliant
149	Lost Horse RS	Lost Horse RS	16936	Area security	Switch	None	Wall	Wall Unshielded	Incandescent Halogen	100	1530	1	2016 Inventory: This light is not used by staff or is seldom used	Replace	Noncompliant
150	Lost Horse RS	Lost Horse RS	16936	Building Egress	Switch	None	Wall	Wall Unshielded	Incandescent Halogen	60	740	1		Replace	Compliant
151	Lost Horse RS	Lost Horse RS	16936	Building Egress	Switch	None	Wall	Wall Unshielded	Incandescent Halogen	60	740	1		Replace	Compliant
152	Lost Horse RS	Lost Horse RS	16936	Building Egress	Switch	None	Wall	Wall Unshielded	Incandescent Halogen	100	1530	1		Replace	Compliant
153	Lost Horse RS	Lost Horse Artists Residence	17058	Building Egress	S+M	None	Wall	Wall Unshielded	Incandescent Halogen	150	2430	1		Replace	Inoperable
154	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
155	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
156	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
157	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
158	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
159	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
160	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
161	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Pathway Illumination	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
162	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Area security	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
163	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Area security	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
164	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Area security	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
165	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Area security	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
166	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	19757	Area security	Switch	Partial	Ground Bollard	Bollard Unshielded	Incandescent Halogen	7	55	1		None	Compliant
167	Jumbo Rocks	Jumbo Rocks Amphitheater building	19757	Building Egress	Switch	None	Wall	Wall Unshielded	Incandescent Halogen	60	740	1	2016 Inventory: This light is not used by staff or is seldom used	Replace	Noncompliant
168	Jumbo Rocks	Jumbo Rocks Amphitheater stage	19757	Area security	Switch	Full	Canopy Soffit	Canopy Recessed	Incandescent Halogen	40	441	1		Replace Lamp	Compliant
169	Jumbo Rocks	Jumbo Rocks Amphitheater stage	19757	Area security	Switch	Full	Canopy Soffit	Canopy Recessed	Incandescent Halogen	40	441	1		Replace Lamp	Compliant
170	Jumbo Rocks	Jumbo Rocks Amphitheater stage	19757	Area security	Switch	Full	Canopy Soffit	Canopy Recessed	Incandescent Halogen	40	441	1		Replace Lamp	Compliant

171	Jumbo Rocks	Jumbo Rocks Amphitheater stage	19757	Area_security	Switch	Full	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	40	441	1		Replace Lamp	Compliant
172	North Entrance	North Entrance Fee Booth	16924	Architectural_Facade	S+P	None	Wall	Wall_Unshielded	Incandescent_Halogen	150	2430	12		Remove	Compliant
173	North Entrance	North Entrance Fee Booth	16924	Architectural_Facade	S+P	None	Wall	Wall_Unshielded	Incandescent_Halogen	150	2430	12		Remove	Compliant
174	North Entrance	North Entrance Fee Booth	16924	Architectural_Facade	Switch	Full	Wall	Wall_Unshielded	Incandescent_Halogen	150	2430	4		Replace	Compliant
175	North Entrance	North Entrance Fee Booth	16924	Architectural_Facade	S+P	None	Wall	Incandescent_Halogen	Incandescent_Halogen	150	2430	0	already disconnected	Remove	Inoperable
176	North Entrance	North Entrance Fee Booth	16924	Architectural_Facade	S+P	None	Wall	Wall_Unshielded	Incandescent_Halogen	150	2430	0	already disconnected	Remove	Inoperable
177	North Entrance	North Entrance Fee Booth	16924	Architectural_Facade	Switch	Full	Wall	Wall_Unshielded	Incandescent_Halogen	150	2430	1		Replace	Compliant
178	North Entrance	North Entrance Fee Booth	16924	Area_security	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1	above work window	Replace	Compliant
179	North Entrance	North Entrance Fee Booth	16924	Building_Egress	Switch	Partial	Canopy_Soffit	Canopy_Drop_Lens	Incandescent_Halogen	40	441	1	in breezeway	Replace	Noncompliant
180	North Entrance	North Entrance Fee Booth	16924	Area_security	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1	above work window	Replace	Compliant
181	Headquarters	HQ Compound/Office Storage Complex	16825	Area_security	Switch	Partial	Pole	Pole_Lantern	Incandescent_Halogen	25	189	1		Replace Lamp	Not within park boundary
182	Headquarters	HQ Compound/Office Storage Complex	16825	Area_security	Photocell	None	Pole	Pole_Drop_Lens	MV	175	6800	12		Remove	Not within park boundary
183	Headquarters	HQ Compound/Office Storage Complex	16825	Area_security	Switch	Full	Flood_Direct	Fixed_Flood	comp_Fluorescent	24	1450	1		Replace	Not within park boundary
184	Headquarters	Artifact Storage Building	16817	Area_security	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	13	750	12		Replace	Not within park boundary
185	Headquarters	Artifact Storage Building	16817	Area_security	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	13	750	12		Replace	Not within park boundary
186	Headquarters	Artifact Storage Building	16817	Area_security	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	13	750	12		Replace	Not within park boundary
187	Headquarters	Artifact Storage Building	16817	Area_security	Photocell	None	Wall	Wall_Unshielded	Comp_Fluorescent	13	750	12		Replace	Not within park boundary
188	Headquarters	Artifact Storage Building	16817	Building_Egress	Switch	Partial	Canopy_Soffit	Canopy_Drop_Lens	Incandescent_Halogen	40	441	1		replace diffuser/lamp	Not within park boundary
189	Headquarters	Native Plant Nursery	17236	Area_security	Switch	None	Pole	Pole_Drop_Lens	MV	175	6800	0		Remove	Not within park boundary
190	Cottonwood	Middle Residence	16877?	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	battery/solar powered	Replace	Inoperable
191	Cottonwood	Middle Residence	16877?	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1		Replace	Compliant
192	Cottonwood	Middle Residence	16877?	Building_Egress	Switch	partial	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	1	custom shield	Replace	Compliant
193	Cottonwood	Most Easterly Residence	16876?	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	battery/solar powered	Replace	Inoperable
194	Cottonwood	Most Easterly Residence	16876?	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1		Replace	Compliant
195	Cottonwood	Most Easterly Residence	16876?	Building_Egress	Switch	partial	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1		Replace	Compliant
196	Cottonwood	Duplex	81670	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	battery/solar powered	Replace	Inoperable
197	Cottonwood	Duplex	81670	Building_Egress	Switch	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	1		Replace	Compliant
198	Cottonwood	Duplex	81670	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	1		Replace	Compliant
199	Cottonwood	Duplex	81670	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1		Replace	Compliant

200	Cottonwood	Duplex	81670	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1		Replace	Compliant
201	Cottonwood	Duplex	81670	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1		Replace	Compliant
202	Cottonwood	Duplex	81670	Building_Egress	Switch	None	Wall	Wall_Unshielded	Comp_Fluorescent	15	850	1		Replace	Compliant
203	Cottonwood	Most Westerly Residence	16878?	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	battery/solar powered	Replace	Inoperable
204	Cottonwood	Most Westerly Residence	16878?	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1		Replace	Compliant
205	Cottonwood	Most Westerly Residence	16878?	Building_Egress	Switch	partial	Wall	Wall_Unshielded	Incandescent_Halogen	75	990	1	on dimmer	Replace	Compliant
206	Cottonwood	Protection Office	16884	Building_Egress	Switch	Partial	Wall	Fixed_Flood	Comp_Fluorescent	15	850	1	next to door	Remove	Compliant
207	Cottonwood	Protection Office	16884	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	above door	replace	Compliant
208	Cottonwood	Maintenance Office	16885	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1		replace	Compliant
209	Cottonwood	maintenance shops	28053	Area_security	Switch	Partial	Canopy_Soffit	Canopy_Drop_Lens	Comp_Fluorescent	20	0	1	2016 Inventory: This light is not used by staff/ not removed.	remove	Noncompliant
210	Cottonwood	maintenance shops	28053	Area_security	Switch	Partial	Canopy_Soffit	Canopy_Drop_Lens	Comp_Fluorescent	20	0	1	2016 Inventory: This light is not used by staff/ not removed.	remove	Noncompliant
211	Cottonwood	VC towards parking lot	16799	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	for parking lot lighting?	replace	Inoperable
212	Cottonwood	VC under arbor	16799	Area_security	S+M+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	2016 Inventory: This light is not used by staff/ not removed	replace	Noncompliant
213	Cottonwood	Interp Office	16874	Area_security	S+M+P	Partial	Canopy_Soffit	Fixed_Flood	Comp_Fluorescent	15	850	1	pointing at map/ On motion Sensor	remove	Compliant
214	Cottonwood	Interp Office	16874	Area_security	S+M+P	Partial	Canopy_Soffit	Fixed_Flood	Incandescent_Halogen	75	990	1	2016 Inventory: This light is not used by staff/ not removed	remove	Noncompliant
215	Cottonwood	Interp Office	16874	Area_security	S+M+P	Partial	Canopy_Soffit	Canopy_Recessed	Incandescent_Halogen	60	740	1	2016 Inventory: This light is not used by staff/ not removed	remove	Noncompliant
216	Cottonwood	Interp Office	16874	Area_security	S+M+P	Partial	Canopy_Soffit	Canopy_Recessed	None	0	0	0	2016 Inventory: This light is not used by staff/ not removed	remove	Noncompliant
217	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
218	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
219	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
220	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
221	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
222	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
223	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
224	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
225	Cottonwood	campground amphitheater path	28005	Pathway_Guidance	Switch	Partial	Other	Bollard_Unshielded	Incandescent_Halogen	12	90	1	path to amphitheater	none	Compliant
226	Cottonwood	amphitheater projection building	28005	Area_security	Switch	Full	Wall	Fixed_Flood	Incandescent_Halogen	30	250	1	on building	none	Compliant
227	Cottonwood	amphitheater projection building	28005	Area_security	Switch	Full	Wall	Fixed_Flood	Incandescent_Halogen	30	250	1	on building	none	Compliant
228	Cottonwood	amphitheater projection building	28005	Area_security	Switch	Full	Wall	Fixed_Flood	Incandescent_Halogen	30	250	1	on building	none	Compliant

229	Cottonwood	amphitheater projection building	28005	Area_security	Switch	Full	Wall	Fixed_Flood	Incandescent_Halogen	30	250	1	on building	none	Compliant
230	Cottonwood	amphitheater projection building	28005	Area_security	Switch	Full	Wall	Fixed_Flood	Incandescent_Halogen	30	250	1	on building	none	Compliant
231	Pinto Wye	Pinto Wye Maintenance Offices	16927	Building_Egress	Switch	None	Wall	Wall_Unshielded	None	0	0	1	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
232	Pinto Wye	Pinto Wye Maintenance Offices	16927	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	60	740	1	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
233	Pinto Wye	Pinto Wye Maintenance Shops	16930	Area_security	Switch	None	Wall	Fixed_Flood	Incandescent_Halogen	250	5000	1	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
234	Pinto Wye	Pinto Wye Maintenance Shops	16930	Area_security	Switch	None	Wall	Fixed_Flood	Incandescent_Halogen	250	5000	1	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
235	Pinto Wye	Pinto Wye Maintenance Shops	16930	Area_security	Switch	None	Wall	Fixed_Flood	Incandescent_Halogen	250	5000	1	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
236	Pinto Wye	Pinto Wye Maintenance Shops	16930	Area_security	Switch	None	Wall	Fixed_Flood	Incandescent_Halogen	250	5000	1	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
237	Pinto Wye	Pinto Wye Maintenance Shops	16930	Area_security	Switch	None	Wall	Fixed_Flood	Incandescent_Halogen	0	0	0	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
238	Pinto Wye	Bell Mountain Bunker		Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	75	990	0.5	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
239	Pinto Wye	Bell Mountain Bunker		Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	75	990	0.5	2016 Inventory: This light is not used by staff/ not removed	Replace	Lights are never on at this facility
240	Indian Cove	Indian Cove RS Parking Lot	16829	Area_security	Photocell	Partial	Pole	Pole_Drop Lens	HPS	150	14400	12		Remove	Noncompliant
241	Indian Cove	Indian Cove RS	16829	Area_security	Photocell	Partial	Wall	Wall_Unshielded	MV	175	6800	12		Replace	Noncompliant
242	Indian Cove	Indian Cove RS	16829	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	75	990	1		Replace	Compliant
243	Indian Cove	Indian Cove RS	16829	Area_security	m+P	Partial	Wall	Fixed_Flood	Incandescent_Halogen	15	112	1	currently not working	Remove	Inoperable
244	Indian Cove	Indian Cove RS	16829	Area_security	Switch	Partial	Wall	Wall_Cutoff	T_Fluorescent	30	0	12		Replace	Compliant
245	Indian Cove	Indian Cove Residence	16830	Area_security	Switch	None	Canopy_Soffit	Wall_Unshielded	comp_Fluorescent	15	850	1		Replace	Compliant
246	Indian Cove	Indian Cove Residence	16830	Building_Egress	Switch	None	Wall	Wall_Unshielded	comp_Fluorescent	15	850	1		Replace	Compliant
247	Indian Cove	Indian Cove Residence	16830	Area_security	S+P+M	None	Wall	Fixed_Flood	Incandescent_Halogen	15	112	0	not working currently	Replace	Inoperable
248	Indian Cove	Indian Cove Residence	16830	Building_Egress	Switch	None	Wall	Wall_Unshielded	comp_Fluorescent	15	850	1		Replace	Compliant
249	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
250	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
251	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
252	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
253	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
254	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
255	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
256	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
257	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant

258	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
259	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
260	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
261	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
262	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant
263	Indian Cove	Indian Cove Amphitheater	16921	Pathway_Guidance	Switch	Partial	Ground_Bollard	Bollard_Shielded	Incandescent_Halogen	40	441	1	path to amphitheater	None	Compliant t
264	Indian Cove	Indian Cove Amphitheater	16921	Area_security	Switch	Partial	Flood_Direct	Fixed_Flood	Incandescent_Halogen	75	990	1	Stage illumination	Replace Lamp	Compliant
265	Indian Cove	Indian Cove Amphitheater	16921	Area_security	Switch	Partial	Flood_Direct	Fixed_Flood	Incandescent_Halogen	75	990	1	Stage illumination	Replace Lamp	Compliant
266	Indian Cove	Indian Cove Amphitheater	16921	Area_security	Switch	Partial	Flood_Direct	Fixed_Flood	Incandescent_Halogen	75	990	1	Stage illumination	Replace Lamp	Compliant
267	Indian Cove	Indian Cove Amphitheater	16921	Area_security	Switch	Partial	Flood_Direct	Fixed_Flood	Incandescent_Halogen	75	990	1	Stage illumination	Replace Lamp	Compliant
268	Indian Cove	Indian Cove Amphitheater	16921	Building_Egress	Switch	None	Wall	Wall_Unshielded	Incandescent_Halogen	40	441	1	Projection Building Door	Replace	Compliant

Outdoor Lighting Retrofit Design Discussion

The document provides a recommended retrofit for the area survey with the primary objectives of preserving natural nighttime lightscapes and providing for human safety. Selections are made from a list of "recommended fixtures", but individual recommendations should be considered to be flexible, depending on the judgement of the electrician and park management. If different materials can be used and the objectives met, variations from these recommendations are encouraged. An energy use analysis is also provided based upon an estimate of the total number of hours per day each light is actually operated. These initial estimates may be in error by a significant margin, but the same values are used for the retrofit (unless intelligent controls are installed as part of the retrofit reducing the total hours) so the comparison of energy consumption between "before and after" installations should be accurate.

The vast majority of outdoor lights we found in Joshua Tree National Park are wall or under canopy mounted, intended to illuminate a building egress point and/or an area near the building. Many (if not most) of these should be replaced. We provide a recommended replacement luminaire on a case by case basis, but each case should be reviewed by an electrician. We have chosen a palette of wall mount and under canopy fixtures that represents a range of quality, light output, energy use, innovation, and pattern of light throw. These concepts are reviewed below in an attempt to assist park staff in selecting the appropriate fixture.

WALL MOUNTED FIXTURES

We have recommended three basic types of wall mounted fixtures: The Dark Sky Sconce, the Glare Buster, and the North Star AWMQS. The Dark Sky Sconce is the least expensive (about \$40, available through Ace Hardware, Lowes, etc.) and simplest of the three, intended for the typical "building egress light". We selected this fixture for Black Rock Campground and areas generally away from the public where night use is not common. It contains essentially no optics, and light is directed primarily downward. It basically allows one to find the door from the outside, and see any obstacles that might be immediately in front of the door from the inside. Low wattage CFL lamps are typically recommended. A favorite of ours for very dark areas is the 7 watt CFL Bug light, which we can only find in a candelabra base, so it requires an adaptor to fit the Dark Sky Sconce. This combination provides a good solution for very dark locations, such as campground rest rooms (see photo).



Dark Sky Sconce from Cooper Lighting, 7 watt CFL bug light and standard to candelabra adaptors

Other "quarter sphere" wall sconces (and other shapes) are available in various colors and material designed for residential building egress where no forward throw is wanted. They range in cost and quality, typically \$100-200, in ceramic, brass, steel, with a variety architectural finishes; a few are pictured below. For typical low visibility "government buildings", paying extra for daytime cosmetics is generally not called for. The Dark Sky Sconce has a clear glass window on the bottom, most of these are open.



Justice Designs "ambiance" rectangular



Ameritech ceramic



Justice designs

When more forward throw light is required, we usually recommend the "Glare Buster" fixture (about \$80). Two models, the GB1,000 (with a standard edison base) and the GB2000 (with a two pin base in which most CFLs are available) are made. In some cases we still recommend the GB1,000 for very low light situations where an incandescent or LED with edison base are called for, or for situations where more light than a 26 watt CFL can provide is required. Both are very well made, somewhat industrial in appearance, and available in white or Bronze. Simple reflector optics give some forward throw, making them a better choice for area lighting with a wall mounting than the sconce. We recommend that ALL flood lights that allow light above the horizontal (whether PAR30 type or quartz halogen reflector) be replaced with this type of light to ensure full shielding. The GB2000 will take CFL lamps up to 26 watts or about 2000 lumens. The GB1,000 can take up to 42 watt CFL. Both are available with either clear or frosted glass bases.



Glare buster at Natural Bridges
Glare Buster Features



Where even more light, forward throw, or a heavy duty industrial fixture are desired, we are recommending the North Star Lighting AWMQS (about \$250), and TWP2 (about \$145) as a high quality, attractive, and flexible solution. This is a commercial grade luminaire, available in several colors, and in lamp intensities from 13 watt CFL to 150 watt Metal Halide, with forward throw optics. These may be appropriate at park headquarters in Twentynine palms to replace the existing incandescent lamp holders on the walls of the LE office and Maintenance office buildings.



North Star Lighting AWMQS (Bronze finish)
finish)



North Star Lighting TWP2 (Bronze finish)

UNDER CANOPY LIGHTING

Under canopies or soffits it is almost always preferred that lighting fixtures be recessed. However, to accomplish this in a retrofit may be impossible or require high labor costs. Some flush mount solutions are available that are fairly easy to install, attractive, and effective. At Joshua Tree we found many outdoor flood type fixtures that should be replaced with a fully shielded design, and with something that provides the proper intensity, spread, and color of light.

For direct downlight with a PAR type lamp, a simple cylinder fixture or "coffee can" is sometimes appropriate. A solution from Progress lighting (\$35-\$45 each) is depicted below. These are flush mount and better than a flood light holder because they are fully shielded.



Progress lighting P5774-31

A wider spread of light can be achieved with a "shoebox" type fixture, with or without a diffusing lens. Finding these to accommodate low wattage lamps and/or with full shielding is a challenge. An innovative choice is LED lights immersed in acrylic in the form of a panel, or in clusters and mounted in some sort of encasement. These products are available custom made from Holly Solar in Petaluma, California. Clusters of LEDs mounted in Trex decking material have been made for an NPS application at Curecante NRA and Yosemite Park and Curry Company. These low voltage light require a power supply, but are reasonably conservative of power and fully shielded when mounted horizontally. We have recommended these for the headquarters area and at Cottonwood, where significant amounts of power are generated with PV systems (see photos).



Holly Solar small LED panel mounted in Trex decking



Holly Solar LED Brick, with LED clusters mounted in Trex decking material.



Holly Solar 12" x 12" "Bus Brick" LED array panel

LIGHTING CONTROLS

Intelligent controls can save energy and conserve the natural lightscape by turning light on only when it is needed. The two types of controls most frequently used are motion sensors and timers. We have recommended the RAB Mini motion sensor for many applications. It requires a 1/2 or 3/4 inch mounting hole in the fixture or a separate outdoor box. These are for 120 volt applications only.

Motion sensors for low voltage lighting are not recommended at this time because of their excess power consumption.



RAB mini motion sensor

Timers are currently in use at headquarters visitor center and Black Rock Nature center. These may be retained or replaced with solid state devices. An astronomical clock timer is available for about \$250. These automatically adjust for the variation in the onset of twilight throughout the calendar year.



Tork digital timer DWZ100B

Retrofit Design

Table 12. Retrofit Design

Retrofit Design												Estimated Costs			Notes
ID	AREA	Location	Action	Controls	Shielding	Mounting Type	Luminaire	Lamp	Watts	Lumens	Hours/Day	Materials	Labor	Total	
			33												
1	Black Rock	Black Rock Nature Center	Replace	Same	full	canopy	HSStainless4	LED5	5	200	4	0.00		0.00	Redesign entryway lighting with six canopy flush mounted low voltage fixtures. Remove most existing fixtures, re- design for even light illumination throughout. Keep timer control, possibly replace with solid-state astronomical clock timer. Indicate stairway with reflective paint on stair edges. All lights on nature center EXCEPT light 5 should be amber in color to keep from attracting insects.
2	Black Rock	Black Rock Nature Center	Replace	Same	full	canopy	HSBrick3	LED3	2.9	120	4	72.00		72.00	
3	Black Rock	Black Rock Nature Center	Replace	Same	full	canopy	HSBrick3	LED3	2.9	120	4	0.00		0.00	
4	Black Rock	Black Rock Nature Center	Replace	Same	full	canopy	HSStainless4	LED5	5	200	4	0.00		0.00	
5	Black Rock	Black Rock Nature Center	Replace	RABMotion	Full	canopy	HSStrip6	LED6	0	0	2	0.00		0.00	
6	Black Rock	Black Rock Nature Center	Remove	Same	full	canopy	HSBrick3	LED3	2.9	120	4	72.00		72.00	
7	Black Rock	Black Rock Nature Center	Remove	Same	full	canopy	HSBrick3	LED3	2.9	120	4	72.00		72.00	
8	Black Rock	Black Rock Nature Center	Remove						0	0	0	0.00		0.00	
9	Black Rock	Black Rock Nature Center	Replace	RABMotion	Full	Wall	AWMQS	CFLBUG13W	13	1200	2	302.83		302.83	
10	Black Rock	Black Rock Nature Center ParkingLot	Remove						0	0	0	0.00		0.00	
11	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
12	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
13	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
14	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
15	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
16	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
17	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
18	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	CFLBUG13W	13	1200	3	6.83		6.83	
19	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	LED2.4	2.4	150	12	15.50		15.50	
20	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	LED2.4	2.4	150	12	15.50		15.50	
21	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	LED2.4	2.4	150	12	15.50		15.50	
22	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	LED2.4	2.4	150	12	15.50		15.50	
23	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	LED2.4	2.4	150	12	15.50		15.50	
24	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	LED2.4	2.4	150	12	15.50		15.50	

25	Black Rock	Black Rock Fire Dorm	Replace Lamp	Same	Same	Same	Same	LED2.4	2.4	150	12	15.50		15.50	
26	Black Rock	Black Rock Fire Dorm	Replace	RABMotion	Full	Wall	GB2000	CFLWW23W	23	1500	2	141.31		141.31	
27	Black Rock	Black Rock Fire Dorm	Replace	Photoswitch	Full	Wall	GB2000	CFLWW13W	13	900	2	94.65		94.65	
28	Black Rock	Black Rock Fire Dorm	Replace	Photoswitch	Full	Wall	GB2000	CFLWW13W	13	900	2	94.65		94.65	
29	Black Rock	Black Rock Fire Dorm	Replace	Photoswitch	Full	Wall	GB2000	CFLWW13W	13	900	2	94.65		94.65	
30	Black Rock	Black Rock Fire Dorm	Replace	Photoswitch	Full	Wall	GB2000	CFLWW13W	13	900	2	94.65		94.65	
31	Black Rock	Black Rock Fire Dorm	Replace	Photoswitch	Full	Wall	GB2000	CFLWW13W	13	900	2	94.65		94.65	
32	Black Rock	Black Rock Fire Dorm	Replace	RABMotion	Full	Wall	GB1,000	CFLWW42W	42	2600	2	130.50		130.50	
33	Black Rock	Black Rock Fire Dorm	Replace	RABMotion	Full	Wall	GB1,000	CFLWW42W	42	2600	2	130.50		130.50	
34	Black Rock	Black Rock Fire Dorm	Replace	RABMotion	Full	Wall	GB2000	CFLWW23W	23	1500	2	141.31		141.31	
35	Black Rock	Black Rock Fire Dorm	Replace	RABMotion	Full	Wall	GB2000	CFLWW23W	23	1500	2	141.31		141.31	
36	Headquarters	Oasis of Mara VC	Mask Sides	Same	Full	Same	Same	Same	24	1500	1	0.00		0.00	
37	Headquarters	Oasis of Mara VC	Mask Sides	Same	Full	Same	Same	Same	24	1500	1	0.00		0.00	
38	Headquarters	Oasis of Mara VC	Mask Sides	Same	Full	Same	Same	Same	24	1500	1	0.00		0.00	
39	Headquarters	Oasis of Mara VC	Mask Sides	Same	Full	Same	Same	Same	24	1500	1	0.00		0.00	
40	Headquarters	Oasis of Mara VC	Mask Sides	Same	Full	Same	Same	Same	24	1500	1	0.00		0.00	
41	Headquarters	Oasis of Mara VC	Replace	RABMotion	Full	Wall	EXL-KT	T_Fluorescent	0	0	1	0.00		0.00	
42	Headquarters	Oasis of Mara VC	Mask Sides	Same	Full	Same	Same	Same	24	1500	1	0.00		0.00	
43	Headquarters	Oasis of Mara VC	Replace Lamp	Same	Full	Same	Same	CFLWW13W	13	900	2	5.65		5.65	
44	Headquarters	Oasis of Mara VC	Remove						0	0	0	0.00		0.00	
45	Headquarters	HQ Admin Bldg	Replace	Same	Full	Wall	GB1,000	CFLWW13W	13	900	1	74.65		74.65	
46	Headquarters	HQ Admin Bldg	Replace	Same	Full	Wall	AWMQS	CFLBUG7W	7	400	1	257.98		257.98	
47	Headquarters	HQ Admin Bldg	Mask Sides	Same	Full	Same	Same	Same	15	850	2	0.00		0.00	
48	Headquarters	HQ Admin Bldg	Remove						0	0	0	0.00		0.00	
49	Headquarters	Oasis of Mara VC	Replace Lamp	Same	Full	Same	Same	CFLWW9W	9	320	2	6.83		6.83	
50	Headquarters	Oasis of Mara VC	Remove						0	0	0	0.00		0.00	
51	Headquarters	Oasis of Mara VC	Remove						0	0	0	0.00		0.00	
52	Headquarters	Oasis of Mara VC	Remove						0	0	0	0.00		0.00	
53	Headquarters	Oasis of Mara VC	Remove						0	0	0	0.00		0.00	

54	Headquarters	Oasis of Mara VC	Remove						0	0	0	0.00		0.00
55	Headquarters	Oasis of Mara VC	Replace	RABMotion	Full	Wall	AWMQS	CFLWW13W	13	900	2	301.65		301.65
56	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
57	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
58	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
59	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
60	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
61	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
62	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
63	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
64	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
65	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
66	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
67	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
68	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
69	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
70	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
71	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
72	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
73	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
74	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
75	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
76	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
77	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
78	Headquarters	Oasis of Mara VC	Replace Lamp/Add Louvre	Same	None	Same	Same	CFLWW2W	2	150	12	0.00		0.00
79	Headquarters	HQ Resources & Admin Staff Office Trailer	Replace	TETimer	Full	Wall	TWP2	TWP213	13	900	2	406.70		406.70
80	Headquarters	HQ Protection Offices	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
81	Headquarters	HQ Protection Offices	Replace Lamp	Same	Full	Same	Same	CFLWW13W	13	900	1	5.65		5.65
82	Headquarters	HQ Protection Offices	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00

Downlamping to 2 watt CFL will alleviate glare, while unshielded the low intensity should meet outdoor lighting guidelines. However, parking lot illumination may need to be added using poles. Such a design is not describe here.

83	Headquarters	HQ Protection Offices	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
84	Headquarters	HQ Protection Offices	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
85	Headquarters	HQ Protection Offices	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
86	Headquarters	HQ Protection Offices	Replace Lamp	Same	Full	Same	Same	CFLWW13W	13	900	1	5.65		5.65
87	Headquarters	HQ Protection Offices	Keep	Same	Full	Same	Same	Same	60	740	1	0.00		0.00
88	Headquarters	HQ Protection Offices	Keep	Same	Full	Same	Same	Same	60	740	1	0.00		0.00
89	Headquarters	HQ Protection Offices	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
90	Headquarters	Facilities Operations Bldg	Replace Lamp	Same	Full	Same	Same	CFLWW13W	13	900	1	5.65		5.65
91	Headquarters	Facilities Operations Bldg	Replace	TETimer	Full	Wall	TWP2	TWP213	13	900	1	406.70		406.70
92	Headquarters	Facilities Operations Bldg	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
93	Headquarters	Facilities Operations Bldg	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
94	Headquarters	Facilities Operations Bldg	Replace	On above	Full	Wall	TWP2	TWP213	13	900	2	145.00		145.00
95	Headquarters	Facilities Operations Bldg	Replace Lamp	Same	Full	Same	Same	CFLWW13W	13	900	1	5.65		5.65
96	Headquarters	Facilities Operations Bldg	Replace	On above	Full	Wall	TWP2	TWP213	13	900	0	145.00		145.00
97	Headquarters	Facilities Operations Bldg	Replace Lamp	Same	Full	Same	Same	CFLWW13W	13	900	1	5.65		5.65
98	Headquarters	Facilities Operations Bldg	Replace Lamp	Same	Full	Same	Same	CFLWW13W	13	900	1	5.65		5.65
99	Headquarters	Facilities Operations Bldg	Replace	On above	Full	Wall	TWP2	TWP213	13	900	0	145.00		145.00
100	Black Rock	Black Rock Maint Shop/Office	Replace	Same	Full	Wall	GB2000	CFLWW23W	23	1500	1	95.31		95.31
101	Black Rock	Black Rock Maint Shop/Office	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
102	Black Rock	Black Rock Maint Shop/Office	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
103	Black Rock	Black Rock Employee Housing	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
104	Black Rock	Black Rock Employee Housing	Replace	Same	Full	Wall	GB1,000	CFLBUG13W	13	1200	1	75.83		75.83
105	Black Rock	Black Rock Employee Housing	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
106	Black Rock	Black Rock Employee Housing	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
107	Black Rock	Black Rock Educatoin Office/Restroom	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
108	Black Rock	Black Rock Educatoin Office/Restroom	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
109	Black Rock	Black Rock Educatoin Office/Restroom	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
110	Black Rock	Black Rock Comfort Station 1	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83
111	Black Rock	Black Rock Comfort Station 1	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83

112	Black Rock	Black Rock Comfort Station 2	Replace	RABMotion	Full	Wall	GB 1,000	CFLBUG13W	13	1200	1	0.00		0.00	
113	Black Rock	Black Rock Comfort Station 2	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	1	45.98		45.98	
114	Black Rock	Black Rock Comfort Station 2	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	1	45.98		45.98	
115	Black Rock	Black Rock Comfort Station 2	Replace	RABMotion	Full	Wall	GB 1,000	CFLBUG13W	13	1200	1	0.00		0.00	
116	Black Rock	Black Rock Comfort Station 3	Replace Lamp/Control	RABMotion	Full			CFLBUG7W	7	400	1	0.00		0.00	
117	Black Rock	Black Rock Comfort Station 3	Replace Lamp/Diffuser/Control	RABMotion	Full			CFLBUG7W	7	400	1	0.00		0.00	
118	Black Rock	Black Rock Comfort Station 3	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		44.83	
119	Joshua Tree Village	Joshua Tree VC	Replace	TETimer	Full	Wall	TWP2	CFLWW13W	13	900	12	412.35		412.35	
120	Joshua Tree Village	Joshua Tree VC	Replace	On above	Full	Wall	TWP2	CFLWW13W	13	900	12	150.65		150.65	
121	Joshua Tree Village	Joshua Tree VC	Replace	On above	Full	Wall	TWP2	CFLWW13W	13	900	12	150.65		150.65	
122	Joshua Tree Village	Joshua Tree VC	Replace	On above	Full	Wall	TWP2	CFLWW13W	13	900	12	150.65		150.65	
123	Joshua Tree Village	Joshua Tree VC	Replace	On above	Full	Wall	TWP2	CFLWW13W	13	900	12	150.65		150.65	
124	Joshua Tree Village	Joshua Tree VC	remove						0	0	0	0.00		0.00	
125	Joshua Tree Village	Joshua Tree VC	remove						0	0	0	0.00		0.00	
126	Joshua Tree Village	Joshua Tree VC	remove						0	0	0	0.00		0.00	
127	Joshua Tree Village	Joshua Tree VC	remove						0	0	0	0.00		0.00	
128	Joshua Tree Village	Joshua Tree VC	remove						0	0	0	0.00		0.00	
129	Joshua Tree Village	Joshua Tree VC	Replace	RABMotion	Full	Wall	GB1,000	CFLWW13W	13	900	12	120.65		120.65	
130	Joshua Tree Village	Joshua Tree VC	Replace	RABMotion	Full	Wall	GB1,000	CFLWW13W	13	900	12	120.65		120.65	
131	Joshua Tree Village	Joshua Tree VC	None						0	0	12	0.00		0.00	
132	Joshua Tree Village	Joshua Tree VC	Replace	T+M	Full	Wall	North Star Lightin AWMQS	CFLWW13W	13	900	12	0.00		0.00	
133	Joshua Tree Village	Joshua Tree VC Sculpture Garden	Replace	S+M+P	Full	Wall	GB 1,000	CFL	0	0	1	0.00		0.00	
134	West Entrance	West Entrance Fee Office/Restrooms	Replace	RABMotion	Full	Wall	TWP2	TWP213	13	900	1	191.00		191.00	do we want hybrid lighting here instead?
135	West Entrance	West Entrance Fee Office/Restrooms	Replace	On above	Full	Wall	TWP2	TWP213	13	900	1	145.00		145.00	
136	West Entrance	West Entrance Fee Office/Restrooms	Replace	On above	Full	Wall	TWP2	TWP213	13	900	1	145.00		145.00	
137	West Entrance	West Entrance Fee Office/Restrooms	Replace	Same	Full	Wall	TWP2	TWP213	13	900	12	145.00		145.00	
138	West Entrance	West Entrance Fee Office/Restrooms	None	Same	Full	Same	Same	Same	150	2430	1	0.00		0.00	
139	West Entrance	West Entrance Fee Station	Replace	RABMotion	Full	Wall	TWP2	TWP213	13	900	1	191.00		191.00	
140	West Entrance	West Entrance Fee Station	Replace	On above	Full	Wall	TWP2	TWP213	13	900	1	145.00		145.00	

141	West Entrance	West Entrance Fee Station	Replace	RABMotion	Full	Wall	TWP2	TWP213	13	900	1	191.00		191.00
142	West Entrance	West Entrance Fee Station	Remove						0	0	0	0.00		0.00
143	West Entrance	West Entrance Fee Station	Remove						0	0	0	0.00		0.00
144	West Entrance	West Entrance Fee Station	None	Same	Full	canopy	Same	Same	150	2430	1	0.00		0.00
145	West Entrance	West Entrance Fee Station	Remove						0	0	0	0.00		0.00
146	West Entrance	West Entrance Fee Station	Remove						0	0	0	0.00		0.00
147	West Entrance	West Entrance Fee Station	None	Same	Full	canopy	Same	Same	150	2430	0	0.00		0.00
148	Lost Horse RS	Lost Horse RS	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	1	45.98		45.98
149	Lost Horse RS	Lost Horse RS	Replace	RABMotion	Full	Wall	GB1,000	CFLBUG7W	7	400	1	122.98		122.98
150	Lost Horse RS	Lost Horse RS	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	1	45.98		45.98
151	Lost Horse RS	Lost Horse RS	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	1	45.98		45.98
152	Lost Horse RS	Lost Horse RS	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	1	45.98		45.98
153	Lost Horse RS	Lost Horse Artists Residence	Replace	RABMotion	Full	Wall	GB1,000	CFLBUG7W	7	400	1	122.98		122.98
154	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
155	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
156	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
157	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
158	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
159	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
160	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
161	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
162	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
163	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
164	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
165	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
166	Jumbo Rocks	Jumbo Rocks Amphitheater walkway	None	Same	Full		Same	Same	7	55	1	0.00		0.00
167	Jumbo Rocks	Jumbo Rocks Amphitheater building	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	1	45.98		45.98
168	Jumbo Rocks	Jumbo Rocks Amphitheater stage	Replace Lamp	Same	Full		Same	LEDPAR20	3	150	1	0.00		0.00
169	Jumbo Rocks	Jumbo Rocks Amphitheater stage	Replace Lamp	Same	Full		Same	LEDPAR20	3	150	1	0.00		0.00

170	Jumbo Rocks	Jumbo Rocks Amphitheater stage	Replace Lamp	Same	Full		Same	LEDPAR20	3	150	1	0.00		0.00	
171	Jumbo Rocks	Jumbo Rocks Amphitheater stage	Replace Lamp	Same	Full		Same	LEDPAR20	3	150	1	0.00		0.00	
172	North Entrance	North Entrance Fee Booth	Remove						0	0	0	0.00		0.00	
173	North Entrance	North Entrance Fee Booth	Remove						0	0	0	0.00		0.00	
174	North Entrance	North Entrance Fee Booth	Replace	S+M+P	Full	Wall	GB 1,000	CFL	0	0	1	0.00		0.00	
175	North Entrance	North Entrance Fee Booth	Remove						0	0	0	0.00		0.00	
176	North Entrance	North Entrance Fee Booth	Remove						0	0	0	0.00		0.00	
177	North Entrance	North Entrance Fee Booth	Replace	RABMotion	Full	Wall	GB1,000	CFLBUG7W	7	400	1	122.98		122.98	
178	North Entrance	North Entrance Fee Booth	Replace	Same	Full	Wall	GB1,000	CFLBUG7W	7	400	1	76.98		76.98	
179	North Entrance	North Entrance Fee Booth	Replace	Same	Full	canopy	HSBB5	LED5	5	200	1	126.00		126.00	
180	North Entrance	North Entrance Fee Booth	Replace	Same	Full	Wall	GB1,000	CFLBUG7W	7	400	1	76.98		76.98	
181	Headquarters	HQ Compound/Office Storage Complex	Replace Lamp	Same	Full	canopy	same	CFLPAR2011W	11	380	1	9.50		9.50	Explosion Proof
182	Headquarters	HQ Compound/Office Storage Complex	Remove						0	0	0	0.00		0.00	
183	Headquarters	HQ Compound/Office Storage Complex	None	Same	Same	Same	Same	Same	24	1500	1	0.00		0.00	
184	Headquarters	Artifact Storage Building	Replace	TETimer	Full	Wall	AWMQS	CFLWW13W	13	900	4	517.35		517.35	
185	Headquarters	Artifact Storage Building	Replace	On above	Full	Wall	AWMQS	CFLWW13W	13	900	4	255.65		255.65	
186	Headquarters	Artifact Storage Building	Replace	On above	Full	Wall	AWMQS	CFLWW13W	13	900	4	255.65		255.65	
187	Headquarters	Artifact Storage Building	Replace	On above	Full	Wall	AWMQS	CFLWW13W	13	900	4	255.65		255.65	
188	Headquarters	Artifact Storage Building	replace diffuser/lamp	S+P	Full	canopy	same	CFLWW13W	13	900	1	0.00		0.00	replace diffuser so flush with canopy
189	Headquarters	Native Plant Nursery	Remove	Switch	Full	canopy	HSBB5	LED5	0	0	1	126.00		126.00	
190	Cottonwood	Middle Residence	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	5	200	1	90.83		90.83	Need to install switch
191	Cottonwood	Middle Residence	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
192	Cottonwood	Middle Residence	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
193	Cottonwood	Most Easterly Residence	Replace Lamp	Switch	Full	canopy	HSBB5	LED5	5	200	1	126.00		126.00	Need to install switch
194	Cottonwood	Most Easterly Residence	Replace Lamp	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
195	Cottonwood	Most Easterly Residence	Replace Lamp	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
196	Cottonwood	Duplex	Replace Lamp	Switch	Full	canopy	HSBB10	LED10	10	500	2	210.00		210.00	Need to wire to attic 12volt power
197	Cottonwood	Duplex	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
198	Cottonwood	Duplex	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	

199	Cottonwood	Duplex	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
200	Cottonwood	Duplex	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
201	Cottonwood	Duplex	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
202	Cottonwood	Duplex	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
203	Cottonwood	Most Westerly Residence	Replace	Switch	Full	canopy	HSBB5	LED5	5	200	1	126.00		126.00	Need to install switch
204	Cottonwood	Most Westerly Residence	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
205	Cottonwood	Most Westerly Residence	Replace	RABMotion	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	90.83		90.83	
206	Cottonwood	Protection Office	Replace	RABMotion	Full	Wall	GB1,000	CFLWW13W	13	900	1	120.65		120.65	
207	Cottonwood	Protection Office	Replace	Switch	Full	canopy	HSBB10	LED10	10	500	1	210.00		210.00	Need to install switch
208	Cottonwood	Maintenance Office	Replace	RABMotion	Full	Wall	DSSconce	CFLWW13W	13	900	1	89.65		89.65	
209	Cottonwood	maintenance shops	remove	TETimer	Full	Wall	HSBrick3	LED3	0	0	1	333.70		333.70	
210	Cottonwood	maintenance shops	remove						0	0	0	0.00		0.00	
211	Cottonwood	VC towards parking lot	replce	TETimer	Full	Wll	HSBick3	LE3	29	12	1	333.70		333.70	Area can be lit with LED Bricks, Need central 12 volt power supply and wire to bricks at strategic locations, put on timer
212	Cottonwood	VC under arbor	replace	On above	Full	Wall	HSBrick3	LED3	2.9	120	1	72.00		72.00	
213	Cottonwood	Interp Office	Replace	RABMotion	Full	canopy	HSSStrip6	LED4.8	4.8	180	1	126.00		126.00	Need to relocated and re-wire for motion sensor
214	Cottonwood	Interp Office	remove						0	0	0	0.00		0.00	
215	Cottonwood	Interp Office	remove						0	0	0	0.00		0.00	
216	Cottonwood	Interp Office	remove						0	0	0	0.00		0.00	
217	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
218	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
219	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
220	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
221	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
222	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
223	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
224	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
225	Cottonwood	campground amphitheater path	none	Same		Same	Same	Same	12	90	1	0.00		0.00	
226	Cottonwood	amphitheater projection building	none	Same		Same	Same	Same	30	250	1	0.00		0.00	
227	Cottonwood	amphitheater projection building	none	Same		Same	Same	Same	30	250	1	0.00		0.00	

228	Cottonwood	amphitheater projection building	none	Same		Same	Same	Same	30	250	1	0.00		0.00	
229	Cottonwood	amphitheater projection building	none	Same		Same	Same	Same	30	250	1	0.00		0.00	
230	Cottonwood	amphitheater projection building	none	Same		Same	Same	Same	30	250	1	0.00		0.00	
231	Pinto Wye	Pinto Wye Maintenance Offices	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	2	44.83		44.83	
232	Pinto Wye	Pinto Wye Maintenance Offices	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	2	44.83		44.83	
233	Pinto Wye	Pinto Wye Maintenance Shops	Replace	Same	Full	Wall	GB1,000	CFLWW42W	42	2600	2	84.50		84.50	
234	Pinto Wye	Pinto Wye Maintenance Shops	Replace	Same	Full	Wall	GB1,000	CFLWW42W	42	2600	2	84.50		84.50	

235	Pinto Wye	Pinto WyeMaintenance Shops	Replace	Same	Full	Wall	GB1,000	CFLWW42W	42	2600	2	84.50		84.50
236	Pinto Wye	Pinto WyeMaintenance Shops	Replace	Same	Full	Wall	GB1,000	CFLWW42W	42	2600	2	84.50		84.50
237	Pinto Wye	Pinto WyeMaintenance Shops	Replace	Same	Full	Wall	GB1,000	CFLWW42W	42	2600	1	84.50		84.50
238	Pinto Wye	Bell Mountain Bunker	Replace	Same	Full	Wall	GB1,000	CFLBUG13W	13	1200	1	75.83		75.83
239	Pinto Wye	Bell Mountain Bunker	Replace	Switch	Full	Wall	GB1,000	CFLBUG13W	13	1200	1	75.83		75.83
240	Indian Cove	Indian Cove RS Parking Lot	Remove						0	0	0	0.00		0.00
241	Indian Cove	Indian Cove RS	Replace	RABMotion	Full	Wall	GB2000	CFLWW13W	13	900	2	140.65		140.65
242	Indian Cove	Indian Cove RS	Replace	RABMotion	Full	Wall	GB2000	CFLWW13W	13	900	2	140.65		140.65
243	Indian Cove	Indian Cove RS	Remove						0	0	0	0.00		0.00
244	Indian Cove	Indian Cove RS	Replace	RABMotion	Full	Wall	GB2000	CFLWW13W	13	900	2	140.65		140.65
245	Indian Cove	Indian Cove Residence	Replace	RABMotion	Full	canopy	PLCylinder	CFLWW13W	13	900	2	0.00		0.00
246	Indian Cove	Indian Cove Residence	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	2	45.98		45.98
247	Indian Cove	Indian Cove Residence	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	2	45.98		45.98
248	Indian Cove	Indian Cove Residence	Replace	Same	Full	Wall	DSSconce	CFLBUG7W	7	400	2	45.98		45.98
249	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
250	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
251	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
252	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
253	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
254	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
255	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
256	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
257	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
258	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
259	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
260	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
261	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
262	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00
263	Indian Cove	Indian Cove Amphitheater	None	Same		Same	Same	Same	40	441	1	0.00		0.00

264	Indian Cove	Indian Cove Amphitheater	Replace Lamp/Point Downward	Same	Full	Wall	Same	CFLPAR2011W	11	380	1	9.50		9.50	
265	Indian Cove	Indian Cove Amphitheater	Replace Lamp/Point Downward	Same	Full	Wall	Same	CFLPAR2011W	11	380	1	9.50		9.50	
266	Indian Cove	Indian Cove Amphitheater	Replace Lamp/Point Downward	Same	Full	Wall	Same	CFLPAR2011W	11	380	1	9.50		9.50	
267	Indian Cove	Indian Cove Amphitheater	Replace Lamp/Point Downward	Same	Full	Wall	Same	CFLPAR2011W	11	380	1	9.50		9.50	
268	Indian Cove	Indian Cove Amphitheater	Replace	Same	Full	Wall	DSSconce	CFLBUG13W	13	1200	1	44.83		4.83	

Recommended Fixtures, Lamps, and Lighting Controls

Table 13. Recommended fixtures, lamps, and light controls

Recommended Fixtures, Lamps, and Lighting Controls											
Item	Full Name	Description	Type	Mounting Type	Lamp Base	Watts	Mean Lumens	Cost	Vendor	Web Link	
GB2000	Glare Buster GB2000	Economical cutoff luminaire	Luminaire	Wall	Bayonet	0.0	0	89.00	Glare Buster	http://www.theglarebuster.com/	Luminaires
GB1000	Glare Buster GB1000	Economical cutoff luminaire	Luminaire	Wall	Medium_Edison	0.0	0	69.00	Glare Buster	http://www.theglarebuster.com/	
SGSconce	Sea Gull Wall Sconce	Building egress light	Luminaire	Wall	Medium_Edison	0.0	0	66.00	Lighting4Sale		
DSSconce	Dark Sky Sconce	Building egress light	Luminaire	Wall	Medium_Edison	0.0	0	38.00	Green Earth Lighting	http://www.greenearthlighting.com/proddetail.asp?prod=L%2DDSSC&cat=8	
VSIL	Visionaire Silhouette	Wall mount area light MH	Luminaire	Wall	Medium_Edison	0.0	0	240.00	Green Earth Lighting		
SSSconce	Seaside Wall Sconce	Building egress light	Luminaire	Wall	Medium_Edison	0.0	0	39.60	Lighting Universe		
EXL-KT	Exceline Kaleidoshade 2	Overhanging linear sign fixture	Luminaire	Wall	T_Fluorescent	14.0	0	230.00	Starry Night Lights		
AWMQS	North Star Lighting AWMQS-FT-9-13CF-BZ	Wall mount sconce style	Luminaire	Wall	Pin	13.0	0	250.00	North Star Lighting		
TWP2	North Star Lighting TWP2	Wall mount sconce style	Luminaire	Wall	Pin	13.0	900	145.00	CRI Lighting Sales	John Molyneaux, CRI Lighting Sales, Inc. 7340 Trade Street, Suite B, San Diego, CA 92121 Ph(858) 695-8300, ext 104, Fax(858) 695-0303 Cell(858) 688-3464	
HSBB10	Holly Solar Bus Brick 10 watt	Flush mount canopy 10 watt LED low voltage	Luminaire	Canopy	Other	10.0	500	210.00	Holly Solar	Mike Hollibaugh Holly Solar Products + Suntronics 1340-D Industrial Avenue Petaluma, Ca 94952 USA T: +707 763 6173 F: +707 763 8755 E: info@hollysolar.com	
HSBB5	Holly Solar Bus Brick 5 watt	Flush mount canopy 5 watt LED low voltage	Luminaire	Canopy	Other	5.0	200	126.00	Holly Solar		
HSBrick3	Holly Solar Brick canopy 3 watt	Flush mount canopy 4 watt LED low voltage	Luminaire	Flush	Other	4.0	250	72.00	Holly Solar		
HSBrick2	Holly Solar Brick canopy 2 watt	Flush mount canopy 4 watt LED low voltage	Luminaire	Flush	Other	2.0	125	54.00	Holly Solar		
HSStrip6	Holly Solar LED strip light 6 feet long	flush mount acrylic led strip, Rigel series	Luminaire	Flush	Other	5.0	250	80.00	Holly Solar		
LEDR304W	White LED bulb, 4.5 watt	90 degree flood light lamp	Lamp	None	Medium_Edison	4.5	252	119.00	LEDTronics		Lamps

CFLBUG13W	Yellow CFL 13 watt lamp	Yellow CFL 13 watt lamp	Lamp	None	Medium_Edison	13.0	1200	6.83	GoodMart		
CFLWW42W	MaxLite Micro Max 42 watt 2700 K CFL	Warm White 42 watt lamp	Lamp	None	Medium_Edison	42.0	2600	15.50	GoodMart		
CFLWW4W	TCP 289 4 watt mini-mini	Warm White CFL 4 watt lamp	Lamp	None	Medium_Edison	4.0	250	5.11	GoodMart		
CFLWW23W	TCP SpringLamp 23 watt 3500K CFL	Warm White CFL 23 watt	Lamp	None	GU24	23.0	1500	6.31	GoodMart		
CFLWW13W	TCP SpringLamp 13 watt 2700K CFL	Warm White CFL 13 watt	Lamp	None	GU24	13.0	900	5.65	GoodMart		
CFLBUG7W	Noli Controls DEC3C-7-Y	7 watt CFL candelabra base--need adaptor	Lamp	None	Candelabra	7.0	400	7.98	Noli Controls		
CFLWW9W	TCP SpringLamp 9 watt 3100K CFL	9 watt CFL warm white edison base	Lamp	None	Medium_Edison	9.0	320	6.83	GoodMart		
CFLWW2W	TCP SpringLamp 2 watt 2700K CFL	2 watt CFL warm white edison base	Lamp	None	Medium_Edison	2.0	150	5.38	GoodMart	http://www.goodmart.com/products/213529.htm	
CFLPAR2011W	Global Consumer 11 watt Par20 Reflector CFL	11 CFL with reflector PAR 20	Lamp	None	Medium_Edison	11.0	380	9.50	1000Bulbs.com		
AWMQS13	AWMQS with 13 watt CFL		Lamp	None	pin	13.0	900	0.00	see AWMQS		
TWP213	TWP2 with 13 watt CFL		Lamp	None	Pin	13.0	900	0.00	see TWP2		
LED2.4	LEDLight 2.4 watt edison base	120 volt AC led lamp 2.4 watt	Lamp	None	Medium_Edison	2.4	150	15.50	LEDLight.com		
LED3	Holly Solar led panel 2.9 watt	12v DC light cluster (Brick)	Lamp	None	Circuit_Board	2.9	120	0.00	Holly Solar	see HSBrick3 Luminaire	
LED2	Holly Solar led panel 2.1 watt	12v DC light cluster (Brick)	Lamp	None	Circuit_Board	2.1	90	0.00	Holly Solar	see HSBrick2 Luminaire	
LED5	Holly Solar led panel 5 watt	12/24v DC light cluster (Bus Brick)	Lamp	None	Circuit_Board	5.0	200	0.00	Holly Solar	see HSBB5 Luminaire	
LED10	Holly Solar led panel 10 watt	12/24v DC light cluster (Bus Brick)	Lamp	None	Circuit_Board	10.0	500	0.00	Holly Solar	see HSBB10 Luminaire	
LED4.8	Holly Solar 6 foot light strip		Lamp	None	Circuit_Board	4.8	180	0.00	Holly Solar	see HSStrip6	
LEDPAR20	LEDLight Super Bright PAR 20	PAR 20 LED Edison Base	Lamp	None	Medium_Edison	3.0	150	40.00	LEDLight.com		

		with 3 super bright LEDs								
RABMotion	RAB Mini Motion Sensor	Small format motion sensor	Control	None				46.00	Green Earth Lighting	Controls
TETimer	Tork Digital timer	Timer with astronomic clock	Control	None				261.70	GoodMart	
Same								0.00		
Photoswitch								0.00		
canopy								0.00		
Custom								0.00		
Wall								0.00		
Full								0.00		
full								0.00		
LED								0.00		
On above								0.00		
Switch								0.00		

Appendix III

San Bernardino County Lighting Ordinance

CHAPTER 83.07: GLARE AND OUTDOOR LIGHTING

Section

83.07.010	Purpose.
83.07.020	Applicability.
83.07.030	Glare and Outdoor Lighting - Valley Region.
83.07.040	Glare and Outdoor Lighting – Mountain and Desert Regions.

§ 83.07.010 Purpose.

The purpose of this Chapter is to encourage outdoor lighting practices and systems that will:

- (a) Minimize light pollution, glare, and light trespass;
- (b) Conserve energy and resources while maintaining nighttime safety, visibility, utility, and productivity;
- (c) Curtail the degradation of the nighttime visual environment.

(Ord. 4011, passed - -2007)

§ 83.07.020 Applicability.

The provisions of this Chapter shall apply to various types of outdoor lighting in the Valley Region, as specified in § 83.07.030 and in the Mountain and Desert Regions, as specified in § 83.07.040.

(Ord. 4011, passed - -2007)

§ 83.07.030 Glare and Outdoor Lighting - Valley Region.

This Section provides standards for outdoor lighting in the Valley Region.

- (a) *Light Trespass Prohibited.* Outdoor lighting of commercial or industrial land uses shall be fully shielded to preclude light pollution or light trespass on any of the following:
 - (1) An abutting residential land use zoning district;
 - (2) A residential parcel; or
 - (3) Public right-of-way.
- (b) *Determination of Light Trespass.* A determination of light trespass shall be made through a quantitative measurement utilizing a standard yardstick (three feet x one and one-half inches). The yardstick shall be placed at the building setback line in the complainant's yard. The yardstick shall be in contact with the ground or may be raised to window level of the dwelling and in a vertical position.

The person taking the measurement shall then determine if a shadow is cast by the light source, that is, the light source, yardstick, and shadow shall be in alignment. Measurements shall not be taken when there is a moon in the night sky.

- (c) *Maximum Allowed Foot-candles.* Direct or indirect light from any light fixture shall not cause glare above five-tenths foot-candles when measured at the property line of a residential land use zoning district, residential parcel, or public right-of-way. Light levels shall be measured with a photoelectric photometer, following the standard spectral luminous efficiency curve adopted by the International Commission on Illumination.

(Ord. 4011, passed - -2007)

§ 83.07.040 Glare and Outdoor Lighting - Mountain and Desert Regions.

This Section provides standards for outdoor lighting in the Mountain and Desert Regions, unless exempt in compliance with § 83.07.040(e) (Exempt Lighting and Fixtures), below.

- (a) *Residential, Commercial and Industrial Land Use Zoning Districts.* The following standards shall apply to all structures and freestanding outdoor light fixtures in all land use zoning districts.
 - (1) *Maximum Height.* Residential pole lighting shall not exceed 12 feet in height.
 - (2) *Shielding Requirements.* New permitted lighting for new construction, unless exempt in compliance with § 83.07.040(e) (Exempt Lighting and Fixtures), below, shall be shielded in compliance with the requirements outlined in Table 83-7 (Shielding Requirements for Outdoor Lighting in the Mountain Region and Desert Region), in order to preclude light pollution or light trespass on:
 - (A) Adjacent property;
 - (B) Other property within the line of sight (direct or reflected) of the light source; or
 - (C) Members of the public who may be traveling on adjacent roadways or rights-of-way.

<i>Table 83-7</i>		
<i>Shielding Requirements For Outdoor Lighting In the Mountain Region and Desert Region</i>		
<i>Fixture Lamp Type</i>	<i>Residential Area Shielded</i>	<i>Commercial/Industrial Area Shielded</i>
Low Pressure Sodium	Fully	Fully

High Pressure Sodium	Prohibited except fully shielded on streets	Fully
Metal Halide	Prohibited	Fully
Fluorescent	Fully	Fully
Quartz	Prohibited	Fully
Incandescent > 60 watts	Fully	Fully
Incandescent 60 watts or less	No requirement	No requirement
Compact fluorescent lights (CFL) > 13 watts	Fully	Fully
Compact fluorescent lights (CFL) 13 watts or less	No requirement	No requirement
Glass Tubes filled with Neon, Argon, or Krypton	No requirement	No requirement
Mercury Vapor	Prohibited	Fully
Halogen	Prohibited	Fully
Searchlights for advertising purposes	Prohibited	Prohibited
Laser source light or similar light intensity light for advertising purposes	Prohibited when projected above the horizontal	Prohibited when projected above the horizontal

(b) *Determination of Light Trespass.* Light trespass shall be determined in compliance with § 83.07.030(a), above.

(c) *Additional Standards for Recreation Facilities.* The following additional standards shall apply to recreational facilities:

- (1) Private recreational facilities shall not be illuminated between the hours of 11:00 p.m. and sunrise.
- (2) Public recreational facilities shall not be illuminated unless the facilities are being utilized. The

illumination shall be turned off no later than 11:00 p.m. or one hour after the termination of the event and/or use, whichever occurs last.

(d) *Additional Standards for Off-Site Signs (Billboards) and On-Site Signs.* Lighting fixtures used to illuminate a new off-site sign and exterior illuminated on-site signs shall be mounted on the top of the sign structure and shall comply with the shielding requirements in Table 83-7 (Shielding Requirements for Outdoor Lighting in the Mountain Region and Desert Region), above.

(e) *Exempt Lighting and Fixtures.* The following outdoor lighting fixtures shall be exempt from the requirements of this Section:

- (1) Fixtures producing light directly by the combustion of fossil fuels (e.g., kerosene lanterns, gas lamps, etc.).
- (2) Neon, argon or krypton outdoor lighting fixtures.
- (3) Outdoor lighting fixtures on facilities or lands owned, operated, or controlled by the United States Government or State of California. Voluntary compliance at those facilities is encouraged.
- (4) Emergency lighting operated by a public utility or agency during the course of repairing or replacing damaged facilities.
- (5) Emergency lighting and fixtures necessary to conduct rescue operations, provide emergency medical treatment, or address any other emergency situation.
- (6) Provided there is no light pollution, or light trespass, or when the lighting fixtures are regulated by motion detector, lighting fixtures within five feet of an entrance or exit door and/or alcove of a dwelling unit, not exceeding a height of eight feet and a wattage not exceeding 75 watts.
- (7) Internally illuminated signs.
- (8) Holiday lighting fixtures or displays.
- (9) Architectural lighting whether it is freestanding or attached to a structure that does not exceed an intensity of 60 watts.
- (10) Pedestrian lighting that does not have an intensity greater than 60 watts.
- (11) Vertical lighting for properly displayed U.S. and State of California flags that does not exceed an intensity of 140 watts.

(f) *Nonconforming lighting.*

- (1) Existing nonconforming outdoor lighting fixtures that were not regulated by previous development codes shall be allowed continued use, except that the lighting shall not be structurally altered so as to extend its useful life, aside from regular maintenance. If the Director determines that a nonconforming lighting fixture results in light pollution or light trespass, the Director may require the light to either be shielded, filtered, redirected, replaced with a less intense light source or otherwise modified (including removal if necessary) to

eliminate the light pollution or light trespass.

- (2) In those cases where the Director has determined that light pollution or light trespass exists, the Director may grant additional time for the property owner to remedy the light pollution or light trespass where a hardship exists. In determining if a hardship exists, the following factors shall be considered:
 - (A) The degree of difficulty in accessing the fixture;
 - (B) Financial difficulty or cost of correcting the light pollution or light trespass;
 - (C) Degree of light pollution or light trespass; or
 - (D) Other similar issues.
- (3) When a hardship exists and a request for temporary relief from the immediate compliance of a remedy action has been submitted to the Director, the following findings shall be made to grant the relief:
 - (A) Special circumstances or conditions apply to the land, structure(s), or outdoor light fixtures for which temporary administrative relief is sought, and the circumstances or conditions are peculiar to the land, structure(s), or outdoor light fixtures and do not apply generally to the land, structure(s), or outdoor light fixtures in the neighborhood.
 - (B) The granting of the temporary administrative relief will generally be in harmony with the intent of this Section and will not be injurious to the neighborhood or otherwise detrimental to the public welfare.
- (4) When a request for temporary relief has been submitted to the Department in a hardship case, the Director shall make a determination within ten business days from the date of the submission of the request and promptly notify the applicant in writing of the decision. Temporary relief shall not exceed a period of 90 days. The Director's determination may be appealed to the Commission within ten days of the decision. Should additional time be required, the request shall be forwarded to the Commission for review and consideration through the Temporary Use Permit process in compliance with Chapter 85.15 (Temporary Use Permits).
- (5) The Director may forward the request for temporary relief to the Commission based upon the degree of light pollution or light trespass, costs of correcting the light pollution or light trespass, or other similar issues.
- (6) In those cases where the Director has determined that light pollution or light trespass exists, and that adjustment or removal of the nonconforming light structure is required, the Director shall fix a time for the adjustment or removal of the nonconforming lighting fixture commensurate with the investment value and related to the depreciated value of the lighting

fixture. The determination may only be made after notice to the owner.

(7) Where the Director has determined the continued existence of a nonconforming light is detrimental to the public health, safety or general welfare, or is a public nuisance, the use of the light may be immediately terminated or abated in compliance with the following procedure:

(A) A public hearing before the Commission shall be used to process this termination or abatement.

(B) A Notice of Termination and a copy of the findings shall be sent to the property owner at least 30 days before the public hearing. Public notice shall be given in compliance with Chapter 86.07 (Public Hearings).

(C) If a termination is ordered, the Commission may provide for a reasonable period of time to amortize any lawful existing uses on the site. Extensions of this time period may be granted for good cause shown on later application to the reviewing authority by any affected person.

(8) In commercial and industrial land use zoning districts, 50 percent of all nonconforming lighting fixtures within parking lots or within open lot sale areas shall be turned off within one hour after closing or between the hours of 10:00 p.m. and sunrise, whichever occurs first.

(A) In those cases where turning off 50 percent of the nonconforming lighting fixtures would constitute a hardship, the Director may grant an administrative exemption based on the following findings:

(I) Special circumstances or conditions apply to the land, structure(s), or outdoor light fixtures for which temporary administrative relief is sought, and the circumstances or conditions are peculiar to the land, structure(s), or outdoor light fixtures and do not apply generally to the land, structure(s) or outdoor light fixtures in the neighborhood;

(II) The strict application of this Section would deprive the applicant reasonable use of the land, structure(s), or outdoor fixtures;

(III) The granting of the temporary administrative relief will generally be in harmony with the intent of this Section and will not be injurious to the neighborhood or otherwise detrimental to the public welfare.

(B) When a request for an administrative exemption has been submitted to the Department in a hardship case, the Director shall make a determination within ten business days from the date of the submission of the request for an administrative exemption and promptly notify the applicant in writing of the decision. The Director

shall determine the period of administrative exemption consistent with § 83.07.040(f)(8)(D). The Director's determination may be appealed to the Commission within ten days of the decision. Should additional time be required, the request shall be forwarded to the Commission for review and consideration through the Temporary Use Permit process in compliance with Chapter 85.15 (Temporary Use Permits).

- (C) The Director may forward the request for an administrative exemption to the Commission based upon the degree of light pollution or light trespass, costs of correcting the light pollution or light trespass or other similar issues.
- (D) In those cases where the Director determines that turning off 50 percent of the nonconforming lighting fixtures is a hardship to the business operator, the Director shall fix a time for the termination of the use of the nonconforming lighting fixture commensurate with the investment value and related to the depreciated value of the lighting fixture. The determination may only be made after notice to the owner.
- (E) In those cases where the Director has determined that light pollution or light trespass still exists even when 50 percent of all nonconforming lights are turned off, and that adjustment or removal of the nonconforming light structure(s) is required, the Director shall fix a time for the adjustment or removal of the nonconforming lighting fixture(s) commensurate with the investment value and related to the depreciated value of the lighting fixture. The determination may only be made after notice to the owner.

(Ord. 4011, passed - -2007; Am. Ord. 4245, passed - -2014)

Appendix IV

Twentynine Palms Lighting Standards

Chapter 19.70

LIGHTING STANDARDS

Sections:

19.70.010	Intent
19.70.020	Definitions
19.70.030	Standards
19.70.040	Penalty

19.70.010 Intent. The intent of this section is: to encourage effective, non-detrimental lighting; to maintain night-time safety, utility, security and productivity; and to encourage lighting practices and systems which will minimize light pollution, glare, and light trespass, conserve energy and resources and curtail the degradation of the night time visual environment of the areas outlined below.

19.70.020 Definitions. The following definitions shall apply to this Chapter:

“Fully Shielded”: Outdoor lighting fixtures shielded or constructed so that light rays are only emitted by the installed fixtures in such a manner that does not direct light upward or onto an offsite structure.

“Night Sky”: A clear sky, between dusk and dawn, with visible stars, despite necessary or desired illumination of private and public property.

“Fixture”: The assembly that holds a lamp and may include an assembly housing, a mounting bracket or polo socket, lamp holder, ballast, reflector or mirror and a refractor or lens.

“Freestanding Lighting”: A light fixture which is not attached to a building.

“Pedestrian Lighting”: Freestanding lighting fixtures not exceeding a height of thirty-six (36)

inches from surrounding ground grade level.

“Architectural Lighting”: Lighting which is either directed towards a residence with the intent of highlighting an architectural feature or a light fixture which is architecturally ornamental in nature or purpose.

19.70.030 Standards.

A. Residential, Commercial, Public and Industrial Land Use Districts: The following standards are applicable to all structures located within residential, commercial, public and industrial land use districts as identified on the City’s General Plan Land Use Map.

1. All lighting, unless exempt, shall be fully shielded Outdoor lighting fixtures established prior to the adoption date of this Chapter, shall come into compliance within one year of the adoption date except as provided below:

a. In the event the property owner or occupant demonstrates that compliance will cause a financial or other hardship, the Code Enforcement Officer may approve time extensions for such lighting fixtures for periods of up to one (1) year. A maximum of three (3) one-

Appendix V

Yucca Valley Outdoor Lighting Ordinance

ORDINANCE NO. 90

AN ORDINANCE OF THE TOWN COUNCIL OF THE TOWN OF YUCCA VALLEY, CALIFORNIA, REPEALING AND REENACTING CHAPTER 8.70 OF TITLE 8 OF THE TOWN OF YUCCA VALLEY MUNICIPAL CODE RELATING TO REGULATIONS FOR OUTDOOR LIGHTING AND NIGHT SKY PROTECTION

The Town Council of the Town of Yucca Valley does ordain as follows:

SECTION 1. MUNICIPAL CODE AMENDED

1.1 Chapter 8.70 of Title 8 of the Town of Yucca Valley Municipal Code is hereby amended in its entirety to read as follows:

"CHAPTER 8.70 OUTDOOR LIGHTING

Sections

- 8.70.010 Purpose and Intent
- 8.70.020 Definitions
- 8.70.030 Outdoor Lighting Fixtures
- 8.70.040 Exemptions
- 8.70.050 Administration and Enforcement
- 8.70.060 Penalties

8.70.010 Purpose and Intent. It is the purpose and intent of this Chapter to establish regulations and standards which will assist in substantially reducing light pollution which can be generated from commercial and residential lighting fixtures and devices; to minimize light pollution which has a detrimental effect on the environment and the enjoyment of the night sky, to reduce and minimize lighting practices which cause unnecessary illumination of adjacent properties; and to implement the Yucca Valley General Plan, Community Design Element, Policy 12, Program 12.A and Program 12.B

8.70.020 Definitions. For the purpose of this Chapter the following terms, phrases, words and their definitions shall have the meaning given herein. Words used in the present tense include the future, words in the plural number include the singular number, and the words in the singular number include the plural number. Words not defined shall be given their common and ordinary meaning.

- (a) "Fully Shielded" means any outdoor lighting fixtures shielded or constructed so that light rays are only emitted by the installed fixtures at angles below a horizontal plane passing through the lowest point of the light source and so not to direct light or light trespass onto adjacent property.
- (b) "Night Sky" is a clear sky, with visible stars, despite necessary or desired illumination of private and public property.
- (c) "Fixture" means the assembly that holds the lamp and may include an assembly housing, a mounting bracket or pole socket, lamp holder, ballast, a reflector or mirror and a refractor or lens.

- (d) "Freestanding Lighting" means a light fixture which is not attached to a building.
- (e) "Attached Lighting" means a light fixture that is attached to a building.
- (f) "Pedestrian Lighting" means freestanding lighting fixtures not exceeding a height of thirty-six (36) inches from ground grade level.
- (g) "Architectural Lighting" means lighting which is either directed towards a residence with the intent of highlighting an architectural feature or a light fixture which is architecturally ornamental in nature or purpose.
- (h) "Light Trespass" means nuisance glare from any lighting onto neighboring property that interferes with viewing of night sky or eliminates the ability to have darkness on the adjacent property or shines into neighboring windows and all or any areas on neighboring properties or structures. Quantitative measurement of light trespass shall be with a standard yard stick (3 ft x 1.5 in.). The yard stick shall be placed at the building setback line in the complainants yard. The yard stick shall be in contact with the ground and in a vertical position. The enforcement personnel shall than determine if a shadow is cast by the light source. The light source, yard stick, and shadow must be in alignment. Measurements shall not be taken when there is a moon in the night sky.
- (i) "New Construction" means new lighting fixtures and/or new building(s)with outdoor lighting.

8.70.030 Outdoor Lighting Fixtures.

- (a) Single Family and Multi-family Residential Land Use Districts: The following standards are applicable to all structures located within single family and multi-family residential land use districts as identified on the official Yucca Valley Zoning District map.
 - (1) Existing Structures located in Single Family and Multi-Family Residential Land Use Districts:
 - (A) Existing outdoor lighting fixtures installed or constructed on developed properties located in any residential land use district, as identified on the official Yucca Valley Zoning Map, and which properties are used for residential purposes, which are non conforming shall be allowed continued use, except that the lighting shall not be structurally altered so as to extend its useful life, aside from regular maintenance.
 - (B) Should it be determined that a non-conforming lighting fixture results in light trespass the Town may require the light to either be shielded, filtered, redirected, replaced with a less intense light source, removed or a combination thereof to eliminate light trespass.
 - (2) New construction and new lighting in single family residential and multifamily residential land use districts.
 - (A) Any new construction and or new lighting located in any residential land use district, as identified on the Yucca Valley Zoning Map and which properties are used for residential purposes, unless exempt shall be fully shielded or recessed in

such a manner as to preclude adverse impacts to adjacent property as a result of light trespass, or to any member of the public who may be traveling on adjacent roadways or right-of-way.

- (b) Commercial and Industrial Land Use Districts: The following standards are applicable to all structures located within commercial and industrial land use districts as identified on the official Yucca Valley Zoning District map.
 - (1) Existing structures located in commercial and industrial Land Use Districts:
 - (A) Existing outdoor lighting fixtures installed or constructed on developed properties located in any commercial or industrial land use district, as identified on the Yucca Valley Zoning Map, and which properties are used for any commercial or industrial purpose, which are non-conforming shall be allowed continued use, except that the lighting shall not be structurally altered so as to extend its useful life, aside from regular maintenance.
 - (B) Should it be determined that a non-conforming lighting fixture results in light trespass the Town may require the light to either be shielded, filtered, redirected, replaced with a less intense light source, removed or a combination thereof to eliminate light trespass.
 - (1) In those cases where light trespass exists and has been determined to be a nuisance, the Director may grant additional time for the property owner to remedy the light trespass where a hardship exists and the following findings can be made. Hardship shall mean that there is a degree of difficulty in accessibility to the fixture, financial difficulty or cost of correcting the light trespass, degree of light trespass, or other similar issues.
 - (a) There are special circumstances or conditions applying to the land, building, or outdoor light fixtures for which temporary administrative relief is sought, which circumstances or conditions are peculiar to such land, buildings, or outdoor light fixtures and do not apply generally to the land, buildings or outdoor light fixtures in the neighborhood.
 - (b) The granting of the temporary administrative relief will generally be in harmony with the intent of this Chapter and will not be injurious to the neighborhood or otherwise detrimental to the public welfare.
 - (2) The Director shall make a determination within five (5) business days from the date of the submission of the request and notify the applicant in writing of his/her decision. Temporary relief shall not exceed a period of 90 days. The Director's determination may be appealed to the Planning Commission within 10 days of the decision. Should additional time be required the request shall be forwarded to the Planning Commission for review and consideration through the Temporary Use Permit process and requirements.
 - (3) The Director may forward the request to the Planning Commission based upon the degree of light trespass, costs of correcting the light trespass or other similar issues.

- (C) Fifty percent of all non-conforming lighting fixtures within parking lots or within open lot sale areas shall be tuned off within one hour after closing or between the hours of 11:00 p.m. and dawn, whichever occurs first.
 - (1) In those cases where turning off fifty percent of the nonconforming lighting fixtures would constitute a hardship, the Director may grant an administrative exemption based on the following findings:
 - (a) There are special circumstances or conditions applying to the land, building, or outdoor light fixtures for which temporary administrative relief is sought, which circumstances or conditions are peculiar to such land, buildings, or outdoor light fixtures and do not apply generally to the land, buildings or outdoor light fixtures in the neighborhood;
 - (b) The strict application of this Chapter would deprive the applicant reasonable use of the land, buildings, or outdoor fixtures;
 - (c) The granting of the temporary administrative relief will generally be in harmony with the intent of this Chapter and will not be injurious to the neighborhood or otherwise detrimental to the public welfare.
 - (2) The Director shall make a determination within five (5) business days from the date of the submission of the request and notify the applicant in writing of his/her decision. Temporary relief shall not exceed a period of 90 days. The Director's determination may be appealed to the Planning Commission within 10 days of the decision. Should additional time be required the request shall be forwarded to the Planning Commission for review and consideration through the Temporary Use Permit process and requirements .
 - (3) The Director may forward the request to the Planning Commission based upon the degree of light trespass, costs of correcting the light trespass or other similar issues.
- (2) New construction and new lighting in commercial and industrial land use districts:
 - (A) Any new construction located in any commercial or industrial land use district, as identified on the Yucca Valley Zoning Map, and which properties are used for commercial and industrial purposes, unless exempt shall be fully shielded or recessed in such a manner as to preclude adverse impacts to adjacent property as a result of light trespass, or to any member of the public who may be traveling on adjacent roadways or right-of-way.
- (c) Recreation Facilities, both public and private. The following standards are applicable to all structures.
 - (1) There shall be no illumination of private recreational facilities between the hours of 11:00 p.m. and sunrise.

- (2) There shall be no illumination of public recreational facilities unless the facilities are being utilized. The illumination must be turned off no later than 11:00 p.m. or one hour after the termination of the event and/or use, whichever occurs first.

(d) Off-Site Signs (Billboards) and Exterior Illuminated On-Site Sign

- (1) Lighting fixtures used to illuminate any new off-site sign and exterior illuminated on-site signs shall be mounted on the top of the sign structure and shall comply with the shielding requirements of this Chapter.

8.70.040 Exemptions. The following outdoor lighting fixtures are exempt from the requirements of this Chapter:

- (a) Fixtures producing light directly by the combustion of fossil fuels, such as kerosene lantern or gas lamps.
- (b) All neon outdoor lighting fixtures.
- (c) All outdoor lighting fixtures on facilities or lands owned, operated, or controlled, by the United States Government, State of California, County of San Bernardino, Morongo Unified School District, Southern California Edison or any other public entity or public agency, not including the Town of Yucca Valley. Voluntary compliance at those facilities is encouraged.
- (d) Emergency lighting operated by a public utility or agency during the course of repairing or replacing damaged facilities.
- (e) Emergency lighting and fixtures necessary to conduct rescue operations, provide emergency medical treatment or address any other emergency situations.
- (f) Provided there is no light trespass, or the lighting fixtures are regulated by motion detector, lighting fixtures within five (5) feet of an entrance or exit door and/or alcove of a dwelling unit, not exceeding a height of eight (8) feet and a wattage exceeding 75 watts.
- (g) Internally illuminated signs.
- (h) Holiday lighting fixture displays.
- (i) Architectural lighting whether it is freestanding or attached to a building which does not exceed an intensity of 40 watts.
- (j) Pedestrian lighting which does not have an intensity greater than 40 watts.
- (k) Vertical lighting for a properly displayed U.S. flag which does not exceed an intensity of 140 watts.

8.70.050 Administration and Enforcement. The Director of the Community Development Department, or his or her designee, shall administer and enforce the provisions of this Chapter. Any person who wishes to appeal any order, decision, or determination made by the

Director shall do so in accordance with this Code.

All existing exterior lighting fixtures, poles, or sources shall comply with the requirements for permits as specified in the Uniform Building Code and/or the National Electric Code.

From time to time, the Community Development Director may recommend, and the Town Council may adopt by resolution, as deemed necessary, rules and regulations to implement the provisions of this section. Such rules and regulations shall have force of law and failure to comply shall be considered a violation of the provisions of this section. The rules and regulations to be adopted shall be implemented with the following intent:

- (1) Maintain the health and safety of persons and property within the Town;
- (2) Avoid undue disruption of persons and traffic within the affected areas of Town.

8.70.060 Penalties. It shall be unlawful for any person to violate any of the provisions of this Chapter.

- (a) Any person who violates the provisions of this Chapter shall receive a correction notice for the first violation for each given year. The notice shall specify the nature of the offense, the date of occurrence and required correction as established by this Chapter.
- (b) Any person subsequently violating or causing or permitting the violation of any of the provisions of this Chapter within one given year shall be guilty of an infraction which shall be punishable in accordance with Sections 1.01.200 through 1.01.250 of the Yucca Valley Municipal Code."

SECTION 2. NOTICE OF ADOPTION Within fifteen (15) days after the adoption hereof, the Town Clerk shall certify to the adoption of this Ordinance and cause it to be published once in a newspaper of general circulation printed and published in the County and circulated in the Town pursuant to Section 36933 of the Government Code.

SECTION 3. EFFECTIVE DATE. This Ordinance shall become effective thirty (30) days from and after the date of its adoption.

APPROVED AND ADOPTED by the Town Council and signed by the Mayor attested by the Town Clerk this 19th day of March, 1998.

MAYOR

ATTEST:

Town Clerk

APPROVED AS TO FORM:

APPROVED AS TO CONTENT:

Town Attorney= wger /

F:\COMMOSOBINANCSCAO I 97.0D M=cX
March 1998 TC

SUMMARY OF ORDINANCE RELATING TO OUTDOOR LIGHTING AND NIGHT SKY PROTECTION

This Ordinance repeals and reenacts Chapter 8.70 of Title 8 of the Town of Yucca Valley Municipal Code relating to the regulations for outdoor lighting and night sky protection. The purpose and intent of the Ordinance is to establish regulations and standards to assist in substantially reducing light pollution generated from commercial and residential lighting fixtures and devices. The Ordinance consists of a definition subsection and provides standards which are applicable to both new and existing construction in residential, commercial and industrial land use districts and recreational facilities throughout the Town. The Ordinance includes exceptions and provides for the administration and enforcement of the standards as well as appropriate penalties.

summary prepared by Nasmi Silvergleid, Town Attorney.

STATE OF CALIFORNIA

COUNTY OF SAN BERNARDINO

TOWN OF YUCCA VALLEY

I, Janet M Anderson , Town Clerk of the Town of Yucca Valley, California hereby certify that the foregoing ordinance was duly and regularly introduced at a meeting of the Town Council on the 5th day of March, 1998, and that thereafter the said ordinance was duly and regularly adopted at a meeting of the Town Council on the 19th day of March, 1998, by the following, vote, to wit:

Ayes: Council Members Crouter, Hockett, Leone, Loveless and Mayor Hunt

Noes: None

Absent: None

Abstain: None

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the Town of Yucca Valley, California, this 24th day of March, 1998.

(Signed)

(SEAL)

Town Clerk of the Town of
Yucca Valley

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Contributors

U.S. National Park Service, Joshua Tree NP

Luke Sabala, Physical Scientist

Stacy Manson, Physical Science Technician

Pam Tripp, Interpretative Ranger

Caitlyn Marrs, Archeological Technician

Jay Theuer, Chief of Cultural Resources

Andrea Compton, Chief of Resources Management

Scott Tremblay, Chief of Buildings and Utilities

U.S. National Park Service, Natural Sounds & Night Skies Division

Dan Duriscoe, GIS Specialist (former)

Kate Magargal, Physical Scientist (former)

Bob Meadows, Physical Scientist

Chad Moore, Night Skies Program Manager

Karen Trevino, Division Chief

Frank Turina, Policy, Planning, and Compliance Program Manager

Jeremy White, Physical Scientist



29 Palms Inn

June 6, 2016

Board of Directors

International Dark-Sky Association

3223 North First Avenue

Tucson, AZ 85719

IDA Board of Directors,

It is with great enthusiasm and encouragement that we hear that Joshua Tree National Park has applied for status of a designated Dark-Sky park. The quality of the night sky is an important part of the quality of life for both the residents of our area and the many visitors who visit this area. As a tourist destination resort owned I can attest to the positive impact the beautiful night sky experience has on tourism.

We applaud JTNP for putting the effort they have made towards this prestigious designation.

Sincerely,

A handwritten signature in blue ink that reads 'Jane Smith'. The signature is written in a cursive style with a large, sweeping 'J' and 'S'.

Jane Smith

Innkeeper-Owner

COACHELLA VALLEY CONSERVATION COMMISSION

73-710 Fred Waring Dr., Suite 200, Palm Desert, CA 92260 (760) 346-1127 www.cvmshcp.org



November 10, 2016

J. Scott Feierabend, Executive Director
International Dark Sky Association
3223 North First Avenue
Tucson, AZ 85719

Dear Mr. Feierabend:

The Coachella Valley Conservation Commission (CVCC) supports the designation of Joshua Tree National Park as an International Dark Sky Association (IDA) Dark Sky Park. Such a designation would further protect a critical park resources and the dark skies of adjacent lands protected by the Coachella Multiple Habitat Species Conservation Plan, as well as enhance the tourism based economy.

The CVCC was formed in 2008 in order to implement, oversee and administer the Coachella Valley Multiple Species Habitat Conservation Plan, a visionary road map for balancing development and the protection of species and habitat in the Coachella Valley- a biological hotspot of national and even continental significance. Joshua Tree National Park, which is adjacent to the lands protected by the CVMSHCP, has identified dark night skies as a critical resource that merits protection, the importance of which is underscored when one considers that 99% of the planet's skies are light polluted and that as of 15 years ago, two-thirds of Americans could no longer see the Milky Way from their backyards. Additionally, the majority of the 25 million people that live in southern California reside in areas with significant light pollution, resulting in Joshua Tree National Park being a night sky oasis with pristine, dark skies.

The CVCC recognizes that there is direct, reciprocal relationship between the protection of Joshua Tree National Park's resources, such as dark night skies, and those of the lands protected by the Coachella Valley Multiple Habitat Species Conservation Plan. Additionally, the protection of the night sky resource can help raise the profile of our desert region as a destination for star gazers, amateur and professional astronomers, who can have an overall beneficial impact on the regional tourism economy. In fact, in 2015 Joshua Tree National Park attracted over 2,000,000 visitors from around California, the nation and the globe who came to Joshua Tree to view pristine night skies; hike through a Joshua tree forest and observe the area's abundant wildlife. These tourists spent over \$96 million in gateway communities surrounding the park and supported over 1300 full and part time jobs.

In the densely populated Coachella Valley and the southern California region, Joshua Tree National Park remains as a core dark sky oasis where millions of visitors can still gaze up in wonder at the Milky Way. Designating Joshua Tree National Park as a "Dark Sky Park" benefits the entire Coachella Valley Multiple Habitat Species Conservation Plan area, as it highlights the importance of protecting the night sky resource in our desert region and raises the profile of the area as a destination for visitors and expert astronomers from around California, the nation and the globe.

Sincerely,

Michael Wilson
Chair

June 5, 2016

Board of Directors
International Dark Sky Association
3223 North First Avenue
Tucson, AZ 85719-2103

IDA Board of Directors,

The Board of the MBCA and its members are proud to support Joshua Tree National Park's application to become a Dark Sky Park. Park visitors will exceed two million in 2016 and we know from visitor surveys that over 65% travel away from the bright lights of their home cities to experience the phenomena of darkness. The Park staff are diligent in their efforts to insure that IDA standards are met and that visitors have opportunities to stare in awe at the Milky Way arching across the heavens and track the rising of the planets and constellations. For every camper the entry fee includes the hours to sit under the star studded heavens while bathed in the utter stillness of the desert night.

Those of us who live here do not take the dark sky as a given; we know we must work to keep our communities' lights dim and pointing down. Partnering with the Park and our local Sky's The Limit Observatory and Southern California Video Astronomers we get out into the county and communities to help craft dark sky friendly lighting ordinances and practices. The Park's designation as a Dark Sky Park will bring pride to our gateway communities, and importantly, encourage residents and businesses to be aware of their lighting choices and make changes as needed.

We add our voice to those requesting that the Board of Directors at IDA accept Joshua Tree National Park's request and approve their application for status as a Dark Sky Park.

Sincerely,



Sarah Kennington, President MBCA



May 28, 2016

John Barentine, Program
Manager International
Dark Sky Association
3223 N. First Avenue
Tucson, AZ 85719

RE- Joshua Tree National Park International Dark Sky Association (IDA) Dark Sky Park Application

Dear John Barentine:

National Park Conservation Association respectfully requests you designate Joshua Tree National Park as an IDA “Dark Sky Park”.

National Parks Conservation Association is the leading voice of the national parks and is dedicated to their preservation for present and future generations. We advocate on behalf of one million members and supporters nationwide, including over 120,000 in the state of California. NPCA’s Joshua Tree and Mojave Field Offices work to safeguard the spectacular ecological, historical, recreational and night sky resources of Joshua Tree National Park, Mojave National Preserve and Death Valley National Park.

Today more than 25 million people live in southern California, the majority of them in crowded, urban areas with significant light pollution where night sky viewing is impaired and few stars are visible. In this densely populated region, Joshua Tree National Park stands as a dark sky oasis where millions of visitors can still gaze up in wonder at the Milky Way. Joshua Tree's location and clear, arid atmosphere enhance night sky viewing for visitors and expert astronomers from around California, the nation and the globe.

Dark starry skies and the night sky resource are of paramount importance at Joshua Tree National Park, making it uniquely qualified for the IDA Dark Sky Park (IDSP) designation. The park has exceptional night sky viewing opportunities and this resource is specifically protected for its scientific, natural, educational, cultural heritage, and the public’s enjoyment.

Joshua Tree National Park has engaged in the following activities that merit consideration for the Dark Sky Park designation:

- Joshua Tree National Park’s January 2015 Foundation Document, which provides basic guidance for planning and management decisions, lists dark skies and the night sky resource as a Fundamental Resource and Value (FRV), warranting primary consideration during the park’s planning processes because the protection of this resource is “Essential to achieving the purpose of the park and maintaining its significance.”
- Joshua Tree National Park Chief Physical Scientist Luke Sabala and Physical Science Technician Stacy Manson have developed a robust, long term data collection program to document light pollution in Joshua Tree National Park.
- Chief Physical Scientist Luke Sabala is providing expertise to non-governmental organizations and

community advocates who have formed a committee to improve San Bernardino County's night sky ordinance under the direction of the Chair of the Board of San Bernardino County Supervisors James Ramos.

- Joshua Tree National Park is celebrating the National Park Centennial and Joshua Tree National Park's Dark Skies in 2016 by hosting a Night Sky Festival that will educate and engage hundreds of astronomers, scientists, cultural speakers, night sky enthusiasts, artists, volunteers, junior rangers and community members from around California, the nation and the world.

In closing, Joshua Tree National Park's world class night sky resource and its important effort to protect, monitor and educate the public about the importance of protecting dark skies make it an ideal candidate for the "Dark Sky Park" designation.

Respectfully,

Seth Shteir, Desert Program Manager (760-332-9776)- sshteir@npca.org National Parks Conservation Association, Joshua Tree, CA



Sky's The Limit Observatory and Nature Center

*P.O. Box 25, Twentynine Palms, CA 92277 - www.skysthelimit29.org - 9697 Utah Trail,
Twentynine Palms, CA 92277*

**Board of Directors
International Dark-Sky Association
3223 North First Avenue
Tucson, AZ 85719-2103**

June 5, 2016

IDA Board of Directors,

Sky's The Limit Observatory and Nature Center is a grassroots, all-volunteer nonprofit organization dedicated to facilitating hands-on experience for learning about the desert, earth, and sky.

We are fortunate to share a property boundary with Joshua Tree National Park at the North entrance in Twentynine Palms, and we are honored to partner with Park staff on educational programs. Most important of these emphasize preservation of the dark night sky.

Our knowledgeable volunteer astronomers augment the Park staff's outreach and provide regular nighttime viewing events that capture dozens – if not hundreds – of visitors to the Joshua Tree Gateway Communities each weekend. Together we work to share concern for the dark sky cause in surrounding communities by creating awareness that urban areas must support the National Park's dark sky efforts.

Among the natural elements protected by the National Park Service, dark skies top Sky's The Limit's priorities. So we are proud to support Joshua Tree National Park as a leader in this effort.

Now, as we approach the 100th Anniversary of the National Park Service, Joshua Tree National Park has reached a milestone protecting dark night skies in their charge.

We understand that a recent tour through JTNP shows that IDA dark sky-approved applications for safety, utility, and enhanced needs meet the standards for dark sky status. This effort shows JTNP will continue to follow the requirements of IDA.

Thanks to the commitment of the Superintendent, Rangers, Scientists, and Staff, Joshua Tree National Park has worked diligently to meet the requirements for designation as a "Dark Sky Park."

We respectfully request the Board of Directors at IDA to accept Joshua Tree National Park's request and approve their application for status as a "Dark Sky Park."

Sincerely,

Jerry F. Mattos, Co-Chair
Sky's The Limit
Observatory and Nature Center
P O Box 25
9697 Utah Trail,
Twentynine Palms, CA 92277



Board of Supervisors
Third District

James Ramos
Chairman

July 29, 2016

Board of Directors
International Dark-Sky Association
3223 North First Avenue
Tucson, AZ 85719-2103

IDA Board of Directors,

San Bernardino County has the unique pleasure of sharing a common boundary with Joshua Tree National Park. Along this boundary our county has a variety of rural areas and urban centers that are contiguous to the wilderness areas of the Park. It has come to our county's attention that Joshua Tree National Park has applied to be designated an International Dark-Sky Association - "Dark Sky Park".

As the Third District Supervisor and Chairman of Board of Supervisors for the County of San Bernardino, I strongly support this positive opportunity for the Park. The dark night skies are important to the citizens of our county and we, as a government agency, support efforts to keep starry skies protected for all citizens to enjoy.

At my direction, we have created a Dark Sky Committee whose task is to address current and future issues regarding light pollution in our county. Our goal is to update our lighting ordinance with elements that bring prudent and positive impacts to improve the quality of our night skies within our county. We hope this will bring positive results in helping to reduce light intrusion going into the Park. The National Park is represented on the committee and their concerns are important to the county as we move toward better management of night lighting.

Designating Joshua Tree National Park as a "Dark Sky Park" has my full support.

Sincerely,

A handwritten signature in black ink, appearing to read "James Ramos".

James Ramos
Third District Supervisor
San Bernardino County



29 Palms Inn

June 6, 2016

Board of Directors
International Dark-Sky Association

3223 North First Avenue

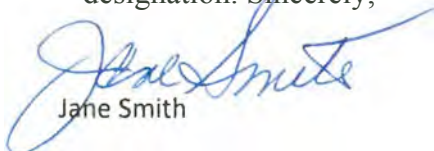
Tucson, AZ 85719

IDA Board of Directors,

It is with great enthusiasm and encouragement that we hear that Joshua Tree National Park has applied for status of a designated Dark-Sky park. The quality of the night sky is an important part of the quality of life for both the residents of our area and the many visitors who visit this area. As a tourist destination resort owned I can attest to the positive impact the beautiful night sky experience has on tourism.

We applaud JTNP for putting the effort they have made towards this prestigious

designation. Sincerely,



Jane Smith

Innkeeper-Own

73950 Inn Avenue Twentynine Palms, CA 92277 * Phone 760.367 .3505 fqx
760.367.4425 • www.29pqlrnsinn.com