

**INTERNATIONAL DARK-SKY ASSOCIATION**

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*TO PRESERVE AND PROTECT THE NIGHTTIME ENVIRONMENT AND OUR HERITAGE OF DARK SKIES THROUGH  
QUALITY OUTDOOR LIGHTING*

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**International Dark-Sky Association  
Dark Sky Places Program Annual Report**

MAY 2013

## Annual IDA DSPlace Report

This is a general report that can be used for dark sky parks and reserves.

**Place Name:** \_\_\_\_\_

**Date of Designation:** \_\_\_\_\_

### Lighting Guidelines

List and explain any changes to the lighting guidelines, if any:

(If more room is needed please add a page titled 'Lighting Guideline Changes')

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List and explain any major changes to lighting within the boundaries of the place that do not meet the lighting guidelines, if any:

(If more room is needed please add a page titled 'Added Lighting')

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What is the current estimated percentage of outdoor lighting fixtures that conform to the lighting guidelines in pursuit of 90% compliance within 5 years? \_\_\_\_\_

If the current percentage is not 90% what are the current plans to achieve that goal?

(If more room is needed please add a page titled 'Conformity Plans')

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## **Dark Sky Places Annual Report Attachments: Chaco Culture National Historical Park**

### **Added Lighting**

In an otherwise dark setting, the visitor center had a significant effect on area wildlife; it's continuously operating bright white lights served as an attractant to both flying and crawling insects, as well as a host of other wildlife species that feed upon them, disrupting natural ecological patterns and cycles.

In April 2014, the park contracted with local electricians to retrofit the existing visitor center exterior lighting. This project aimed to reduce the adverse effects of inappropriate outdoor lighting, while simultaneously improving the overall functionality, safety and aesthetics. This effort was documented in a poster that was developed for the park's Dark Sky Park Dedication (see attached).

Summary of Visitor Center changes:

- The park was able to significantly decrease its night lighting by changing from dusk-to-dawn to motion-sensored fixtures.
- Eight lighting fixtures were changed from partially-shielded to fully-shielded, providing the most protection from light glare.
- Two lighting fixtures were determined to be unnecessary and removed completely.
- All light bulbs were standardized to a 60W-equivalent LED.
- Lighting intensity was decreased from 1400 lumens to 800 lumens per fixture.
- Lighting color/temperature changed from 5000K blue light to 2700K amber light.

The park completed additional lighting changes to comply with outdoor lighting guidelines:

- Non-conforming 150W mercury vapor pole lights were completely removed from an employee recreational area.
- Portico overhang lights were completely removed from the front of employee apartments. Compliant, shielded lights were installed to replace these lights years ago, but the old lights were never removed until now.
- Standardized all existing housing area exterior lights to a 40W equivalent, 450 lumens, 2700K LED light bulb.
- Replaced bluish solar pathway lights on public walkway to observatory with amber solar pathway lights that have inserts to reduce direct glare.

### **Conformity Plans**

In the lighting guidelines, Chaco identified a number of techniques to improve the overall lightscape of the park. These techniques involved education, curfews, and interior lighting mitigations. In the next few years, the park will seek to bring these alternatives into effect.

- Interior lighting mitigations in housing, visitor and office areas, including light-blocking shades and window films.
- Labels on all exterior light fixtures to inform of appropriate replacement bulbs.
- Introduction of lighting curfew in both campground and housing area.
- Visitor and employee education on the role of natural darkness in the canyon.

### **Sky Quality Measurements:**

The NPS Night Skies Division has completed several night sky quality inventories at Chaco. Measurements taken in June 2013 informed the park's initial IDSP application. Repeat measurements were taken in May 2014; this data is currently being analyzed. The park has participated in most of the monthly international Globe at Night citizen night sky monitoring campaign, beginning in January 2014. These values can be found on the Globe at Night website.

The park's goal is to have a more refined, long-term monitoring protocol developed by the end of the December, 2014. This monitoring program, to be led by park staff and volunteers, will involve annual measurements using light meters and Sky-Quality Meters, as well as repeat panoramic high-quality photography.

Chaco will choose night sky quality inventory locations throughout the park. These locations will be chosen for three factors: 1) representative of the overall night sky quality in the park, 2) repeatability and ease of access, and 3) correspondence with the park's established key observation points and scenic quality locations. However, because the park has three detached units located 15-30 miles from the main park unit, nighttime accessibility is difficult. These units are located near communities and areas of potential energy development, making monitoring crucial and urgent.

In its initial application, the park identified a number of threats to its night sky quality and in particular, singled out the pressures from oil and gas development in the San Juan Basin. The NPS Night Skies Division is partnering with the park to develop models that monitor oil and gas activity impacts on night sky quality. This on-going process will better enable the park to provide information to agency partners, such as the Bureau of Land Management. This process will also allow the NPS Night Skies Division to assist other park units within the National Park Service with the monitoring and modeling of adverse impacts to night skies.

## Outreach Programs Held

Name of Program	Date	# Attendees	Description
Dark Sky Park Dedication and Star Party	April 24-27, 2014	213	Formal celebration held to honor the park's dedication as an IDA Dark Sky Park. This event was originally scheduled in Oct 2013, but was canceled due to the federal government shutdown. See attached flyer and schedule of events for more information.
Crownpoint Community Star Party	December 6, 2013	60	Star party jointly hosted by the park, The Albuquerque Astronomical Society, and Navajo Technical University. Event involved two talks and long telescope session.
Regular night sky evening programs	Held thrice weekly from May-October		Ranger-led presentation on archaeoastronomy and night skies, followed by observatory telescope viewing.
Full moon walks at Pueblo Bonito	Held once monthly from May-October		1.5 hour ranger-guided walk through Pueblo Bonito as the sun sets/ full moon rises, focused on night sky stories.
School Visits	January and July 2014	380	Presentations on night skies, light pollution, and archaeoastronomy given to large groups of elementary students.
AstroJazz	September 4, 2014		Experimental astronomy/musical performance by guest lecturers in the park.
Larry Baker			Guest lecture on archaeoastronomy at nearby Chacoan site, Salmon Ruins.
John Ninnemann			Guest lecture on photography of archaeoastronomy sites in Chaco Canyon.
The Bridge			Ranger-led outreach program on archaeoastronomy held at Senior Citizen facility in Aztec, NM.
Friends of Chaco Book club			Ranger-led outreach program on archaeoastronomy to park beneficiary group, Friends of Chaco.
The Society of Cultural Astronomy in the Southwest			Ranger-led outreach program on archaeoastronomy at the annual meeting of the Society of Cultural Astronomy in the Southwest.

## Future Plans

Name of Program	Date	Description
Biannual Star Party in Chaco Canyon	October 24-26, 2014	Part of the ongoing twice-yearly star parties that are cohosted by the park and The Albuquerque Astronomical Society.
Friends of Chaco Book club		Ranger-led outreach program on archaeoastronomy to park beneficiary group, Friends of Chaco.
Regular night sky evening programs	Held twice weekly from November-April	Ranger-led presentation on archaeoastronomy and night skies, followed by observatory telescope viewing.
Full moon walks at Pueblo Bonito	Held once monthly from May-October	1.5 hour ranger-guided walk through Pueblo Bonito as the sun sets/ full moon rises, focused on night sky stories.



# CHACO CULTURE VISITOR CENTER LIGHTING RETROFIT PROJECT



## SUMMARY

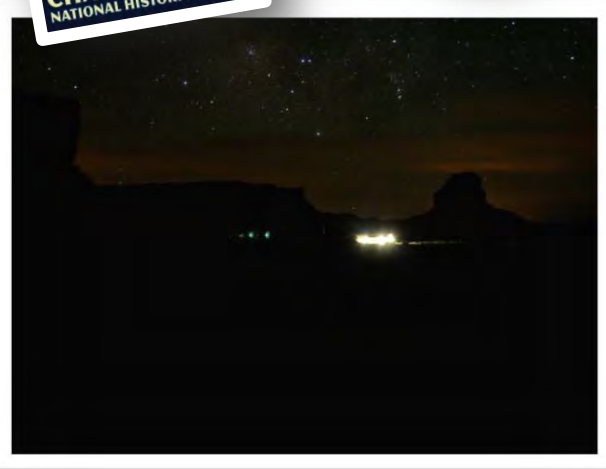
As an International Dark Sky Park, Chaco has pledged to reduce light pollution originating from the park. The first major project undertaken to support this goal is an exterior lighting retrofit of the visitor center building.

The Chaco Canyon Visitor Center was the park's single most problematic structure in terms of its production of nighttime light pollution. In an otherwise dark setting, the visitor center had a significant effect on area wildlife; its continuously operating bright white lights served as an attractant to both flying and crawling insects, as well as a host of other wildlife species that feed upon them, disrupting natural ecological patterns and cycles.

The nighttime illumination of the visitor center violated many of the park's central outdoor lighting principles regarding the location, intensity, color, timing, duration, and shielding of light fixtures. This project aimed to reduce the adverse effects of inappropriate exterior lighting, while simultaneously improving the overall functionality, safety and aesthetics of exterior lighting.



AFTER: As of April 18, 2014, the visitor center's lighting footprint is shown to have reduced considerably. Because the lights are on motion sensors, this photo shows the MAXIMUM amount of light that would exist while the building is occupied. This area remains completely dark for the majority of the night.



BEFORE: On June 2, 2013, the visitor center served as an unnecessary beacon of light in the dark canyon. This photo shows both direct glare and light trespass, two forms of bad lighting. These lights continuously operated throughout the night.

## HIGHLIGHTS

- The park was able to significantly decrease its night lighting by changing from dusk-to-dawn to motion-sensored fixtures.
- Eight lighting fixtures were changed from partially-shielded to fully-shielded, providing the most protection from light glare.
- Two lighting fixtures were determined to be unnecessary and removed completely.
- All light bulbs were standardized to a 60W-equivalent LED.
- Lighting intensity was decreased from 1400 lumens to 800 lumens per fixture.
- Lighting color/temperature changed from 5000K blue light to 2700K amber light.

BEFORE: Previous visitor center lighting. Note both the glare emanating from the fixture and the amount of insects on the wall drawn to the intense, white light.



On average, each fixture is now used **11 hours less per night**.

This is a reduction of 4,015 hours per year, which would be like operating the lights 24 hours a day for 67 straight days.

AFTER: Current visitor center lighting. The shielded fixture helps to protect vision from temporary damage. Both color temperature and intensity were reduced.

## NPS BEST LIGHTING PRACTICES

1. Light only *where* you need it.
2. Light only *when* you need it.
3. Use *shielded* fixtures and direct them downward.
4. Select lamps with *warm* colors.
5. Use the *minimum* amount of light necessary.
6. Use the most *energy-efficient* bulb and light fixture.

This project was completed thanks to a generous grant from the Friends of Chaco.



# Chaco Culture National Historical Park

## *International Dark Sky Park Designation*

### Thursday

## April 24, 2014

**10:00 am (1.5 hours)**

**Guided walk through Chetro Ketl**

*Meet at Pueblo Bonito / Chetro Ketl parking lot*

**11:00 am (1 hour)**

**“Astronomy and the Solar System”**

David Frizzell

*Visitor Center auditorium*

**2:00 pm**

***International Dark Sky Park Dedication***

*Visitor Center area*

**3:00 pm**

**Book signing by Dr. Tyler Nordgren**

*Visitor Center lobby*

**3:30 pm (1 hour)**

**“Astronomy and the Deep Sky”**

David Frizzell

*Visitor Center auditorium*

**5:00 pm (1.5 hours)**

**Guided walk through Pueblo Bonito**

*Meet at Pueblo Bonito / Chetro Ketl parking lot*

**8:00 pm (1 hour)**

**“Stars Above, Earth Below,  
Astronomy in the National Parks”**

Dr. Tyler Nordgren

*Visitor Center amphitheatre*

**9:00 pm – Star Party**

**Constellation tour followed by telescope viewing**

*Visitor Center area*

Solar scopes will be open for viewing throughout the day.



# Evening Program

**Tuesdays, Fridays and Saturdays**

**AT THE CHACO AMPITHEATER**

**8:30 PM**



**Join a Park Ranger for an Evening Program. Skies permitting, telescopes will be open for public viewing following the presentation.**

**BRING FLASHLIGHTS AND DRESS WARMLY**

**In case of inclement weather the program will be held in the Visitor Center Auditorium. Telescope availability is dependent upon weather conditions.**



## An Evening Walk through Pueblo Bonito



Join a Ranger for an evening walk through Pueblo Bonito and watch the full moon rise. Learn about the moon's importance to the people of the past and present during this special program.

The program will last 1 ½ hours

**Program is limited to 35 people. Participants will need to make a reservation at the Visitor Center on the day of the program.**

**Tuesday, September 9<sup>th</sup>, 2014  
8:00 pm**

**Meet at the Pueblo Bonito Parking Lot.**

**Bring a flashlight (no headlamps) and come prepared for cooler weather.**

## Chaco Culture National Historical Park is recognized as International Dark Sky Park

By Hannah Grover The Daily Times

Updated: 04/27/2014 01:41:06 AM MDT

Daily-Times.com

### Chaco Culture National Historical Park is recognized as International Dark Sky Park

#### MORE ON CHACO

##### *Ways to enjoy natural darkness*

**Conquer your fears:** Many people are uncomfortable in the dark. Carry a flashlight in your pocket while walking in a dark area.

**Make a night-vision-friendly flashlight:** A normal flashlight can damage your night vision. It takes 30 minutes of being in the dark without looking at any light to recover your night vision. Cover your flashlight with red cellophane or a red filter to prevent damaging your night vision.

**Stargaze:** Astronomy clubs, science centers and national parks offer opportunities to learn about the night sky and to look through telescopes. San Juan College also has astronomy opportunities.

**Go for a moonlight hike:** On full moon nights, there is enough light to see in most places. Let your eyes adjust fully before the hike.

**Watch nocturnal wildlife:** Many animals are most awake at night. Look for owls, bats, deer or bobcats.

**Be inspired:** Learn about the night sky through myth, literature, scientific discovery and religion.

**More info:** [nature.nps.gov](http://nature.nps.gov).

##### *Protect the night*

**Shield your lights:** Adjust porch lights to point downwards and use good neighbor light fixtures.

**Use light only when you need it:** Install motion sensors on porch lights to cut down on money, improve security and reduce light pollution.

**Use less light:** Switch to more energy efficient light bulbs

**More info:** [nature.nps.gov](http://nature.nps.gov).

##### *Chaco Night Sky Program*

**April through October:** The park offers night sky programs every Friday, Saturday and Tuesday at sunset.

**June 21 and 22:** Park staff will present a special summer solstice program at Casa Rinconada.

**Sept. 22:** Autumn equinox program at Casa Rinconada

**Dec. 21:** Winter solstice celebration at Kin Kletso

### ***International Dark Sky Parks***

Natural Bridges National Monument in Utah

Cherry Springs State Park in Pennsylvania

Galloway Forest Park in Scotland

Zselic National Landscape Protection Area in Hungary

Goldendale Observatory Park in Washington

Clayton Lake State Park in New Mexico

Hortobagy National Park in Hungary

Observatory Park in Ohio

The Headlands in Michigan

Big Bend National Park in Texas

Death Valley National Park in California

Chaco Culture National Historical Park in New Mexico

Northumberland National Park and Kielder Water Forest Park in England

Eifel International Dark Sky Park in Germany

Mayland Community College Blue Ridge Observatory and Star Park in North Carolina

Parashant International Night Sky Province in Arizona

- Apr 26:
- [Five questions with author and archaeoastronomer Tyler Nordgren](#)

CHACO CULTURE NATIONAL HISTORIC PARK — Stargazers of all ages gathered on Thursday to celebrate the night sky as the Chaco Culture National Historical Park received the designation of an International Dark Sky Park. The designation is given to areas that preserve the night sky and educate the public about the importance of dark night skies.

Chaco is the 13th park in the U.S., Hungary, England and Scotland to receive the designation from the International Dark-Sky Association. The organization also recognizes reserves and communities that protect the night sky.

The Albuquerque Astronomy Society last year nominated Chaco for the designation. At the time, Dee Friesen was president of the group.



*Tyler Nordgren, author of "Stars Above, Earth Below," gives a talk on Thursday about the importance of keeping a dark sky at the Dark Sky*

"It's an opportunity for Chaco to show off its night sky," he said of the designation after he set up a telescope for stargazing near Chaco's amphitheater on Thursday night.

He was accompanied by other members of the group, including Gordon Schaefering, who moved to Santa Fe last year from New York.

"I think people miss the beauty of what's out there," Schaefering said, commenting that many people never see the Milky Way galaxy or planets like Saturn or Jupiter.

Aesthetics aside, the dark sky is important because of its effect on ecosystem and human health, said Nathan Ament, coordinator for the Colorado Plateau Dark Skies Cooperative. He said studies on women who work night shifts have shown the late-night hours can lead to an increased rate of breast cancer.

In addition to health, the night sky has been important to Chaco since the time the kivas were first built in A.D. 900 and 1150.

"What we're doing tonight is maintaining a very ancient tradition," said Great Bear Cornucopia, an interpreter at Chaco.

Cornucopia said the sky influenced the Chacoans, and people who visit the park today to see the stars connect with the area's history.

"We have a direct link from the world we live in to the world the Chacoans lived in," Cornucopia said.

Tyler Nordgren, a professor at University of Redlands in California, approached Cornucopia in 2007 about documenting the night sky in Chaco. Since then, Nordgren has traveled to many national parks to observe both the stars and light pollution. He authored "Stars Above, Earth Below" about the night skies in the parks.

Nordgren, who is also a member of the board of directors of the International Dark Sky Association, spoke at Chaco's dedication ceremony at dusk on Thursday.

Prior to working as a professor in California, Nordgren worked at an observatory in Flagstaff, Ariz., where he first encountered truly dark skies. After moving to Los Angeles, he recalled his first night in the populated city. When the sun set, the familiar stars were not visible.

"It's like the sky I knew had just disappeared," he said.

Seven years later, Nordgren took a sabbatical from work. While many astronomers spend their sabbaticals at observatories and writing papers,



*Telescopes are assembled on Thursday at the Dark Sky Designation Ceremony at Chaco Canyon National Historic Park.*

Nordgren opted to document the night skies of the national parks.

Nordgren told the audience on Thursday that most people today can no longer see the natural night skies.

"The Milky Way had become a symbol of something different, like grizzlies and glaciers and granite cliffs," he said.

But, he said, there is a lot that people can learn from the stars, including the Milky Way Galaxy. He described the galaxy as 100 billion stars crammed into a giant pinwheel.

"We live inside that great, big pinwheel," he said.

By observing the stars, astronomers determined the Earth is not located at the center of the galaxy. Because of this, the Milky Way is most visible during the summer when the earth is looking toward Sagittarius at the center of the galaxy. In the winter, the earth looks toward Orion and away from the center.

Nordgren also spoke about ancient astronomy at Chaco.

"Our ideas of time and location and direction all come from the stars," Nordgren said.

As an example, he pointed to the kivas in Chaco that align with true north. He said the kivas were likely built by looking at where the shadows point when the sun is at its highest point in the sky.

Nordgren explained the sun was also important to Chacoan culture because it helped them decide when to plant. One petroglyph at Chaco has even been interpreted as depicting a solar eclipse.

The sky still remains an important aspect of Chaco Culture National Historical Park, But, Nordgren said, light pollution from cities like Albuquerque, Gallup and Grants is starting to encroach on the night sky.

Other national parks have already lost their night skies, Nordgren said. He showed a picture of Arches National Park in Moab, Utah, at night with the light from the city reflecting off of the rock formations.

"We've banished darkness from this park," he said.

Nordgren said light pollution can be stopped almost instantly by taking a few steps, such as modifying street lamps. With a typical street lamp, 50 percent of light is reflected up into the sky and another 10 percent is reflected horizontally. Nordgren said this light is wasted electricity and adds to the carbon footprint.

If cities replace their street lights, he said, they should consider putting shades on the lights, to direct the light downward. These types of lights are sold in stores as good neighbor lights for people wanting to modify their house lights.

"We can get our stars back," Nordgren said.

*Hannah Grover covers news, arts and religion for The Daily Times. She can be reached at 505-564-4652 and [hgrover@daily-times.com](mailto:hgrover@daily-times.com). Follow her [@hmgrover](https://twitter.com/hmgrover) on Twitter.*





查科峡谷标识

### 在查科峡谷体验暗夜公园

暗夜公园是专门设立的夜空保护地区。

从2007年开始，国际暗夜协会在美国及世界各地先后认证了16个国际暗夜公园、8个暗夜保护区和6个暗夜社区。这些暗夜保护地区有严格的夜空测试标准、照明控制方案和管理监督措施，使夜空资源像其它自然、文化遗产一样得到保护，让城市的居民、特别是孩子们能在这里看到最美的星空，让野生动物有一处适宜的夜间栖息地；同时，也为当地旅游增添了一个新的景观。

11月17日，我随国际暗夜协会的理事康妮·沃克、行政主管斯科特·卡德一道，驱车前往新近认证的国际暗夜公园——查克国家文化历史公园，该



查克公园天文台圆顶

公园位于新墨西哥州西北部的查科峡谷。这里是1000年前印第安人的聚居地，其中一些遗址和岩画与天文有关，被美国政府和联合国教科文组织确定为文化历史保护区。从图森到查克峡谷500多公里的路程，先后经历了沙漠、台地、森林、草原等壮观的西部风情，于傍晚驶入崎岖不平的景区进出土路。许多游客为此叫苦不迭，戏称“坏路通向好地方”；但公园管理者却有他们的初衷：让查科峡谷保持它的原生态！

查科峡谷平均海拔2000至3000米，入口有一座叫法伽达的孤峰，台壁上刻有标尺和符号，标示着不同季

节太阳、月亮和行星的位置，被称为印第安人的天文台。出于保护的考虑，法伽达孤峰已经不允许游客攀登了，远处设置的高倍望远镜可以观察岩画。夕阳西下，法伽达在太阳的余晖下熠熠生辉，美丽



印第安人的建筑



法伽达孤峰的星空



法伽达孤峰的星空

间。游客来查克公园，白天可以看到古印第安人可能是记录1054年超新星爆发的岩画（中国宋代文献中的“天关客星”，现在所称的蟹状星云）；晚上或欣赏繁星、或月下漫步，感受纯正的夜空。1997年，一位名叫约翰·瑟菲克的天文爱好者在做了几个月的调查后，决定向公园捐赠设立25英寸（635毫米）望远镜和圆顶，这是目前美国国家公园管理局唯一自主运营的天文台。该天文台每周开放3次，为爱好者们捕捉了数万幅CCD照片，并根据NASA的安排参加了月球观测等项目。我们入住的当晚恰逢农历十月十五，通透的月光下可以看清手表的数字，相机为我记录下了法伽达孤峰和满月。

第二天我们行走在查科峡谷中，景区管理人员凯蒂突然提醒说：“麋鹿！”我看见百十米外有几十只大角鹿正沿着谷底前进，后面的几只看到我们还停下来回望，一种环境友好的感觉油然而生。一位来自加拿大的游客听说我们是国际暗夜协会的，自我介绍他也是天文爱好者，专门为查科峡谷的夜空而来。他认为，暗夜保护很有意义，人类应当为自己和各种动物创造友好相处的环境，包括美丽的星空和优质的暗夜环境。☺

责任编辑 / 孙媛媛

的金星出现在孤峰的西侧，荒芜的沙漠草原空无一人，让人更加感受到这座古天文台的神秘和伟岸。

查克公园距离新墨西哥州第二大城市阿尔伯克基150公里，四周主要是牧场，使这里得以保持良好的自然环境、包括优质的夜空。更为重要的是，当地居民有着良好的生态意识和暗夜意识。新墨西哥



印第安人的岩画，被认为是1054年超新星爆发的记录

哥州于1978年设立了首部“暗夜保护法”，查克公园从2002年开始对光污染监测和控制。这里的人工光亮不超过夜空的13%，目视星等可达6.8等，黄道光、气辉等微弱天象均可看到。由于措施得力，近5年来夜空质量基本没有发生变化，被国际暗夜协会确定为“金”级暗夜标准（国际暗夜协会的夜空质量分为3级，其中对于目视星等规定：金级6.0等以上，银级5.5等~5.9等，铜级5.0等~5.4等）。

公园总面积150平方公里，绝大部分为自然黑暗区，没有任何照明设施；允许设置户外照明的是游客中心、游客留宿区、天文台和广场，以及游客露营区等，仅占景区总面积的1%。公园的理念是：只在需要的地区和需要时间提供适度的照明。他们采用琥珀色低照度光源，并通过屏蔽措施防止向上散射和形成眩光、通过定时或人工措施限制照明时



印第安人“大房子遗址”