



Dark Skies

Report

Looking to the Stars

How to Create Responsible Night Lighting at the
Stibnite Gold Project & Mitigate Light Pollution

Prepared for Midas Gold Idaho, October 30, 2018, Benjamin V. Banet

Dark Skies

Introduction

“Staring at the night sky has guided ships, fueled dreams and inspired fields of scientific study for millennia. In Idaho, if you look up at night, you will be blessed with the beauty of a star-studded sky. It is an iconic piece of our outdoor experience. At Midas Gold, it is important to our team that we do our part to protect this part of our state’s heritage.” - [Laurel Sayer, CEO of Midas Gold Idaho](#)





Benjamin Banet, *Dark Skies Intern*

We are fortunate to be building a company in a state where there are individuals, cities and companies who are committed to reducing light pollution. Through the research of Benjamin Banet and the guidance of some of Idaho's leaders in dark skies initiatives, we now have a blue print to help guide our engineers as we try to limit light pollution during operations at the Stibnite Gold Project. We hope you will enjoy reading Benjamin's

report and learning how Midas Gold, and other companies, can help protect our dark skies.

Thank you to everyone who helped put this work together. We promise you we will continue to stare up at the stars in the night sky and let them, and you, inspire us.



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Executive Summary

As part of their commitment to environmental responsibility, Midas Gold Idaho will strive to minimize their impact on Idaho's starry skies.

While the Stibnite Gold Project site is rich in gold and antimony, it is also notable for its lack of something else - artificial light at night. The remote region of Central Idaho where the project is located has exceptionally dark night skies for North America. This vanishing resource is so unique that, in 2017, the International Dark Sky Association designated the Central Idaho Dark Sky Reserve, just 45 miles from the Stibnite Gold Project site, as a location of international significance for its view of the night sky.



THE KEY WAYS FOR MIDAS GOLD TO MITIGATE LIGHT POLLUTION:

- 1 Develop a comprehensive lighting plan
- 2 Select appropriate lights based on Correlated Color Temperature (CCT) and Color Rendering Index (CRI)
- 3 Ensure lights are shielded
- 4 Customize lights to the worksite
- 5 Install lights properly
- 6 Conduct active lighting management
- 7 Maintain a long-term monitoring plan

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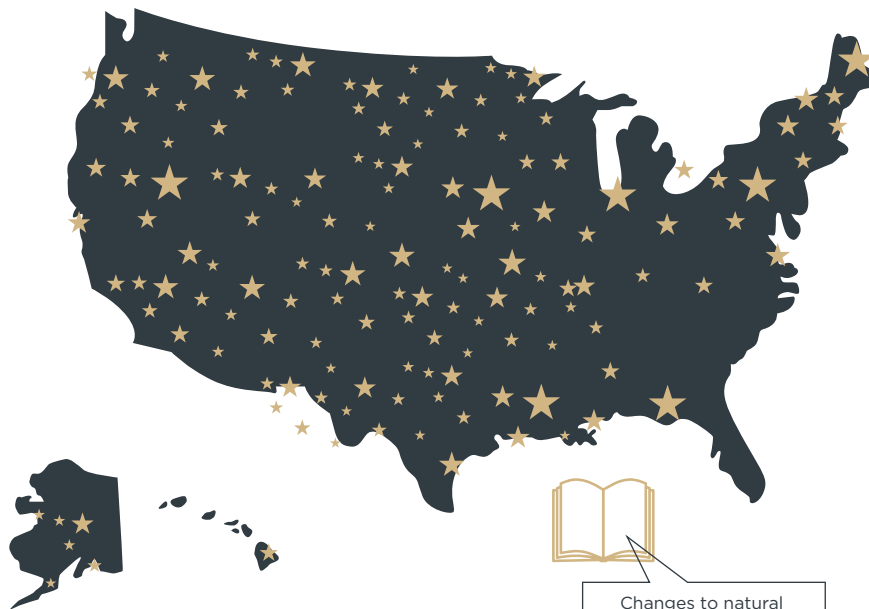
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What Is Light Pollution?

Humans are dramatically affecting the nighttime environment of the planet.

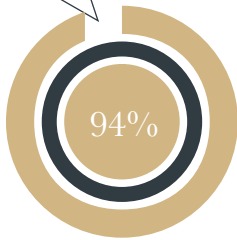
Since the first electric streetlight was installed about 150 years ago, the illumination of our homes, workplaces, and cities has become so commonplace that humans are dramatically affecting the nighttime environment on the planet.





Changes to natural nighttime lighting levels caused by humans are known as **light pollution**.

A 2010 study determined that 94 percent of North Americans live under a night sky that is at least twice as bright as its natural level.



70 percent of the population experiences a night sky that is four times brighter than its natural level.

We face four different types of light pollution - glare, light trespass, clutter and skyglow (Chepesiuk 2009; IDA 2009).

GLARE

Excessive brightness that causes visual discomfort and difficult seeing.

LIGHT TRESPASS

Occurs when light designed to illuminate one area travels beyond its useful range.

CLUTTER

Excessive groupings of bright lights that are often confusing and over-illuminate an area.

SKYGLOW

General brightening of the night sky over developed areas that originates from wasted light.

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The Case for Reducing Light Pollution

Improve worker safety.

Protect ecosystems.

Save money.



Reducing Light Pollution



IMPROVE WORKER SAFETY

Worker safety is closely related to good visibility. Poorly designed lighting may enhance glare in the worksite. In a work environment with heavy machinery, steep slopes, explosives, and other mining hazards, glare-free lighting is a must to keep workers safe.



PROTECT ECOSYSTEMS

Light pollution disrupts the natural rhythms of day and night in an ecosystem. When wildlife is exposed to artificial light at night, it can cause disorientation, attraction or repulsion (Longcore and Rich 2013). These behaviors may alter an animal's natural patterns of foraging, migration, reproduction or communication. Responsible lighting reduces impacts on wildlife.



SAVE MONEY

According to the U.S. Department of Energy, roughly 30 percent of the lighting in the United States is wasted (Gallaway et al. 2010). This means the average company could save roughly a third on its lighting costs by using fewer lights focused directly where work is occurring. Light that shines towards the sky or off the property is simply wasted. Improper lighting costs companies money.

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How Midas Gold Can Mitigate Light Pollution

Midas Gold needs to start with an honest and thorough assessment of lighting needs at the stibnite Gold project site.

By asking multilayered questions and digging deeply into the needs of the operation, different lighting areas will naturally emerge. Each task performed at the Stibnite Gold Project site is unique and needs its own lighting solution – this is known as Lighting Management Areas (LMA).



1

MAKE A PLAN

THE FOLLOWING ARE SOME OF THE QUESTIONS THAT NEED TO BE ADDRESSED:

What operations are crucial at night?
Where do these operations take place?

Does lighting
need to be
mobile or is it
possible to be in
a fixed position?

Are lighting needs anticipated
to change over the duration
of the project? If so, how?

Is the ability to
distinguish colors
(color rendering)
important for tasks?

One-size-fits-all lighting formulas used to be the norm. Unfortunately, this typically results in unsafe levels of glare, wasted power and unnecessary light pollution. Today, LED lighting technology is highly configurable, so lighting solutions can easily be designed and implemented for different LMAs.

Knowing what light output is needed for each LMA will allow lighting to be tailored to specific tasks. This will enable workers to operate machinery safely and efficiently, reduce light pollution and utility bills, and minimize environmental and cultural impacts on neighboring areas.

2

PROPER COLOR TEMPERATURE AND RENDERING

Next, Midas Gold must select the right lights for each area of the site. One of the first criteria for selecting LEDs is that they have a suitable correlated color temperature (CCT) at or below 3,000K. LEDs of high CCT emit a disproportionate amount of their light in the blue wavelengths, which has disruptive effects on the biology of humans and other organisms. Blue wavelengths of light also scatter further in the atmosphere as light pollution. In just the past several years, technology has enabled certain LEDs to emit little or no blue light while maintaining excellent efficiency and color rendering when needed.

Another consideration when creating different lighting areas is the need for color rendering, the ability to distinguish between different colors accurately. When tasks require precise color rendering, there are LED options that meet that need, but they are not necessary for all tasks at the site.

3

SHIELDING



Shielding lights is a key aspect of responsible lighting and ensures light is directed toward the area it is needed (BLM- WY State Office 2013). If lights are not shielded, their output is distributed elsewhere contributing to light pollution. This wasted light leads to higher utility costs. Virtually all manufacturers make shields for their lights which allows light to be directed where it is needed. Midas Gold should aim to have zero light emitted upward.

4

THE RIGHT AMOUNT & DIRECTION

Over-lighting was a common problem with legacy lighting technology. LED lighting will easily allow Midas Gold to build lighting solutions with the correct amount of lumens without over-lighting. This will help reduce problems with over-illumination such as increased glare, light trespass, clutter, and skyglow.



LEDs emit 180°
outward light



Traditional bulbs emit
360° outward light

An additional benefit of LEDs is they are inherently directional and emit light outward at 180°, compared to a traditional bulb which emits light at 360°. Legacy lighting technology typically emitted light in circular patterns, which led to over-lighting or underlighting areas. LED lights use controlled beam patterns. This important upgrade in efficiency allows light to be directed to an active site so little to no light is wasted.

5

INSTALL LIGHTS HIGH & FACING DOWN

Midas Gold must install lights correctly to maximize worker safety and mitigate light pollution. All lights should be mounted high and installed facing directly downward (Wren and Locke 2015) to ensure they are directed where needed and not upward skyglow or into workers' eyes as glare.



Traditional, horizontally-aimed light towers cause severe glare and are highly inefficient compared to aiming all light down to the worksite (Wren, Shepperd, Staples 2015).

Traditionally, lighting was mounted around the perimeter of a site and aimed horizontally towards the interior of the site (Wren and Locke 2015). In these cases, half of the light is immediately being wasted because it is lighting the sky and not the site and the angle of the remaining light can also cause direct glare for employees becoming a genuine safety hazard.



Aiming existing fixtures down has a dramatic impact on both the quality of light at a site and the surrounding landscape. This before and after comparison of a natural gas plan in Texas illustrates the value of "mount high, aim low" strategy. (Wren, Shepperd, Staples 2015).

Glare is vastly reduced by mounting lights high and aiming the down along a vertical axis. By mounting lights vertically and facing them downward, light is directed where work is happening and glare is dramatically decreased (BLM- WY State Office 2013). In situations where it is impossible to install lighting above a work site, all efforts should be made to keep lights angled no more than 30° off of vertical and ideally 20° or less off of vertical to enhance safety and reduce glare and skyglow. When lights are installed at an angle, shielding is important to keep light below the horizontal plane so it is focused on the worksite and not scattering to the environment and sky.

6

LIGHT ONLY WHEN YOU NEED IT

Responsible lighting needs to be carried on throughout the life of the Stibnite Gold Project to ensure work areas are being illuminated only when necessary. In the past, legacy lighting technology was left on all night long because of warm-up and cool down times. LED lights reach full brightness immediately, so they can be switched on or off as needed without delay.



LED technology can easily be integrated with switches, timers, and motion sensors in a process known as network lighting to ensure lights are on when needed and off when not. Network lighting control systems give site managers tools to monitor lighting remotely, track maintenance, detect outages, dim lights and more (CA Lighting Technology Center 2014). Network control systems will enable Midas Gold to maximize the potential benefits of LED technology.

7

MONITOR & ADAPT

Midas Gold should monitor lighting over the years to ensure the best lighting management protocols are being followed and light output falls within an expected range. Publicly-available remote sensing data of the earth at night gives Midas Gold a straightforward, non-biased way to measure the total amount of light being generated from the site. If changes are detected from these high-level observations, site managers on the ground know adjustments must be made.

Midas Gold can download remote sensing data and use geographic information systems software to analyze lighting changes and determine if there are trends. Values should be roughly identical over the years, except for slightly higher light output during the winter months due to increased reflectance from snow. As activity increases or shifts to other areas of the project site, values will inherently change. However, if there is an upwards trend in the data that is not easily explained, a lighting audit should be conducted to determine what fixtures could be contributing to increased skyglow with the goal of eliminating the cause and redirecting light downward to where activity is taking place.