



COCONINO



MILITARY INSTALLATION
SUSTAINABILITY



Dark Sky Lighting

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Joining You Today



Matrix



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Today's Presentation

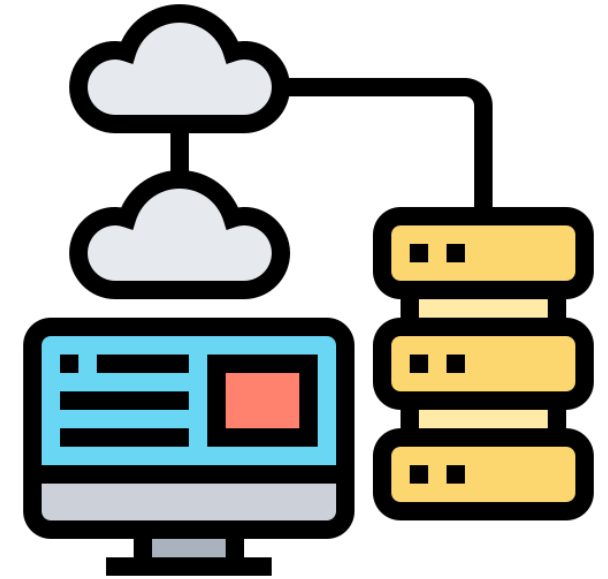
- **What is Coconino Military Installation Sustainability (MIS)?**
- **Dark Sky Task**
 - Non-conforming Lighting Database
 - Outreach Materials
 - Site Demonstration
- **Thank you, Questions and Answers**

Non-conforming Lighting Database



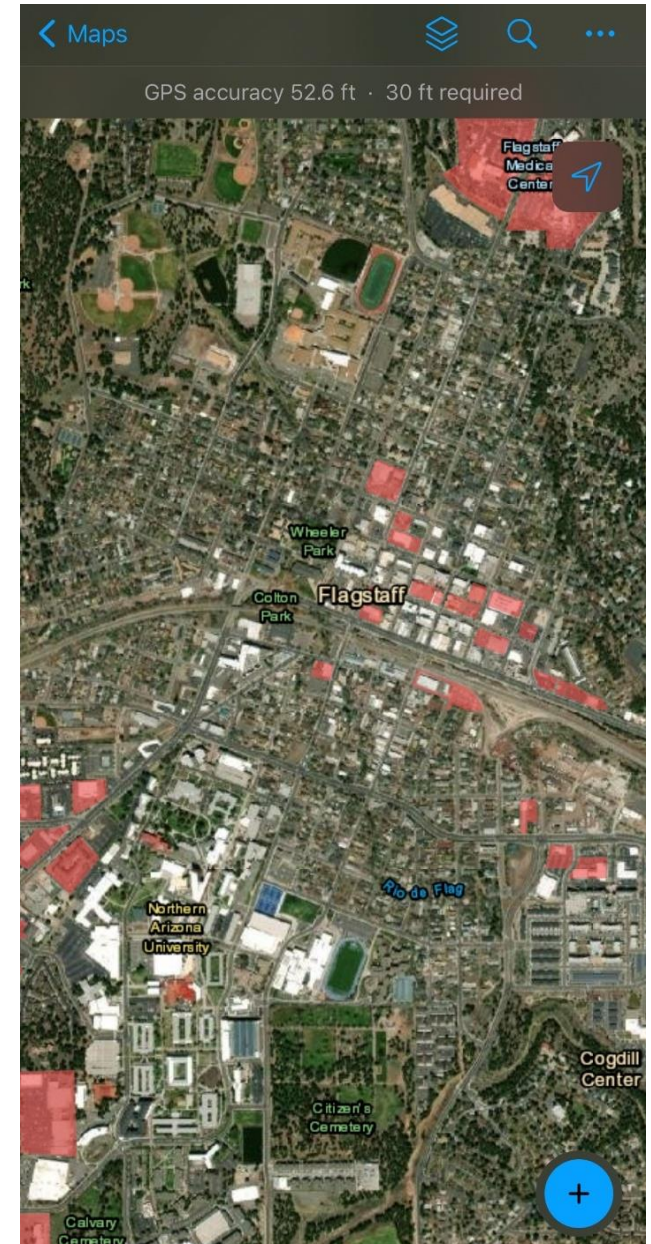
Database Design and Construction

- **Cloud-based geospatial database**
 - Hosted by Coconino County's ArcGIS Online
 - Easily integrates with the County's current system
 - **SECURE**
 - Creates the foundation for the web mapping suite
 - Field Maps (for field data collection)
 - Reporting and progress applications
 - Relates all information to the relevant parcel
 - Allows for storage of photos and media



MOBILE APP: Field Maps

- **Provides mobile data collection**
 - Integrates easily into Coconino County GIS
 - Intuitive application for surveyors shows parcels for survey
- **Addresses needs of the Dark Sky Specialist**
 - Accurate location data for collecting lighting fixtures
 - Comprehensive forms to collect the necessary level of detail



Dark Sky Web Apps

- **Includes 3 Tools**
 - Parcel Reporting Application
 - Lighting Survey Progress Dashboard
 - Dark Sky Program Progress Dashboard

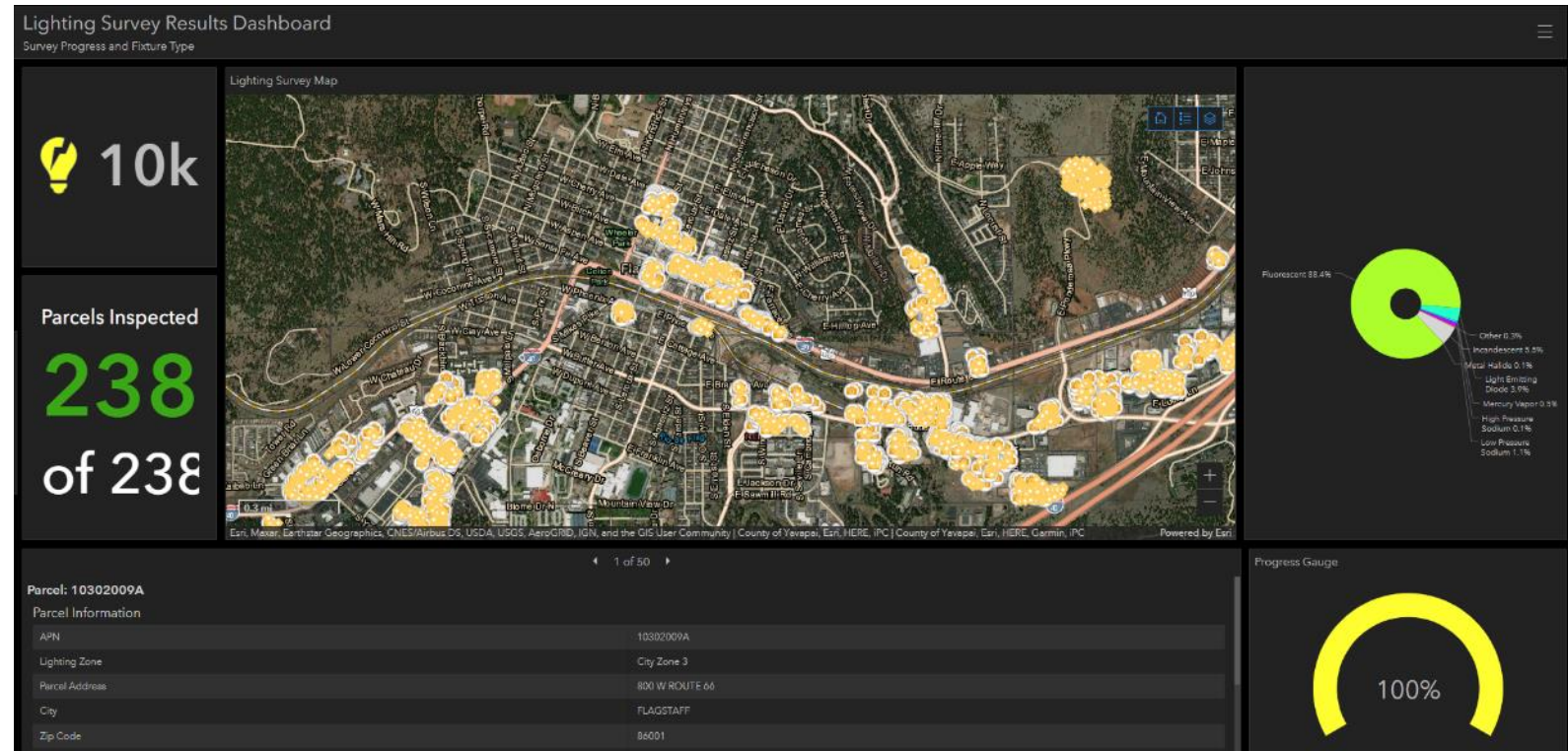
Parcel Reporting Application

- **Web map for viewing collected information in the field**
 - [Link](#) 
 - Generates an individual parcel report
 - Counts lighting fixtures present on-site by type
 - Includes relevant parcel information
 - Owner
 - Address
 - Status of lighting non-compliance

Non-conforming Lighting Database

Lighting Survey Progress Dashboard

- **Cloud-based database provides real-time updates**
 - Number of parcels surveyed
 - Total fixtures recorded with type
 - Parcels brought into compliance



Dark Sky Program Progress Dashboard

- **Cloud-based database provides real-time updates**

- Tracks yearly progress of the program
- Number of non conforming parcels
- Number of parcels brought into compliance by
 - Year
 - Month
 - Week



Non-conforming Lighting Database

Database Sustainability Plan



NAVIGATING ARCGIS FIELD MAPS

COCOONINO COUNTY MILITARY INSTALLATION SUSTAINABILITY DATABASE SUSTAINABILITY PLAN

Layers: Choose to hide or display overlay features onto the map

Search Function: Locate specific Addresses or named locations

Ellipsis: More options; Basemap, Bookmarks, Edit Multiple, Legend, Markup, Measure, and Share Map

My Location:

- When Arrow is blue Shows your current location with map oriented North
- When Arrow is blue with a line above it: Shows your current location with map oriented to face direction your device is pointing
- When Arrow is grey and the map goes grey: current location

Note: The user may be prompted by the browser to access location first

Zoom Controls: Pinch or pull two fingers anywhere on while touching the screen

Parcels Highlighted in Red: Parcels indicated for survey. Zooming in and selecting will show pertinent parcel information

Add New Feature:

- Photo
- Lighting Fixture
- Parcel

FEATURES AND FORMS

There are four primary features that are available for data collection in the field. Two require users to place a point on the map and to add attribute information and photographs (Luminaire and Photos). The other two features are forms: Inspection and Contact.

Every parcel survey involves:

- Capturing lighting fixture photos, locations, and attributes as a Luminaire feature.
- Capturing general parcel photos with the Photos feature, and
- Completing an Inspection Form.

Documenting contact information on the Contact form is not required however, field surveyors may encounter owners or managers who have concerns or questions regarding the survey process. The Contact form provides a standardized space to record stakeholders' names, phone numbers, email addresses, and affiliations.

NON-COMPLIANCE PROGRAM TRACKING DASHBOARD

COCOONINO COUNTY MILITARY INSTALLATION SUSTAINABILITY DATABASE SUSTAINABILITY PLAN

The Non-compliance Program Tracking dashboard provides a high-level overview of parcel status (conforming/non-conforming) across the program. It displays the current survey and non-conforming status of all parcels within the county. It also tracks the response to non-compliance in terms of how many non-compliant parcels were surveyed and brought into compliance, by year.

Total Survey Progress: A graphic display of the percentage of parcels within Coconino County that have and have not been surveyed.

Parcels Brought into Compliance: A graphic display of how many parcels have been addressed and brought into compliance and the total number of parcels identified as non-compliant through survey and inspection.

Map: This map displays current survey data, parcels that have been flagged for inspection, and parcels that have been surveyed.

Number of Parcels Surveyed: This chart displays the number of parcels that have been surveyed over time, by month or year.

Parcels Identified as Non-Compliant: This chart identifies surveyed parcels found to be non-compliant, by week, month, or year.

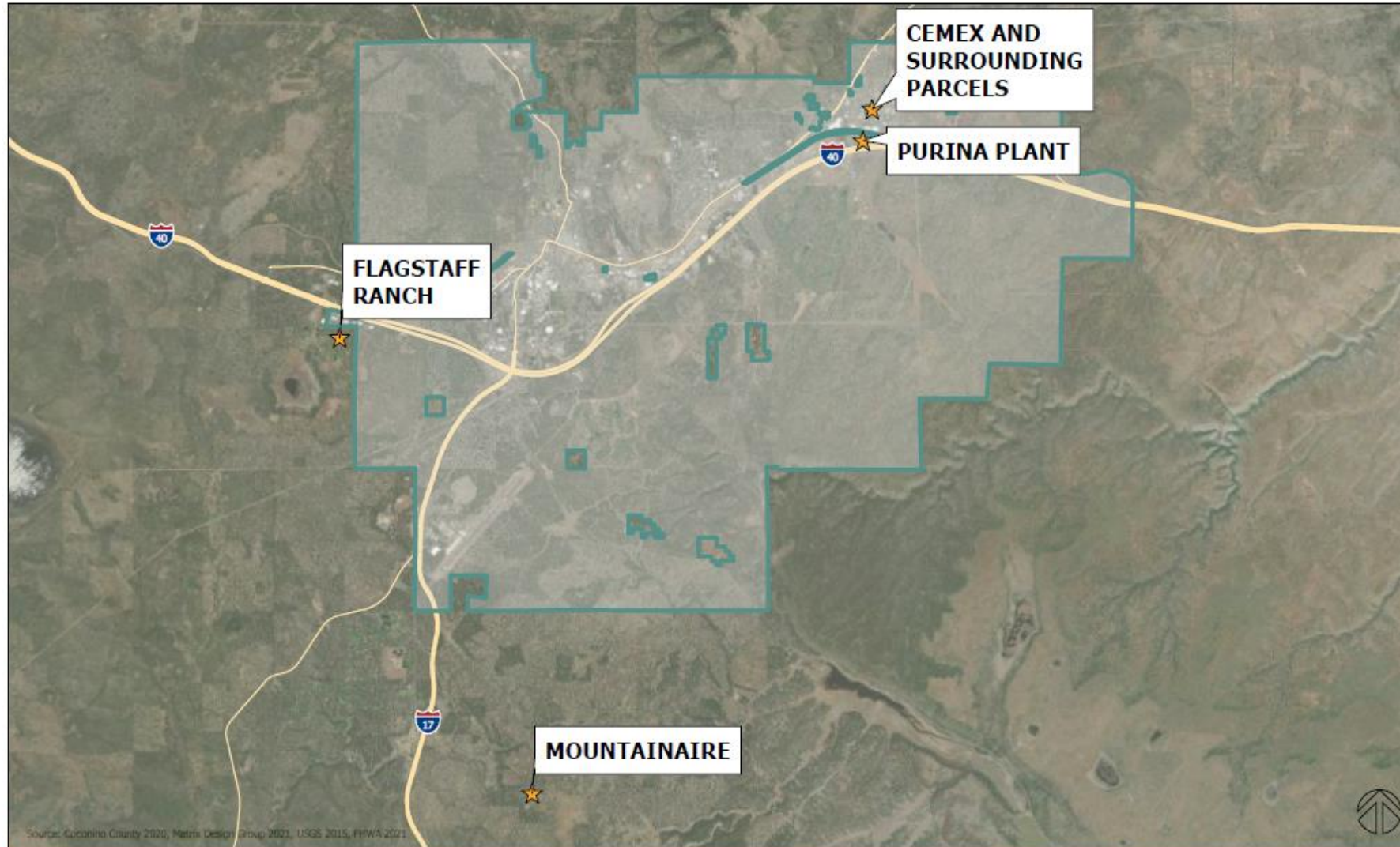
The dashboard features a central map of Coconino County with highlighted parcels. To the left, there is a gauge chart showing '1' out of '20' and a pie chart. Below the map, there is a line graph showing survey progress over time and a bar chart showing the number of parcels surveyed by month.

Aerial Survey



Aerial Survey

Aerial Night Drone Survey Sites



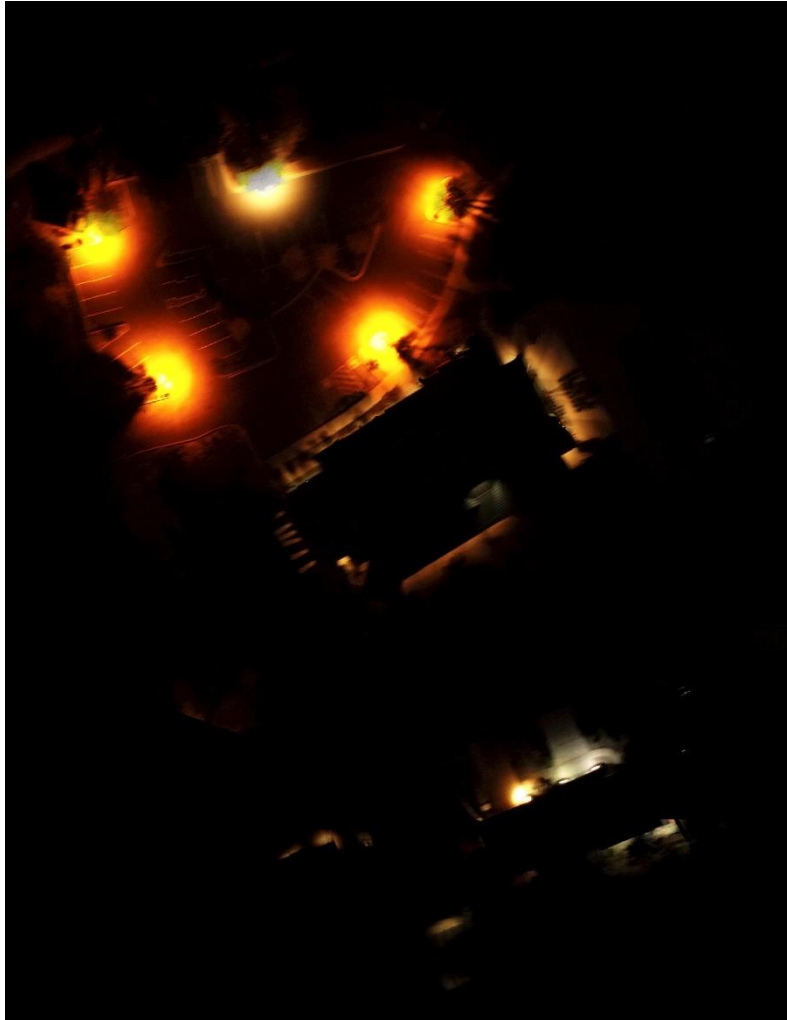
Aerial Night Drone Survey Sites

- **Photographed light intensity**
- **Identifies single point light fixture locations**
- **Surveyed 4 areas**
- **Drone Survey generated:**
 - 2,500 photos covering an extent of 400+ acres.
- **Assists in identifying where on-ground surveys teams need to focus**
- **Serves as a baseline for performance metric to survey dark sky improvement**

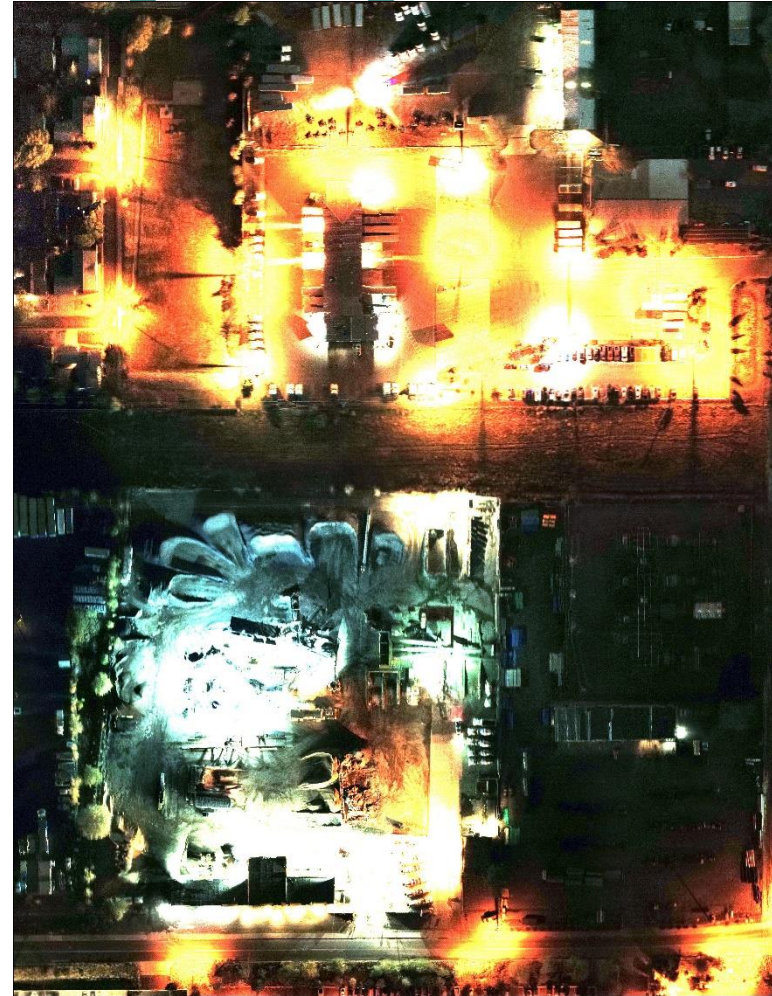
Aerial Survey

Aerial Night Drone Survey

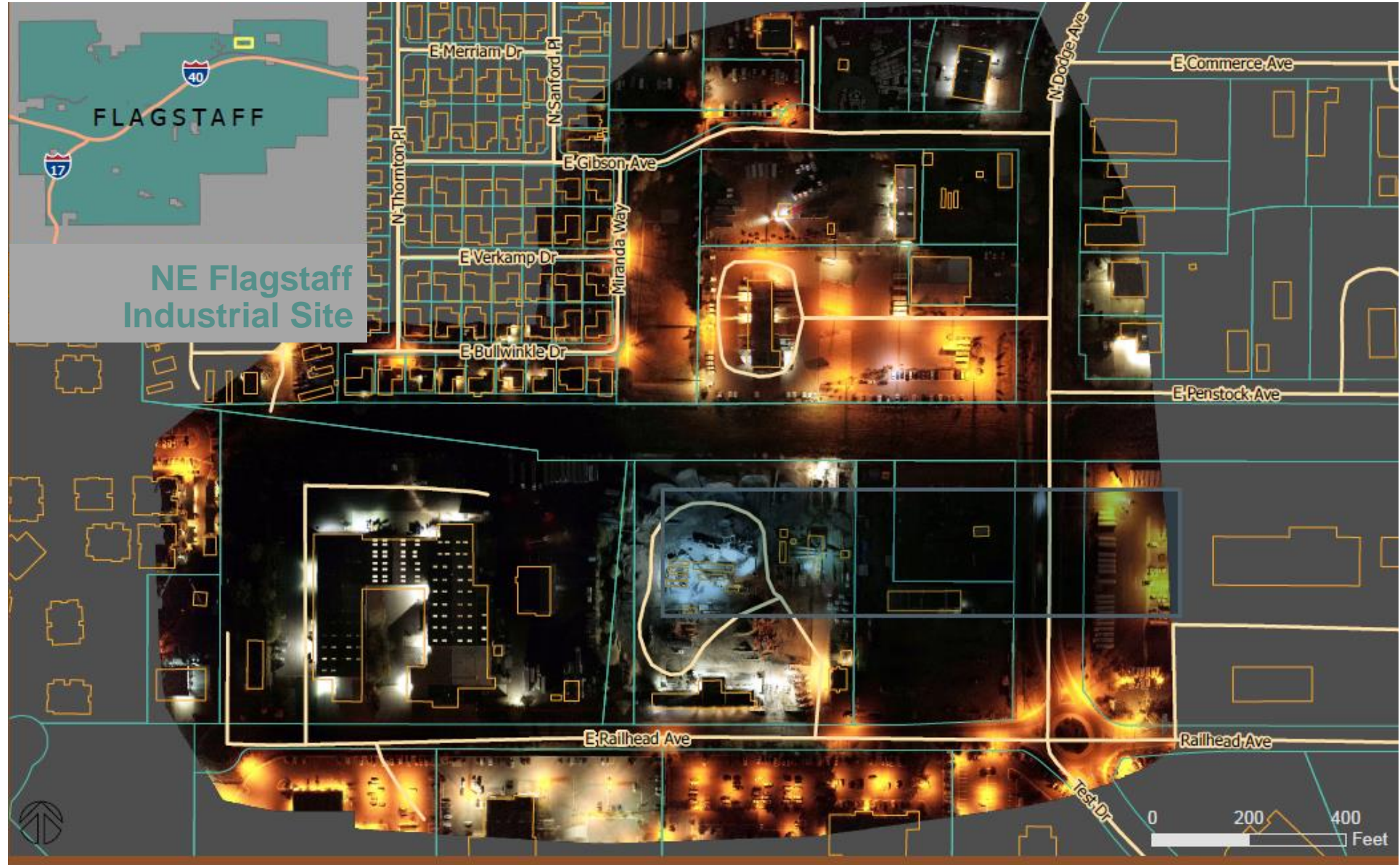
Flagstaff Ranch Site



Cemex Plant and Neighboring Parcels Site



Aerial Survey



Outreach and Education



Outreach Campaign Brochures

- Tri-fold brochures
- Distribute throughout the community and online
- Promotes compliance
- Customized for Commercial/Industrial

OUTDOOR LIGHTING REQUIREMENTS

There are three lighting classes and two lighting zones. These determine where and when you can use outdoor lighting, how much lighting you are allowed to emit on your property, and what kind of lighting you can use.

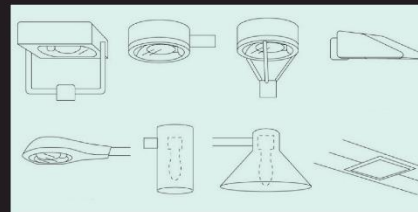
Class 1 lighting is used for applications where color rendition is required to preserve the effectiveness of an activity such as display areas, entries, and sports fields.

Class 2 lighting is used for applications where general illumination for safety or security is the primary concern such as walkways, driveways, roads, and parking lots.

Class 3 lighting is used for outdoor decorative purposes such as building or landscaping accent lights.

◆ **Color:** Narrow-spectrum amber LEDs (NSALEDs) are the preferred lighting sources. Code compliant NSALEDs have a peak intensity wavelength between 589 and 595 nanometers. Other bulbs should have a correlated color temperature of 2,700K or less.

◆ **Full Shielding:** Fully shielded lighting fixtures are the best at reducing light pollution and trespass.



Examples of fully shielded light fixtures

◆ **Partial Shielding:** Partially shielded light fixtures emit some light sideways and upwards. This includes flood lights that are pointed at the ground at a 45 degree or less.



Examples of partially shielded light fixtures

WHERE TO LEARN MORE

Both Flagstaff and Coconino County have laws that maintain and enhance dark skies. These laws are aimed at reducing light pollution and minimizing energy losses.

See Flagstaff Zoning Code: Division 10-50.70 and Coconino County Zoning Code Chapter 4, Section 4.3 for more information.

For assistance with code compliance, contact Flagstaff Community Development or Coconino Community Planning Department, or their dark sky compliance specialists.

CITY OF FLAGSTAFF Community Development

211 W. Aspen Avenue
Flagstaff, AZ 86001
PH: (928) 213-2104
flagstaff.az.gov/10/community-development

Dark Sky Compliance Specialist

Janice Hakala
EMAIL: janice.hakala@flagstaffaz.gov
PH: 928.213.2148

COCONINO COUNTY Coconino Planning Department

2500 N. Fort Valley Road, Building 1
Flagstaff, AZ 86001
PH: 928.679.8850
coconino.az.gov/136/community-development

Dark Sky Compliance Specialist

Mark Stento
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PH: 928.679.8856

DARK SKIES

COMMERCIAL AND INDUSTRIAL PROPERTIES

Help Defend the Darkness

Protect the region's glorious night skies

Save energy with approved fixtures

Improve the quality of the nighttime environment at your home or business

You can make a difference!



Prepared by
Matrix

This brochure was prepared under contract with Coconino County as a component of the Coconino County Military Installation Sustainability program. Financial support for this brochure was provided by the Department of Defense Office of Local Defense Community Cooperation (OLDCC). The content reflects the views of Coconino County and does not necessarily reflect the views of the OLDCC.

FLAGSTAFF was recognized as the world's first International Dark Sky City in 2001. Flagstaff and Coconino County are at the forefront of the effort to reduce light pollution through education and best practices. This brochure provides a concise overview of outdoor lighting regulations and information on how to bring nonconforming lighting into conformance.

Outreach Campaign Brochures

- Tri-fold brochures
- Distribute throughout the community and online
- Promotes compliance
- Customized for Residential

WHO NEEDS DARK SKIES?

TOURISTS: Stargazing and astrotourism are ingrained in Flagstaff and Coconino County's culture. The dark skies in the area and the ability to see the night sky draw over 100,000 tourists a year.

YOU AND YOUR COMMUNITY: Dark skies are a priceless contribution to quality of life and personal health.

ASTRONOMERS: The Lowell Observatory is an educational and economic cornerstone of the community. It consists of five separate telescopes that attract researchers from all over the world. Important astronomical observations occur at these facilities every year.

THE MILITARY: The area hosts two Naval facilities that support astronomical research and critical military operations. They bring \$8.7 million a year and economic benefits to the region. Camp Navajo also relies on natural darkness for important night training operations.

WHAT PREVENTS DARK SKIES?

Light Pollution: There are four primary causes of light pollution:

Excessive and Misdirected Light – Excessive light, or light shining in the wrong directions – directly into the sky or into your eyes – wastes energy and creates glare and sky glow.

Glare – When excessively bright or unshielded lights shine directly into your eyes, actually decreasing your ability to see.

Light trespass – When light illuminates areas where it is unneeded or unintended, like when your neighbors' light shines into your house.

Visual Clutter – When large numbers of poorly shielded and overbright lights create a cluttered appearance, often making it difficult to find what you need to see.

**Be a Dark Sky Citizen!
Update and Redirect Your Exterior Lights**

Useful Light Misdirected Light and Glare

DID YOU KNOW?
Replacing unshielded porch or garage lights with shielded fixtures helps dark skies, keeps your light on your property, and makes your lighting more neighbor-friendly! Consider using amber lights to decrease glare and other adverse effects.

THE EFFECTS OF LIGHT POLLUTION

ENVIRONMENT
Nocturnal wildlife is impacted. Predators are not able to see and prey have difficulty hiding. Sleeping, eating, reproduction and migration patterns are thrown off reducing wildlife vitality.

ENERGY
Energy consumption is wasted when lights are left, or too much light is being used. Financial costs and the costs to the environment increase from improper lighting.

HEALTH
Humans can suffer from misguided circadian rhythms leading to melatonin imbalances that increases the risk of obesity, depression, certain cancers, diabetes, and immune system problems.

CRIME
Data show crime does not actually decrease as light increases. Effective lighting design utilizing fully shielded fixtures can enhance security while using less energy and lowering impact.

SAFETY
Bright, unshielded white lights may negatively affect safety and adversely affect drivers in particular by creating dark shadows and blinding glare.

DID YOU KNOW?
Switching from conventional high-intensity lighting to LEDs can save you money every year due to the improved quality and longevity of LED bulbs. Just be sure to use amber colored LED products that do not emit blue light.

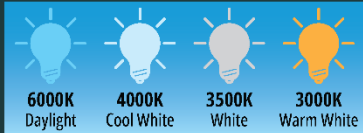
Outreach and Education

Outreach Campaign Brochures

- Outdoor Lighting Code Update
- Code Overview and Understanding

THE RIGHT COLORS FOR DARK SKIES

The color of the light has a big effect on wildlife and astronomical observations. "Whiter" colored lights disorient wildlife and confuse their sleeping, feeding, and mating habits. They can have negative effects on people too. White light is also difficult to filter when making astronomical observations.



6000K Daylight
4000K Cool White
3500K White
3000K Warm White

❌ Not Recommended for Residential Use and Restricted for Commercial Use



2700K/NSALED
Extra Warm White

✅ Recommended for Residential and Required for Commercial Applications

Select light bulbs with a warm, amber color (2700K) or Narrow-Spectrum Amber LEDs (NSALEDs). NSALEDs need to have a peak intensity wavelength between 589 and 595 nm. These lights are the best solutions to reduce light pollution and maintain dark skies.



COCONINO

KNOW THE CODE FLAGSTAFF & COCONINO COUNTY LIGHTING CODE

DO YOUR PART TO KEEP OUR SKIES DARK

In order for Camp Navajo, the Naval Observatory Flagstaff Station (NOFS), the Naval Precision Optical Interferometer (NPOI), and other observatories in the area to operate light pollution must be minimal.

WHY REGULATE LIGHTING?

The City of Flagstaff was the first city to create a comprehensive lighting code designed to minimize light pollution, preserve the natural night sky, and support the observatories in Coconino County. Coconino County has adopted a similar lighting code that supports and expands Flagstaff's efforts to a regional commitment. The lighting codes also support night training missions at Camp Navajo, the largest National Guard facility in the state, support astrotourism, and protect the health of residents and wildlife.

LIGHTING MEASUREMENT

Lighting is measured in lumens, which is a unit used to measure the actual amount of light that is produced by a light source. Manufacturers of light bulbs and fixtures usually provide the number of lumens produced by their products. The lighting code limits total lumens on a property by lighting zone.

EASY STEPS FOR BETTER LIGHTING

- ✓ Know your lighting zone.
- ✓ Upgrade your lights to Amber colored LEDs and use fully shielded fixtures.
- ✓ Illuminate with no more light than necessary
- ✓ Only use lights **when** needed and install them only **where** needed

DID YOU KNOW?

Flagstaff was the first city in the world to be named an International Dark Sky City and is known worldwide for its commitment to preserving dark skies.

WHAT ARE LIGHTING ZONES?

The Flagstaff and Coconino County lighting codes are designed to protect dark skies around the observatories in Coconino County. More restrictive standards apply in zones near the observatories and become less stringent for properties further away. Whether your property is located in lighting zone 1 or 2, using dark sky friendly fixtures and bulbs will help support the local economy, improve your quality of life, and preserve the one-of-a-kind night skies.

Demonstration Projects



Residential and Non-Residential Success

- Provide the community with real-world local examples of dark sky success
- Feature compliance successes and construction-related successes
- Before/after photos; Poster-board for display in city hall and online
- Partner with local vendors



COCONINO



MILITARY INSTALLATION
SUSTAINABILITY



Thank you!

