CASPER

SHARED INSIGHT

TOWN OF MIDDLETON, WI NOISE STUDY
MAY-OCTOBER 2024

TOWN OF
MIDDLETON
Wisconsin

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1. History and Background

In April of 2024, the Town of Middleton, Wisconsin ("Town") contacted Casper Airport Solutions, Inc to perform a noise study on the acoustical impact of the nearby Morey Field Airport (C29) on the Town's residential areas. The airport itself is located within the city limits of the neighboring City of Middleton, Wisconsin ("City") resulting in ongoing communication between both municipalities on the operational impact and future plans for the airport. Casper has been tasked with providing acoustic and flight analysis to further provide scientific context to these communications.

C29 is a public use GA airport owned by the City of Middleton situated in the northwest corner of the City's limits. The airport is served by two tenants, one of which provides FBO services, and both provide flight instruction. Together, they produce a notable majority of daily flights at the airport. The airport is home to a paved east/west runway designated 10/28, and a turf runway oriented north/south designated 1/19. The turf runway is open seasonally and was open for the entirety of our study period.

Between the dates of May 30, 2024, and October 1, 2024, Casper placed a portable noise monitor at two locations approximately 1 nautical mile and 1.6 nautical miles west of runway 10/28 at C29. The first location was monitored from May 30 to July 31, and the second location was monitored from August 1 to October 1. The locations were installed and maintained by our primary subcontractor, Sanchez Industrial Designs (SID). The operational analysis period overlaps coterminously with the noise monitoring dates.

The purpose of this document is to provide the details of the aircraft noise collected at the monitoring sites and to provide some recommendations to the Town which could lower the impact of that noise.

2. Glossary of Terms

ACNE – Aircraft Noise Event, or a noise event caused by an aircraft as opposed to a community sound

A/FD – *see CS – Chart Supplement*

AGL – Above Ground Level, referring to an aircraft's height above the ground

ARP – Airport Reference Point, the geographic center point of an airport

AEDT – Aviation Environmental Design Tool

ATC(T) – Air Traffic Control (Tower)

C29 – Middleton Municipal Airport AKA Morey Field

CFR – Code of Federal Regulations

the "City" – Referring to the City of Middleton, WI

CS – Chart Supplement; a pilot's manual that contains data on public use and joint use airports, seaplane bases, heliports, VFR airport sketches, NAVAIDs, communications data and weather data sources

DNL – Day-Night Average Sound Level; the standard used by the EPA and DOT for measuring sound exposure over long periods of time. Sometimes also expressed as LDN.

FAR – Federal Aviation Regulation

FBO – Fixed Base Operator. An airfield tenant that provides aeronautical services including fueling, flight instruction, storage, etc.

GA – General Aviation

LAmax – Maximum sound level reached during a measurement period

LT – Local Time (CST/CDT)

METAR – Meteorological Aerodrome Report

MSL – Mean Sea Level, referring to an aircraft's altitude normalized for the barometric pressure at sea level

N-Above – Number of ACNEs counted at a noise monitoring site above a certain threshold dBA

NE – Noise Event

nm – Nautical Mile

NMT – Noise Monitoring Terminal

RWY – Runway

SEL – Sound Exposure Level; the total sound energy produced during an event, concentrated into one second

SENEL - The noise exposure level of a single aircraft event measured over the time between the initial and final points when the noise level exceeds a predetermined threshold

SID – Sanchez Industrial Design. Casper's primary hardware and maintenance subcontractor

T-Above – Time above (in seconds) a monitoring site was exposed to aircraft noise above a certain threshold dBA

the "Town" – referring to the Town of Middleton, WI

TWY – Taxiway

UTC – Universal Time Coordinated

3. Airport Operational Information

This section will cover the operational landscape of C29 both as it functioned during the study period and more generally. Any anomalous operational fluctuations during the study period will be detailed in this section.

For clarity, a "flight" is considered in this study as either a landing, a takeoff, or a local flight; a flight that both takes off and lands at C29. For runway use statistics, local flights are counted as both a takeoff and a landing.

During the study period, C29 saw 10,129 flights, for an average of 82 per day. July 3 saw the highest number of single-day operations with 169 and August 15th saw the lowest with only 2. Hourly distribution of flights was even across the hours of 1000 and 1800, with slow tapers up and down. Only 17 flights were flown between the hours of midnight and 0600 during the study period.

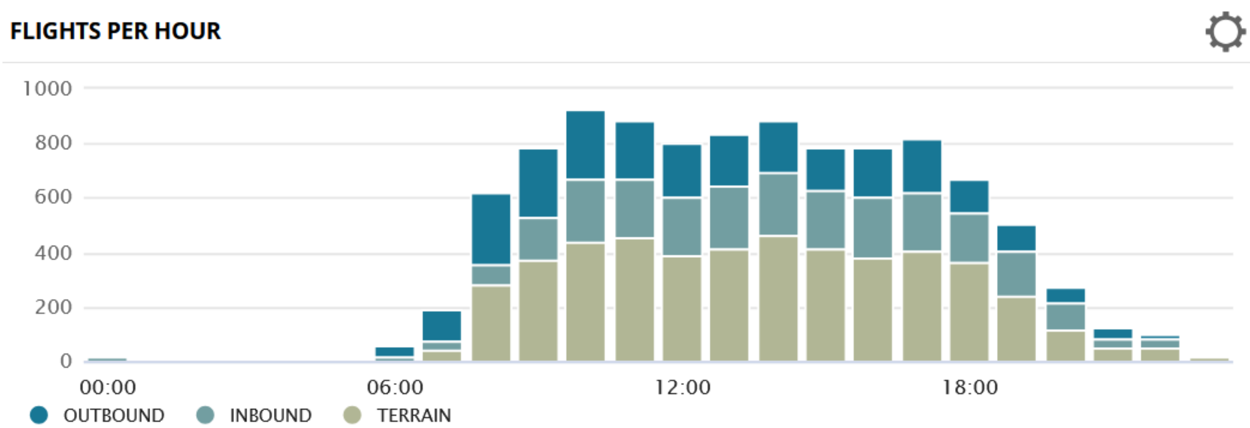

Figure 1: Bar graph depicting hourly rates of traffic during the study period. Note: Terrain can be used interchangeably with Local flights in this context.

3.1 Runway Usage

During the study period, runway 28 was used more than 50% of the time, and runway 10 was used more than 35% of the time. The rest of the operations were split between helicopter traffic that did not utilize either direction, and runway 1/19. Though runway 28 utilization contributed to both the majority of flights and the majority of noise events, we will be focusing on the details of the operations that caused noise events themselves, rather than only runway utilization. This is partly due to the concept of "flow" (described below) which dictates that not all runway 28 operations are flying on the same side of the airfield, and also due to the fact that many local flights at C29 used both runways.

3.1.1 Flow

Runway "flow" refers to the phenomenon of aircraft landing and taking off from the same runway heading. Because runway numbers are based on their direction relative to a compass rose, an aircraft arriving and departing on the same runway are always "pointed" in the same direction. For example, runway 10/28 is named so because one end is oriented roughly 280 degrees, and the other end is oriented roughly 100 degrees. By definition, runway headings at opposite ends will always be 180 degrees apart.

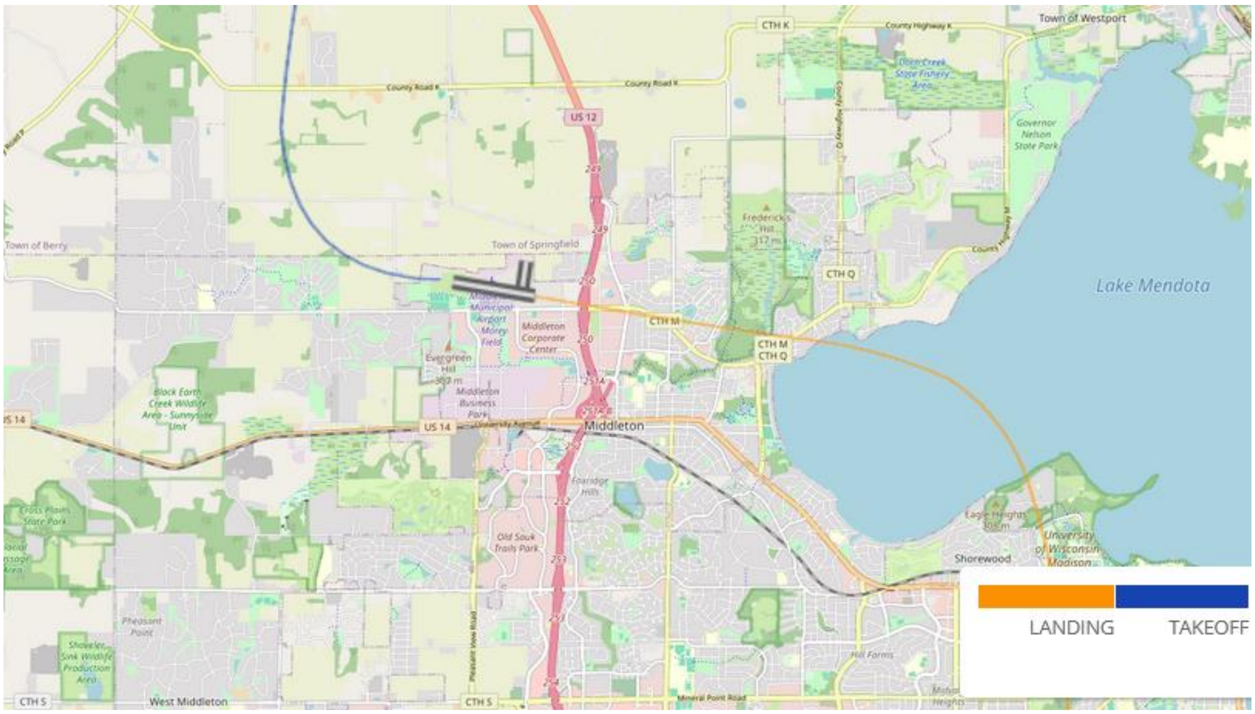

Figure 2: Both of these aircraft are using runway 28 because they are "pointed" in the same direction. This would be considered a west flow

3.1.2 Effects of Wind on Flight

Runways are typically built after a comprehensive study on the prevailing wind direction in the area. For both safety and efficiency, it is highly preferable to take off and land into the wind direction. At many airfields, a second runway that is perpendicular to the main runway is built, usually referred to as the "crosswind runway". C29 is no exception, as prevailing wind direction is almost always coming from the west, which explains much of why runway 28 is used more frequently than runway 10 or the crosswind 1/19.

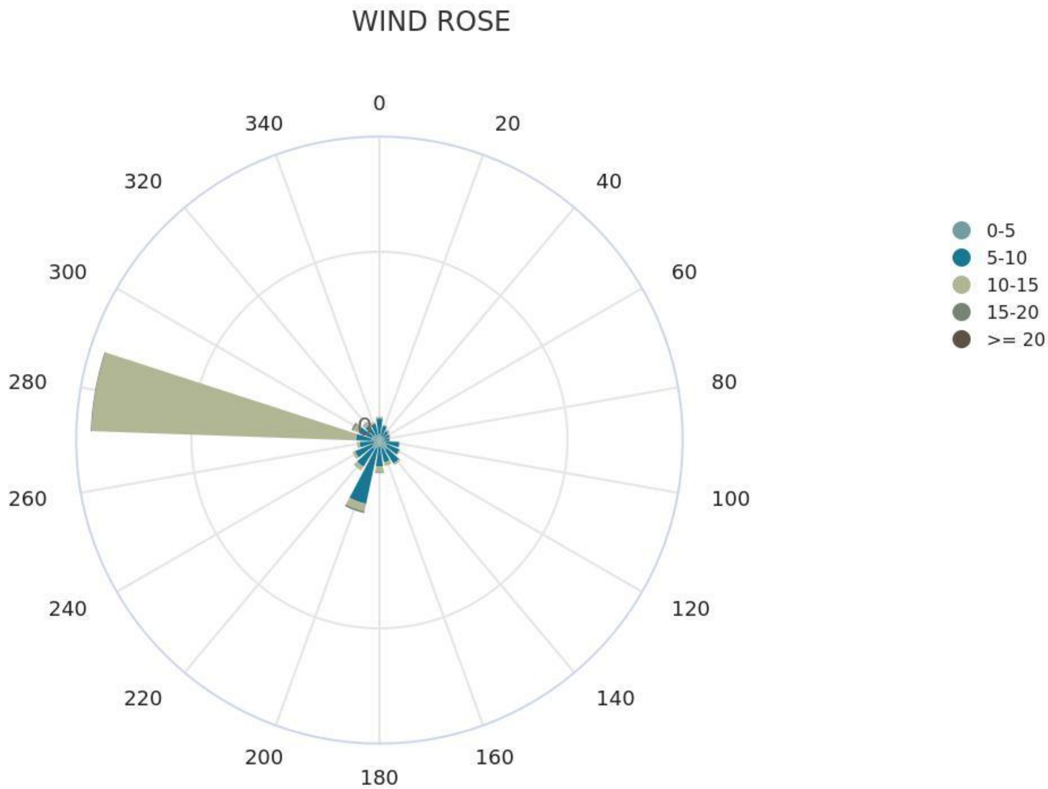

Figure 3: Wind direction at C29 over the study period. Wind did not always come from heading 280, though the vast majority of strong winds and gusts did.

3.1.3 1/19 RWY Use

Less than 10% of all operations during the study period used runway 1/19, though more than half of local flights using this runway used both landing surfaces. Many aircraft departed from 10/28 and landed on 1/19 and vice versa. Though only 72, or, 3% of all noise events captured during the noise study could be contributed to 1/19 use, all but two of those were non-local, or used both landing surfaces.

Runway 1/19 use is an interesting illustration of why operational intricacies should be considered more heavily than runway use itself. All land that is part of the Town west of the airport is avoided by aircraft using this runway and remaining in the pattern, though this was not the case for more than half of all flights. We will expand on this further at the end of this section.

3.2 C29 Chart Supplement and Effect on Operations

The FAA publishes a series of manuals organized by US geographical region, known as the Airport/Facilities Directory, or A/FD. These include short reference summaries for pilots known as chart supplements and are updated every 56 days. The FAA's chart supplement for C29 which was valid during the study period includes a note on community noise which reads in full: "Avoid noise sensitive area 1 mi SW; see City or Morey Airplane Co websites for details".

Both the City website and the Morey Airplane Co website contain text detailing various noise abatement procedures for different runway uses. For the purposes of this study, we will focus on three items published within for Morey Field: Runway 28 departures, traffic pattern, and traffic altitude.

3.2.4 Runway 28 Departures

Both The C29 Pilot Handbook published by the City and the Morey Airplane Co Noise Abatement Procedures webpage note that for Runway 28 departures, pilots should turn to a 300-degree heading after departure until they reach an altitude of 1,000ft AGL, or 1,928ft MSL, at which point they may continue with their filed flight plan or remain in the traffic pattern. This procedure, while voluntary, was followed with approximately 76% compliance.

This procedure results in aircraft vectoring slightly to the north after takeoff, then flying an extended departure leg one nautical mile past takeoff. There are no further noise abatement instructions published for after aircraft meet the "300 gate", though 69% of aircraft that followed the instructions simply continued flying a local pattern.

Aircraft that did not meet the noise abatement instructions were split 50% between aircraft that simply disregarded the instructions and flew the runway 28 left hand traffic pattern, and 50% aircraft that dispersed in all directions to other airfields.

The noise impact of aircraft using the procedure vs. aircraft that did not will be outlined further in a later section.

3.2.5 Traffic Pattern and Altitude

For aircraft remaining in the traffic pattern following a runway 28 departure, a left-hand pattern is to be followed. In the continental US, a left-hand traffic pattern is typically standard unless otherwise published. For all four departure headings at Morey Field (1, 10, 19, and 28), a left-hand pattern is used, though no operational clarification is provided on either the C29 chart supplement nor the City or Morey Airplane Co website.

While in the traffic pattern, aircraft utilizing C29 are expected to remain at an altitude of 1,928 ft MSL. This is clarified in the Pilot Handbook as being operationally necessary due to the overhang of the class C airspace emanating from Dane County Regional Airport (KMSN) which requires aircraft using C29 to remain below 2,300ft MSL, as well as a safe altitude minimum of 1,000 ft above any obstacles on the ground.

The figure below is a VFR sectional chart showing C29 under the Class C airspace of KMSN. The numerical value of 49/23 displayed in purple next to the C29 icon denotes that the "floor" of this airspace is 2300ft MSL and the "ceiling" is 4,900 ft MSL. Aircraft need special equipment as well as express permission from KMSN ATCT to enter this airspace.

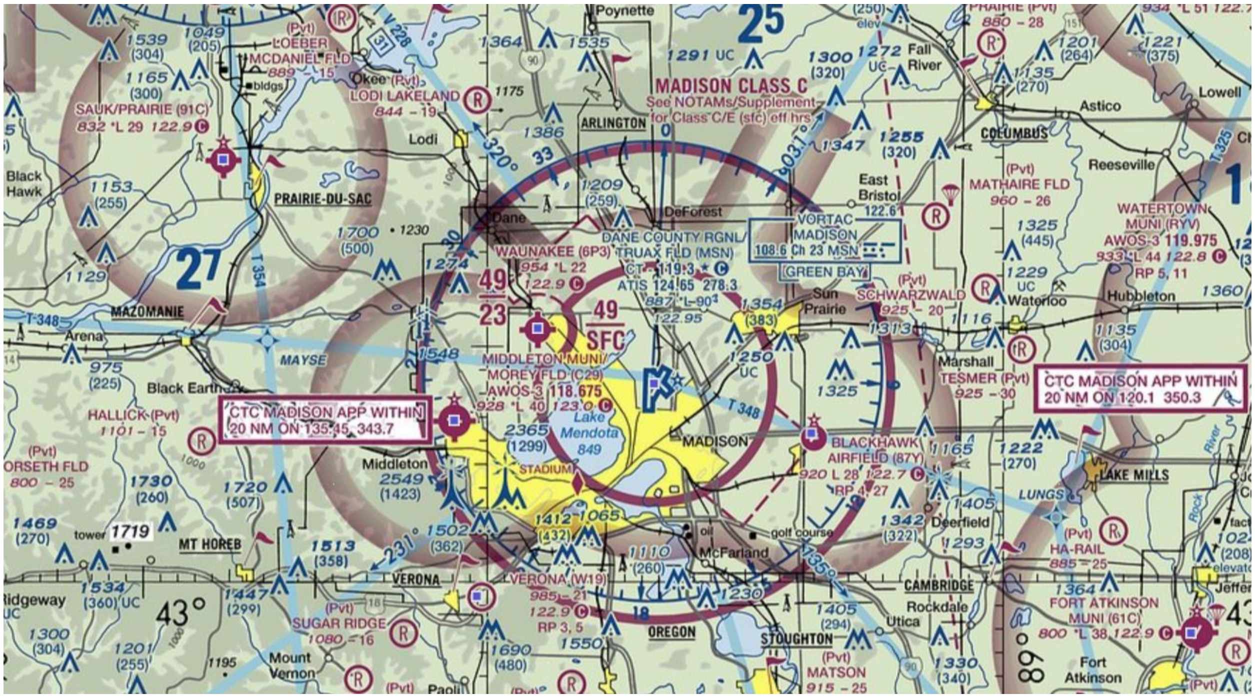

Figure 4: VFR sectional depicting C29 under the Class C airspace of KMSN

3.3 Fluctuations in Traffic

As mentioned, C29 averaged 82 operations per day during the study period. Statistical outliers for this time included August 21 (152 operations), June 27th (156 operations), July 19th and 20th (164 and 163 operations, respectively), and July 3rd with the most operations during the study period at 169.

Low points during the period include August 15th (2 operations), June 22nd (5 operations), July 5th (7 operations), and June 1st (10 operations). High winds and/or heavy rain, among other factors, contributed to low operational counts on these days.

While there is a correlation between the number of operations and the number of noise events, the type of operation and runway usage contributes more heavily to how much aircraft noise the Town experiences. The average number of aircraft noise events per day during the study period was 18 though, on August 21, there were only 9 ACNEs, even though it was in the top 5 in the number of operations per day with 152. This was due to an uncharacteristic usage of runway 10, as opposed to runway 28. Because all runways use a left hand traffic pattern, local flights using runway 10 operate to the north of C29 and largely avoid the Town.

3.3.6 July 19th Airshow

On Friday, July 19th C29 hosted an airshow called "Rock the Ramp" which featured some acrobatic aircraft operations. The event was held between 1700 and 2200, with the FAA issuing two temporary regulations active for that day: a boundary within which acrobatic operations were to have taken place, and a Certificate of Waiver which listed several FARs related to acrobatic flights that were to be waived during this time.

Aircraft performing acrobatic flights remained within this boundary, though there was a notable exception with repositioning flights which left the area and flew over the Town. Only three noise events were captured between the hours of 1800 and 1900, though one noise event caused by a repositioning of an EA300 acrobatic aircraft (N821MG) at 1830 did reach an LAmax of 80dBA – the 4th loudest noise event of the study period.

3.4 Operational Conclusions

Operations at C29 disproportionately utilize runway 10/28, due to it being the only paved surface, all-season runway. Still, runway 28 is used with much more frequency than runway 10, at least partially due to wind. With such a large percentage of flights operating locally, the left-hand traffic pattern for runway 28 brings many aircraft at C29 over the Town. The airfield and its users have an acknowledgement of a noise sensitive area to the southwest of the airfield boundary and a corresponding procedure to mitigate noise for this area. Although this procedure is flown regularly, its effect on noise will be covered in the next section.

C29 is constrained by the Class C airspace of nearby KMSN. There are vertical limitations within a significant radius of C29 which prevents aircraft from flying much higher than the pattern altitude without prior approval. The base segment of the Class C airspace is situated to the east of the airport, which reaches the surface area, constraining aircraft flying away from the Town.

With the two tenants at C29 servicing most of the operators, and with many of the aircraft utilizing the airfield being based there, it stands to reason why usage of the noise abatement procedure is flown as closely as it is. There is a good opportunity to work with these facilities to broaden the outreach for this program and even to expand it. More on this in the recommendations section of this report.

4. Noise Measurement

To briefly outline the noise measured for the purposes of this study, all noise is expressed in A-weighted decibels; the normalization of sound pressure as it is perceived by human ears. All other sub-measurements, i.e. LAmax, SEL, and LEQ, are standards used in aviation and other industries to comply with DOT and EPA regulations for noise compatibility.

The Noise monitors placed in the Town constantly "listen" to the decibels in the immediate area. Should a sound reach a threshold above an ambient outdoor sound level, this sound is recorded and stored in one second LEQ segments for the duration of the identified noise event. For both locations in the Town, the threshold was set to 55dB. It's important to clear this with confidence so we know we are dealing with noise that is easily differentiated from the background.

Once this noise event is captured our system will analyze the footprint it created and cross reference it with any aircraft that has flown within a cylinder measuring 1nm wide and 10,000ft high. Using a proprietary algorithm, our server can identify and automatically correlate noise events to a noise profile of any nearby aircraft.

Individual Community Noise Events and Aircraft Noise Events are calculated and expressed in both LAmax and SEL. LAmax denoting the highest peak of a noise event in dBA, and SEL denoting all the energy in a single event compressed into one second. Averaging these events is done by adding a 10dB "penalty" to noise events captured between the hours of 2200 – 0700 local time, resulting in an average noise metric known as DNL, which is the EPA standard used in all US states excluding California.

Looking beyond these EPA and DOT approved metrics, there has been a growing interest in alternative noise metrics, specifically "N-Above", a metric that counts individual ACNEs above a specific dBA threshold, and "T-Above", which counts the amount of time a monitor is exposed to decibel levels above a certain threshold. In cases like C29, where the fleet mix typically would not create noise at the level that would meet standards for federal involvement, metrics like N-Above and T-Above are used to express noise that is closer to the lived experience of communities nearby these types of facilities. While these metrics are available, we are going to focus more on the operational intricacies of C29 and how they create noise, rather than the noise metrics themselves.

5. Methodology

5.1 Placement of Monitors

Two sites for noise measurement were chosen for reasons including ease of access, level of security, and proximity to aircraft overflights.

For the purpose of this study, these locations are simply labeled "site 1" and "site 2," respectively, for anonymity. The geographic coordinates for each site were provided to Casper to ensure proper location within the Casper Noise system and to allow for consistent correlation between recorded noise events and aircraft overflights.

5.2 Portable NMT Hardware, Specifications, and Calibration

The two portable NMTs used for this noise study were Larson Davis 831Cs. These NMTs comply with the international reference standard ISO20906 on unattended monitoring of aircraft sound in the vicinity of airports.

The list of primary NMT components included is as follows:

- Sound Level Meter (SLM): Larson Davis 831C (ANSI S1.4-2014 Class 1) equipped with an outdoor microphone unit.
- NMT manager (data collection): StratoPi with proprietary disk image for remote processing and direct communication with Casper.
- Power Supply manager: Casper Power Control Box
- 4G modem: Teltonika RUT240 Modem + Verizon SIM Card

These components are secured inside of a Pelican 1550 Case and include a tripod and chain for security.

To confirm the efficacy and accuracy of the microphone and other units, the SLM is capable of self-calibration, but is also configured to be calibrated manually with an acoustic tool. Details on these two types of calibrations are as follows:

Acoustic Calibration
Referred to as a "physical calibration", a standardized source of a known decibel level (Precision Acoustic Calibrator CAL200) is placed upon the SLM microphone. During this process the SLM levels the received tone from the calibrator to match the actual dB produced by the calibrator. This method of calibration is conducted during each deployment of the portable monitor.

Calibration Check
The SLM additionally performs a daily calibration check at 0200. In this instance, the SLM attempts to self-calibrate concurrently with a connectivity check. Failure to connect indicates an issue with power source, communications, or system calibration and immediately notifies Casper staff of errors.

Figure 5: Portable NMT with case open

6. Site Monitoring

During the study period, our monitors collected 2225 noise events that could be contributed to aircraft. Of those, 2008 were aircraft that were utilizing C29 and the rest were categorized as "transit". Of the 217 noise events that were classified this way, 152 originated or departed from KMSN.

The following sections will provide analysis of each site using comparable noise statistics to each other. The intention is to provide the Town with industry standard noise statistics, but also to provide intersectional analysis of both noise and operational tendency at C29.

6.1 Testing Site 1 (May 30 – July 31)

Note: The NMT experienced a short downtime during the study period. The NMT was offline from 1530 on July 12 to 1630 on July 15. This will not measurably affect the noise analysis for Site 1.

Site 1 was originally going to be the only site monitored, but the Town and Casper agreed to a second monitoring location. This site was situated 1nm west of the paved area of runway 10/28 and is located in the area deemed "noise sensitive" by both the FAA's chart supplement for C29 and the airfield tenants themselves, and the area over which aircraft flying the voluntary "300" noise abatement procedure are intended to avoid.

While the monitor was deployed, it identified 1,165 ACNEs. These noise events were distributed along the following LAmax brackets

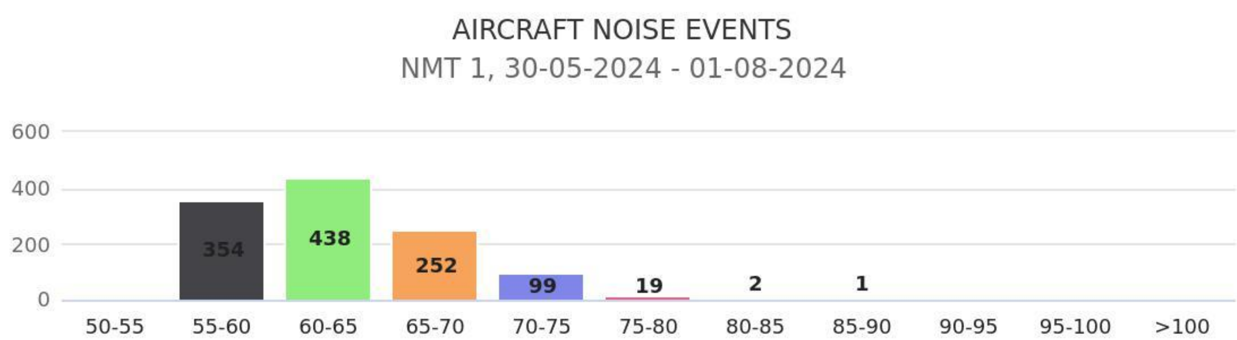

Figure 6: LAmax levels for each ACNE over site 1

58.4% of all ACNEs were caused by aircraft departing from runway 28, which is disproportionately high relative to operational statistics for the period from May 30 to July 31. Aircraft departing runway 28 or using runway 28 for local operations only contributed 45% of all operations during that time.

Conversely, aircraft landing runway 10 or using runway 10 for local operations contributed 24.9% of all operations during the same time, but only 14.7% of ACNEs. This indicates that aircraft using runway 10 have a lower noise impact on the Town than aircraft using runway 28.

Though it is not common practice to focus on individual noise events, we do want to take the time to point out statistical outliers. The highest noise event captured at this site was a C172 which, interestingly, did not fly the runway 28 left hand pattern, but did fly the runway 10 left hand pattern. Because many aircraft using runway 10 are landing as they pass the Town, it is common for altitudes to be on the lower side, though only 185 of the 1,165 ACNEs were caused by aircraft using this runway, and the majority of those noise events were below 70 dBA LAmax. Aircraft on arrival have a different sound footprint because of flap and landing gear configuration, but typically can be quieter because the throttle is much lower. For aircraft such as single engine Cessna like this one, it is common for the throttle to toggle between low power and idle. There may have been an operational need for the throttle to be engaged higher than is typical for this specific operation.

It may also be worth noting that this aircraft contributed to 70 ACNEs at site 1, second only to another C172 with 99. The individual five aircraft that contributed to the most ACNEs during this time committed 27.8% of all ACNEs, relative to their 34.4% contribution to all C29 flights during the same period.

6.1.1 Effect of “300” Noise Abatement Procedure

As mentioned earlier in this report, aircraft departing runway 28 follow the published noise abatement procedure regularly. During the monitoring period for site 1, aircraft performed this procedure 75% of the time. Because departures and local operations from runway 28 are a majority of all C29 operations and of ACNEs during the study period, it is a crucial piece to the puzzle of the noise impact on the Town.

Of the 717 ACNEs from aircraft utilizing runway 28 (subject to the procedure), 442 were from aircraft that flew the noise abatement procedure correctly (61.6%). This is still a disproportionately low figure given the adherence to the procedure. Many of these aircraft made a turn to reenter the pattern after departure, and many continued their flights beyond C29, though those primarily avoided the built-up areas of the Town and registered very low noise levels.

The efficacy of the noise abatement procedure is evident in the dispersion of aircraft noise above and below certain thresholds. Despite making up 61% of all ACNEs, aircraft that followed the procedure accounted for 86.3% of all noise events that were recorded below 60 dBA, and 79.3% of all noise events below 65 dBA. Conversely, these aircraft only contributed 27.9% of all ACNEs above 65 dBA. Only one of the top 20 ACNEs by LAmax bracket were caused by an aircraft flying this procedure.

Despite many aircraft making the gate then flying past the monitors as they reenter the circuit, the reason for the stark reduction in LAmax could be that the extra time taken after takeoff to reestablish circuit altitude resulted in a higher average altitude upon passing the monitor.

As mentioned earlier, aircraft that departed runway 28 using the noise abatement procedure and not reentering the traffic pattern only accounted for 2 out of 65 ACNEs above 70 dBA. This is likely due to the offset, which allows aircraft to avoid the Town.

6.2 Testing Site 2 (August 1 – Oct 1)

The monitor for site 2 was placed 1.6nm west of the departure end of runway 28, and 0.6nm west of the first location. Because the posted noise abatement procedures for runway 28 only specified a noise sensitive area "1 mi SW" of the airport, it was not specifically designed to accommodate the area this far west of the airfield. This section will, in part, explore whether the procedure was effective regardless of the language describing the noise sensitive area.

While the monitor was deployed, it identified 1,060 ACNEs. These noise events were distributed along the following LAmax brackets.

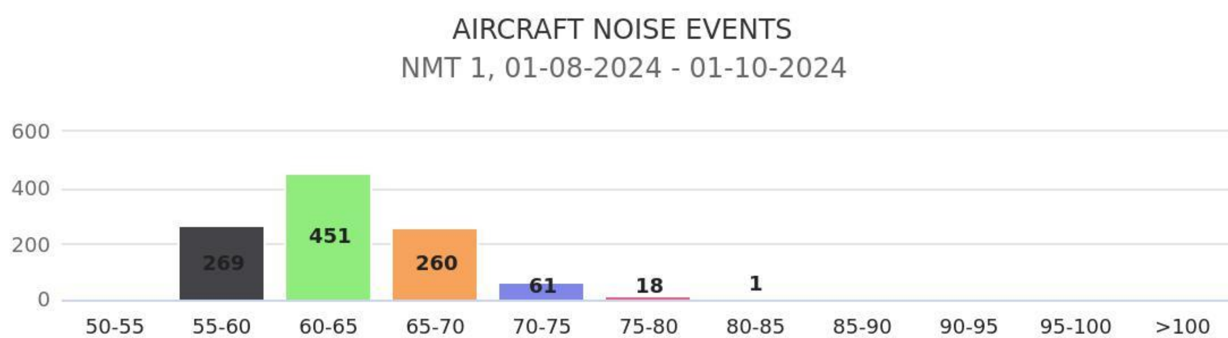

Figure 7: LAmax levels for each ACNE for site 2

As with testing site 1, departures and local flights utilizing runway 28 contributed 720, or 67.9%, of all noise events at this location, a disproportionately high number considering those operations only made up 40% of all flights during the testing period.

Conversely, aircraft landing runway 10 or using runway 10 for local operations contributed 31.8% of all operations during the same time, but only 11% of ACNEs. This indicates again that aircraft using runway 10 have a lower noise impact on the Town than aircraft using runway 28, even for a site that is further away in the same direction of the airfield.

Another interesting trend we should make note of here is that runway 28 operations went down a noticeable amount as a percentage of overall operations (45% during the first period to 40% during the second), though their contribution to noise events rose from 58.4% to 67.9%.

An initial observation as to why this may have occurred is of course the increased distance from the airfield. For the first testing site, it was common for aircraft utilizing the left hand traffic pattern on runway 10 to still engage with the NMT on the base leg and final approach. For testing site 2, an extended downwind leg or some other atypical runway 10 operation was needed to incur an ACNE.

There was no noticeable shift in weather during this time that would have reduced the usage of runway 28.

Another effect that could have contributed to this was the increased number of aircraft departing runway 28 and vectoring south. In the first portion of the testing period there was much more dispersal of aircraft departing runway 28 and not reentering the pattern. In the second half, many more remained runway heading or turned south.

As with the first half of the study, we found it worth mentioning that many of the ACNEs captured by the monitoring sites were caused by a small number of aircraft. In this portion, the five aircraft responsible for the most noise events contributed to 37% of all operations from August 1 to October 1, and 34.4% of all ACNEs, a higher percentage than during the first half.

6.2.2 Effect of “300” Noise Abatement Procedure

During the second half of the study period, 77.6% of qualified aircraft flew the voluntary noise abatement procedure. Despite the procedure being flown with roughly the same frequency as in the first half, aircraft that flew the procedure still contributed 79% of all ACNEs from aircraft departing runway 28, a much higher figure than at the first site. The primary reason for this is that the procedure itself is not inclusive of this section of the Town. As reiterated at the beginning of this section, the procedure only outlines a noise sensitive area one mile southwest of the airfield. This means that, even for aircraft honoring the procedure, they expect to only fly with a heading of 300 degrees for one mile before turning. As we saw in the previous section, more aircraft during this period vectored to the south after departing runway 28, resulting in a strong noise impact.

While at the first site, aircraft following the procedure contributed a far smaller amount of high-dB noise events (above 65dB), this was not the case at site 2. Aircraft following the procedure still accounted for 69.2% of all noise events above 65dBA at site 2, compared to only 27.9% at site 1.

6.3 Site Monitoring Conclusions

Noise monitoring at both sites has given us insight into the kinds of operational nuance that result in the greatest noise impact on the Town. These will be cross-examined with the conclusions in section 3.4 to create Casper’s finalized recommendations for action by the Town outlined in the next section.

The further west a home is located from the departure end of runway 28, the less impacted that home is from operations other than 28 departures. Aircraft utilizing runway 10 or the turf crosswind runway rarely extend their circuit segments to the point that they create a measurably significant noise impact to any westerly homes. Homes in the eastern half of the Town may experience noise impact from aircraft utilizing the runway 10 left hand circuit pattern on base and final legs, but these operations do not prove to have nearly as strong of an impact from aircraft departing runway 28 and disregarding the voluntary noise abatement procedure.

The voluntary noise abatement procedure that asks pilots to fly a heading of 300 after departing runway 28 for at least 1nm is much more effective for homes in the eastern half of the Town. For homes in the west, aircraft flying the procedure had almost no discernable impact on the amount or intensity of ACNEs as aircraft that disregarded it completely. On the other hand, aircraft flying the procedure had a pronounced impact on both the amount and intensity of noise events for homes in the east.

There is both a disproportionately large number of overall operations and, subsequently, ACNEs caused by a very small number of individual aircraft. As many as 35% of all operations for the entire study period were flown by only 5 aircraft, with a proportional number of ACNEs caused by those same aircraft.

Ultimately, the over-utilization of runway 28 contributes greatly to the noise impact on the Town. Usage of the other 3 runway ends contributes both a lower amount and lower intensity of ACNEs.

7. Finalized Recommendations

This section will cover the operational and collaborative suggestions concluded by Casper. Some of these recommendations deduced by the newly assessed data included herein may have unforeseen challenges beyond any agreement between the City and Town and should be used as an initiation for mutually beneficial solutions for all interested parties.

7.1 Extend the Voluntary Noise Abatement Procedure

The current FAA chart supplement outlines a "noise sensitive area 1 mi SW" of the airfield. The Morey Airplane Co. website provides more explicit details to fly heading 300 after taking off runway 28 before continuing with a filed flight plan. As deduced in this study, this procedure is flown with a high level of adherence. While increased adherence would be beneficial, a much more beneficial solution for the noise impact on the Town, especially for areas in the western half of the Town, would be to expand the defined noise sensitive area to 2.6nm (as measured from the departure end of runway 28 to Enchanted Valley Rd). Should the expansion of this noise sensitive area be agreed upon by the Town, the City, and the airport tenants, an aeronautical chart change can be submitted for consideration by the FAA on their website.

7.2 Right Hand Traffic Pattern for Runway 28

Currently, the traffic pattern at runway 28 is a left hand pattern, which is standard for US airports unless otherwise stated. Our suggestion that runway 28 be converted to a right hand pattern would significantly decrease the intensity if not also the amount of aircraft noise events over the Town. According to the FAA's Airplane Flying Handbook (FAA-H-8083-3C) Chapter 8: Airport Traffic Patterns, an aircraft pattern change to a right hand pattern is done at the discretion of the airport, so long as "the airport displays approved visual markings indicating that turns should be made to the right". It is not without precedent for one runway at a GA facility to operate on a right hand pattern while other runways operate on a left hand pattern.

7.3 Increased Use of Runway 10 When Wind Allows

While prevailing winds at C29 come from the west dictating the use of runway 28 during most times, the runway is still used 61.7% of the time when wind speeds were reported zero by the local weather station (written as 00000KT on METAR reports indicating zero wind speed, zero direction). As we have outlined in this report, use of runway 10 significantly lowers the impact of noise on the Town, especially for homes in the western portion of the Town. We would suggest the increased use of runway 10 during times when wind is not a factor.

7.4 Targeted Education of "Heavy Users"

Whatever changes may or may not be officially adopted or modified from this study, the fact remains that a very small number of aircraft contribute to a highly disproportionate number of overall operations at C29. It is likely that these are flown by different people engaging in flight training but, if they do belong to a flight school, a significant reduction on noise in the Town can be achieved if the owners or the flight schools taking stewardship of these aircraft commit to following either existing noise abatement procedures, or following the measures laid out in the recommendations herein.

7.5 Continued Noise Studies

Understanding the effectiveness of any adopted noise abatement measure will require future study for comparison. If a trial period for any operational change is agreed upon, Casper will be able to provide a comparative study.

Regardless of the implementation of expanded noise abatement, should the City and C29 begin construction projects outlined in the 2022 Master Plan, the operational output and subsequent noise impact could change drastically. A noise study conducted upon the conclusion of any construction is strongly recommended by Casper.