# LIGHTING ANALYSIS FOR RURAL AIRPORTS

## A Component of the Alaska Aviation System Plan

SFAPT00142 AIP 3-02-0000-023-2017

Prepared For:

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# 1.0 INTRODUCTION

This study is a component of the Alaska Aviation System Plan (AASP) focused on developing a consistent approach to the planning, design, and maintenance of airport lighting system installations and improvements across Alaska's expansive airport network. The State of Alaska owns and operates 237 airports, including 235 rural airports and the Fairbanks (FAI) and Ted Stevens Anchorage (ANC) International Airports. Rural airports are vital to Alaskan communities providing access to essential supplies, mail, schools, medical/dental services, and travel. The mission of the state-owned rural airports is "to sustain and improve the quality of life throughout Alaska." The scope of this study was limited to the 235-state owned and operated rural airports.

## 1.1 PURPOSE

The purpose of this report is to examine the lighting needs of rural airports in Alaska; inventory and document the existing airport lighting systems; analyze maintenance procedures and climatic effects on the economic life of these systems; and make recommendations to support system preservation, safety, and sustainability.

## 1.2 NEED

In May 2001, the Federal Aviation Administration (FAA) submitted a study to the U.S. Congress titled *Aviation Access to Remote Locations in Alaska* (House Report 106-940 accompanying H.R. 4475, Fiscal Year [FY] 2001 Department of Transportation Appropriations). The report detailed the challenges faced by remote Alaska communities, including a lack of airport lighting, and made recommendations to increase aviation access to medical facilities.

In the 20 years since the report, the FAA, State of Alaska, and other entities have worked tirelessly to address the challenges of accurate weather reporting systems, instrument approaches, and airport lighting. Automated Weather Observing System (AWOS) installation has improved weather reporting at some locations, airport lighting has been installed at many airports, and new Global Positioning System (GPS) approaches are continually being developed.

The need for airport lighting in Alaska is much more significant than in other regions of the National Airspace System. Several reasons contribute to this need, as follows:

- 82 percent of the communities and FAA-recognized locations in Alaska are not accessible by road.
- 142 communities rely on DOT&PF-provided airport infrastructure as their only transportation connection.
- Many communities on the road system also rely on air transportation of critical patients to advance care facilities.
- Daylight hours in winter months are minimal; on the winter solstice, Fairbanks International Airport (FAI) has 3 hours and 42 minutes when the sun is above the horizon, Ted Stevens Anchorage International Airport (ANC) has less than 5½ hours, and communities north of Fairbanks experience even fewer daylight hours. The extreme is at Wiley Post-Will Rogers Memorial Airport (BRW) in Utqiagvik where the sun is below the horizon for 67 days. When the winter sun is above the horizon, the zenith angle is low (2

degrees in Fairbanks and 6 degrees in Anchorage). Reduced, low-angle light; overcast skies; and snow-covered terrain can result in even experienced pilots losing visual ground reference.

- Extreme weather, low light, winds, and blowing snow adversely impact the operational ability to conduct visual flight rules (VFR) flight operations.
- During the summer months, wildfires can cause heavy smoke layers that limit visibility. Wildfire suppression also requires reliable airports to facilitate firefighting operations, which rely heavily on aircraft support.
- Vast expanses of terrain with few towns or other easily identifiable landmarks for VFR flights, combined with a lack of weather reporting stations, can result in loss of ground reference.

These factors and other considerations make reliable airport lighting systems a vital and potentially lifesaving component of airport infrastructure in Alaska. This report catalogs existing infrastructure; documents maintenance challenges; and makes recommendations to support planning, project development, and maintenance objectives to sustain viable airport lighting infrastructure at the Alaska Department of Transportation & Public Facilities (DOT&PF) rural airports in Alaska.

## 1.3 RURAL AIRPORT DEFINITION AND CLASSIFICATIONS

The scope of services for this project was limited to rural airports owned and operated by DOT&PF. The 214 airports included in this study are public use, land-based facilities at the local, community, and regional classification levels. The rural airport definition encompasses all DOT&PF facilities except for ANC and FAI. For this study, Diomede Island Heliport (DM2) is considered an airport with one runway landing surface.

This report uses the current AASP airport classification system to group airports by functional class. The AASP system applies Alaska-specific criteria to group airports into classifications that define the airport's role within the system, including a specific designation if the airport serves a community that has no road connection to the highway system. The AASP classification definitions are defined in the following subsections.

### *1.3.1 Regional Class Airports*

Regional class airports support critical services to several smaller communities and must have reliable lighting systems. These airports are typically designed to accommodate larger aircraft and have instrument approaches with low minimums as well as more landside facilities, infrastructure, and services available than community and local class airports. Of the 27 DOT&PF regional class airports, 19 airports are FAA Part 139 certificated with FAA required staffing, 6 other airports are staffed, and only 2 airports (Emmonak and Fort Yukon) lack DOT&PF staffing. Airports in this class must meet three of the following criteria:

- Are designated primary airports, as defined by the FAA, with at least 10,000 annual passenger enplanements
- Are air carrier hubs as defined by the FAA

- Are U.S. Postal Service hubs or handle more than 2 million pounds of cargo (freight and mail, enplaned and deplaned) annually
- Have Federal Aviation Regulation Part 139 commercial operating certificates
- Are in towns/regions/areas with health facilities that serve two or more communities
- Are Alaska Department of Natural Resources (DNR) designated primary or secondary fire-tanker bases
- Serve communities with U.S. Coast Guard facilities.

### *1.3.2 Community Class Airports – Off-Road or On-Road*

Community airports generally fulfill the role of serving as a small community's primary airport when no larger regional or international airports serve the function. These airports usually serve the basic needs of the community, including hospital airlift (medevac), local aviation-related business, and emergency needs. When two or more communities are in close geographic proximity and accessible to one another year-round (within 1 hour of driving time), a community airport may serve its primary airport role for more than one community. Community airports are further subdivided into off-road or on-road categories depending on whether the airport has year-round road access to the intrastate road system.

Community airports are defined as public airports, heliports, or seaplane bases that serve as the main air transportation facility for communities that:

- Have a permanent population of at least 25 residents
- Have a public school, and
- Are located more than 1 hour by a road that is accessible year-round from an international, regional, or other community airport.

### *1.3.3 Local Class Airports – High Activity, Low Activity, and Non-National Plan of Integrated Airport Systems*

Local class airports are defined by the AASP as those airports that are typically considered as general aviation airports. This classification defers to the FAA National Plan of Integrated Airport Systems (NPIAS) definitions of high activity, low activity, and non-NPIAS. High-activity airports have more than 20 based aircraft, low-activity airports have fewer than 20 based aircraft, and non-NPIAS airports are not included in the FAA NPIAS. The AASP is currently in the process of adopting the newly identified NPIAS asset classes for general aviation facilities identified as local class in this report. Because of the research timing, this report uses the high activity, low activity, and non-NPIAS definitions that were current at the time of data collection.

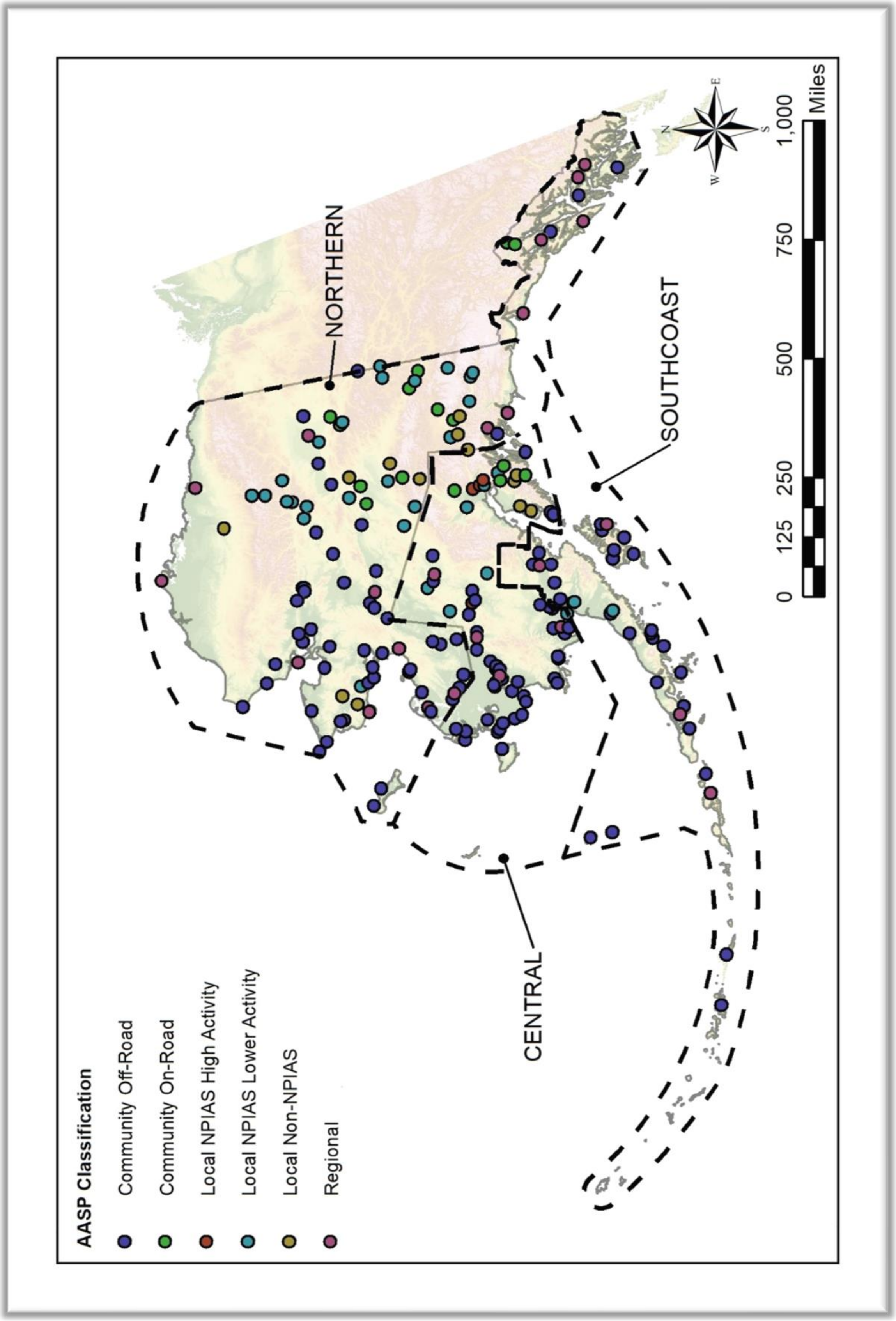



**Figure 1-1**. Alaska Aviation System Plan Classifications of DOT&PF Rural Airports.

For this study, airports are further categorized by DOT&PF region: Northern, Central, and Southcoast. Tables 1-1 through 1-3 list the DOT&PF public use, rural, land-based facilities considered in this study by their FAA three-digit identifiers.

**Table 1-1.** Rural Land Based Airports in the DOT&PF Northern Region

| Community Off-Road | | | | Community On-Road | Local Non-NPIAS | Local NPIAS Low Activity | | Regional |
|---|---|---|---|---|---|---|---|---|
| 49 airports<br>53 runways | | | | 9 airports<br>9 runways | 9 airports<br>9 runways | 23 airports<br>23 runways | | 11 airports<br>11 runways |
| 0AK | EAA | KVL | SVA | 51Z | 4AK | 15Z | GBH | BRW |
| 2A9 | ELI | KYU | SVS | 6K8 | 5QC | 3T4 | K29 | CDV |
| 2C7 | GAM | MDM | SXP | CEM | 94Z | 5CD | MHM | ENM |
| 6A8 | GLV | MOU | TAL | CRC | AK7 | 5Z5 | MYK | FYU |
| 7KA | HCA | NUL | TER | CZO | UMM | BTT | PPC | GAL |
| AFM | HLA | OBU | WBB | GKN | UMT | BYA | RMP | KSM |
| ANV | HUS | PHO | WBQ | HRR | Z14 | CHP | WCR | OME |
| AUK | IAN | RBY | WLK | MLY | Z81 | CKX | WSM | OTZ |
| BVK | IWK | RSH | WMO | ORT | Z93 | CXC | Z55 | SCC |
| CIK | KAL | SHG | WTK | | | CXF | Z84 | UNK |
| D76 | KGX | SHH | | | | CZN | Z91 | VDZ |
| DEE | KKA | SHX | | | | DCK | | |
| DM2 | KTS | SMK | | | | | | |

**Table 1-2.** Rural Land Based Airports in the DOT&PF Central Region

| Community Off-Road | | | | Community On-Road | Local Non-NPIAS | Local NPIAS High Activity | Local NPIAS Low Activity | Regional |
|---|---|---|---|---|---|---|---|---|
| 44 airports<br>44 runways | | | | 4 airports<br>5 runways | 5 airports<br>5 runways | 4 airports<br>5 runways | 7 airports<br>8 runways | 5 airports<br>8 runways |
| 16A | CLP | KEB | SCM | 5HO | 5KS | BCV | 2AK | ANI |
| 4A2 | DUY | KEK | SLQ | IEM | 9Z9 | BGQ | A14 | BET |
| 4KA | EEK | KLG | SOV | SWD | JLA | RDV | AQY | DLG |
| 5A8 | EWU | KNW | SRV | TKA | NIN | UUO | FLT | MCG |
| 9A3 | FSP | KWT | TCT | | SMU | | SKW | HOM |
| A61 | GGV | MBA | TLT | | | | Z17 | |
| A63 | GNU | MYU | TOG | | | | Z40 | |
| AKI | HPB | OOK | VAK | | | | | |
| C05 | IGT | PGM | WNA | | | | | |
| CFK | IIK | PKA | Z09 | | | | | |
| CJX | JZZ | PTU | Z13 | | | | | |

**Table 1-3.** Rural Land Based Airports in the DOT&PF Southcoast Region

| Community Off-Road | | | | Community On-Road | Local NPIAS High Activity | Local NPIAS Low Activity | Regional | |
|---|---|---|---|---|---|---|---|---|
| 29 airports 30 runways | | | | 2 airports 2 runways | 1 airport 2 runways | 2 airports 3 runways | 10 airports 17 runways | |
| 2A3 | A79 | IGG | PEV | HNS | 5NK | 9A8 | ADQ | WRG |
| 4K0 | ADK | KCL | PNP | SGY | | WSN | AKN | YAK |
| 4K5 | AFE | KFP | PTH | | | | CDB | |
| 5NN | AJC | KVC | SDP | | | | DUT | |
| 6R7 | AKA | KYK | SNP | | | | GST | |
| 7AK | AKK | ORI | | | | | ILI | |
| 9K2 | AKW | OUL | | | | | PSG | |
| 9Z8 | HNH | PBV | | | | | SIT | |

# 2.0 DATA COLLECTION

Data collection for this study focused on assembling existing AASP airfield-related data (i.e., runway codes, length, width, elevation, surface type, seasonal use, weather stations, edge lighting, Visual Glideslope Indicators [VGSIs], Runway End Indicator Lights [REILs], approach lights, airport reference codes, planned design aircraft, airport class, maintenance responsibility, aviation network); community-related data (i.e., closest community, population, Alaska Native Claims Settlement Act [ANCSA] designation); U.S. Department of Transportation Bureau of Transportation Statistics (BTS) 2019 T-100 carrier data (i.e., annual enplanements, freight/mail loads, carrier names); and aircraft operations (e.g., commercial, general aviation, air taxi). Data collection is intended to inform the analysis and identify trends.

A GIS analysis was conducted using weather-related state and federal data sources to locate airports with possible special weather considerations. This analysis resulted in a generalized scale for each airport depicting sunlight, winter temperature, wind, and precipitation.

With the collected data, facility data profiles were developed for each runway, as provided in Appendix A. Each facility profile contains runway characteristics, lighting inventory, weather traits, and other relevant information that aviation planners may find helpful in understanding the basic operational requirements and relative climate/environmental circumstances associated with the facility. Other runway attributes include runway name, width, elevation, and current and planned airport reference codes.

## 2.1 AIRPORT LIGHTING INFRASTRUCTURE

The data collection for this report used existing reports, documents, and outreach to individual DOT&PF airport managers and superintendents to inventory airport lighting infrastructure components in the rural airport system. Lighting specifications and other technical information were obtained from FAA Advisory Circular (AC) 150/5340- 30J, *Design and Installation Details for Airport Visual Aids* and AC 150/5300-13A, *Airport Design*.

### *2.1.1 Runway Edge Lighting*

Within the hierarchy of lighting systems, the most predominantly used visual aid is runway edge lighting, which outlines the usable, operational surface of the runway during periods of darkness and low-visibility weather conditions. The FAA requires that any airport equipped with runway edge lighting also be equipped with a rotating beacon (AC 150/5300-13A § 624a).

Runways without edge lighting typically do not have other lighted visual aid types. Rural Alaskan airports have some exceptions with REILs installed at facilities that do not have runway edge lighting. In 2000, the FAA approved the State of Alaska's modification to standard (MOS) to establish airport marking standards for unpaved runways. The standard modifies FAA AC 150/5320-24 *Runway and Taxiway Edge Lighting System* by including the installation of reflective cones and markers on unlighted and unpaved runways.

Runway edge lights are typically either high or medium intensity. Regional airports with precision instrument runways generally have high-intensity runway lighting (HIRL) while community and local airports with visual or non-precision instrument runways typically have medium-intensity runway lighting (MIRL); however, exceptions exist. See Table 2-1 and Figures 2-1, 2-2, and 2-4 for a breakdown of runway edge lighting installations at rural airports in Alaska.

Runway threshold or runway end lights are part of the runway edge light installation. The edge lights and threshold lights combine to outline the usable landing area of the runway.

**Table 2-1.** Runway Edge Lighting Inventory at DOT&PF Rural Airports

| DOT&PF Region | Lit Runways | Unlit Runways |
|---|---|---|
| Northern | 84 | 27 |
| Central | 50 | 25 |
| Southcoast | 43 | 11 |
| **Total** | **177** | **63** |

**Figure 2-1.** Unalakleet Runway Threshold End Lights (Photograph by Shawn Crites).

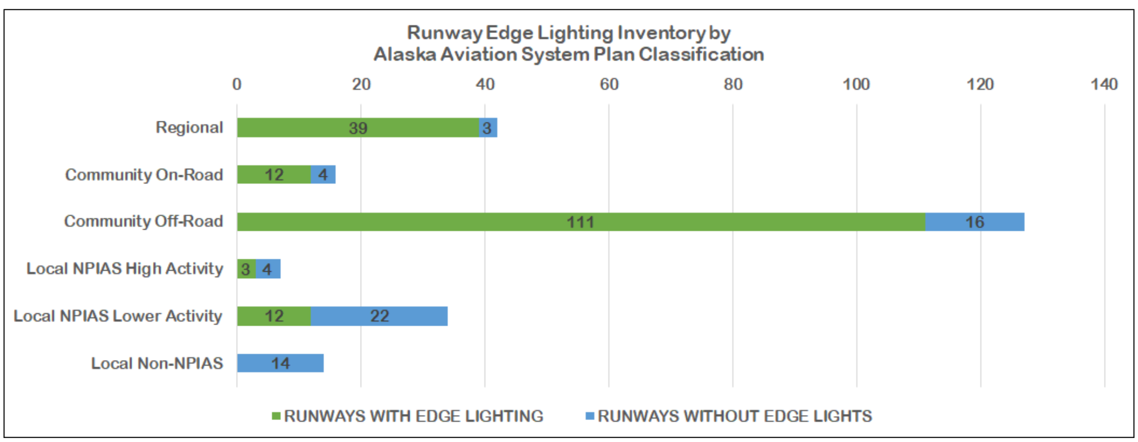



**Figure 2-2.** Runway Edge Lighting by Alaskan Aviation System Plan Classification.

**Figure 2-3.** Coldfoot (CXF) Runway Edge Light Lighting, Photograph by Dave Wilson, Aviation Risk Solutions, Inc.

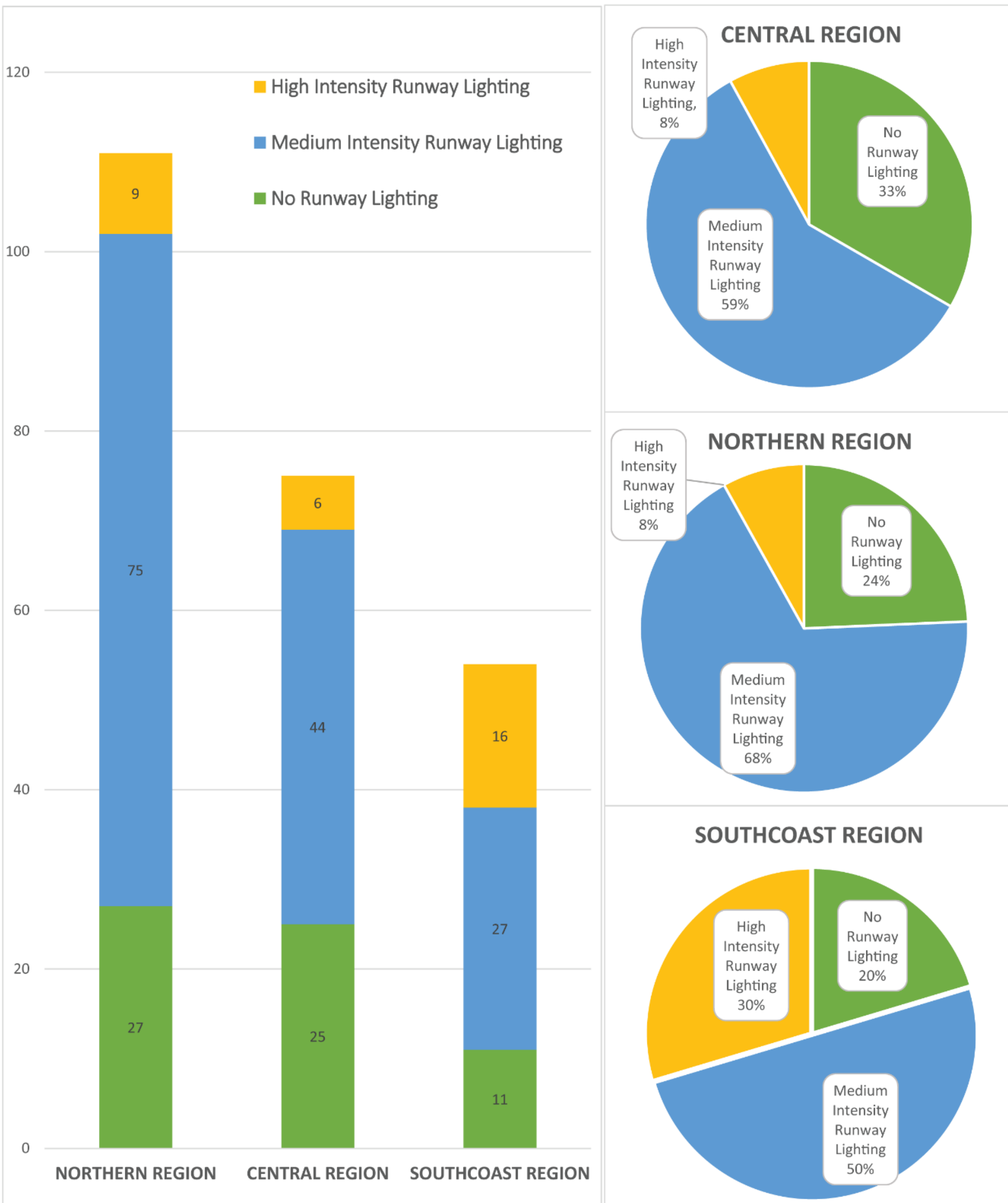



**Figure 2-4.** Runway Edge Lighting by Type and Region at Rural Airports
(177 runways, approximately 74 percent of DOT&PF's Rural Airport System have runway edge lighting).

### *2.1.2 Runway End Identifier Lights*

REILs provide rapid and positive identification of the end of the runway using two synchronized, unidirectional (or omnidirectional) flashing lights. Unidirectional systems are typical in Alaska. The lights are positioned on each side of the runway landing threshold facing the approach area and aimed at an angle of 10 to 15 degrees outward from a line parallel to the runway centerline. Detailed design and installation information can be found in AC 150/5340-30J. The typical layouts depicted in Figure 2-5 are copied from Appendix A of the same AC. Sample lights are shown in Figure 2-6.

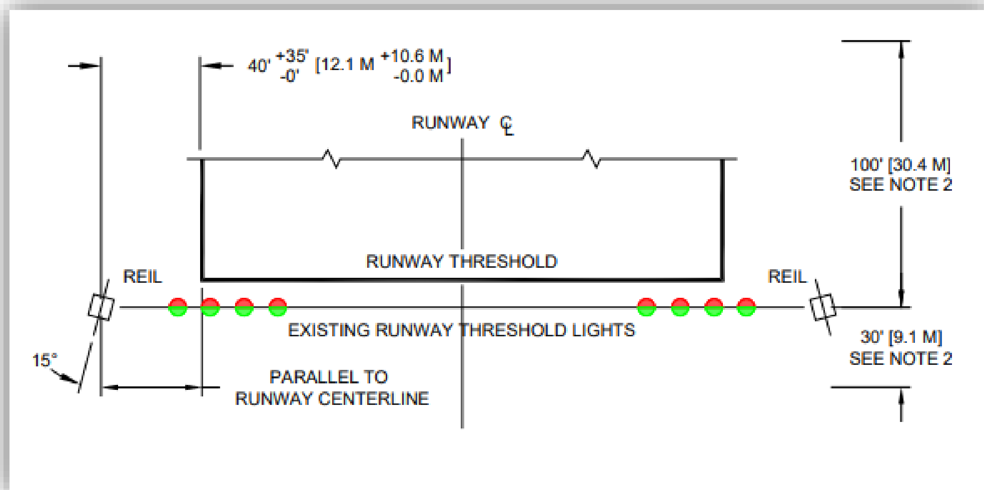


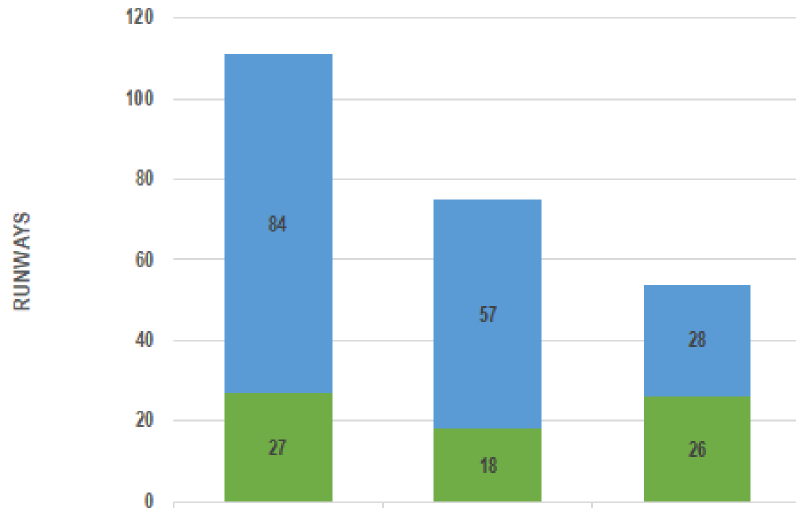

**Figure 2-5.** Typical REIL Installation.

(a) (b)

**Figure 2-6.** The Two Types of Standard Incandescent Runway End Identifier Lights: (a) Omnidirectional and (b) Unidirectional.

REILs help pilots to identify runway geometry that may be obscured by other lights surrounding the runway, recognize a runway that lacks clear contrast with the surrounding terrain, and distinguish a runway during periods of reduced visibility. The REIL has an approximate range of 3 miles in daylight and 20 miles at night.

REILs have two system types: omnidirectional and unidirectional (Figure 2-6). The FAA guidance recommends omnidirectional REILs to provide circling guidance at locations where the procedure is operationally acceptable. Unidirectional REILs are recommended where environmental conditions require that the area affected by the flash from the REIL be greatly limited. Omnidirectional REILs are not always designated as such in existing documents. The data collection for this study documented only six omnidirectional REILs. Figure 2-7 and Figure 2-8 depict a breakdown of runways with edge lighting and REILs and airports that have lighted runways without REILs.




| | NORTHERN REGION | CENTRAL REGION | SOUTHCOAST REGION |
|---|---|---|---|
| WITHOUT REIL | 84 | 57 | 28 |
| WITH REIL | 27 | 18 | 26 |

**Figure 2-7.** Runway End Identifier Lights by Alaska DOT&PF Region.

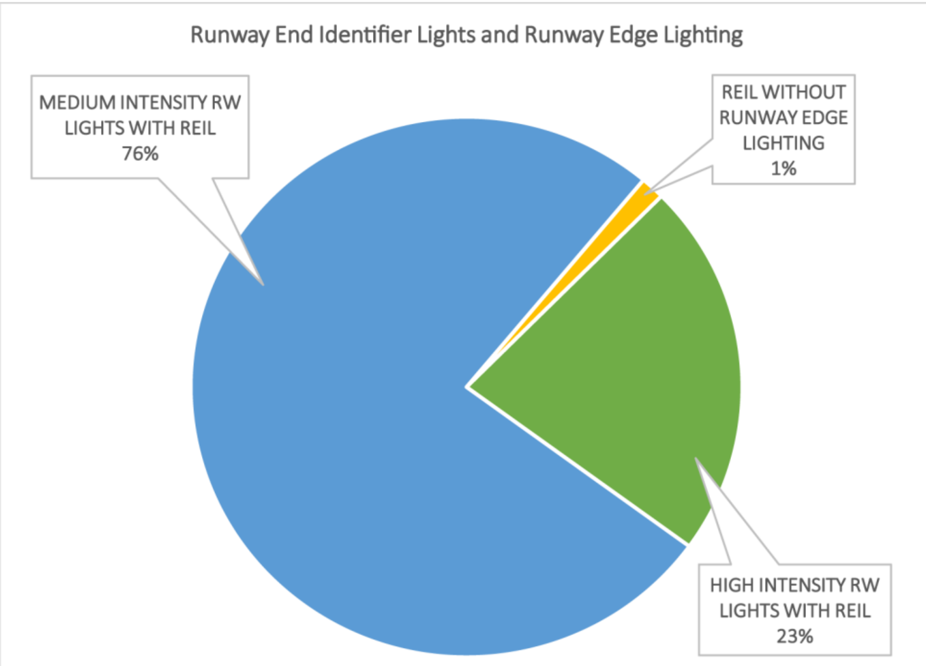



**Figure 2-8.** Runway End Identifier Lights and Runway Edge Light Inventory.

### *2.1.3 Visual Glideslope Indicators*

Visual Glideslope Indicators (VGSI) are visual aids comprising ground-installed lighting units that are used to provide visual approach slope information to pilots upon approach. The indicator's lighting units emit a light projection along the preferred approach path to provide guidance for a safe decent. VGSIs are available in two main types: Visual Approach Slope Indicator (VASI) and Precision Approach Path Indicator (PAPI), as shown in Figure 2-9.

New VASI installations were discontinued per FAA Order 6850.2B, dated August 20, 2010. The FAA continues to maintain existing systems. Any new installations are typically PAPIs and the installation, ownership, and maintenance requirements are shifting away from FAA and are now the responsibility of the airport sponsor. Because of the dwindling availability of parts for the older VASI systems, lighting projects contemplated at airports with existing VASIs should contact the FAA early in the planning process to facilitate coordinating the replacement of older system components.

The FAA has anecdotally reported locations requesting to retain the VASI systems when other lighting upgrades were installed.

(a)

(b)

(c)

**Figure 2-9.** Visual Glideslope Indicators at (a) Ralph M Calhoun Memorial, Tanana (TAL) (2020); (b) Selawik (2017); and (c) Unalakleet (UNK) (2017).

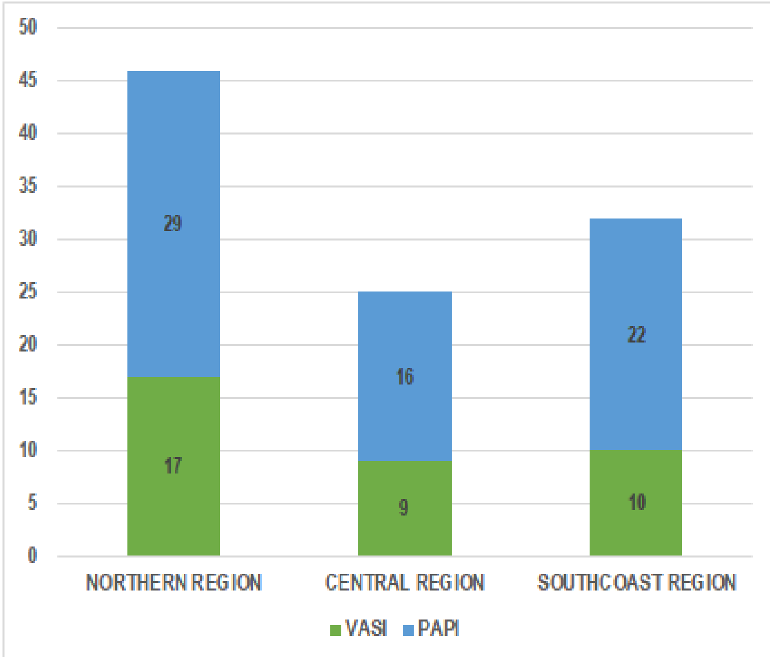



**Figure 2-10.** Visual Glideslope Indicator Inventory by Type and DOT&PF Region.

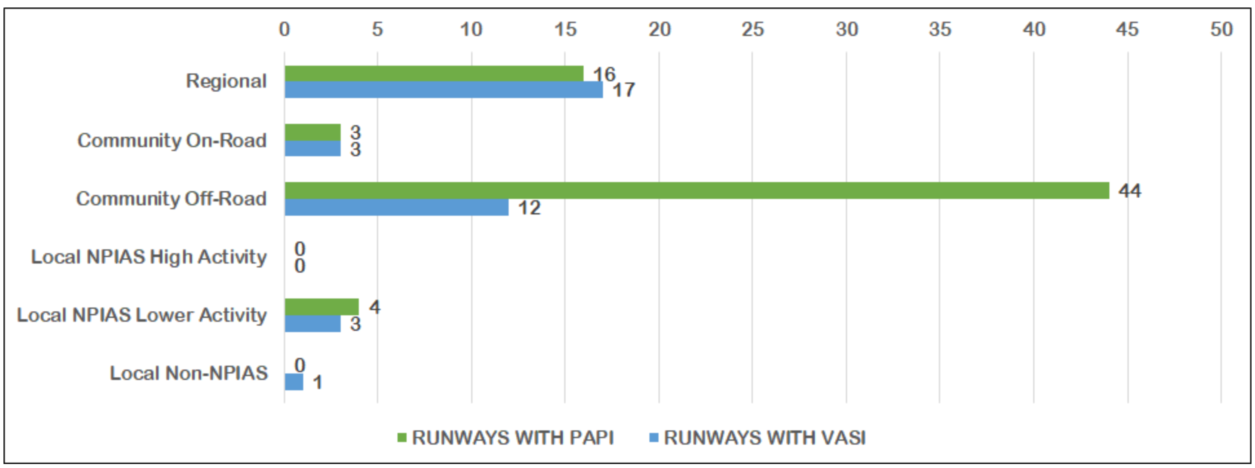



**Figure 2-11.** Visual Glideslope Indicator Inventory by Type and Alaska Aviation System Plan Classification.

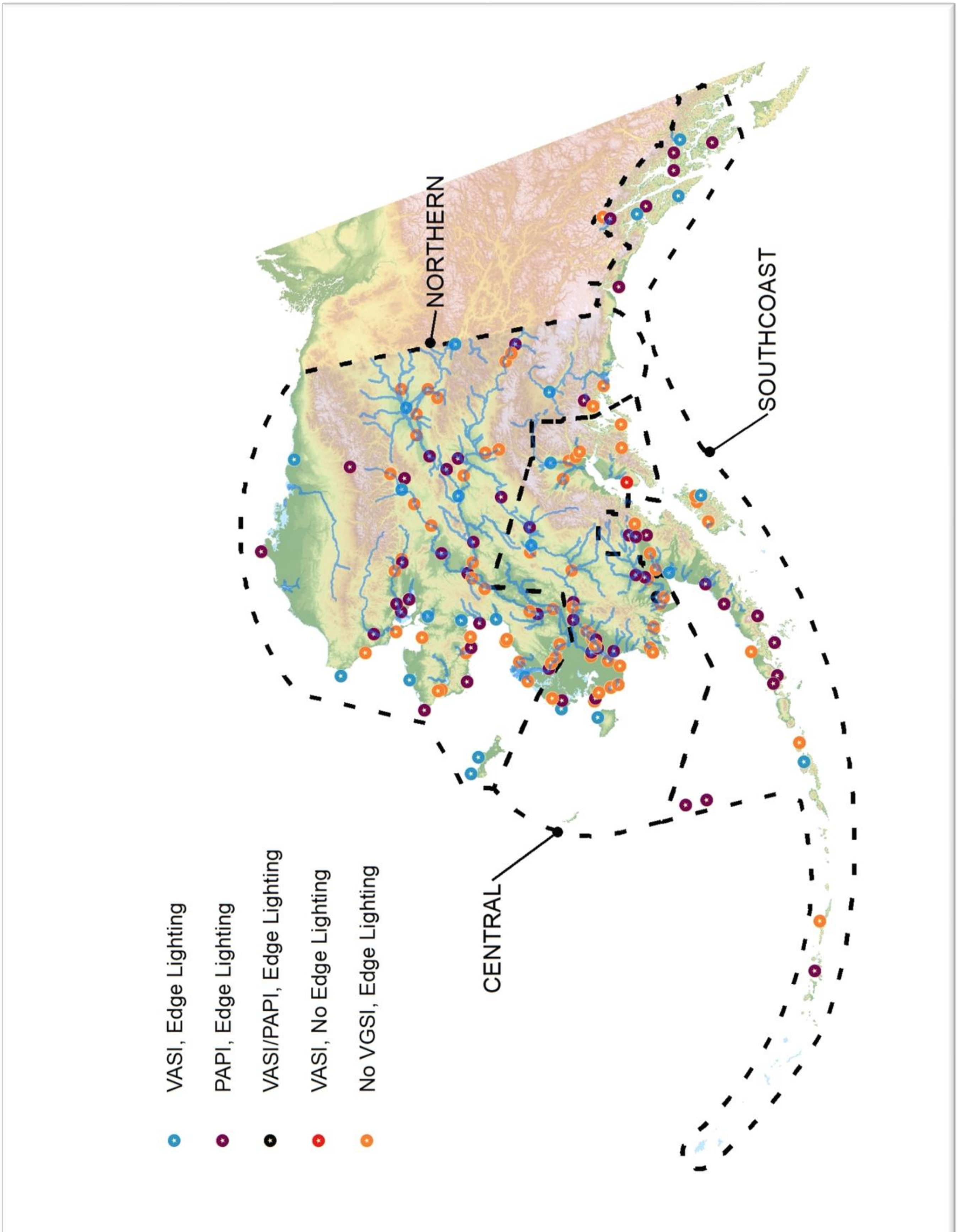



**Figure 2-12.** Runway Lighting and Visual Glideslope Indicator Inventory.

### *2.1.4 Approach Lighting Systems*

Approach Lighting Systems (ALS) transition pilots from instrument flight to visual flight for landing. The ALS configuration and level of sophistication depend on the operational requirements of the runway.

The ALS are a configuration of signal lights starting at the landing threshold and extending into the approach area for a distance of 2,400–3,000 feet (ft) for precision instrument runways and 1,400–1,500 ft for non-precision instrument runways. Some systems include sequenced flashing lights, which appear to the pilot as a ball of light traveling toward the runway at a high speed (twice per second). ALS can be medium-intensity (MALS), use runway alignment indicator lights (MALSR), use sequenced-flashing lights (MALSF), or use omnidirectional lights (ODALS). ODALS is a configuration of seven omnidirectional sequenced-flashing lights located in the runway approach area. The ODALS provides circling, offset, and straight-in visual guidance for non-precision approach runways.

A typical ALSF-2 system (high-intensity ALS with sequenced-flashing lights) consists of 247 steady-burning lights, including green threshold lights (49 lights); red side-row-bar lamps (9 rows, 54 lamps); and high-intensity, steady-burning white lights (144); plus 15 flashing lights commonly referred to as strobes.

Runways may have ALS for both approaches, on only one approach, or a different type of ALS on each approach, which explains why having more than one ALS at an airport is possible.

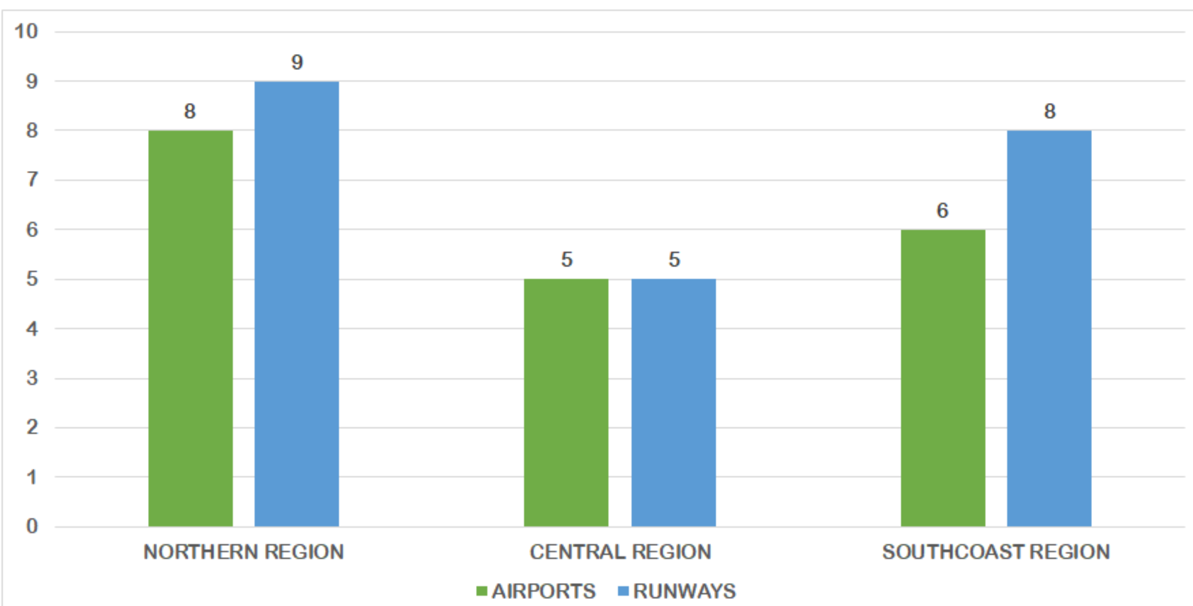



**Figure 2-13.** Approach Lighting System Installations by DOT&PF Region.

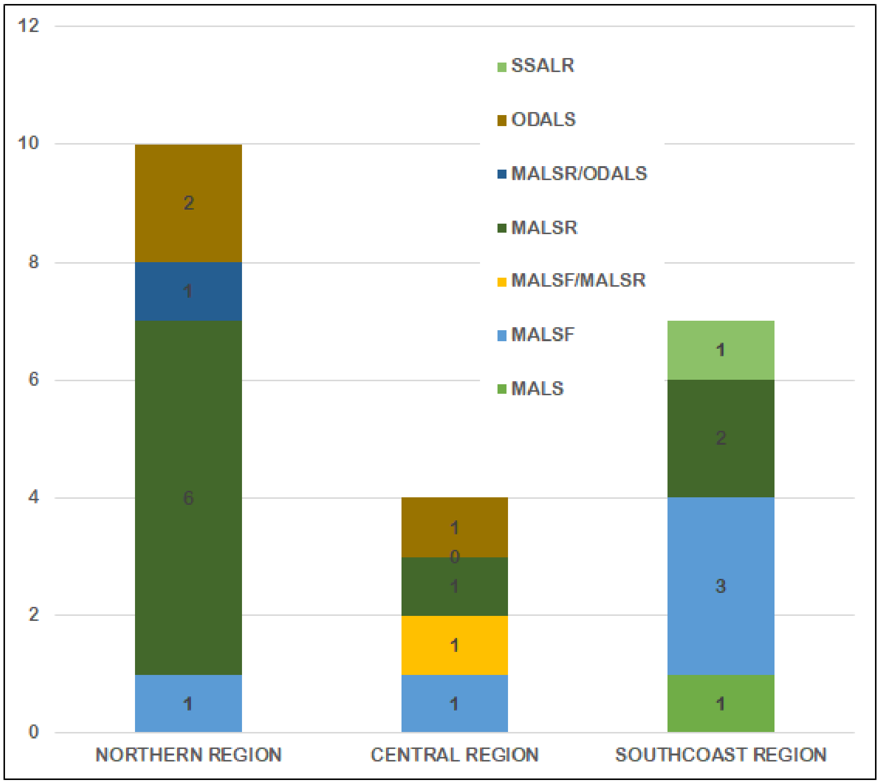



**Figure 2-14.** Approach Lighting System Type by DOT&PF Region.

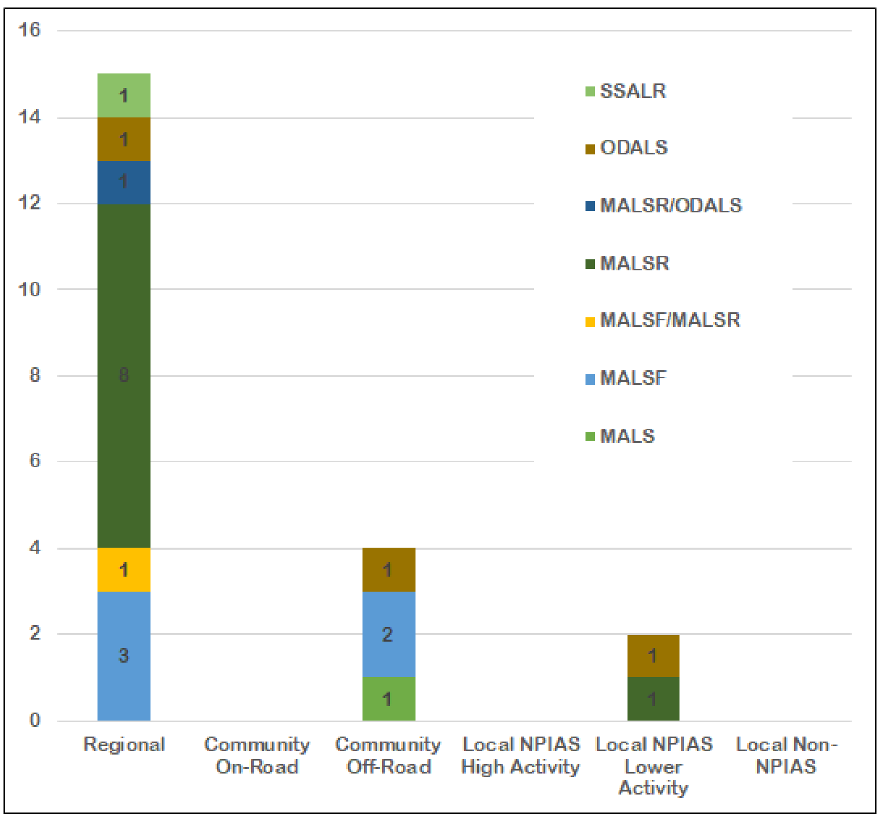



**Figure 2-15.** Approach Lighting System Type by AASP Classification.

## 2.2 WEATHER-RELATED CONSIDERATIONS

Alaska has nine distinct physiographic and environmental regions that create the greatest range of climatic conditions of all 50 U.S. states. This geographic area is vast with varying topographies and climates ranging from temperate rainforests in the southeast to the northern one-fifth of the state that lies above the Arctic Circle.

Aircraft operations are affected by various inclement weather types that require visual aids for aircraft operations. The four major weather considerations in this analysis are listed as follows along with the source(s) used in the analysis:

- Figure 2-16: Sunlight: National Renewable Energy Laboratory (NREL), U.S. Department of Energy (DOE)
- Figure 2-17: Winter Temperature: U.S. Department of Agriculture (USDA) U.S. Forest Service (USFS)
- Figure 2-18: Wind: Alaska Energy Authority (AEA)
- Figure 2-19: Precipitation: USDA and USFS. Green dots on the maps indicate lit runways and red dots indicate unlit runways.

Extreme weather conditions support the need for weather reporting equipment and visual aids. Data collection for this study, however, determined no direct correlation between weather conditions and airport lighting life expectancy. FAA-certified lighting equipment undergoes rigorous testing and is required to function in extreme conditions; however, interviews with several airport managers and lighting maintenance technicians working at airports that are not part of DOT&PF rural airport system but are located in arctic and subarctic regions indicated maintenance challenges with LED elevated taxiway and runway light fixtures in wet snow conditions. These challenges are as follows:

- The LED lights do not produce enough heat to keep the lens clear of snow and ice.
- The heaters recommended for cold environments are expensive to operate.
- If the light becomes obscured and is hit by an aircraft or snowplow, the replacement cost is two to three times the cost of an incandescent or quartz light fixture.

The conclusion is that while FAA-certified lighting may function in extreme weather; preventative and regular maintenance is still required. Maintenance for LED fixtures can be challenging. Therefore, the decision to install one type of lighting over another is specific to the airport. When choosing a lighting system, meteorological conditions play an important role in the decision-making process.

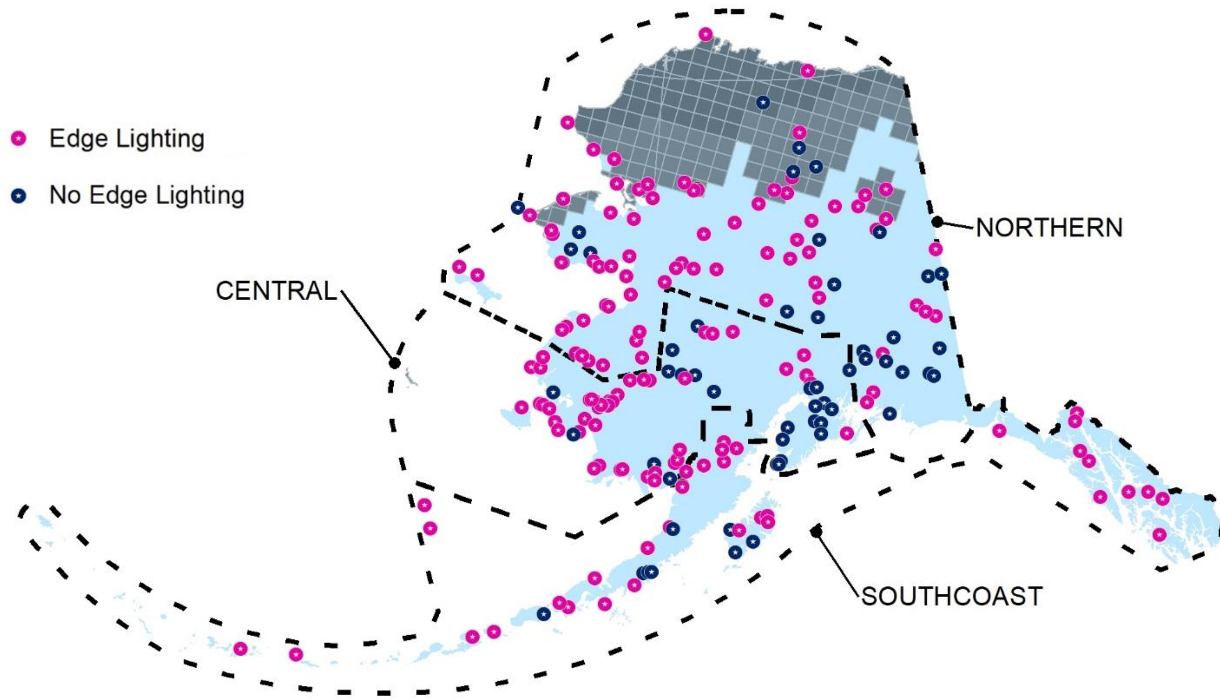



**Figure 2-16.** Map Summary of Extreme Climatic Conditions (Low Winter Sunlight). Darker regions of the map show areas with extremely low winter sunlight.

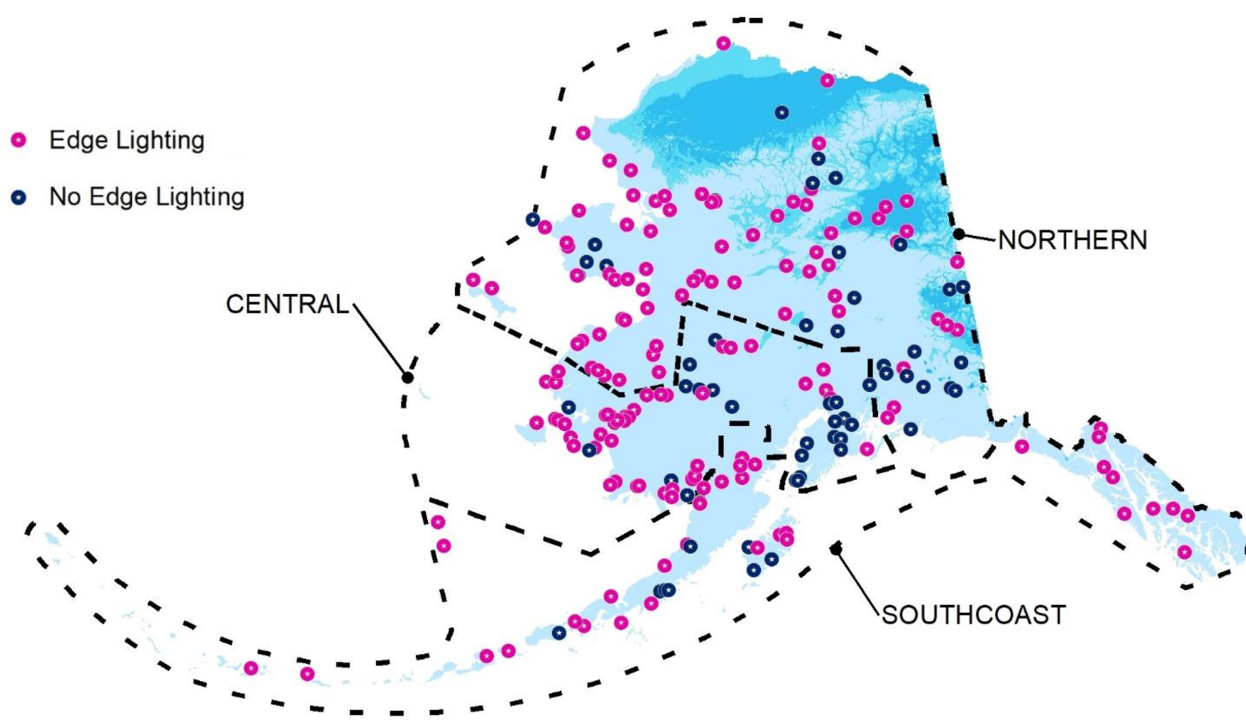



**Figure 2-17.** Map Summary of Extreme Climatic Conditions (Low Winter Temperatures) Ice blue regions are areas with extremely low winter temperatures.

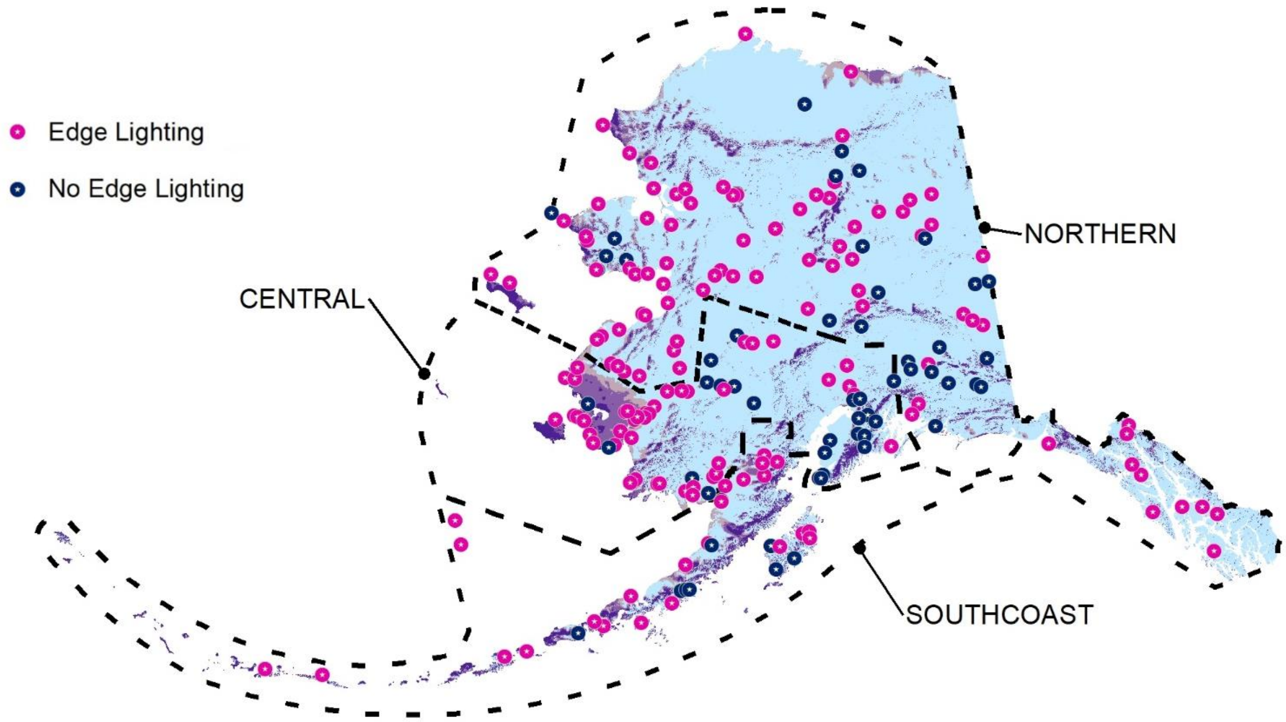



**Figure 2-18.** Map Summary of Extreme Climatic Conditions (Extreme Wind Conditions)
Darker colored regions have extreme wind conditions.

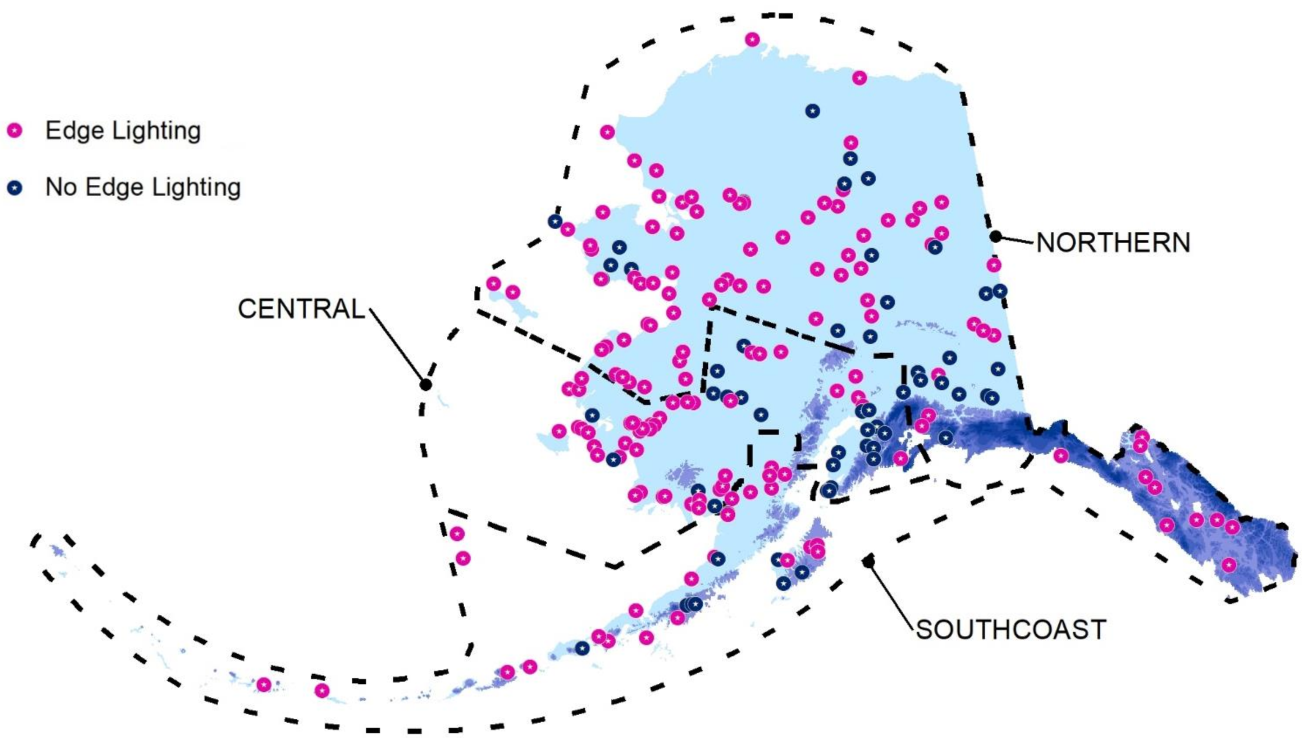



**Figure 2-19.** Map Summary of Extreme Climatic Conditions (High Annual Precipitation)
Darker regions have relatively high annual precipitation.

**Table 2-2.** Summary of Weather Observations by DOT&PF Region*

| Weather Consideration | Regional Observation |
|---|---|
| Sunlight | Northern Region has extremely low winter sunlight at 29 of its 101 airports. |
| Winter Temperature | Northern Region has extremely low winter temperatures at 51 of its 101 airports and Central Region has extremely low winter temperatures at 3 of its 69 airports. |
| Wind | Central Region has extreme wind conditions at 16 of its 69 airports; Southcoast Region has extreme wind at 12 of its 44 airports; and Northern Region has extreme wind at 10 of its 101 airports. |
| Precipitation | Southcoast Region has very high annual precipitation at 11 of its 44 airports; Central Region has very high annual precipitation at 5 of its 69 airports; and Northern Region has very high annual precipitation at 3 of its 101 airports. |

* The scope of this project was limited to DOT&PF owned, rural, land-based facilities at the local, community, and regional classification levels.

Weather impacts maintenance and visual inspection capabilities. Constant snow removal activities are known to increase the likelihood of damage to runway edge lights and obscure visible identification of that damage, which allows water to enter sealed vaults and light cans. Freeze-thaw cycles increase the probability of long-term damage from water and cause ground shifts that impact buried conduit and other infrastructure. These conditions challenge maintenance personnel, even at facilities that are staffed 24 hours per day, 7 days per week, and are intensified at airports that are unattended or maintained by contractor personnel who are not trained or authorized to repair lighting components.

**Figure 2-20.** Noorvik, 2019 (Photograph by Statewide Aviation (SWA).

Weather reporting capability is not airport lighting by definition; however, the capability is included in this inventory because accurate weather is a critical component of flight operational safety and go-no-go determinations in rural Alaska. Accurate weather information combined with reliable airport lighting may greatly increase the ability of air carriers and medevac flights to serve a community. Hourly and special weather reports are available as METAR text data from equipment owned and maintained by the National Weather Service (NWS), FAA, Department of Defense (DoD), or third-party weather equipment owned and maintained by the FAA, DoD, State, and local public/private organizations at airports across the region. The most common aviation weather reporting systems include the Automated Weather Observing System (AWOS) and the Automatic Surface Observation System (ASOS).

An AWOS is a fully configurable airport weather system that provides continuous, real-time information and reports on local airport weather conditions. The AWOS measures the combined barometric pressure, wind speed and gusts, wind direction, temperature and dew point, visibility, sky condition, runway-surface condition, and other parameters, depending on which instrument sensors are present. Weather data are often disseminated via a computer-generated voice message and broadcast over radio in the airport vicinity. As shown in Table 2-3, 114 AWOS are installed at Alaska's DOT&PF rural airports, 92 airports are without an AWOS, and 8 airports have planned AWOS installations in the near future.

ASOSs are mostly operated and controlled by the NWS, DoD, and sometimes the FAA. There are currently more than 900 ASOS sites in the United States. These systems generally report at hourly intervals, but also report special observations if weather conditions change rapidly and cross aviation operation thresholds. ASOSs almost always have a basic level comparable to AWOS-III, which means that they can tell barometric pressure, wind speed and direction, density altitude, visibility, sky condition, ceiling height, and precipitation.

In 2017, the AASP conducted a special study on weather reporting in Alaska. Two reports detailing the issues and ongoing efforts to improve weather reporting are available on the AASP website (alaskaasp.com): Alaska Weather Equipment Needs Summary and Aviation Weather Reporting in Alaska.

**Table 2-3.** Automated Weather Observing Systems Inventory by DOT&PF Region

| DOT&PF Region | Airports With AWOS | Airports Without AWOS |
|---|---|---|
| Northern | 61 | 40 |
| Central | 31 | 38 |
| Southcoast | 30 | 14 |
| **Total** | **122** | **92** |

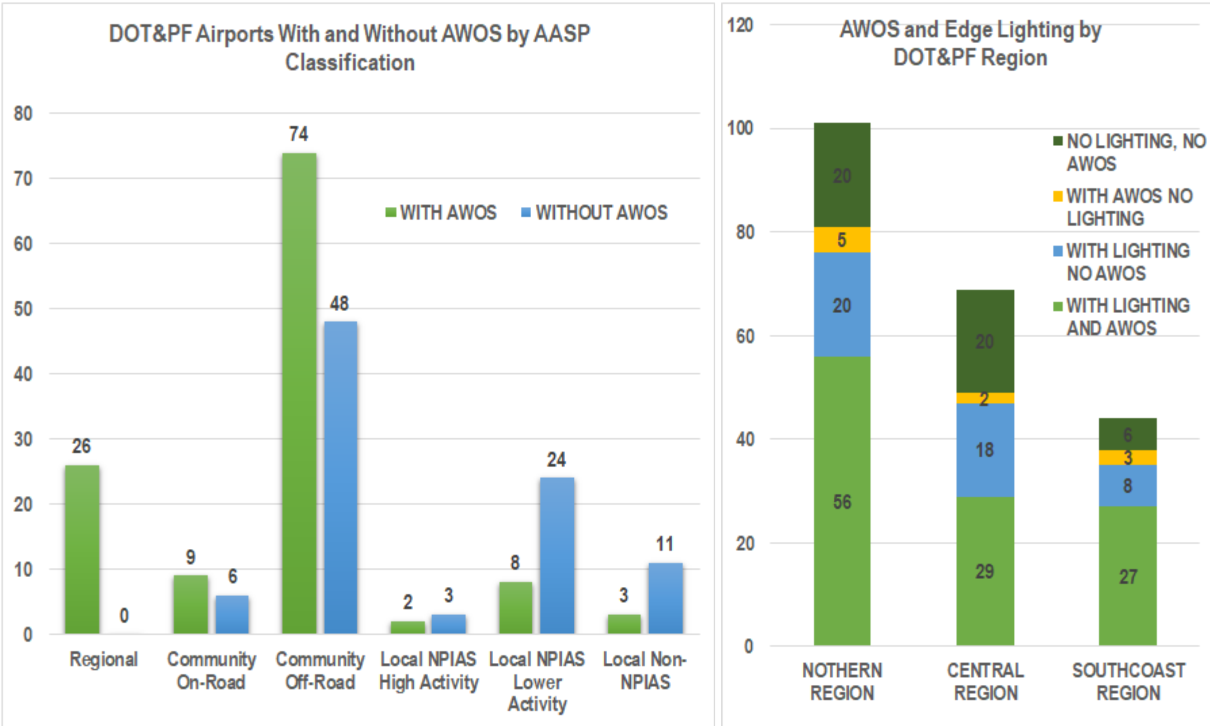



**Figure 2-21.** Existing and Planned AWOS by AASP Classification and DOT&PF Region.

## 2.3 GEOGRAPHIC CONSIDERATIONS

### *2.3.1 Isolated Facilities*

Because of Alaska's vast geographic expanse and many mountain ranges, 39 DOT&PF airports are considered isolated from the system. An isolated airport is defined as an airport facility that is more than 50 miles from another airport that has a lighting system. This definition is based on the standard 30-minute fuel reserve observed by private pilots. Figure 2-23 shows isolated facilities.

**Table 2-4.** Isolated Facilities by DOT&PF Region and Lighting System

| DOT&PF Region | Lighting System | No Lighting System |
|---|---|---|
| Northern | 13 | 8 |
| Central | 2 | 9 |
| Southcoast | 7 | 0 |
| **Total** | **22** | **17** |

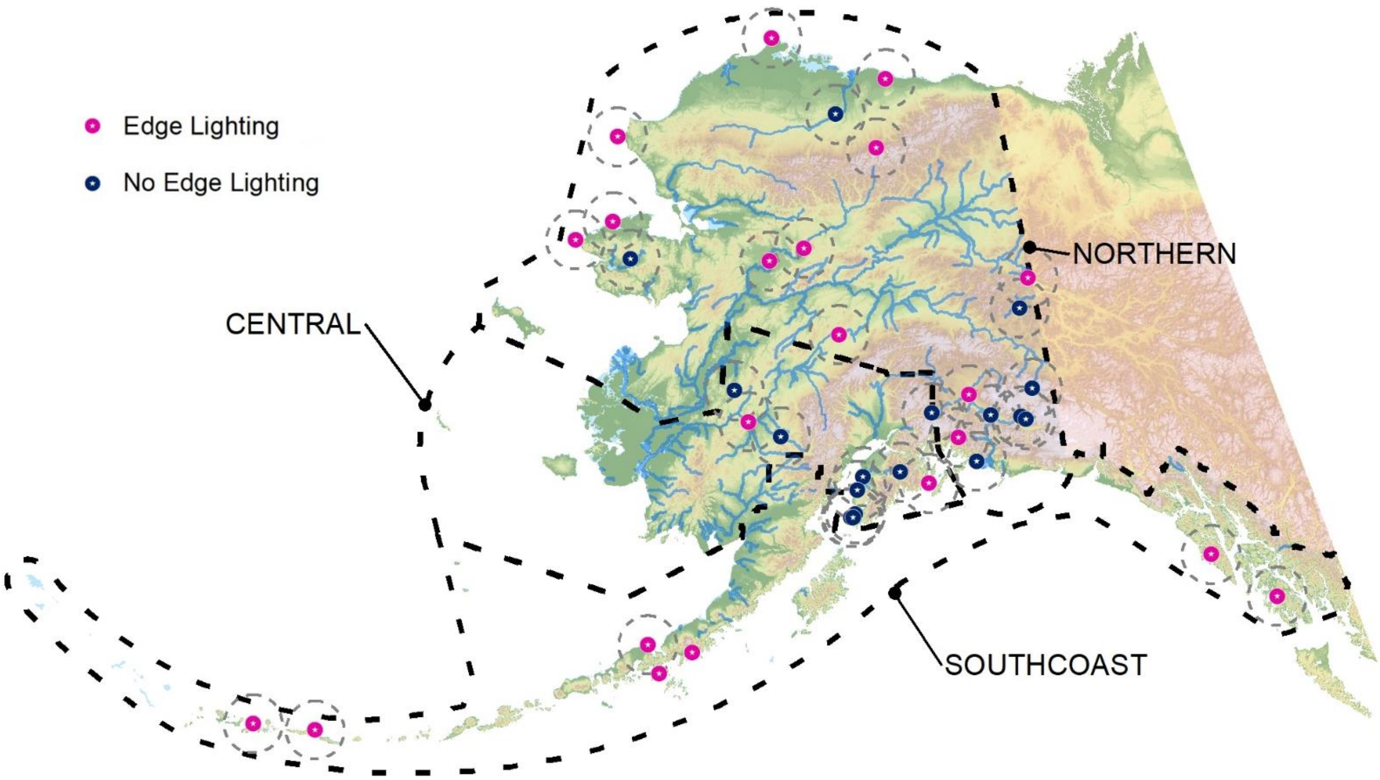



**Figure 2-22.** Isolated Facilities

### 2.3.2 Airports Near Rivers

Airports located near major rivers may experience more fog, which causes more frequent low visibility than at other airports. In rural Alaska, rivers are commonly used for transportation, either by watercraft in the summer or snow machines in the winter. This transportation method provides a seasonal possibility for alternative ways to access nearby airports in an emergency when aircraft are unable to land. Eighty-one percent of airports with a nearby river have existing edgeway lighting. The map in Figure 2-24 illustrates the locations of airports near rivers; pink dots indicate lit runways and purple dots indicate unlit runways.

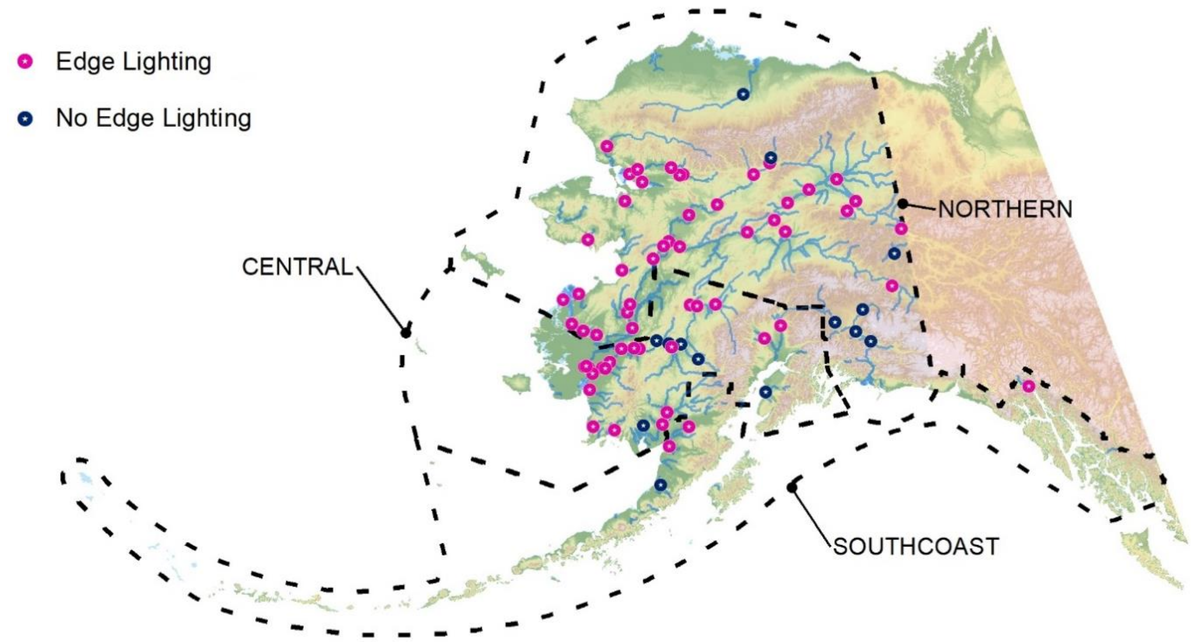



**Figure 2-23.** Airports Near a River.

## 2.4 RUNWAY CHARACTERISTICS

Characteristics such as runway geometry, surface quality, and seasonal use could be useful variables to consider when interpreting lighting system maintenance history, costs, and difficulties in following standard maintenance protocols. These attributes are more relevant when seen in the context of other data in the inventory and the attributes are put into context in the facility data profiles available in Appendix A.

### *2.4.1 Runway Length*

Runway length varies widely among rural airports and ranges from 1,200 ft to more than 10,000 ft long at Cold Bay (CDB), which serves as an emergency diversion alternate for ANC. The median runway is approximately 3,200 ft long. Unlit runways range from 1,200 to 6,700 ft long; the median unlit runway is roughly 2,300 ft long. Lit runways range from 1,520 to 10,179 ft long; the median lit runway is 3,650 ft long. Runway length will be evaluated further as part of a future AASP task.

### *2.4.2 Surface Quality*

Runway surfaces include various aggregates of turf, turf-gravel, dirt, gravel-dirt, gravel, concrete, asphalt-gravel, asphalt, and asphalt-concrete. The review of documents and interviews with maintenance and operations (M&O) personnel did not reveal a direct correlation between surface material and the useful life of the lighting system; however, surface irregularities such as heaving and soft spots should be considered a red flag indicating that buried conduit and light cans may be experiencing underground impacts. Airport managers with these issues on the runway surface should conduct inspections/testing of the lighting system components to check for faults or damage and report the results to the planners if replacement and a future capital project is needed.

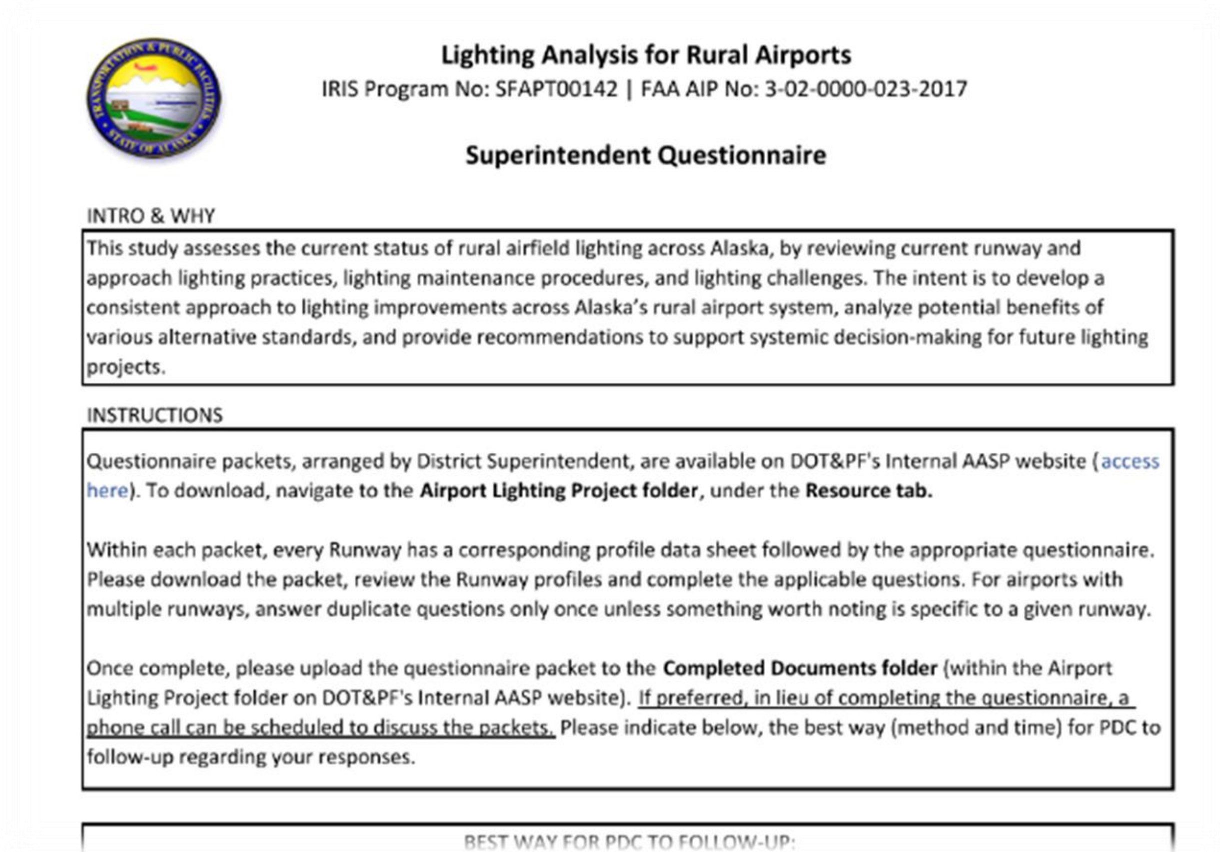
## 2.5 ASSOCIATED COMMUNITY INFORMATION

Most communities off the road system are served by a community, local, or regional rural airport. In several instances, airports are in a depopulated location but still serve a community interest. Data collected in 2019 found that Alaska’s 214 rural, land-based airports serve 196 communities totaling more than 111,840 residents. The median community population is 249 and the average is 570. The largest community is Sitka with a population of 8,733, while the smallest listed population is Portage Creek with 1 person.

Each facility data profiles in Appendix A includes information from the U.S. Department of Transportation Bureau of Transportation Statistics T-100 2019 data bank and FAA operations data. Passenger and freight/mail totals are for every flight that lands at the subject airport. The number of commercial, general aviation, and air taxi operations helps to determine the operational capacity of the airport. Figure 2-26, which is clipped from Ambler Airport’s profile, shows all of the commercially connected routes that regularly fly to the subject airport, the planned design aircraft, which air carriers serve the airport, which aviation network the airport is a part of, and what entity provides the maintenance at the airport. Community information assists in understanding the importance of or need for airport lighting.

## 2.6 STUDY QUESTIONNAIRES

Questionnaires were developed to accompany each facility data profile sheet with the intention to verify some of the existing data, collect material- and maintenance-related information regarding the lighting systems, and request insight/feedback from a maintenance perspective. These questionnaires were dispersed to DOT&PF superintendents. See Appendix B for a copy of the Superintendent Questionnaires.



**Lighting Analysis for Rural Airports**
IRIS Program No: SFAPT00142 | FAA AIP No: 3-02-0000-023-2017

**Superintendent Questionnaire**

INTRO & WHY

This study assesses the current status of rural airfield lighting across Alaska, by reviewing current runway and approach lighting practices, lighting maintenance procedures, and lighting challenges. The intent is to develop a consistent approach to lighting improvements across Alaska's rural airport system, analyze potential benefits of various alternative standards, and provide recommendations to support systemic decision-making for future lighting projects.

INSTRUCTIONS

Questionnaire packets, arranged by District Superintendent, are available on DOT&PF's Internal AASP website (access here). To download, navigate to the **Airport Lighting Project folder**, under the **Resource tab.**

Within each packet, every Runway has a corresponding profile data sheet followed by the appropriate questionnaire. Please download the packet, review the Runway profiles and complete the applicable questions. For airports with multiple runways, answer duplicate questions only once unless something worth noting is specific to a given runway.

Once complete, please upload the questionnaire packet to the **Completed Documents folder** (within the Airport Lighting Project folder on DOT&PF's Internal AASP website). If preferred, in lieu of completing the questionnaire, a phone call can be scheduled to discuss the packets. Please indicate below, the best way (method and time) for PDC to follow-up regarding your responses.

BEST WAY FOR PDC TO FOLLOW-UP:

**Figure 2-24.** Superintendent Questionnaire.

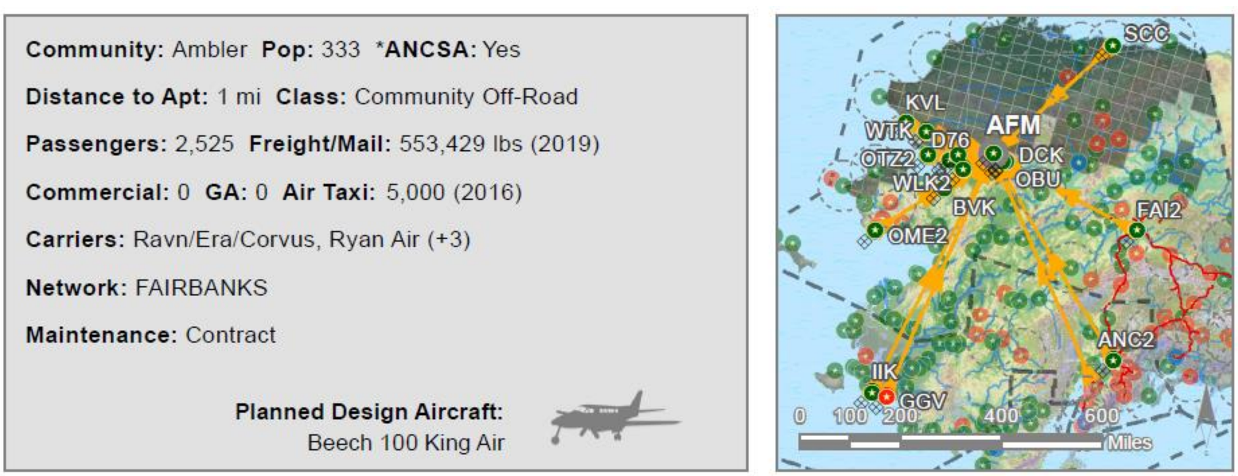



**Figure 2-25.** Ambler Airport Lighting Profile Showing Carrier Data and Community Information.

# 3.0 ANALYSIS

## 3.1 INTERVIEW AND QUESTIONNAIRE RESULTS

The project team distributed 297 interview packets to 13 airport superintendents.

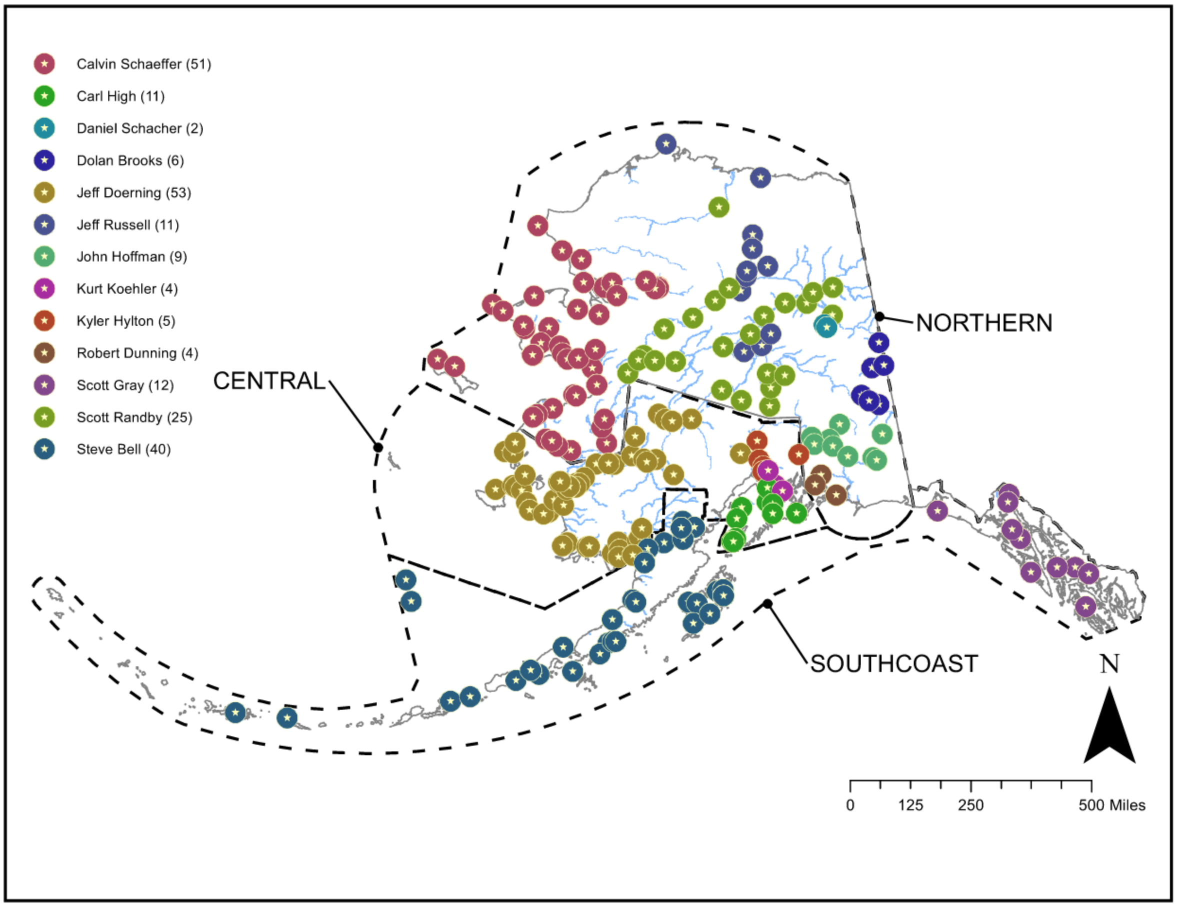



**Figure 3-1.** DOT&PF Airport Superintendents (June 2021)

**Lighting Analysis for Rural Airports**
IRIS Program No: SFAPT00142 | FAA AIP No: 3-02-0000-023-2017

**Superintendent Questionnaire - Airport List**

| M&O SUPER | AIRPORT | LOC ID | LTG | NO LTG | PART 139 |
|---|---|---|---|---|---|
| Calvin Schaeffer | PILOT STATION (0AK) | 0AK | X | | |
| Calvin Schaeffer | KOTLIK (2A9) | 2A9 | X | | |
| Calvin Schaeffer | SHAKTOOLIK (2C7) | 2C7 | X | | |
| Calvin Schaeffer | QUARTZ CREEK (5QC) - Kougarok | 5QC | | X | |
| Calvin Schaeffer | NOME (94Z) - Nome City Field | 94Z | | X | |
| Calvin Schaeffer | AMBLER (AFM) | AFM | X | | |

**Figure 3-2.** DOT&PF Superintendent Questionnaire – Airport List

The returned questionnaires and follow-up interviews informed this study's analysis. The following is a summary of feedback and reported challenges associated with the rural airport lighting systems:

- Funding for maintenance is limited.
- Qualified and willing maintenance personnel are lacking (both contractors and electricians).
- Preventive maintenance is insufficient; system testing is not performed.
- Poor power quality has shortened the useful life of some equipment.
- Repeated ground-freeze/thaw cycles have created frost-heave issues.
- Water in systems, drainage issues, and corrosion have been observed in locations with high water tables.
- Wiring issues occur in areas with direct-bury conductors (and flooding, in particular).
- Time is lacking to make repairs with available equipment and materials.
- Most snow removal equipment damage and other maintenance-related issues occur during weather events (snowstorms), when:
  - All of the other airports in the region are having the same issue.
  - Getting an electrician to the airport is very difficult.
  - Repairs are hard to make because of poor weather conditions and insufficient daylight.
- LED fixtures are very susceptible to moisture. Both on the coast and in the interior, M&O personnel are seeing corrosion issues, which lead to a full fixture replacement instead of a bulb. Because of these issues, DOT&PF is not receiving the anticipated cost benefit; lights are being replaced yearly at three to four times the anticipated cost.
- Multiple airports reported that LED fixtures were installed for the taxiway edge lights but not the runway edge lights. In a few situations, the upgrade to LED fixtures (for runway [RW] edge lights) was planned, but this case was not true for most airports. The mixed light sources require maintenance to have more parts on hand to repair the lighting systems.
- Many new installations make use of metal light can bases, which is beneficial because rings and extensions are available to make final adjustments or repair damage.
- Some unlit airports have (DOT&PF-owned) temporary emergency lighting systems that can be deployed if necessary. The local communities are responsible for the cost to freight the temporary system out to the airport. The option to ship these systems has not been embraced by all the eligible communities, and DOT&PF currently has systems available.

The questionnaires provided an opportunity to report the date of installation and historical equipment damage related to the lighting systems and associated components. This study had a goal to determine the approximate economic life of the lighting systems for DOT&PF planners and designers to rely upon to make future decisions regarding the system's infrastructure. Based on the returned questionnaires, room for improvement is available regarding asset tracking within DOT&PF's Maintenance Management System (MMS).

Without quantitative data, an economic-life determination for the components is based on conjecture. DOT&PF is continually working to improve tracking, but detailed historical data are practically nonexistent. Experienced M&O personnel provided assessments and possible solutions based on experience and common sense, but without documentation and tracking mechanisms, a definitive determination of economic or functional life across the system is not attainable. The available information suggests that systems reach their economic life at 20 - 30 years. Exceptions always exist and planners must rely on M&O experience and recommendations.

## 3.2 AGING INFRASTRUCTURE

To determine the approximate age of the installed lighting systems, the Airport Improvement Program (AIP) grant funding history and available project records and as-built documents were reviewed with the following assumptions:

- The year the lighting system was installed is the year that funding was granted for the project.
  - Included lighting-specific projects and (new) airport construction projects.
- If a lighting or major construction project was not listed, record documents were reviewed, and the installation date was estimated based on available project information.

More than 80 percent of airport lighting systems were installed (or funding was obligated) before 2010, and approximately 55 percent of the existing lighting systems were installed before the year 2000, as shown in Figure 3-1. The average age of the runway lighting systems is approximately 20 years. Installation breakout by year is detailed in Figure 3-2.

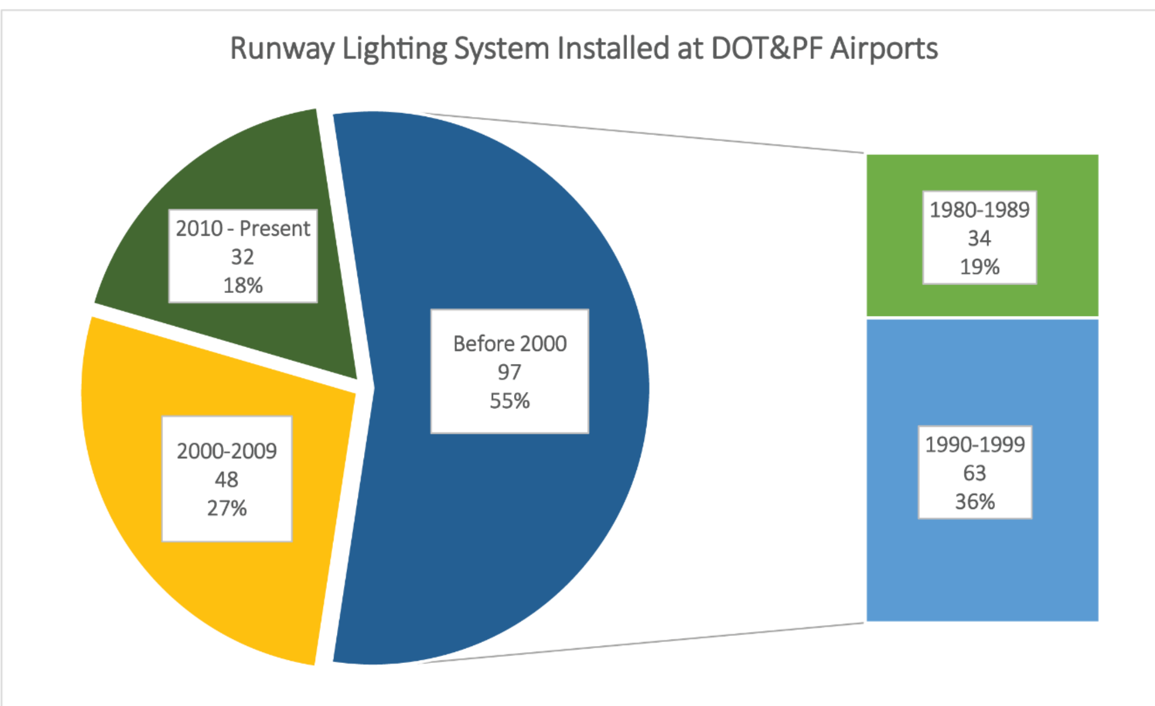



**Figure 3-3.** Estimated Age of Current Airport Lighting Installations.

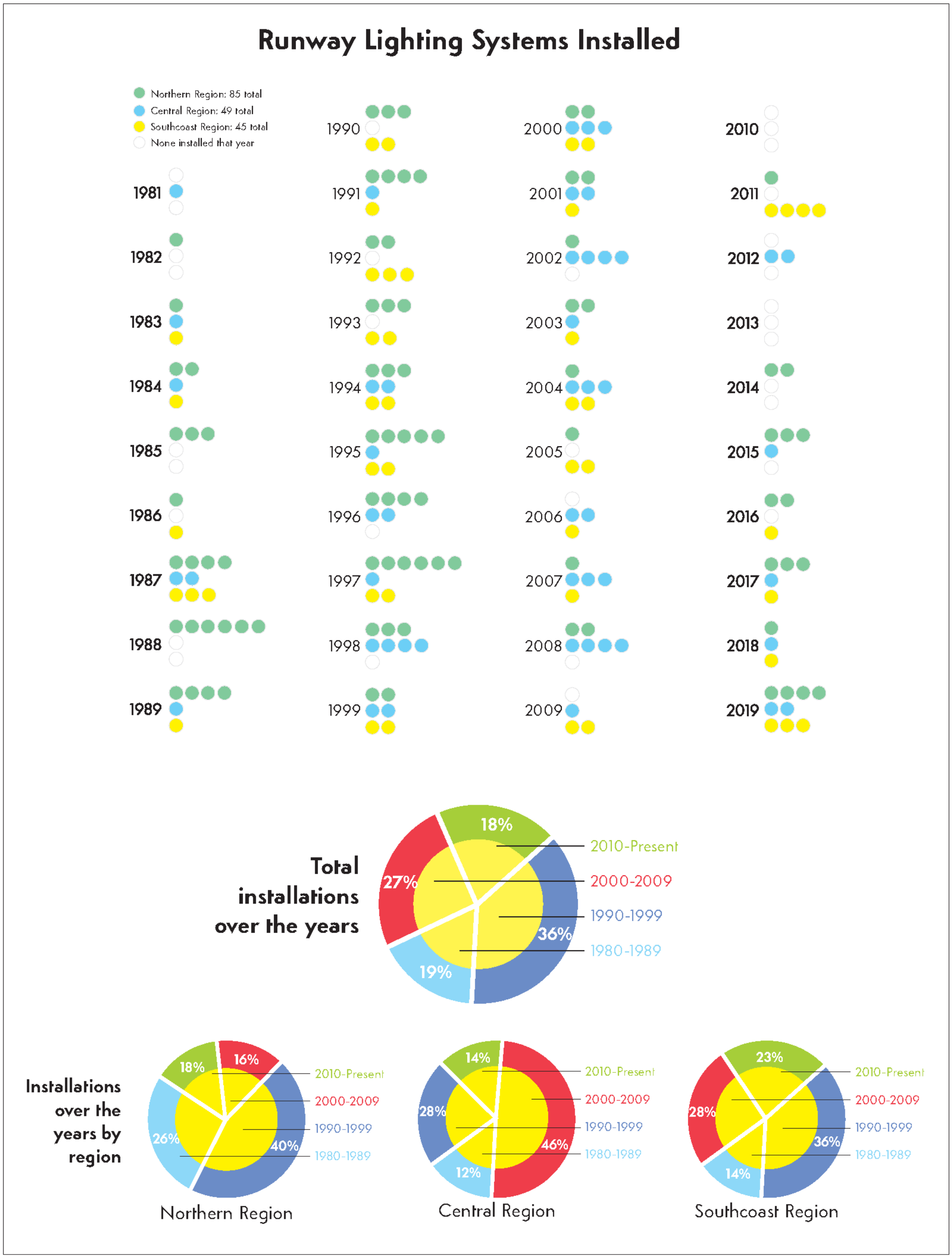



**Figure 3-4.** Lighting Installation by Year and Region

## 3.3 USEFUL LIFE ASSESSMENT

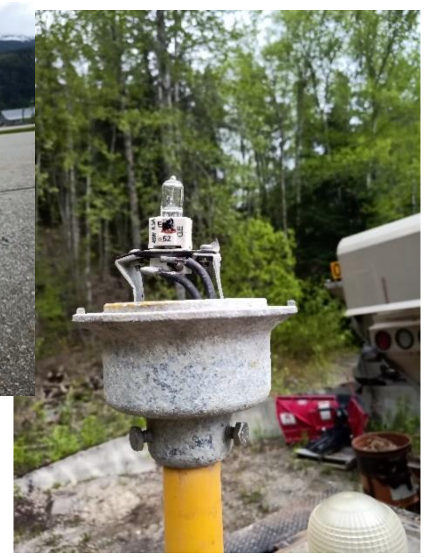
An original goal of this study was to determine the useful life of rural airport lighting systems for planning purposes. The FAA definition of "useful life" in Order 5100.38D, *AIP Handbook,* is *"the period during which an asset or property is expected to be usable for the purpose it was acquired. It may or may not correspond with the item's actual physical or economic life."* In Table 3-7 of the AIP Handbook, the FAA lists 10 years as the minimum useful life for airport lighting and signage. This guideline means that lighting is eligible for AIP grant funding if the lighting has been in operation for at least 10 years. The reality of extremely limited funding makes the FAA useful life assessment a fact that planners need to be aware of; however, the FAA determination of eligibility for AIP funding should not be the sole determining factor for replacing a light system.

A more fiscally useful assessment would be that of economic life, which is defined as the amount of time an element is in service before its replacement is more advantageous economically than the continued maintenance required to keep the element in service. Economic life is difficult to assess for DOT&PF airports, regardless of geographical region, because M&O personnel are extending the lives of lighting systems with ingenuity and emergency repairs. An example of this resourcefulness occurred recently at the Skagway Airport, where finding parts for the 40-plus-year-old lighting system was becoming impossible. When the lighting infrastructure at the Sitka Airport was last upgraded, DOT&PF salvaged the "gently used" edge light fixtures at Sitka for use at the Skagway Airport. This process did not solve issues with the system itself, which is still experiencing water leaking into the light cans and corroding conduit, but the crew is keeping the lights on.

Skagway In-House Runway Lighting Replacement Story

Before: Light fixtures were more than 40 years old and parts were a scarce commodity.



This is just one example of how DOT&PF employees work every day to keep airports safe and operational in the current fiscal climate. Thanks to Shaun McKnight, Skagway Airport Foreman, for photographs and sharing this remarkable story.

Skagway In-House Runway Lighting Replacement Story
AFTER: DOT&PF salvaged the old lights from a light project at Sitka (SIT) and gave them a new home in Skagway. The "new" fixtures are brighter, easier to find parts for, and more resistant to the constant attention of the local raven population.

These types of repairs and fixes are completed in house or by contractors across the system and are not necessarily reflected in record drawings or updated with the AASP inventory. A simple review of Notices to Airmen (NOTAMs) regarding outages for the airport lighting at Skagway Airport might lead to the conclusion that problems do not exist. A review of the record drawings might indicate that a runway lighting system in Southeast Alaska has a functional life of 40-plus years. Assessing if a specific system has exceeded its economic or functional life by evaluating M&O budgetary data or reviewing NOTAMs is impossible.

Efforts by DOT&PF to attribute costs to specific components will aid in future assessments. The most accurate information sources are currently the superintendent, airport manager, foreman, or electrician directly responsible for the lighting system in question. Based on the interviews conducted for this study, the personnel directly maintaining the systems can provide very accurate assessments of economic life. The data collection, interviews, and analyses conducted during this study indicate the economic life of airport lighting systems to be approximately 20 – 30 years, with recognized outliers.

Another assessment that is commonly used for equipment is that of functional life, which refers to the amount of time that equipment may be in service before the equipment is rendered obsolete because of an inability to meet performance requirements or changes in functional requirements. A functional life assessment would be appropriate if changes were made to FAA guidance, airport classification, design aircraft, or approach lighting. For example, if the FAA scheduled an installation of precision approach at a runway with MIRL, then the functional life of the MIRL system would be a consideration and an upgrade to HIRL would be appropriate.

Communication breakdowns are possible between M&O personnel and the planners responsible for initiating project nominations. In some cases, the initial project nomination is based on NOTAM outages or a Capital Improvement and Maintenance Program (CIMP) inspection[1] conducted by personnel who may not be fully aware of all the maintenance issues. This scenario is especially common in CIMP inspections conducted during summer months when lighting issues are not as obvious. To address this issue, the CIMP inspection guidelines require that the inspector contact the airport manager as part of the research before inspection. Stressing the importance of this communication is recommended to bridge the gap between planners and M&O personnel as work continues to improve the reporting of maintenance issues and costs associated with specific components.

AIP funding does not cover M&O costs, and the State of Alaska's adopted Airport Project Evaluation Board (APEB) scoring criteria (used to rank proposed projects) does not give high marks to standalone lighting replacement or rehabilitation projects. Lighting projects are most successful in the scoring criteria when combined with runway-surface rehabilitation projects. Airports, particularly those on the road system, generally do not score high enough to warrant a standalone lighting project. This scoring system results in M&O personnel working to keep 30-year-old systems operational well past their useful and economic lives. These older systems do meet FAA AIP eligibility for replacement; however, because of limited funding, the systems do not score high enough in the DOT&PF APEB process to obtain funding.

## 3.4 AIRPORT LIGHTING NEEDS PRIORITY DETERMINATION

The project team explored the issue of priority ranking for lighting needs. The general consensus was that lighting needs should be prioritized by the role that the airport serves. Special consideration should be given to those airports serving off-road communities with no local medical facilities where the airport is the only way for the population to access emergency medical services.

Interviews conducted during the study period concluded that basic airport lighting systems have been installed or are in the funding plan for all DOT&PF airports that have documented a critical need and appropriate power source. Continued assessment and consideration of population changes, critical aircraft, and availability of medical facilities should continue, but the focus will now shift to sustaining the existing systems. Routine maintenance needs to be supplemented with periodic electrical system evaluations, and any major surface rehabilitation should include upgrading and replacing the associated lighting infrastructure.

The ANC field maintenance electricians have documented dangerous ground-fault occurrences in older systems. Consideration should be given to conducting a standardized electrical assessment for all systems 20 or more years old. The inspections should focus on those elements that could cause serious injury or death to maintenance workers. Those systems that pose a danger should be prioritized for funding.

[1] DOT&PF's CIMP inspection program systematically and comprehensively assesses, documents, and tracks airport needs. Assessing and documenting airport maintenance and capital needs supports safety by helping airport sponsors identify, prioritize, and implement safety-related improvements.

## 3.5 MAINTENANCE BEST PRACTICES AND FUNDING

The primary reasons for airport lighting system maintenance and repairs were grouped into the following three categories:

| General: | Other: | Preventable: |
|---|---|---|
| safety, compliance | power quality, equipment durability, wildlife | contractor damage, snow removal operations |

### *3.5.1 General: Safety and Compliance*

Within the DOT&PF rural airport system, the primary roadblock to best maintenance practices is funding. Safety and compliance are two areas that are generally prioritized for funding; therefore, inspecting lighting systems regularly and reporting safety and compliance issues promptly are important.

### *3.5.2 Other: Power Quality, Equipment Durability, and Wildlife*

Power quality is normally the most difficult area to improve because the primary power source is generally not a DOT&PF asset to control. All AIP-funded lighting equipment must be tested to FAA standards and approved for the environmental conditions of the airport. Warranty work should be monitored, and faulty products should be assessed during the warranty period. Wildlife may be partially controlled with fencing and hazing; however, where it is a continuous issue, a wildlife assessment is recommended to provide additional recommendations for mitigation.

### *3.5.3 Preventable: Snow Removal Operations*

Snow removal operations, regardless of operator skill, training, and experience, will occasionally result in damage to runway lighting. While the preventable category is accurate, the realities of obscured lights, low visibility, and slick operating surfaces indicate that snow removal operations will have a detrimental impact on runway lighting fixtures. Increased training, reviewing snow removal plans, and developing best practices are still important to increasing the system reliability but should be balanced with the knowledge that eliminating all of the snow removal-related damage is unlikely.

Evidence has been documented that some airports experience more snow removal-related damage than other airports. Individual superintendents are responsible for determining if some of this damage is preventable and for taking appropriate steps to minimize damage.

Airports (both outside of the DOT&PF system and within the rural system) occasionally report practically no damage to elevated lighting fixtures during snow removal operations. Those airports report snow removal plans that specify snow clearing only to the edge line or the remaining 10 ft from lighting fixtures until the snow event is over and lights can be cleared in daylight. Some airports require that clearing within 2 ft of fixtures and light cans be done by hand, while others report that if plows stay at least 5 to 10 ft away from the lights and do not create snow berms, the remaining snow settles, melts, or blows away. Snow conditions obviously vary by region and time of year, so the methods that work for one airport may not work for another.

DOT&PF maintenance foremen and supervisors should review snow removal plans and instructions to contractors regularly; test alternative snow removal procedures; and make changes, when prudent, to protect lighting.

**Figure 3-5.** Watertight systems only keep water out until they are compromised. (Photograph by Angela Smith).

# 4.0 RECOMMENDATIONS FOR CONSIDERATION

The recommendations in this report fall into five general categories, as listed below, that are presented in more detail in the following text. Note that the recommendations in this section will often apply to multiple airports and are contingent upon additional funding and/or resource and funding realignment.

- Project Planning and Design
- Maintenance and Operations
- Equipment and Asset Tracking
- Funding
- Community Engagement and Awareness

## 4.1 PROJECT PLANNING AND DESIGN

### *4.1.1 Develop a Flow Chart and/or a Frequently Asked Questions*

Develop a flow chart and/or a Frequently Asked Questions (FAQ) on the airfield lighting design process for planners, designers, and maintenance personnel to identify the information required and considerations that need to be addressed regarding airport lighting and/or standby power. This flow chart and/or FAQ document should outline the general process, suggested contacts, and questions that need to be answered. Standard designs are adjusted for varying environments in the current process; however, better understanding of the specific challenges of each airport allows those unique items to be considered early in the planning process. The goal is to get input from M&O personnel early in the planning and design process to address known issues specific to the project site and obtain M&O input on specific design alternatives to consider.

The flow chart should include an evaluation of whether standby generation is needed for a project. Use historical information and future projections regarding utility power reliability as part of the decision-making process to determine if standby generation is recommended with airfield lighting projects.

Better information on specific needs will also provide information to facilitate more accurate planning-level cost estimates. Increasing accuracy of planning-level cost estimates benefits the internal management of funding allocation.

### *4.1.2 Develop Best Management Practices*

In Alaska, one size does not fit all; accordingly, one design does not work for all rural airports. Using one method to plan or design for a system covering such a diverse and expansive geographic area is unrealistic.

If the technology or products involved in a project are changing, consider whether the newer technology is the best option for the Alaskan environment. LED lighting systems in arctic regions require heaters in winter; in the summer months, when the heaters are not needed, these regions experience as many as 24 hours of daylight. One potential consideration is whether an LED system is the best choice for this environment. Developing written best management practices for methods and materials in each region or subregion does not restrict flexibility but does inform the goal of improving system longevity.

If an airport lighting system is being replaced, consider a whole system replacement over a partial replacement. Whole system replacement can increase the availability of interchangeable parts and reduce the amount of spare parts needed on hand. Insufficient available equipment and materials was a significant maintenance issue identified in this study.

#### *4.1.3 Design for System Preservation Versus Expansion*

If funding will not be available to maintain the system, consider installing the minimum needed for safe operations. The planning team's goal should be early identification of the minimum lighting requirements to enhance safety while recognizing that maintenance costs and personnel availability dictate a conservative approach to component installation. Runway edge lights and an airport beacon are generally considered the minimum installation. If taxiway lights are proposed, evaluate using retroreflective taxiway edge markers (FAA Specification L-853) to minimize cost, maintenance, and electrical usage.

Using omnidirectional REILs in remote locations increases safety without excessive additional infrastructure. Pilot interviews for this study indicated that omnidirectional REILs would be valuable in flat terrain as well as mountainous terrain where circling approaches are the norm.

Add interviews with air carriers and medevac flight operators using the facility during the planning stage to determine if the airport has special challenges requiring additional lights or if safe operations are possible with reduced infrastructure. REILs are installed and maintained by the FAA, but lighting project coordination allows for DOT&PF input on FAA systems.

If technology or products are changing, consider testing new products in the specific environment. FAI obtained FAA approval to test LED runway lights at its location. The testing process found that the advertised benefits of LED lights were offset by the need for heaters and the much higher cost of replacement lights. The conclusion was that LED runway lights did not result in cost savings at this location for the project in development.

As discussed in Section 4.1.2, consider a policy of whole system replacement rather than partial replacement to reduce the spare parts purchased and stored on site. Airport lighting systems are interrelated by physical connections and regulatory requirements for low-visibility aircraft operations. Partial replacement may appear as cost saving during the initial assessment, but high mobilization costs in rural Alaska for emergency repairs or additional projects make whole system replacement a viable option for any rural lighting project.

### 4.2 Maintenance and Operations

#### *4.2.1 Improve Causation, Asset, and Material Tracking*

Research efforts conducted for this study revealed that M&O resources focus their limited time on reactive maintenance (repairing broken or malfunctioning lights) and no time is allocated for tracking the cause and cost of asset failure. DOT&PF is working to improving tracking, but the current process does not provide enough relevant information for decision-makers. The goal of system sustainability requires that the causation and cost of repairs be accurately documented, which can lead to improved decision-making for contracts, training, and design efforts. An example is the need to know if a higher rate of lighting damage at a particular airport is caused by vandalism, snow removal processes by the contractor, or environmental issues.

### 4.2.2 Improve Training, Snow Removal Plans, and Contract Language

DOT&PF could add to or modify the existing contractor onboarding process to provide additional training to rural snow removal contractors. Potential options include having trainees travel to the nearest hub or DOT&PF developing an on-site training plan. DOT&PF could potentially integrate this training program into a formal mentorship program with the larger-hub airports.

Consider adding lighting repair and associated training to contracts. Review possible incentives to include in contract language for contractors that have minimal light damage; conversely, penalties or disincentives could be added to all contracts for those who experience a higher-than-normal rate of light damage.

### 4.2.3 Install Light Poles or Flags

Airports in Canada and the northern United States have successfully used reflective flags or poles to assist snow removal operators in identifying runway and taxiway light locations during low-visibility conditions. If used, the poles or flags must meet frangibility requirements and be securely attached to the light base or light fixture to ensure that the poles or flags do not become foreign object debris (FOD).

The FAA guidance does not specifically approve or disapprove the installing of light-locator marking systems. The planner or design engineer is required to coordinate the specifics with the FAA project manager for new airport projects. Consider testing different manufacturer and product options at airports that experience blowing snow or heavy snowfall and higher-than-average runway lighting damage from snow removal operations.

**Figure 4-1.** Example of Snow Pole Installed on Taxiway Light.

### 4.2.4 Schedule and Complete More Preventive Maintenance Activities

Performing consistent preventive maintenance is one method for extending the life of an airfield lighting system. Because of the electrical hazards of lighting systems, most maintenance may only be completed by a qualified electrician. Regularly testing electrical system insulation is one example of a preventive maintenance procedure that the FAA recommends occurring as frequently as once per month.

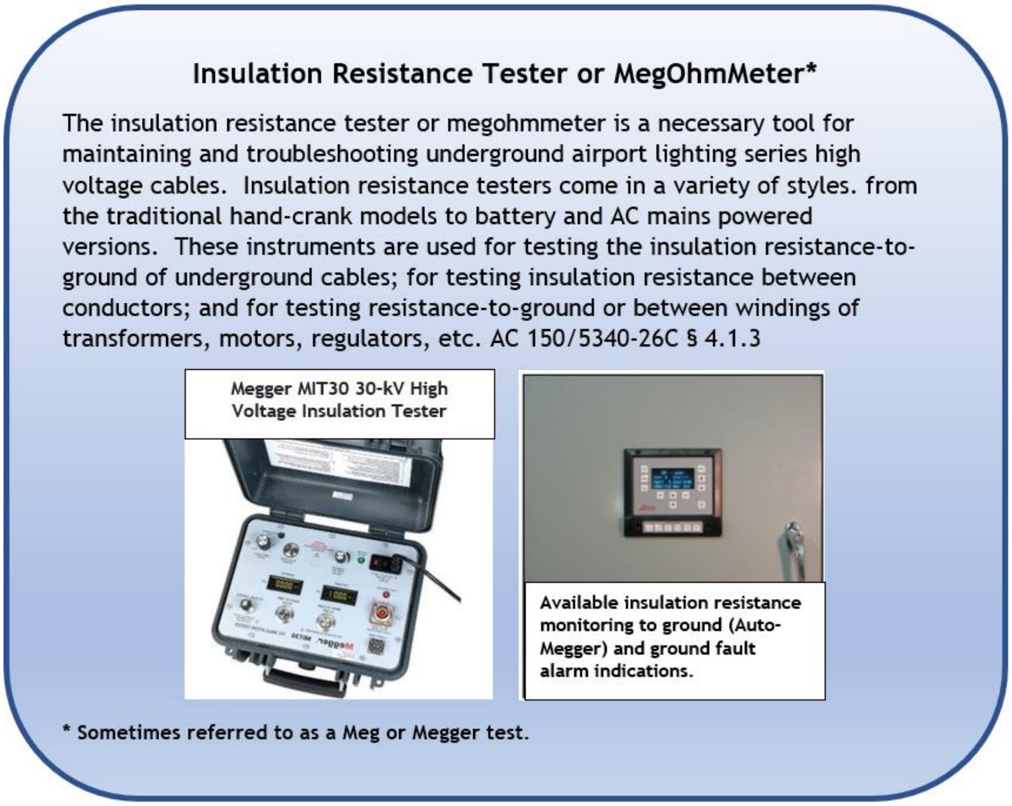



**Figure 4-2.** Meg Test Information.

In remote locations where an electrician is not available to conduct regular testing, project documents should specify the requirement for new installations to be equipped with insulation resistance-monitoring systems. These systems enable Megger checks, as described in Figure 4-2, by most airport personnel with minimal training. Consistently monitoring Meg values provides a picture of underground cable, connector, and transformer conditions. Decreasing values allow for determining more precise and verifiable replacement timelines. A sharp drop in values can alert the maintenance team to the need to repair a break or partial break and mitigate the risk of ground-fault injuries or fatalities.

### *4.2.5 Explore Statewide Contract or Shared Resources*

DOT&PF could develop a statewide contract or potentially use Alaska International Airport System (AIAS) electricians to complete site visits on a cyclical basis to develop maintenance needs and/or evaluate the system. These evaluations would be similar to CIMP or 5010 Airport Inspection programs but apply to the whole electrical system.

### *4.2.6 Develop a Statewide Term Contract*

The current rural electrical systems are generally undermaintained. Skilled labor is insufficient, and the electricians that do travel to the rural locations are focused on emergency repairs or reactive maintenance and cannot, or do not, perform preventive maintenance because of time and/or funding limitations.

Interviews conducted during this study identified difficulties both in Alaska and at Lower 48 airports in the ability to hire and retain qualified airport lighting maintenance personnel. Salt Lake

City International Airport (SLC) has instituted an intern program and Metropolitan Washington Airports Authority is currently offering cash sign-on bonuses for airfield electrician jobs. Other airports interviewed reported that airfield lighting maintenance is a unique skillset and is often performed in challenging weather conditions, which makes hiring and retention difficult, specifically when private contractors and industrial employers pay rates that are significantly higher. To address this ongoing issue, DOT&PF should consider updating the job classification or developing statewide or regional term contracts to provide emergency repairs and routine maintenance at rural airports.

DOT&PF Southcoast Region has an electrical airfield lighting repair contract in place and their experience could provide a resource to SWA or for other regions.

## 4.3 EQUIPMENT AND ASSET TRACKING DATA

### *4.3.1 Improve Asset/Material Tracking*

DOT&PF could better quantify and analyze trends related to lighting system economic life and reliability if information were consistently available and accurate. DOT&PF should consider providing a convenient way to incorporate daily report data into the Maintenance Management System (MMS) database and develop data pulls to the AASP to accurately convey each airport's state at a given time. Superintendents, foremen, or contractors should document and report the minor damage and replacements that occur at each airfield so that recurring issues can be identified and addressed.

A CIMP inspection only documents the condition of the installed system(s) during the specific inspection and does not give a complete impression of the system's operability. Previous CIMP inspection reports can be pulled to improve understanding, but the effort is cumbersome and only as accurate as the inspector's knowledge of airfield lighting allows. DOT&PF should consider providing methods other than formal inspections for easily updating airport needs and deficiency lists to get a better idea of current conditions and where to prioritize efforts.

### *4.3.2 Improve Vandalism Tracking*

Vandalism at rural airports is a known issue. DOT&PF has instituted several public campaigns to raise awareness about vandalism and the danger that vandalism poses to the community, especially if a medevac flight is required. These campaigns should continue and funds should be allocated to educate the public and track and document incident occurrences. Requesting assistance from community elders, tribal councils, law enforcement, and the legislature is more successful if evidence and cost accounting records are documented to support requests for assistance.

## 4.4 FUNDING

### *4.4.1 Develop an Avenue to Fund General Preventive Electrical Maintenance*

The rural airport lighting systems are suffering because of a lack of preventive maintenance and training.

Certified Airfield Professional (CAP) training is available from the airport lighting supplier Airside Solutions. Previous classes held at FAI and ANC included 3 days of extensive training. Employees who attended those classes gave the training positive reviews and said that the company brought in various types of airfield lighting fixtures and provided hands-on sessions.

DOT&PF should consider a training schedule that includes all Alaskan regions and local sponsor airports. One class per year rotated between regions would be an effective tool to train more staff and reduce travel costs. Partnering with Juneau, Kenai, and other local sponsor airports would reduce costs because of higher participation and enable regions to plan for training time and travel costs well in advance. DOT&PF could also consider making the CAP certification a requirement for contractors wishing to bid on rural airport lighting maintenance projects. Additional points could alternatively be given to CAP-certified contractors in the contract evaluation process. The American Association of Airport Executives (AAAE) offers Airport Certified Employee (ACE) Airfield Lighting Maintenance Program certification; these classes are available online.

### *4.4.2 Develop a Training and/or Mentorship Plan to Address the Current Labor Shortage of Qualified Airfield Electricians With Airfield Training*

Because of the electrical hazards related to lighting, most maintenance is currently completed by a qualified electrician. DOT&PF should explore sharing electricians across airports as possible (e.g., ANC and FAI). DOT&PF should also consider online mentorship and on-the-job training by teaming senior personnel with junior personnel.

DOT&PF should consider partnering with tribal corporations, unions, and the Alaska Vocational Technical Center (AVTEC) program to develop a training and apprentice program specific to airfield lighting. If such a program is instituted, that program will benefit the rural communities and provide both the international and rural systems with a larger pool of potential employees. All regions and the international airports currently report difficulties in hiring and retaining qualified airfield electricians.

Salt Lake City International Airport in Utah has an active electrical apprenticeship program and has offered to share its experience with DOT&PF. Other northern U.S. states, including North Dakota, Montana, and Wyoming, train their maintenance personnel using the CAP or AAAE certifications to safely perform routine maintenance and basic repairs. The advanced training detailed here does not preclude the need for qualified journeyman electricians to conduct some testing and wiring repairs; however, the training greatly reduces the need for electricians to do simple aboveground maintenance and light replacement activities.

## 4.5 COMMUNITY ENGAGEMENT AND AWARENESS

DOT&PF should make a concerted effort to understand and appropriately target rural audiences with messages concerning the importance of runways and airport lighting systems to our communities while emphasizing the need to protect and preserve the infrastructure from inadvertent damage or intentional vandalism. An excellent collaborator in developing new outreach and messaging to rural audiences is the Tribal Relations Liaison with DOT&PF.

Efforts to address airport vandalism include:

- DOT&PF's Willy Widgeon: Runways are for Airplanes coloring and activity book for school-age children, which is available on the Statewide Aviation (SWA) website
- Runways are for Airplanes posters

- Resolution 18-10-01 calling for the *Prevention of Vandalism and Damage to Rural Airports and Runways*, promulgated by the Association of Village Council Presidents (AVCP) to address vandalism at airports.

These and other efforts have helped to inform the public about the potential safety implications to residents, but the problem continues to plague some communities. The issue requires continuing attention and developing even better partnerships with the communities involved. DOT&PF should increase efforts to reach out to experts and use internal assets to develop meaningful programs that will resonate with the target audience.

Implementing a community-based Adopt-an-Airport Program or similar programs could be helpful to increase community engagement and awareness.

## 4.6 ADDITIONAL RECOMMENDATIONS

The team compiled several additional recommendations based on further conversations with DOT&PF staff, Lower 48 airports, and pilots:

- A complete inventory of the type, manufacturer, and age of all systems should be published internally.
- Any project that replaces old lighting systems should contractually include salvaging old components and distributing those components to airports still using that lighting system. This process is currently used in some regions, but the process should be expanded statewide.
- The planning team submitting a nomination for replacing or upgrading an existing lighting system should reach out to the air carriers serving the community early in the process, ideally as the design aircraft are verified, and discuss the lighting needs. Considerations to be discussed include:
  - In addition to runway edge lighting, what would be the next most valuable, safety enhancing visual aid in this location? The response and justification should be documented.
  - Lighting elements that are not vital to increasing safety could be eliminated to allow funding and maintenance resources to be focused on the most valuable assets.
  - Air carrier plans change and should be identified in the earliest steps of the process. Follow-up verification with air carriers should occur during the design phase.
- Throughout the research and interview phase of this study, it was obvious that the number one resource that DOT&PF has to ensure the sustainability of the airport system is its employees. Despite reduced budgets and challenging environments, these workers are finding innovative solutions to challenging issues. Personnel assigned to individual airports invariably refer to "my airport." They are invested, they care, and they are constantly thinking of ways to improve their facilities. Contractors with a 1- or 3-year contract are not thinking about working a few extra hours to make conditions better for next year or 5 years—this scenario can be related to the care and maintenance on a personal vehicle compared to the care given to a rental car.

- Consider incentives or renewal options to encourage contractors to take more ownership in the airports they maintain.
- Continue to look for ways to employ local residents to maintain rural airports; consider part-time positions or other innovations to build a sustainable, dedicated, and knowledgeable work force.
- Renew efforts to educate decision-makers on the critical nature of the rural airport system.
- Take every opportunity to allow contractors to work and train with experienced and dedicated DOT&PF airport employees operating within an airport environment.

## 5.0 RECOMMENDATION REVIEW AND PRIORITIZATION

A partial list of recommendations was presented to a statewide review team representing the planning, design, maintenance, and construction perspectives. Several recommendations could be implemented concurrently based on regional priorities and the existing guidance.

1. Develop flow chart and/or a Frequently Asked Questions (FAQ) of the airfield lighting design process for planners, designers, and maintenance personnel. **[4.1.1]**
2. Design for system preservation versus expansion. **[4.1.3]**
3. Improve asset/material tracking to track useful life and reliability. **[4.3.1]**
4. Develop avenue to fund general preventive electrical maintenance. **[4.4.1]**
5. Develop a statewide contract or use AIAS electricians to complete site visits on a cyclical basis to develop maintenance needs and/or evaluate the system. **[4.2.3]**
6. Improve vandalism tracking. **[4.3.2]**
7. Develop a training and/or mentorship plan to address the current labor shortage of qualified airfield electricians which require specialized training. **[4.4.2]**
8. Increase community engagement and awareness. **[4.5.1]**

**Figure 5-1.** Recommendation Priority Ranked by DOT&PF.

## 6.0 CONCLUSIONS

DOT&PF has made significant progress in adding new systems and improving airport lighting at rural airports during the last 12 years; however, reduced maintenance funding and aging systems are creating new challenges statewide. The FAA AIP grant program considers 10 years to be the useful life of airport lighting and signage, which means that a decade-old system is eligible for replacement with AIP grant funds. This study finds that the average age of runway lighting across the system is approximately 20 years, and more than 19 percent of airport lighting systems are now exceeding the 30- to 40-year age. The statistics are daunting; however, the consensus is that the airports with the greatest need for lighting systems have been addressed or are programmed for lighting projects in the near term. The task for management is to focus on the aging infrastructure with a programmatic approach to replace systems that have reached, or, in many cases, exceeded their economic lives.

The second significant finding is that preventative maintenance,[2] such as Megger testing, is practically nonexistent and routine maintenance is sporadic depending entirely on the availability of trained staff, which varies significantly across the system. Funding for additional, qualified electricians and trained maintenance personnel is a challenge in the current fiscal environment. Increased training opportunities for existing positions will be valuable, but all of the current employees already fulfill several roles and often work at multiple facilities; therefore, increased training will help but not solve preservation concerns. The most disconcerting fact within the overall maintenance finding is that broken/frayed electrical connections and potentially dangerous faults are concealed underground and not readily visible hazards. Programmatic replacement of extremely old systems and those with documented, systemic issues is the most practicable option.


**Figure 6-1.** Bethel Airport Signage. (Photograph by Michael Cook).

[2] As defined by AC 150/5340-26C § 3.3, *Preventive Maintenance Program* – "Reliable functioning of airport lighted visual aids is essential to airport safety, capacity, and operation especially for low visibility operations. Therefore, it is essential that a preventive maintenance program be established to ensure reliable service and proper equipment operation. Properly scheduled inspections, testing, and calibrations are essential to the proper functioning of these systems."

## 7.0 ADDITIONAL RESOURCES/GUIDANCE

Reference material cited for this report is current at the time of publication. Users should always refer to the most recent version of FAA guidance.

- DOT&PF Rural Airport Maintenance Manual – New Contractor Orientation
- FAA Modification to Standards, State of Alaska *Airport Marking Standards for Unpaved Runways* (2000)
- FAA AC 150-5340-26, *Maintenance of Airport Visual Aid Facilities*
- FAA AC 150/5340-30J, *Design and Installation Details for Airport Visual Aids*
- FAA Order 5300-38D, *Change 1, Airport Improvement Program Handbook*
- Airport Cooperative Research Program (ACRP) Report 138, *Preventive Maintenance at General Aviation Airports, Volume 1: Primer* (2015)
- ACRP Report 138, *Preventive Maintenance at General Aviation Airports, Volume 2: Guidebook* (2015)
- ACRP Report 148, *LED Airfield Lighting System Operation and Maintenance* (2015)
- ACRP Synthesis 67, *Airside Snow Removal Practices for Small Airports With Limited Budgets - A Synthesis of Airport Practice*
- DOT&PF Rural Airfield Electrical Testing Checklist (Appendix D).

# APPENDIX A

## Facility Data Profiles

available at www.alaskaasp.com

# APPENDIX B

## Superintendent Questionnaires

# Lighting Analysis for Rural Airports

IRIS Program No: SFAPT00142 | FAA AIP No: 3-02-0000-023-2017

## Superintendent Questionnaire

INTRO & WHY

This study assesses the current status of rural airfield lighting across Alaska, by reviewing current runway and approach lighting practices, lighting maintenance procedures, and lighting challenges. The intent is to develop a consistent approach to lighting improvements across Alaska's rural airport system, analyze potential benefits of various alternative standards, and provide recommendations to support systemic decision-making for future lighting projects.

INSTRUCTIONS

Questionnaire packets, arranged by District Superintendent, are available on DOT&PF's Internal AASP website (access here). To download, navigate to the **Airport Lighting Project folder**, under the **Resource tab.**

Within each packet, every Runway has a corresponding profile data sheet followed by the appropriate questionnaire. Please download the packet, review the Runway profiles and complete the applicable questions. For airports with multiple runways, answer duplicate questions only once unless something worth noting is specific to a given runway.

Once complete, please upload the questionnaire packet to the **Completed Documents folder** (within the Airport Lighting Project folder on DOT&PF's Internal AASP website). <u>If preferred, in lieu of completing the questionnaire, a phone call can be scheduled to discuss the packets.</u> Please indicate below, the best way (method and time) for PDC to follow-up regarding your responses.

BEST WAY FOR PDC TO FOLLOW-UP:

☐ VIA PHONE @ ____________

When is generally a good time? (M-F, 8AM-5PM), Morning, Afternoon, etc. ____________

☐ VIA EMAIL @ ____________

☐ OTHER (SPECIFY) ____________

HAVE YOU COMPLETED AND RETURNED THE QUESTIONNAIRE PACKET?

☐ Yes, I have reviewed the packet and returned the questionnaire.

☐ I have reviewed the packet but have not completed the questionnaire.

☐ No, I have not reviewed the packet or completed the questionnaire.

CLICK TO SUBMIT VIA EMAIL

# Lighting Analysis for Rural Airports

IRIS Program No: SFAPT00142 | FAA AIP No: 3-02-0000-023-2017

## Superintendent Questionnaire

**AIRPORT NAME:** ____________ **AIRPORT ID:** ____________

1

| Existing Approach Lighting Information (Complete if Applicable/Known) | | | |
|---|---|---|---|
| **Type** | **Corrections to Existing Information (If applicable)** | **Project Grant Number (or Year Installed)** | **Maintenance Problems (If applicable)** |
| VGSI (PAPI, VASI) | | | |
| REIL | | | |
| Approach Lighting[1] | | | |

1. For 'UNK/UNK', list No or None if approach lighting does not currently exist. If approach lighting does exist, list type (ODALS, MALS/R, ALSF).

2

| Existing Edge Light Information (Complete if Applicable/Known) | | | | | | |
|---|---|---|---|---|---|---|
| **Location** | **Intensity[1] (MIRL/HIRL)** | **Light Source (LED vs Incandescent)** | **Above or Below Grade Light Bases** | **Light Base Material (HDPE or Metal)** | **With or Without Heaters** | **Grant Number (or Year Installed)** |
| Runway | | | | | | |
| Taxiway | | | | | | |

1. Edge light intensity: Complete only if existing intensity is different than what is listed on Runway data sheet.

3

**Have you repaired and or replaced the following equipment within the specified time period? Provide quantity, and reason for repair/replacement if known.**

| Equipment | Within the past year | Within the past 2-5 years | Within the past 5-10 years |
|---|---|---|---|
| VGSI (PAPI, VASI) | | | |
| REIL | | | |
| Runway Edge Light | | | |
| Taxiway Edge Light | | | |
| Light Can Base | | | |
| Transformer | | | |
| Conduit/ Conductors | | | |
| Other (Please specify) | | | |

## Superintendent Questionnaire

| | |
|---|---|
| 4 | **Are there any special maintenance procedures specific to this airport?** |
| | |

| | |
|---|---|
| 5 | **Are damaged light bases replaced entirely, or repaired with can sleeves (or similar equipment)?** |
| | |

| | |
|---|---|
| 6 | **What is the primary factor for maintenance at this airport?** |
| | |

| | |
|---|---|
| 7 | **Are there any issues with the current lighting system(s) that are not already covered?** |
| | |

# Lighting Analysis for Rural Airports

IRIS Program No: SFAPT00142 | FAA AIP No: 3-02-0000-023-2017

## Superintendent Questionnaire

**AIRPORT NAME:** ______________________ **AIRPORT ID:** ______________________

1

| Existing Approach Lighting Information (Complete if Applicable/Known) [1] | | | |
|---|---|---|---|
| **Type** | **Corrections to Existing Information (If applicable)** | **Project Grant Number (or Year Installed, if applicable)** | **Maintenance Problems (If applicable)** |
| VGSI (PAPI, VASI) | | | |
| REIL | | | |
| Approach Lighting | | | |

1. If Runway does not have existing lighting, skip question 1. If lighting is present, complete the above table with known information.

2 **Are there any special maintenance procedures specific to this airport?**

3 **What is the primary factor for maintenance at this airport?**

4 **Are there issues with any existing system(s) that are not already covered?**

5 **Opinion: Is there a need for lighting at this airport? What reasoning or circumstances support your opinion?**

# APPENDIX C

## Recommendations Brainstorm Summary

TECHNICAL MEMORANDUM

| Client | DOT&PF | Date | September 11, 2020 |
|---|---|---|---|
| Project Name | Rural Airport Lighting Analysis | Prepared by | Jordan Martin, Angela Smith |
| Subject | Rural Airport Lighting Analysis Recommendations Collaboration | | |

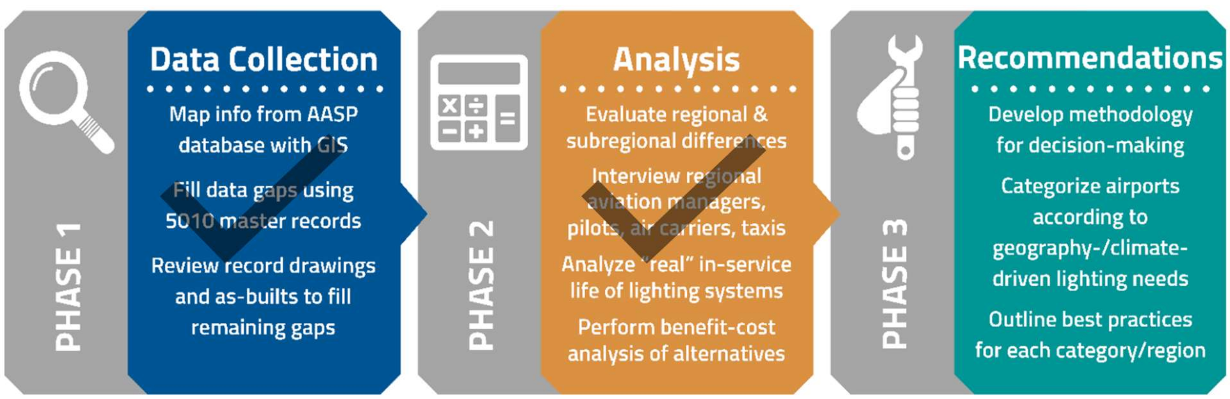
## Project Goal

Recommend a standard or methodology that would support systemic decision-making regarding airport lighting projects.

## Background

This project is exploring the lighting needs of general aviation airports around the State of Alaska. Runway and approach lighting are beneficial and desirable for all airports, but the decision to install lights, and the types of lights, is generally made on a case-by-case basis. **To install or not to install is NOT the focus of this study.**

This project is being completed in three phases as shown in the graphic below.
Phase 2 is nearly complete, and Phase 3 is underway.




## Additional Resources

- DOT&PF Rural Airport Maintenance Manual – New Contractor Orientation
- FAA A/C 150-5340-26 - Maintenance of Airport Visual Aid Facilities
- ACRP Report 138: Preventive Maintenance at General Aviation Airports Volume 1: Primer (2015)
- ACRP Report 138: Preventive Maintenance at General Aviation Airports Volume2: Guidebook (2015)
- ACRP Report 148: LED Airfield Lighting System Operation and Maintenance (2015)
- ACRP Synthesis 67: Airside Snow Removal Practices for Small Airports with Limited Budgets - A Synthesis of Airport Practice

## Discussion Topics at Project Kickoff

### Things we thought would impact our recommendations

- Materials (incandescent vs led fixtures; metal vs HDPE light can base; with or without heaters)
- installation method (above grade vs below grade light can installation)
- Quantity and frequency of repairs/replacement
- Maintenance responsibility and procedures (DOT maintenance vs contracted; full vs partial can replacement; preventative maintenance)
- Snow removal operations (responsibility; methods)


Coastal airports have different soil, terrain, and weather conditions than inland airports.

## Anticipated and Explored Trends

- Climate related performance issues based on precipitation, temperatures
- Similarities in airports served by same carrier
- Differences among similar airport classifications

# Trends we are noticing

✓

Designs can be adjusted for varying environments – designers need to get input from local M&O during design

Airfields are extending life of systems to last as long as necessary (at staffed airport)

Many recently installed LED fixtures are installed with heaters (within last 2-3 years)

NR is trying to test out a few locations to see how these systems perform in the NR

Many new installations make use of metal light can bases. Rings and extensions available to make final adjustments.

## Identified Maintenance Issues

yes... this is accurate

- funding limitations
- labor – qualified and willing maintenance personnel
- lack of preventative maintenance, system testing not performed
- dips and sinking in safety areas, and around light bases – uneven light lines along RW/TW
- ground freeze/thaw – creating frost heave issues
- water in systems; drainage issues
- corrosion observed in locations with high water tables
- wiring issues in areas with direct-bury conductors (and flooding in particular)
- time it takes to make repairs
- available equipment and materials

## Primary Factors (Reason) for Maintenance/Repairs

**General:** safety, part 139 operations

**Other:** power quality, equipment durability

**Preventable:** contractor damage, snow removal operations

NR started to charge the contractors to repair damage (Tom Williams idea)

document

## Recommendation Topics (so far…)

### *Design and Installation*

- ~~Develop~~ methods and materials best management practices to improve consistency between regions

**develop a flowchart for M&O-design related question or FAQ to help our foreman and superintendents**

- ~~Develop SOP requiring~~ M&O participation in design phase of new or replacement lighting systems

early

### *Maintenance Practices*

existing training program is limited due to the dangerous activity associated with underground

- Preventative Maintenance

develop checklist specific for rural ligthting

- Snow Removal Operations

providing additional training in this area is a good idea

### *Funding: Capital vs Maintenance*

- possibility of statewide grant funding for minor lighting replacement projects
- training programs for snow removal

training program, send community members to regional hub to receive training

funding for training is really tough... has to come from DOT funds

- training programs for electrical system preventative maintenance activities

### *Community Involvement and Responsibility*

- Explore possible agreements with local governments/tribal entities to share costs, experienced electricians or training
- Seek community resolution on Airport Watch Group creation to help protect "their" infrastructure.

potentially tie to Adopt an Airport for reporting

DOT developed airport lighting coloring book to increase awareness - Could look into working with Dept of Education to help increase awareness... this would be a long term strategy
Need to understand the audience - sell the things that the youth value (getting to BB game, getting treats)

**Emergency Lighting System** - no established process to assign to airports; request based from the community.... program development is looking into ways to having cost-sharing with community (similar to highway side)

How do we decide to include standby power (generator) for lighting system?

Constant current systems (need an electrician for preventive maintenance and testing) verses constant voltage systems

**What about sharing the international airport system electricians to travel to train, mentor, periodic checks? ---- Great idea!**

What about we do a 5-year term contract to provide emergency electrical repairs in the rural system? (NR has something similar for highways e.g. guardrail repairs)

What about something like they did for the pavement management system... dedicated person that completes the inspections/preventative maintenance on a rotation basis... pavement inspections every 3 years at each airport...would equate to 100+ inspections per year... implementation could be a challenge

**useful life of system components:**
regulator life ~ 10 years

Develop/Adjust APEB lighting criteria set... stand alone lighting systems do not score well currently - currently in discussion in the regions

Focus on preservation verses expansion/new construction with budget cuts. Need to take care of what we have.

Consider: When was the last time FAA paid verses when was the last time DOT has completed a major repair with State funds?

Plan is to push out all the draft recommendations to the M&O and design groups (will start with chiefs)

# APPENDIX D

## Rural Airfield Electrical Testing Checklist

# Rural Airfield Electrical Testing Checklist

Notes:

1. Contact airport manager to obtain approval prior to performing any tests.
2. Only qualified Electricians experienced with constant current series circuits may perform the tests. Those not familiar with constant current series circuits must not perform these tests.
3. This testing procedure is intended to be general in nature. Personnel performing tests need to follow manufacturers' recommended procedures for testing; those procedures supersede any instructions given.
4. Energized electrical work is prohibited unless allowed by NFPA 70E and the Electrical Contractor's safety policies and procedures.
5. If any code violations or safety concerns are encountered during construction, notify the Department's representative immediately for resolution.
6. Always de-energize circuits prior to disconnecting.
7. Always follow lock-out / tag-out (LOTO) procedures.
8. Always use properly rated test equipment. Ensure test equipment is rated for the maximum voltage of each circuit tested.

Tested by: ______________________________________________ Date: _________________

______________________________________________

**Runway and Taxiway Lighting Circuits**

Underground Power Cable Insulation Resistance Readings

1. Perform conductor insulation resistance to ground reading at the series cutout (SCO) on the ungrounded constant current series runway lighting circuit. Test at 1,000V. Record the value below. Expected value is > 2,000 megohms initially after installation; this value is expected to decrease on the order of 10% each year (from the previous year).

   ______________________________________________________________________________

2. Perform conductor insulation resistance to ground reading at the SCO on the ungrounded constant current series taxiway lighting circuit (if separate from the runway lighting circuit). Test at 1,000V. Record the value below. Expected value is > 2,000 megohms initially after installation; this value is expected to decrease on the order of 10% each year (from the previous year).

   ______________________________________________________________________________

Lighting Circuit Resistance Readings

1. Perform series lighting circuit loop resistance reading at the SCO on the ungrounded constant current series runway lighting circuit. Record the value below. Expected value varies by circuit.

   ______________________________________________________________________________

2. Perform series lighting circuit loop resistance reading at the SCO on the ungrounded constant current series taxiway lighting circuit. Record the value below. Expected value varies by circuit.

   ______________________________________________________________________________

Runway and Taxiway Lighting Operation Tests

1. At the lighting control panel, test each of the lighting intensity steps manually to ensure proper operation. Note any deficiencies.

   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________

2. At the lighting control panel, set the lighting control to Radio. Test each of the lighting intensity steps manually using radio mic clicks to ensure proper operation. Ensure lights remain on for 15 minutes after the last click. Note any deficiencies.

   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________

Runway / Taxiway Lighting and EEB Visual Observation

1. Energize the runway and taxiway lighting circuits and visually inspect each system. Indicate if any lamps do not illuminate or if any lighting equipment is physically damaged.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

2. Visually inspect the following: EEB structure/building and appurtenances; electrical service(s) and disconnecting means; and EEB interior electrical equipment, including the lighting control panel, radio controller, panelboard(s), series cutout, lighting fixtures, and electric heater(s). Note conditions of each, and note any issues observed.

______________________________________________________________________________
______________________________________________________________________________
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3. Note any other deficiencies that are observed.

______________________________________________________________________________
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**Constant Current Regulator (CCR) Tests**

CCR Input Tests

1. Measure the CCR input voltage. Record the value below. Expected value is ±5% of nominal input voltage.

   ______________________________________________________________________________

2. Measure the CCR input current with runway and taxiway lighting energized. Record the value below. Expected value varies by site.

   ______________________________________________________________________________

CCR Output Tests

1. For the next test listed in #2, do not use a portable meter. Use the CCR's digital readout display to determine the measured values.
2. At the CCR, determine the output rms voltage and true rms output current of each lighting intensity step. If an output current value falls outside the acceptable ranges listed below, carefully adjust the output current at the controller board. Record the values below after any adjustments have been made.

CCR in Remote Control

Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V

CCR in Local Control

Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V
Step: ________ Output current: __________ Amps Output voltage: ___________ V

The acceptable true rms output current values in amperes (by step) are as follows:

| | |
|---|---|
| Class 1, Style 1, 3-Step: | 6.5 to 6.7 (B100), 5.4 to 5.6 (B30), and 4.7 to 4.9 (B10) |
| Class 1, Style 2, 5-Step, 6.6A: | 6.5 to 6.7 (B5), 5.1 to 5.3 (B4), and 4.0 to 4.2 (B3), 3.3 to 3.5 (B2), and 2.7 to 2.9 (B1) |
| Class 2, Style 2, 5-Step, 20A: | 19.7 to 20.3 (B5), 15.5 to 16.1 (B4), and 12.1 to 12.7 (B3), 10.0 to 10.6 (B2), and 8.2 to 8.8 (B1) |

3. At the CCR, record the rating of constant current regulator: ____________________________
   Ensure that the output rms voltage multiplied by the true rms output current does not exceed the rated load on the CCR nameplate.
   Notes: ________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

CCR Short Circuit and Open Circuit Tests

1. Perform CCR short circuit test per the specific CCR manufacturer's instructions. Record the results. The typical steps, which can be followed if manufacturer's instructions are unavailable, are:
   a. Remove power to the regulator.
   b. Isolate the constant current series circuit from the CCR using the SCO. Rotate the handle of the SCO to the Test and Measure position.
   c. Energize the regulator and record the output current at each lighting step.
   d. Remove power from the regulator, place the cover back on the SCO with the handle rotated to the Operation position, ensure the system has been restored to its original position, and re-energize the regulator.

2. Perform CCR open circuit test per the specific CCR manufacturer's instructions. Record the results. The typical steps are:
   a. Remove power to the regulator.
   b. Remove the cover of the SCO to create an open circuit.
   c. Energize the regulator; the open circuit protective device should quickly open to de-energize the regulator. Ensure the device resets properly.
      Pass: __________ Fail: __________ If fail, describe: _____________________
      ________________________________________________________________
      ________________________________________________________________
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      ________________________________________________________________
   d. Remove power from the regulator, place the cover back on the SCO with the handle rotated to the Operation position, ensure the system has been restored to its original position, and re-energize the regulator.
   e. Note: this test should typically be performed one time per year.

CCR Local Control Switch Operation & Visual Observation

1. Operate the local control switch to check for proper operation of relays and contactors.
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2. Check all indicating and/or warning lights and note if any are illuminated.

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3. Visually inspect all fuses and circuit breakers.

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4. Check for any burnt or loose connections.

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5. Check for rust spots, missing covers, or other physical damage.

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CCR Capacitor Bank Test (for Ferroresonant CCRs)

Note: Only qualified Electricians experienced with constant current series circuits, including troubleshooting CCRs, may perform the following capacitor bank test.

Note: the steps below are specific to ADB Ferro CCRs. The steps and procedure may differ depending upon the specific CCR manufacturer and model number.

1. Check to see if the CCR's Tank Current is written on the inside of the CCR door or somewhere next to the CCR. If so, skip to Step #11 below. If not, proceed to the next step, #2.
2. De-energize power to the regulator at the AC source.
3. Isolate the constant current series circuit from the CCR by removing the SCO.
4. Rotate the handle of the SCO and re-insert in the Test and Measure position.
5. Unplug the gate wires at the Universal Regulator Controller (URC) board. This will cause the SCR to be totally off, which means there is zero current in the tank circuit which causes maximum output to the field.
6. Turn the CCR on and verify that it shuts down on Overcurrent. If it doesn't shut off, make a note below. This is an indication that some capacitors are already bad. Note: faulty capacitors will typically have bulging cases.

   Shuts down on overcurrent? (Y/N) _______________

   If "No", stop procedure. Make a note that the capacitor bank should be replaced. Plug the gate wires back in and place the field circuit back on the CCR by removing the SCO and re-inserting in the Operation position. Re-energize the regulator at the AC source in order to place the system back in service.

   If "Yes", proceed to the next step, #7.

7. After a successful shutdown, plug the gate wires back in and place the field circuit back on the CCR by removing the SCO and re-inserting in the Operation position. Re-energize the regulator at the AC source.
8. With the normal field load on the CCR, turn the CCR to the highest step and tune it to 6.6 amps.
9. Measure the current in the tank circuit (one of the big wires on the SCR).
10. Write the value of the measured tank current, and today's date, on the inside of the CCR door or next to the CCR using a permanent marker.
11. Check the capacitors: turn the regulator to the high step with the load still on it and compare the current written down to the current being measured. If the measured current in the tank circuit has gone down from the recorded value, then this is an indication that capacitors have failed. If the current is nearly the same, the capacitor bank is operating properly.

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**Lighted Wind Cone Circuits**

1. Determine whether the power source for the lighted wind cone is constant current or ≤600V constant voltage. Perform voltage reading of the lighted wind cone circuit at the power source. Use the CCR's digital readout display to determine the voltage for constant current series circuits; do not check a constant current circuit with a voltmeter. Record the value below. Expected value is within ±10% of nominal system voltage. If series circuit, note whether an isolation transformer or power adapter is used.

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   ______________________________________________________________________________

2. Perform conductor insulation resistance to ground reading on each ungrounded lighted wind cone power circuit that has not yet been tested. Test constant current series systems circuits at 1000V, and test ≤600V circuits at 500V. Record the value below. Expected value for constant current series systems is >2,000 megohms initially after installation; this value is expected to decrease on the order of 10% each year (from the previous year). Expected value is approximately 100 megohms initially after installation for ≤600V systems.

   ______________________________________________________________________________

3. At the lighting control panel, use the selector switch and ensure that the primary wind cone operates correctly in the ON, OFF, and AUTO (photocell-controlled) positions. Ensure that the supplemental wind cone operates the same as the primary or is on when the runway and taxiway lights are on.

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4. Visually inspect operation and physical condition of the wind cones. Note any deficiencies below, such as: rust; damage to pole, foundation, or wind sock; or inoperable lowering winch. The wind sock should be replaced annually.

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**Rotating Beacon Tests**

1. Perform conductor insulation resistance to ground reading on the ungrounded beacon power circuit. Test at 500V. Record the value below. Expected value is approximately 100 megohms initially after installation.

   ______________________________________________________________________________

2. Perform voltage reading of the beacon circuit at the power source. Record the value below. Expected value is within ±10% of nominal system voltage.

   ______________________________________________________________________________

3. At the lighting control panel, use the selector switch and ensure that the rotating beacon operates correctly in the ON, OFF, and AUTO (photocell-controlled) positions.

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   ______________________________________________________________________________

4. Visually inspect operation of the rotating beacon and associated telltale relay and obstruction lights (if present). Verify the vertical angle of the beam is no less than 2° above the horizontal. Clean the lens. Check lamp condition; lamp should be replaced annually. Note any deficiencies below.

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5. Inspect physical condition of rotating beacon. Note any deficiencies below, such as: rust; damage to pole, foundation, mounting platform, or access ladder (as applicable); or inoperable lowering winch (if applicable).

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**<u>Record of Electrical Infrastructure</u>**

Upon completion of the electrical testing, and as time allows, provide a brief written description of the existing airfield lighting infrastructure in order to develop a record of what exists at the site. The information to document includes, but is not limited to:

- Electrical utility – ratings, size, type, location
- Electrical service equipment – voltage, phase, ratings, mains
- Engine-generator set, if applicable – enclosure/shelter, voltage, phase, ratings, fuel supply, starting system
- Runway/taxiway lighting – incandescent, halogen, or LED lamps; steel or HDPE light bases; cones or markers on/at fixtures
- Wind cone(s) – incandescent or LED, internally or externally lit, wind sock size
- Rotating beacon – intensity/wattage; pole-mounted (tilt-down or fixed) or SREB-mounted (roof mounted with/without ladder and with/without work platform)
- FAA navigational aids and related infrastructure

**<u>Other Concerns or Deficiencies Noted</u>**

# APPENDIX E

## **Draft** Airport Lighting Assessment and Planning Questionnaire

# Airport Lighting Assessment and Planning Questionnaire

*Submit completed questionnaire with APEB nomination package.*

**Airport Facility:** ______ **Location ID:** ______

**Assessment By:** ______ **Assessment Date:** ______

This questionnaire is a tool to assess and verify lighting needs during project development.
Please coordinate with the airport manager and regional M&O specialist to answer the following questions.

**Helpful Links**

| | |
|---|---|
| Airport Improvement Program Handbook | FAA Order 5300-38D, Change 1 |
| Maintenance of Airport Visual Aid Facilities | FAA AC 150-5340-26 |
| Design and Installation Details for Airport Visual Aids | FAA AC 150/5340-30 |

Q1 Has a Capital Improvement and Maintenance Program (CIMP) inspection been completed within the last 3 years?

Yes ☐ --> briefly explain: [date, brief description of airfield lighting condition based on CIMP report]
No ☐

Q2 Are there ***documented*** airport lighting maintenance issues or concerns at this facility?

Yes ☐ --> briefly explain: [exposed conduit, damaged junction boxes, power supply problems, etc.]
No ☐

Q3 Are there ***specific*** airport lighting maintenance procedures in place at this facility?

Yes ☐ --> briefly explain: [snow removal procedures/attachments, preventative maintenance schedule, etc.]
No ☐

Q4 Has the airport lighting system been recently repaired/upgraded? *(other than stem, bulb replacement)*

Yes ☐ --> briefly explain: [lighting infrastructure replacement/repairs included… ]
No ☐

Repair/Replace Year: ______

Repair/Replacement by: [term contract, specialty contractor, M&O, etc.]

Q5 In the past 5 years, what NOTAMs been issued **due to lighting problems at this facility?**

[NOTAM reference, date, details, etc.… ]

Q6 Are runway and taxiway edge light types consistent?

Yes ☐ Type: [LED, incandescent, quartz]
No ☐ Type(s): RW: [LED, incandescent, quartz], TW: [LED, incandescent, quartz]

Notes: ______

# Airport Lighting Assessment and Planning Questionnaire

(continued)

Please review most recent CIMP inspection report for the facility. If a CIMP inspection is scheduled please coordinate with the Inspector, Airport Manager, and Regional M&O Specialist to complete the following HIGH LEVEL lighting inventory. This inventory should be completed either on-site or by personnel who have been on-site and visually confirmed equipment. In the notes section please indicate manufacturer/type/model if available and any maintenance concerns. This is intended to determine if a detailed airport lighting inspection/inventory is necessary. Accurate information will assist in correcting existing documents or alerting the department to the need for a full lighting inventory.

**Place a checkmark next to each item observed at the airport, provide installation year if known.**

| | Item(s) | Year Installed | Concerns (Y/N) | Notes |
|---|---|---|---|---|
| **Airfield Lighting (typically located on the airfield)** | | | | |
| | Runway lights | | | |
| | Taxiway lights | | | |
| | Ramp/Apron lights | | | |
| | Runway End Identifier Lights (REIL) | | | |
| | VGSI (VASI/PAPI) | | | |
| | Rotating beacon & beacon disconnect switch | | | |
| | Lighted Wind cone (primary) | | | |
| | Lighted Wind cone (secondary) | | | |
| | Obstruction Lights | | | |
| | Weather station | | | |
| | Hand holes, manholes, junction boxes, etc. | | | |
| | Conduit [RW, TW] | | | |
| | Cable, ground wire [RW, TW] | | | |
| | Signs and Markers | | | |
| **Airfield Lighting Equipment (typically located nearby, or inside electrical equipment building/enclosure)** | | | | |
| | Power utility meter/disconnect service equip | | | |
| | Circuit breaker panelboard | | | |
| | Constant current regulator | | | |
| | Series circuit cutout & troubleshooting plugs | | | |
| | Airport lighting control panel; L-821 | | | |
| | Airport lighting radio controller; L-854 | | | |
| | Radio controller power backboard | | | |
| | Manual transfer switch | | | |
| | Generator inlet breaker, cabinet | | | |
| | Airport lighting radio controller antenna | | | |
| | Exterior, interior lighting | | | |
| | Airport lighting test push button | | | |


Homer (HOM) Airport MALSR
SWA Archive Photo

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*The preparation of this document was supported in part with financial assistance through the Airport Improvement Program from the Federal Aviation Administration (AIP Grant No. 3-02-0000-024-2018) as provided under Title 49 USC §47104. The contents do not necessarily reflect the official views or policy of the FAA. Acceptance of this report by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted therein, nor does it indicate that the proposed development is environmentally acceptable in accordance with appropriate public laws.*