# Saint Paul Downtown Airport (STP)
# Annual Sound Study Report

## October 2020

***Revised 10-16-2020***

**Community Relations Office**

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# 1.0 Introduction

The Metropolitan Airports Commission (MAC) completed the 2020 STP Annual Sound Study in support of the St. Paul Downtown Airport Advisory Council (DAAC) 2020 Work Plan and supplemental conditions of the flood wall erected in 2009. The study involved two industry standard methods for assessing aircraft sound: field-measurement analysis and modeled data.

This study was conducted by MAC Community Relations staff, using certified equipment and scientific guidelines. The results of this study are intended to enhance communication about sounds associated with St. Paul Downtown Airport (STP) aircraft activity. As such, field measurements captured aircraft sound events and community sound events at six locations surrounding STP during a seven-day period: August 7-13, 2020

Sound level modeling for STP flight activity was conducted using the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) modeling software to provide expanded sound data coverage as a tool to inform the DAAC and airport stakeholders about aircraft activity and corresponding sound levels for the same seven-day study period.

Data not correlated to aircraft arriving to or departing from STP are included in this study as community sound events.

The sections below describe the STP runway use, aircraft operations, weather, field-measured data collection process and analysis, AEDT modeling data and analysis, a comparison of measured data and modeled data, and a summary of aircraft noise complaints received during the study period.

# 2.0 Operations

STP is a general aviation, public use airport owned and operated by the MAC. The airport is a primary reliever airport for Minneapolis -St. Paul International Airport and accommodates personal use and recreational aircraft, business general aviation and air taxi aircraft, flight training and military aircraft. The aircraft operating at the airport currently include single and multi-engine propeller-driven aircraft, corporate jet aircraft, and helicopters.

An FAA air traffic control tower is located at STP, and air traffic controllers directed aircraft into and out of STP between 8:00 A.M. and 4:00 P.M. during the study period.[1] There are three runways available for use at STP: Runway 14/32, Runway 13/31, and Runway 9/27. Helicopters may land and depart from areas other than a runway.

According to FAA aircraft operations counts for STP during August, the three-year average prior to 2020 shows 4,072 monthly operations, with 1,018 flights using the airport during an average week when the Air Traffic Control Tower is staffed. In August 2020, the FAA reported a total of 2,322 STP flight

[1] These operating hours were implemented in response to COVID-19 in spring 2020.

operations, and during the study period 503 tower counts. An operation is counted when an aircraft utilizes a runway at STP.

Due to the existence of flight training at STP, a single flight will often have multiple operations as pilots conduct touch and go operations for proficiency. It is normal and expected that the airport will be busier in the summer with increased flight training and recreational flying. However, flight activity during the study period was impacted by COVID-19, and operational levels at STP were about half of typical levels that historically occur in August at that airport.

The MAC Noise and Operations Monitoring System (MACNOMS) also collects flight tracking data and reports operations data attributed to STP. During the study period, MACNOMS data show 383 total operations at STP with 190 arrivals and 193 departures. Table 2.1 shows the number of arrivals and departures on each STP runway per day. The highest levels of STP runway use occurred on Runway 14 with 106 arrivals and 120 departures.

**Table 2.1: STP Aircraft Activity per Runway each Day during the Study Period**

| Runway | 7-Aug | 8-Aug | 9-Aug | 10-Aug | 11-Aug | 12-Aug | 13-Aug | **Runway Total** |
|---|---|---|---|---|---|---|---|---|
| **STP Arrivals** | | | | | | | | |
| 9 | 2 | | | | | 1 | 1 | **4** |
| 13 | | 6 | | | 2 | | | **8** |
| 14 | 18 | 10 | 13 | 1 | 10 | 19 | 35 | **106** |
| 27 | 1 | 2 | | 1 | 4 | | | **8** |
| 31 | | | 1 | | | 1 | | **2** |
| 32 | | 4 | 6 | 27 | 19 | 6 | | **62** |
| **STP Departures** | | | | | | | | |
| 9 | | 1 | | | | 1 | 1 | **3** |
| 13 | | | | | 1 | 1 | | **2** |
| 14 | 21 | 14 | 12 | 1 | 10 | 18 | 44 | **120** |
| 27 | | | | | | 1 | | **1** |
| 31 | | 7 | | 1 | 1 | | | **9** |
| 32 | | 1 | 6 | 25 | 19 | 7 | | **58** |
| **Daily Total** | **42** | **45** | **38** | **56** | **66** | **55** | **81** | **383** |

Runway 14/32 was used for 90 percent of the activity during the study period, Runway 13/31 was used 5 percent and Runway 9/27 was used 4 percent. Figure 2.1 shows the STP flight tracks for daytime arrivals and departures.

There were 38 flights that operated between the hours of 10:00 P.M. and 7:00 A.M.; 17 of those flights were arrivals and 21 were departures. Figures 2.2 depicts STP flight tracks for nighttime arriving and departing flights during the study period.

The STP Annual Sound Study was conducted twice previously during the month of August in the years 2017 and 2010. The STP flight operations during the August 1-7, 2017 study period totaled 770 arrivals and departures, about twice as many operations as the number of flights during this 2020 study period. During the August 12-18, 2010 study period the number of STP arrivals and departures totaled 857.

While weather conditions typically have a direct impact on aircraft operations levels at STP, and any airport, the reduction in the amount flight activity at STP in August 2020 compared to the same time period historically is related to reductions in corporate activity associated with the COVID-19 pandemic

rather than adverse weather. Weather during the study week was desirable for flying with typical mid-summer wind and temperature patterns, and very little precipitation occurred. Weather conditions (e.g.; temperature, precipitation, wind, etc.) affect airport activity, runway use decisions and aircraft performance. In addition to operational factors, weather conditions can also affect the way sound is transmitted and observed. For these reasons, weather data are documented during the study period. A summary of daily weather conditions is provided in the Appendix.

Figure 2.1: STP Daytime (7:00 A.M to 10:00 P.M.) Operations During Study Period

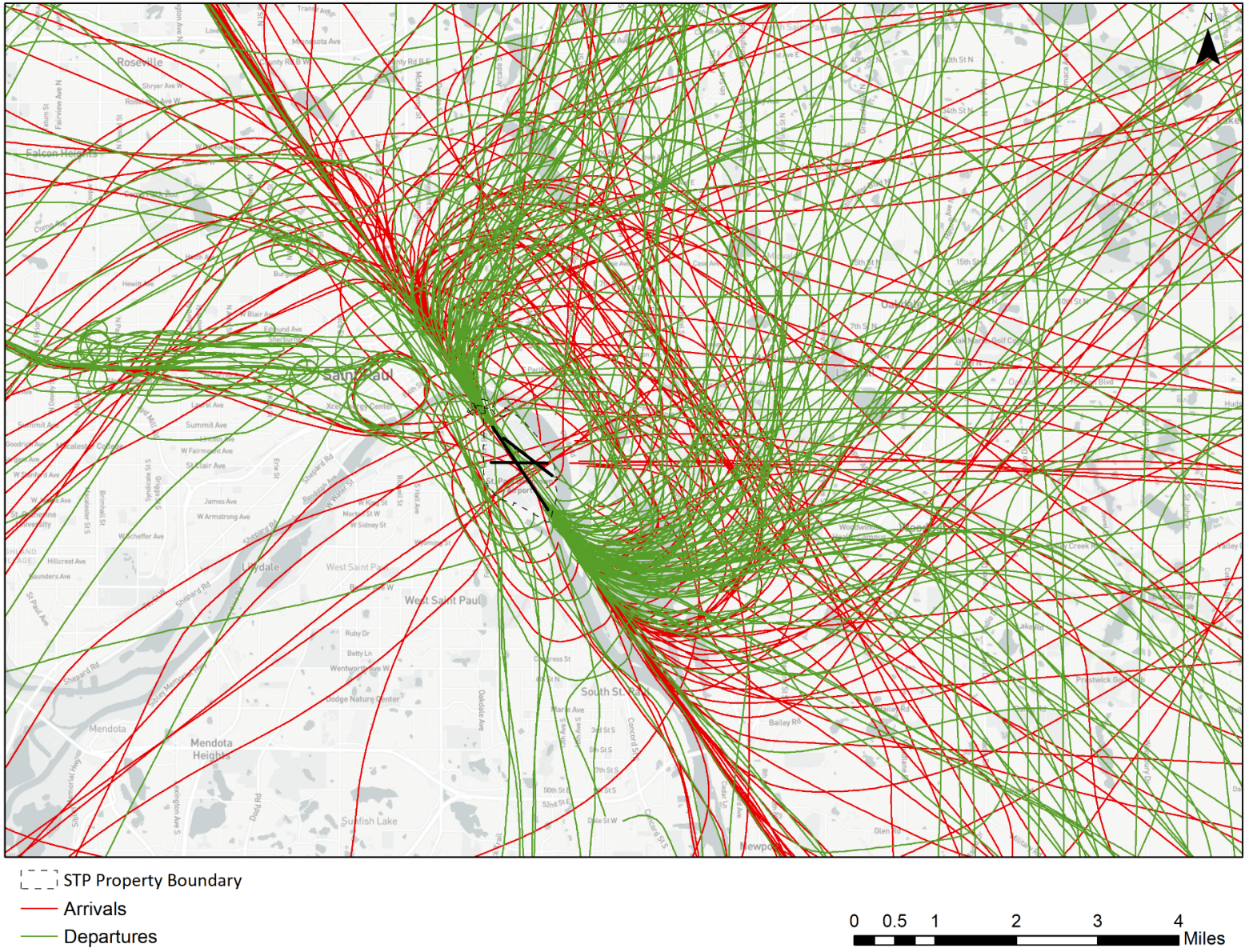
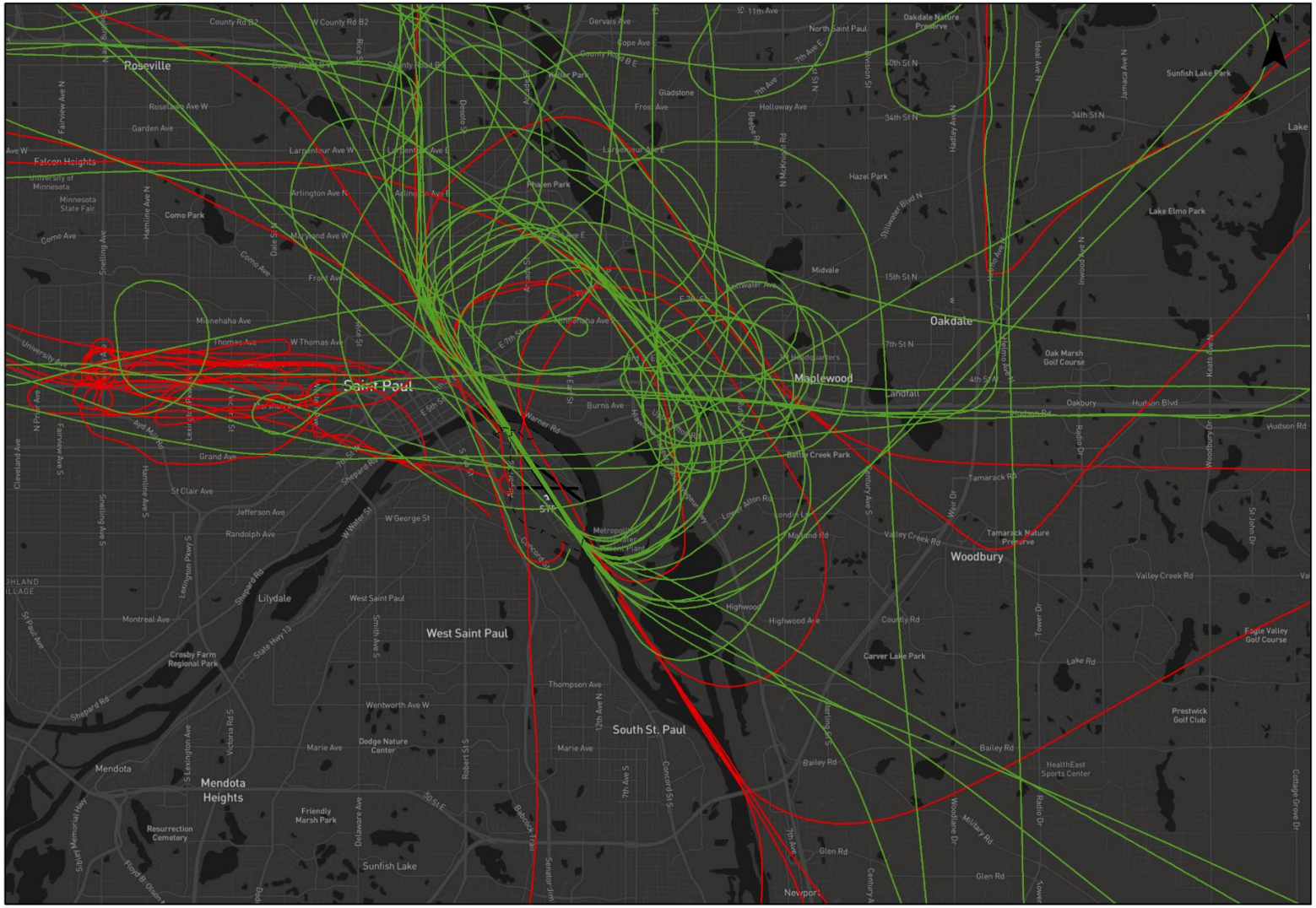


Figure 2.2: STP Nighttime (10:00 PM to 7:00 AM) Operations During Study Period



# 3.0 Field-Measured Sound Data Collection

An STP Annual Sound Study, assessing field-measured sound data, has been conducted since 2007. The MAC has committed to the annual study in accordance with Supplemental Conditions of Agreement (MAC action taken on June 19, 2006) related to the flood protection project at STP. A core element of the flood protection plan was the construction of the flood wall at STP in 2009 to mitigate flood events that historically have required the airport close. A copy of the Supplemental Conditions is provided in the Appendix.

Since 2007, six field measurement sites have been positioned in coordination with DAAC District Council memberships, and consistent with MAC Mobile Sound Monitoring Guidelines. These guidelines, and a map of all Saint Paul Districts are provided in the Appendix.

Field measurement sites are positioned in the same locations each year as much as possible to assist with comparing results. In 2020, four of the six sites were able to be positioned in the same locations as previous studies, however, two site locations were adjusted because of access concerns.

The dates of this study period are August 7-13, 2020. These dates were coordinated with the full DAAC membership during its meeting on May 19, 2020. Figure 3.1 shows a map of the field measurement equipment locations, and Figure 3.2 shows a picture of each field measurement site used in the 2020 study. Equipment specifications and are provided in the Appendix.

Figure 3.2: Field Measurement Equipment Locations

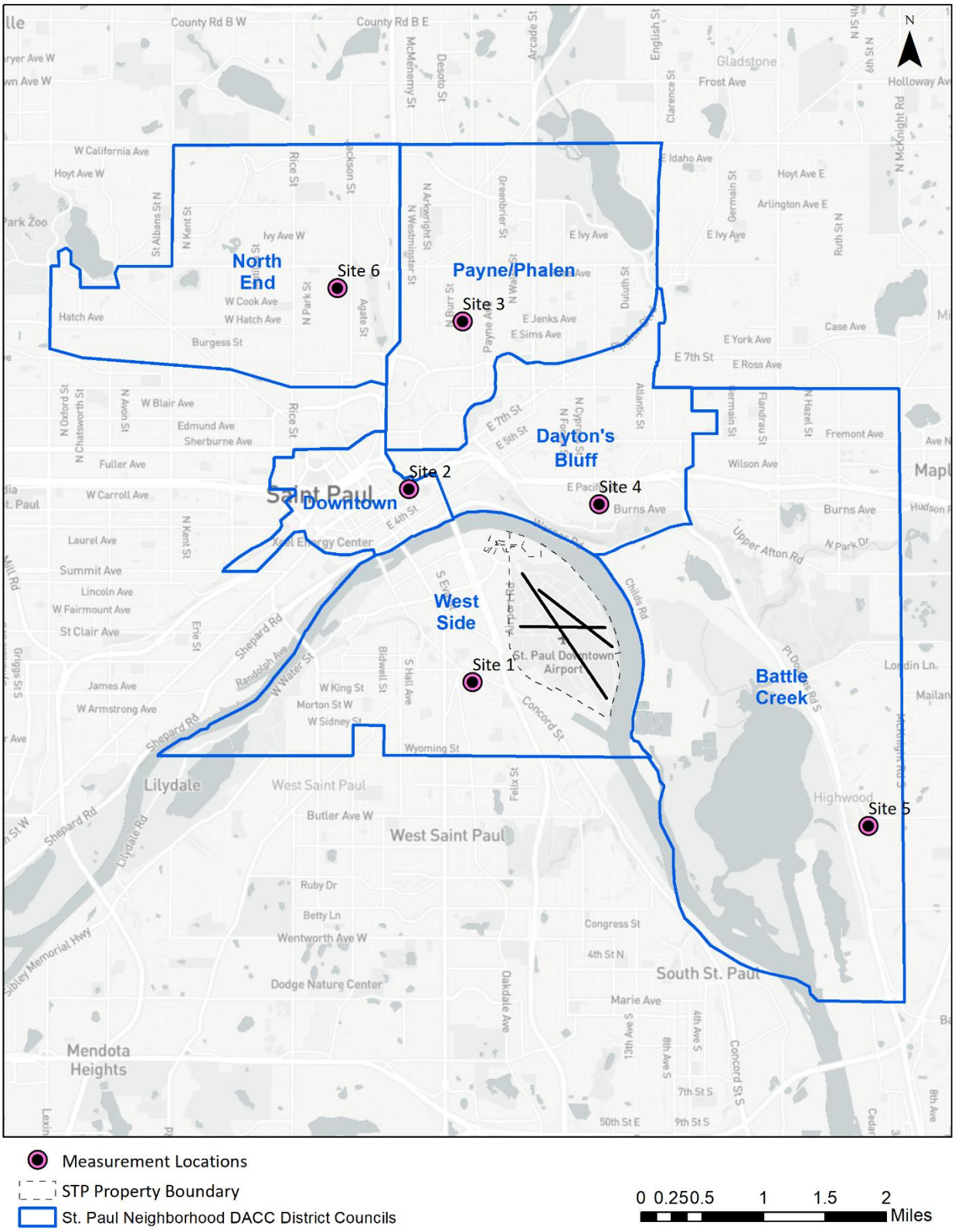


Figure 3.2: Field-Measurement Site Photos

## 3.2 Field Measurement and Analysis Parameters

One sound analyzer collected data at each of the field-measurement sites. Each site operated continuously measuring sound levels utilizing a slow response with A-weighting (dBA), as federally-prescribed by standards for collecting aircraft sounds in the FAA's 14 CFR Part 150. Sound events are identified and documented when the sound level exceeds 65 dBA for four seconds or longer. When these sound event thresholds are met, the distance of the sound source from the measurement equipment is irrelevant.

In this study, sound events from aircraft and community sound sources were detected. Sound events were correlated with STP flight track data, collected by MACNOMS, using temporal and spatial parameters (time and distance). All uncorrelated sound events, including non-STP aircraft operations, are referred to in this report as community events.

## 3.3 Field-Measurement Data Results

There were 138 aircraft sound events and 1,037 community sound events measured at the six sites during the seven-day study period. This section summarizes information for both aircraft and community sound sources described in terms of single event metrics ($LA_{max}$, SEL, Event Duration) and summary-based metrics (DNL, ADNL, CDNL and $LA_{90}$).

### Single Event Metrics

The single event $LA_{max}$ metric indicates the maximum sound level measured during the event. Table 3.1 shows the daily number of single event aircraft sounds that exceeded 65 dBA for four seconds. Overall,

The largest number of aircraft sound events captured during the study period on a daily basis occurred on Wednesday, August 12 with 27 events, and on Tuesday, August 11 with 26 events. The smallest number of aircraft sound events measured during the study period occurred on Sunday, August 9 with 10 events.

Site 6 measured the most aircraft sound events during the study period with 36 events. The second-highest number of aircraft sound events was 29 events at Site 2. Both of these sites measured aircraft using Runway 14/32, which is the most-heavily used runway during the study period. More detail about runway use was provided in Section 2.0.

**Table 3.1: Number of Measured Single Event STP Aircraft Sounds per Day**

| | Fri. August 7 | Sat. August 8 | Sun. August 9 | Mon. August 10 | Tues. August 11 | Wed. August 12 | Thur. August 13 | Site Total |
|---|---|---|---|---|---|---|---|---|
| **Site 1** | 1 | | | 2 | | 2 | 4 | **9** |
| **Site 2** | 2 | 8 | | 5 | 7 | 2 | 5 | **29** |
| **Site 3** | 2 | 1 | 2 | 4 | 12 | | 6 | **27** |
| **Site 4** | | | 1 | 2 | 2 | 4 | 2 | **11** |
| **Site 5** | 5 | 4 | 2 | 4 | 1 | 4 | 6 | **26** |
| **Site 6** | 7 | 5 | 5 | | 4 | 15 | | **36** |
| **Daily Total** | **17** | **18** | **10** | **17** | **26** | **27** | **23** | **138** |

Figure 3.3 shows the number of aircraft sound events that were measured each hour during the study period. The highest number of aircraft sounds were captured during the 1:00 P.M. and 3:00 P.M. hours with 17 and 15 measured aircraft sound events, respectively. Site 6 measured the highest number of aircraft sound events during a one-hour period with 36 events. Site 1 measured the fewest aircraft sound events, a total of nine.

There were 18 aircraft sound events measured during the nighttime hours of 10:00 P.M. – 7:00 A.M. Of these, five aircraft sound events occurred during the 10:00 P.M. hour (Sites 1, 2, 3, and 5) and four occurred during the 12 A.M. hour (Sites 2 and 4). There were no aircraft sound events measured during the hours of 2:00 A.M. and 4:00 A.M.

Figure 3.3: Number of Single Event STP Aircraft Sounds Above 65 dBA per Hour by Site

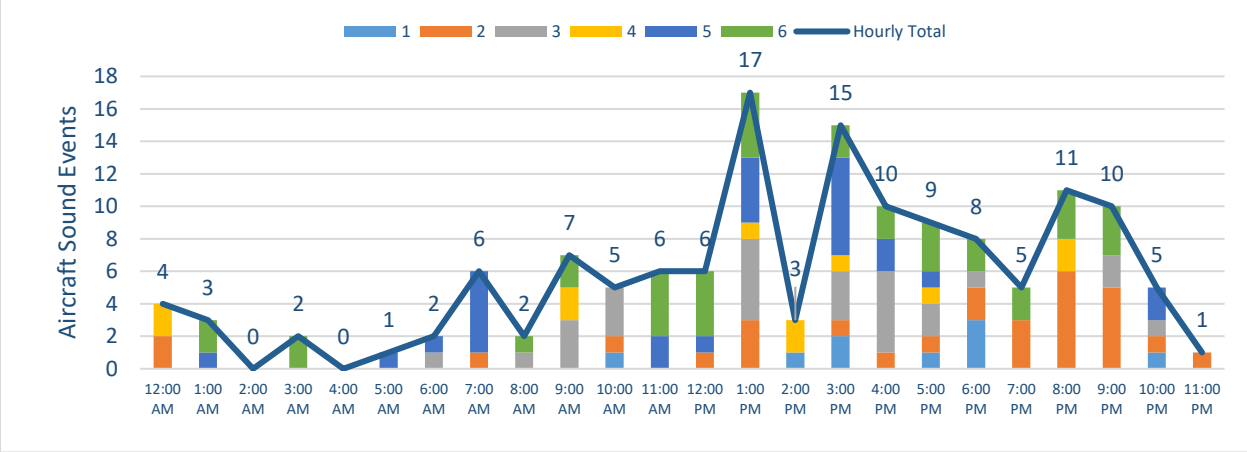


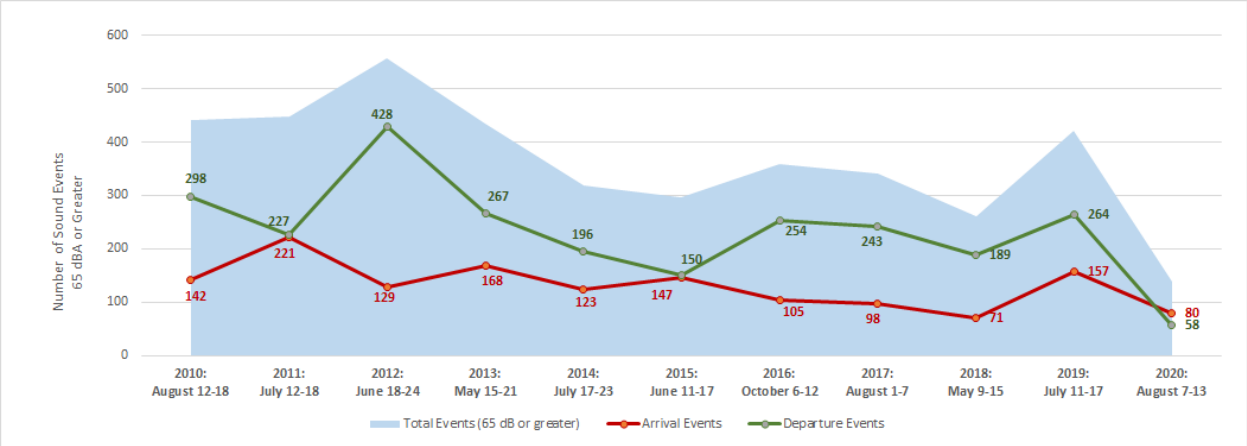

Table 3.2, below, shows the number of measured aircraft arrival and departure sound events with $LA_{max}$ levels at or above 65 dBA, 80 dBA, 90 dBA, and 100 dBA at each site. A total of 138 aircraft sound events were measured at or above 65 dBA. Of those, four events were at or above 80 dBA and none were at or above 90 dBA.

The highest number of arrival sound events was 33, measured at Site 6. The highest number of departure sound events was 20 measured at Site 5.

Sound events measured during each study period between 2010 and 2020 are shown in Figure 3.4. This is provided for historical reference. Trends should not be inferred due to variations in study parameters.

| Table 3.2: Number of Single Event Aircraft Sounds by Level | | | | |
|---|---|---|---|---|
| Site | # of Events > 65dBA | # of Events > 80dBA | # of Events > 90dBA | # of Events > 100dBA |
| **Aircraft Arrivals** | | | | |
| 1 | 6 | 1 | 0 | 0 |
| 2 | 16 | 1 | 0 | 0 |
| 3 | 13 | 0 | 0 | 0 |
| 4 | 6 | 0 | 0 | 0 |
| 5 | 6 | 0 | 0 | 0 |
| 6 | 33 | 0 | 0 | 0 |
| **Arrival Total** | **80** | **2** | **0** | **0** |
| **Aircraft Departures** | | | | |
| 1 | 3 | 0 | 0 | 0 |
| 2 | 13 | 0 | 0 | 0 |
| 3 | 14 | 1 | 0 | 0 |
| 4 | 5 | 0 | 0 | 0 |
| 5 | 20 | 1 | 0 | 0 |
| 6 | 3 | 0 | 0 | 0 |
| **Departure Total** | **58** | **2** | **0** | **0** |
| **Total Aircraft Events** | **138** | **4** | **0** | **0** |

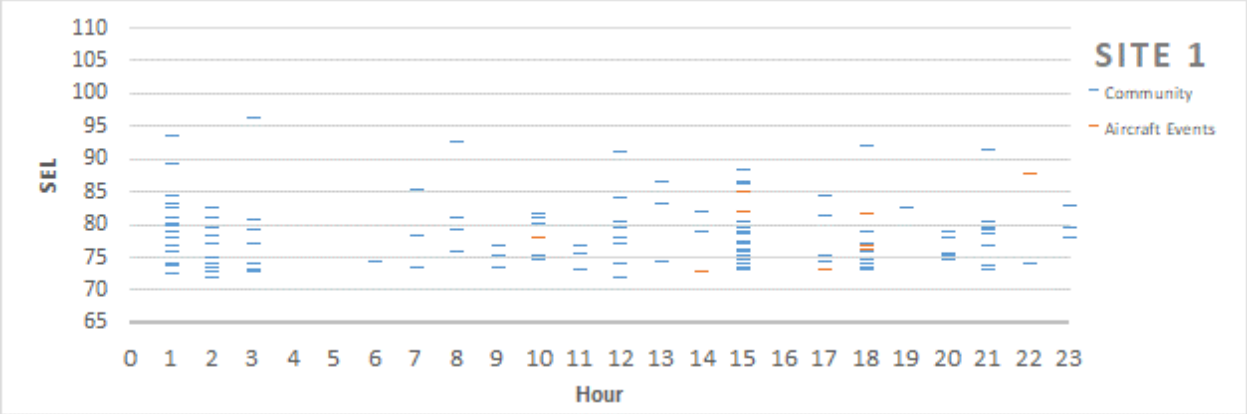
Figure 3.4 Sound Event Totals Measured during Study Periods in 2010 - 2020

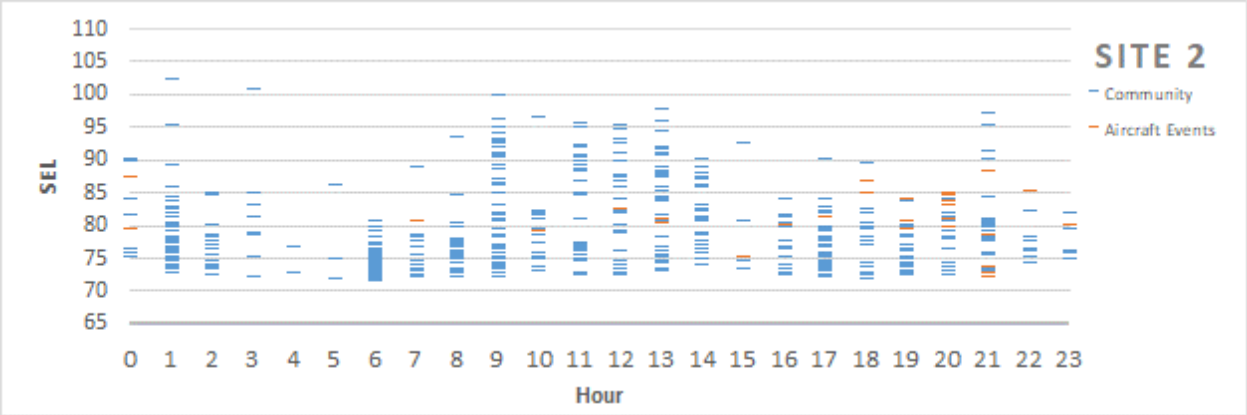


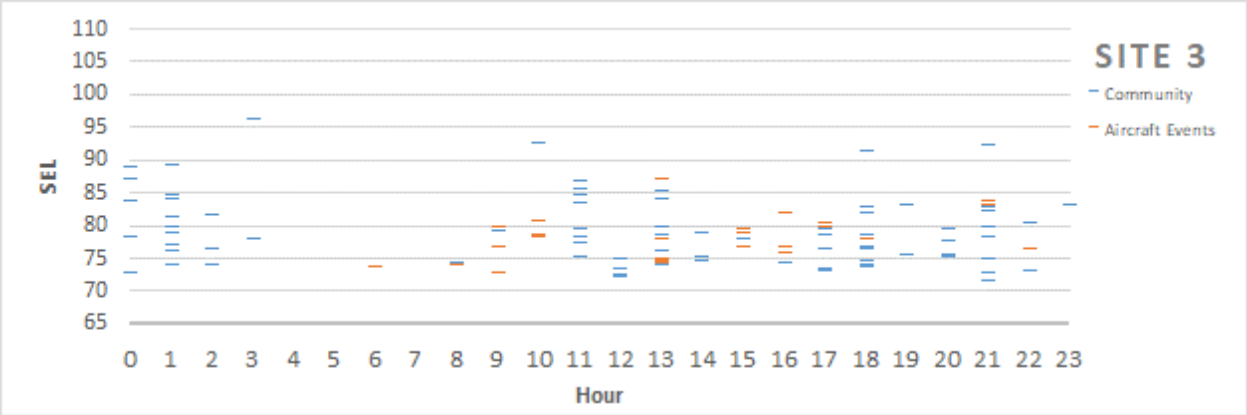

Single sound events cannot be directly compared without normalization due to variations in sound levels and durations. The Sound Exposure Level (SEL) is a metric that provides a way to directly compare each event by expressing the sound energy of that event as a single second (1s) value, regardless of the actual event duration. The SEL and $LA_{max}$ are not the same and in many cases and they rank differently.

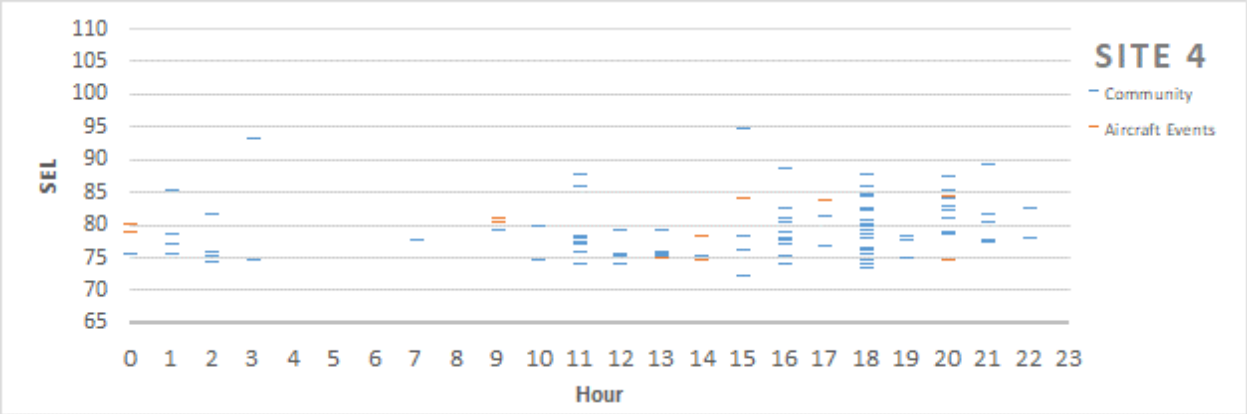
Figure 3.5 shows the measured hourly aircraft and community SEL events for each site.

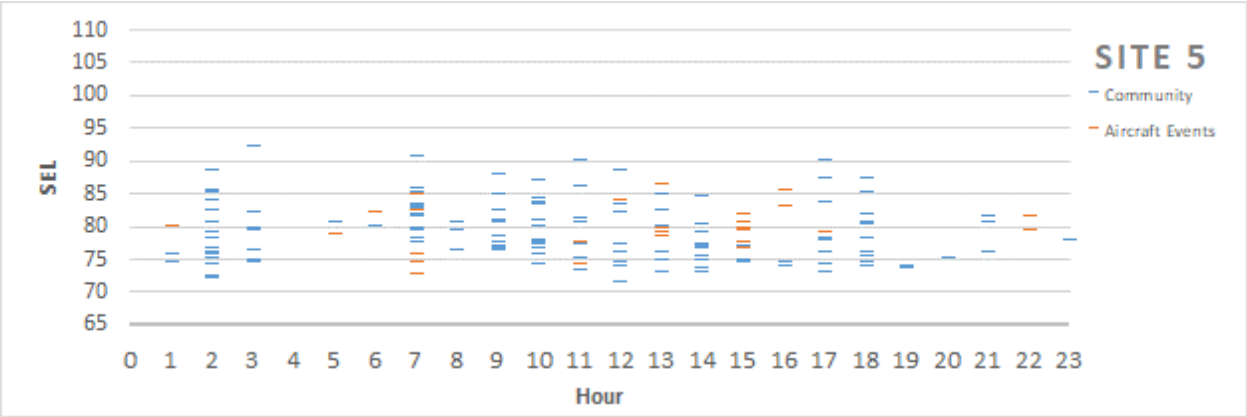
Figure 3.5: Aircraft and Community Single Events per Hour (SEL)

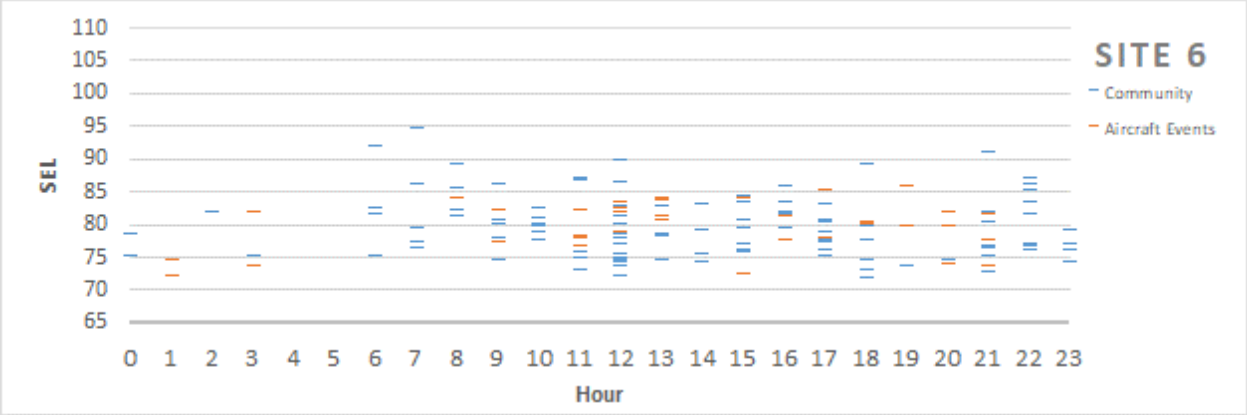





Sites 1 and 2 measured the highest SEL community events, and the highest SEL aircraft events occurred at Site 5 and Site 2. Table 3.3 shows the types of aircraft associated with highest $LA_{max}$ and SEL at each site during the study period, ranked by $LA_{max}$.

The aircraft sound event with the longest duration was measured at 33 seconds and occurred at Site 2 by an unknown aircraft type on August 13, 2020 at 6:46 P.M. with a $LA_{max}$ at 75.8 dB and a SEL of 84.8.

The loudest aircraft sound event during the study period occurred at Site 2 with a Cessna C560 jet measuring a maximum level at 82.9 dBA on August 13 at 9:20 P.M. The SEL for this aircraft sound event measured at 88.1.

Table 3.3 Top-Ten Single Event FCM Aircraft Sounds per Site

| Site 1- District 3 (Mt. Hope Dr) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date and Time | $LA_{max}$ | Duration | SEL | Aircraft Type | Flight ID | Rank $LA_{max}$ | Rank SEL |
| 8/10/2020 22:07 | 81.3 | 26 | 87.6 | UNK | Unknown | 1 | 1 |
| 8/12/2020 15:14 | 75.3 | 25 | 84.9 | UNK | A73AB4 | 2 | 2 |
| 8/7/2020 15:02 | 74.9 | 14 | 81.9 | SR22 | Unknown | 3 | 3 |
| 8/13/2020 18:40 | 74.3 | 16 | 81.5 | UNK | Unknown | 4 | 4 |
| 8/12/2020 10:00 | 69.7 | 10 | 77.9 | C172 | N8488L | 5 | 5 |
| 8/13/2020 18:46 | 68.8 | 8 | 76.7 | UNK | Unknown | 6 | 6 |
| 8/13/2020 18:45 | 67.9 | 9 | 76.0 | UNK | Unknown | 7 | 7 |
| 8/10/2020 17:11 | 67.5 | 4 | 73.0 | C172 | N758CE | 8 | 8 |
| 8/13/2020 14:30 | 67.1 | 4 | 72.8 | C208 | N76AZ | 9 | 9 |

| Site 2- District 17 (Allen Building) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date and Time | $LA_{max}$ | Duration | SEL | Aircraft Type | Flight ID | Rank $LA_{max}$ | Rank SEL |
| 8/13/2020 21:20 | 82.9 | 16 | 88.1 | C560 | N910TR | 1 | 1 |
| 8/13/2020 22:05 | 79.8 | 13 | 85.1 | BE9L | N55MN | 2 | 4 |
| 8/11/2020 0:55 | 78.4 | 21 | 87.3 | UNK | Unknown | 3 | 2 |
| 8/10/2020 18:02 | 77.7 | 19 | 86.7 | UNK | Unknown | 4 | 3 |
| 8/12/2020 20:30 | 75.9 | 18 | 84.9 | BE40 | N287LS | 5 | 5 |
| 8/13/2020 18:46 | 75.8 | 33 | 84.8 | UNK | Unknown | 6 | 6 |
| 8/8/2020 20:58 | 75.6 | 21 | 84.7 | R44 | N134AA | 7 | 7 |
| 8/13/2020 12:32 | 74.3 | 16 | 82.5 | B407 | N119SP | 8 | 11 |
| 8/8/2020 19:38 | 73.8 | 22 | 83.9 | R44 | N134AA | 9 | 8 |
| 8/8/2020 20:32 | 73.8 | 19 | 83.6 | R44 | N134AA | 10 | 9 |

| Site 3- District 5 (Jenks Av) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date and Time | $LA_{max}$ | Duration | SEL | Aircraft Type | Flight ID | Rank $LA_{max}$ | Rank SEL |
| 8/11/2020 13:38 | 80.0 | 16 | 87.0 | BE40 | N287LS | 1 | 1 |
| 8/13/2020 21:53 | 76.0 | 12 | 83.0 | BE20 | N70MN | 2 | 3 |
| 8/13/2020 21:42 | 75.3 | 14 | 83.6 | BE20 | N70MN | 3 | 2 |
| 8/7/2020 10:41 | 74.3 | 9 | 80.7 | C56X | N560FS | 4 | 5 |
| 8/7/2020 17:13 | 73.0 | 9 | 80.4 | E55P | N974SC | 5 | 6 |
| 8/10/2020 16:25 | 72.6 | 14 | 81.7 | BE40 | N287LS | 6 | 4 |
| 8/10/2020 17:51 | 72.1 | 10 | 79.8 | GLF5 | N168CE | 7 | 7 |
| 8/9/2020 10:01 | 72.0 | 8 | 78.2 | C56X | DOW885 | 8 | 12 |
| 8/11/2020 10:37 | 71.9 | 9 | 78.6 | UNK | Unknown | 9 | 11 |
| 8/11/2020 9:07 | 71.8 | 13 | 79.7 | F2TH | N244C | 10 | 8 |

| Site 4- District 4 (Suburban Av) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date and Time | $LA_{max}$ | Duration | SEL | Aircraft Type | Flight ID | Rank $LA_{max}$ | Rank SEL |
| 8/10/2020 17:53 | 77.8 | 13 | 83.8 | C72R | N758CE | 1 | 3 |
| 8/12/2020 15:29 | 76.7 | 13 | 84.1 | B429 | N961BK | 2 | 2 |
| 8/12/2020 9:56 | 74.9 | 10 | 80.3 | A109 | N519CG | 3 | 5 |
| 8/12/2020 20:35 | 74.9 | 22 | 84.4 | UNK | Unknown | 4 | 1 |
| 8/11/2020 9:49 | 72.4 | 13 | 80.9 | A109 | N519CG | 5 | 4 |
| 8/10/2020 14:28 | 69.1 | 12 | 78.3 | B737 | N315TS | 6 | 8 |
| 8/9/2020 14:59 | 68.6 | 5 | 74.4 | GLF5 | EJM10 | 7 | 11 |
| 8/13/2020 20:27 | 68.5 | 6 | 74.5 | PA32 | N82965 | 8 | 10 |
| 8/12/2020 0:22 | 68.3 | 16 | 78.9 | B407 | Unknown | 9 | 7 |
| 8/11/2020 0:18 | 68.3 | 21 | 80.0 | UNK | | 10 | 6 |

| Site 5- District 1 (Skyway Dr) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date and Time | $LA_{max}$ | Duration | SEL | Aircraft Type | Flight ID | Rank $LA_{max}$ | Rank SEL |
| 8/13/2020 13:28 | 81.8 | 11 | 86.5 | AEST | N60772 | 1 | 1 |
| 8/10/2020 16:18 | 77.8 | 14 | 85.4 | GLF5 | N749CP | 2 | 2 |
| 8/7/2020 12:08 | 77.3 | 14 | 83.9 | CL30 | N832LA | 3 | 4 |
| 8/11/2020 7:12 | 76.8 | 20 | 84.9 | E55P | N974SC | 4 | 3 |
| 8/8/2020 16:56 | 76.0 | 12 | 83.1 | F900 | DOW890 | 5 | 5 |
| 8/10/2020 7:59 | 73.2 | 15 | 82.6 | TBM9 | N22HP | 6 | 6 |
| 8/12/2020 6:43 | 73.0 | 15 | 82.1 | CL30 | N370EL | 7 | 7 |
| 8/12/2020 15:47 | 72.5 | 12 | 80.5 | LJ25 | N251TS | 8 | 10 |
| 8/10/2020 15:18 | 72.4 | 10 | 79.7 | E55P | DOW974 | 9 | 12 |
| 8/8/2020 13:32 | 72.3 | 8 | 79.0 | C56X | N753JL | 10 | 16 |

| Site 6- District 6 (Abell Dr) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date and Time | $LA_{max}$ | Duration | SEL | Aircraft Type | Flight ID | Rank $LA_{max}$ | Rank SEL |
| 8/7/2020 17:56 | 78.9 | 10 | 85.3 | C25A | N209AM | 1 | 2 |
| 8/7/2020 19:23 | 78.8 | 14 | 85.7 | H25B | N244FL | 2 | 1 |
| 8/12/2020 15:52 | 76.1 | 15 | 84.0 | GLF5 | EJM10 | 3 | 4 |
| 8/12/2020 13:03 | 75.8 | 16 | 83.9 | PC12 | N348PC | 4 | 5 |
| 8/12/2020 8:47 | 75.8 | 16 | 84.1 | PC12 | N522BB | 5 | 3 |
| 8/9/2020 20:09 | 75.7 | 9 | 81.9 | GLF5 | N56BU | 6 | 12 |
| 8/12/2020 13:06 | 75.7 | 15 | 83.6 | E55P | EJA374 | 7 | 6 |
| 8/8/2020 11:05 | 75.7 | 12 | 82.1 | LJ45 | N36GL | 8 | 10 |
| 8/8/2020 12:26 | 75.6 | 11 | 82.6 | C56X | N753JL | 9 | 8 |
| 8/7/2020 9:24 | 75.4 | 11 | 82.1 | G150 | N581SF | 10 | 9 |

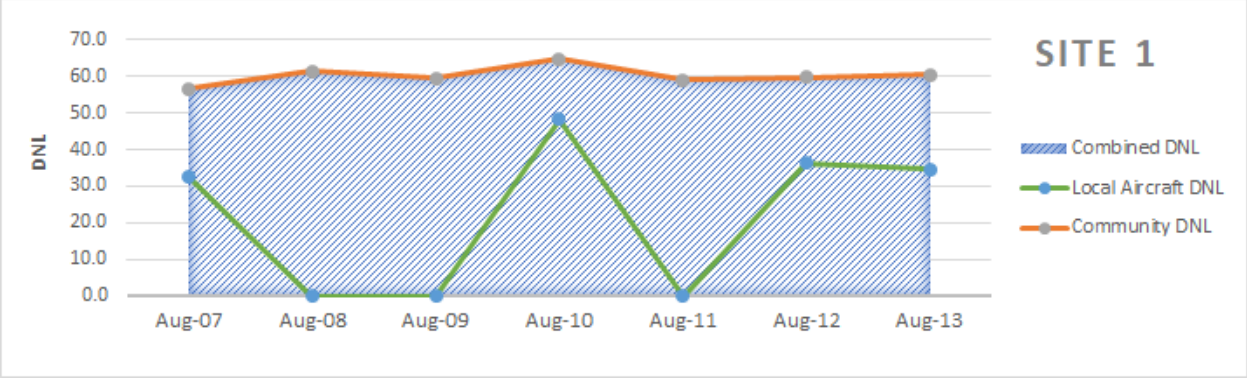
### Summary Based Metrics

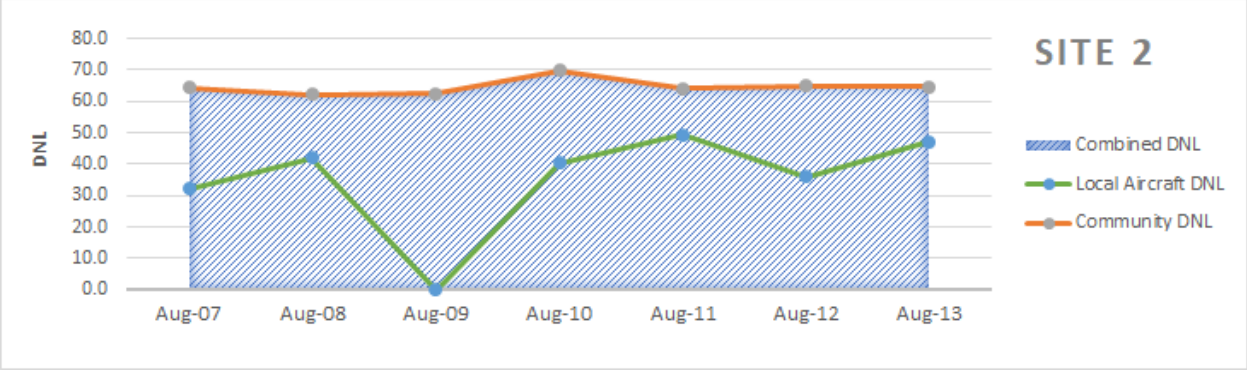
The Day-Night Average sound level (DNL) is an acoustic, summary-based metric that represents the total accumulation of all sound energy during a 24-hour day, including a 10 dB penalty applied to all sounds between 10:00 P.M. and 7:00 A.M. The FAA prescribes the use of DNL to establish a federal aviation threshold of significance of 65 dB DNL. DNL at or above 65 dB are considered incompatible for sensitive land uses such as residences and schools. The MAC distinguishes between aircraft and community using Aircraft DNL (ADNL) and Community DNL (CDNL) respectively.

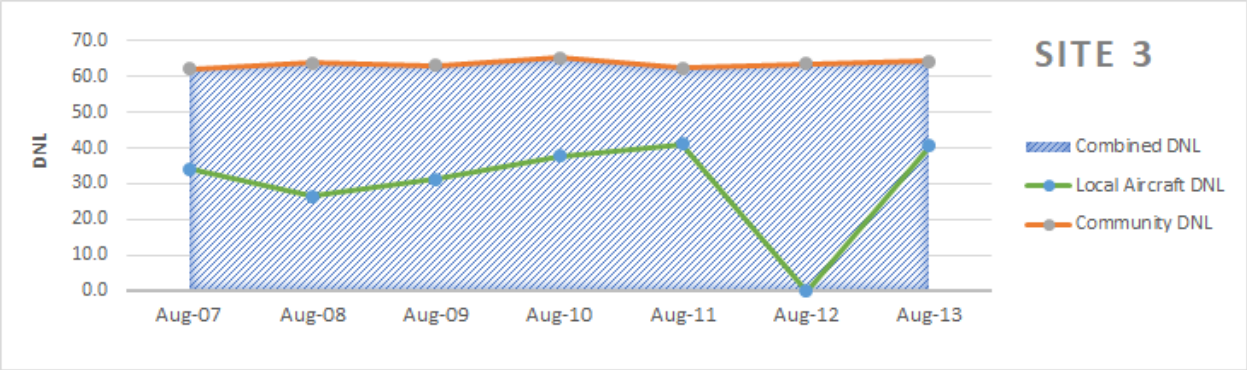
Figure 3.6 shows the ADNL and CDNL accumulations during the study period for each site. The highest ADNL occurred at Site 2 with 49.4 dB DNL on August 11, which is below the federal threshold of significance. The CDNL at Site 2 on the same date was 64.2 dB DNL and the combined DNL was 64.3 dB DNL.

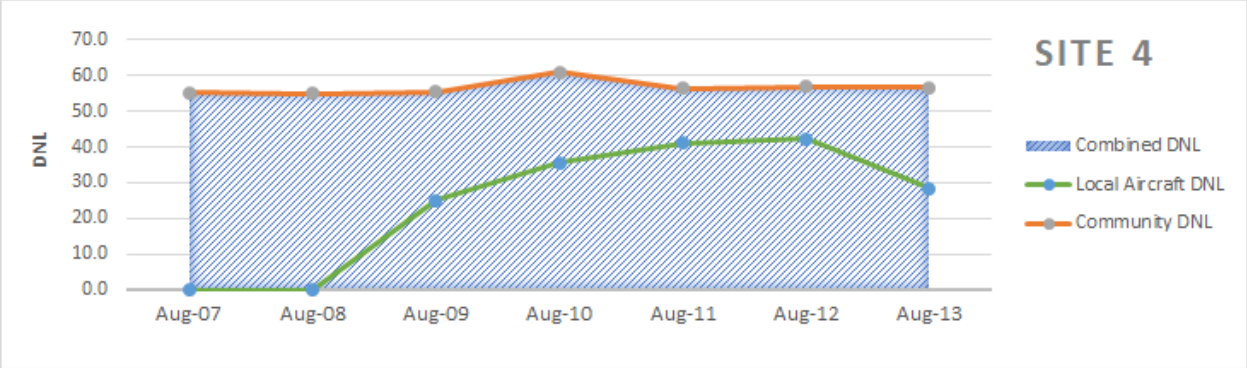
The highest combined DNL was 69.9 dB DNL, which occurred at Site 2 on August 10. The CDNL of 69.9 and the ADNL of 40.4 dB DNL on this date are contributing to this high level combined DNL. More detail about the field-measured DNL can be found in the Appendix.

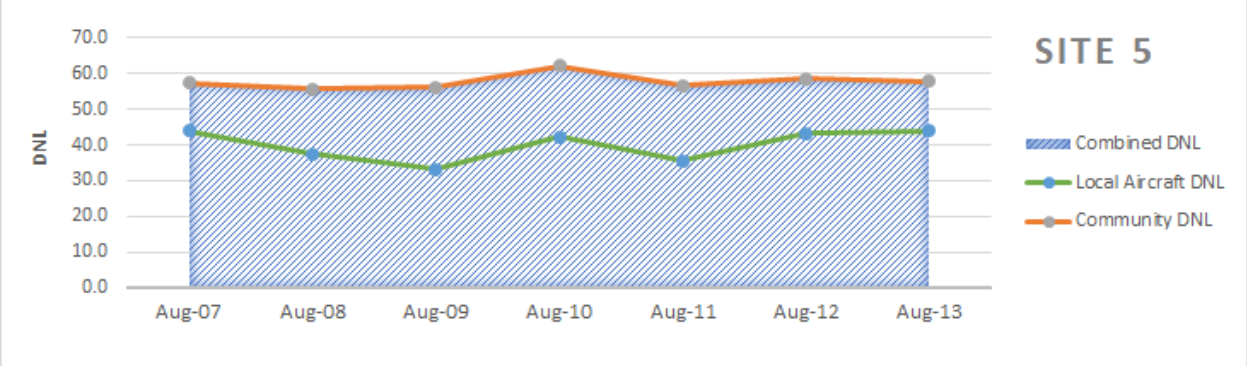
Figure 3.6: Aircraft and Community DNL Accumulations

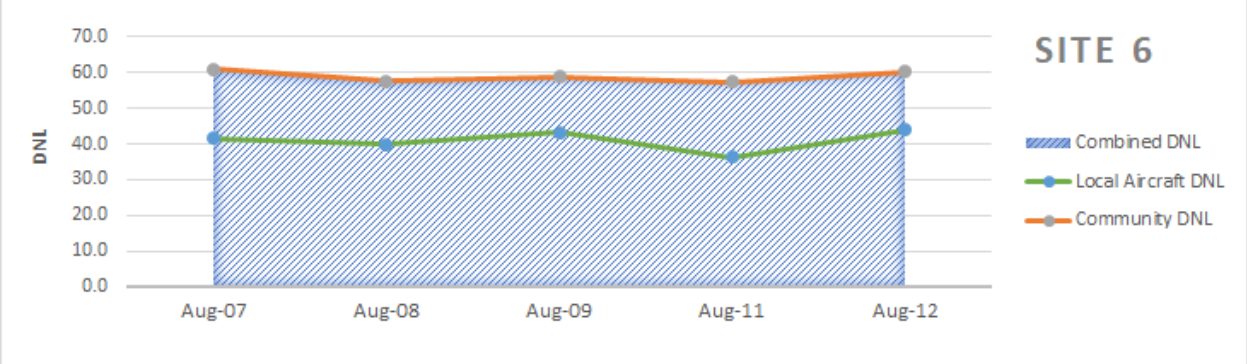



SITE 3
DNL
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Aug-07
Aug-08
Aug-09
Aug-10
Aug-11
Aug-12
Aug-13
Combined DNL
Local Aircraft DNL
Community DNL


SITE 4
DNL
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Aug-07
Aug-08
Aug-09
Aug-10
Aug-11
Aug-12
Aug-13
Combined DNL
Local Aircraft DNL
Community DNL


SITE 5
DNL
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Aug-07
Aug-08
Aug-09
Aug-10
Aug-11
Aug-12
Aug-13
Combined DNL
Local Aircraft DNL
Community DNL


SITE 6
DNL
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Aug-07
Aug-08
Aug-09
Aug-11
Aug-12
Combined DNL
Local Aircraft DNL
Community DNL

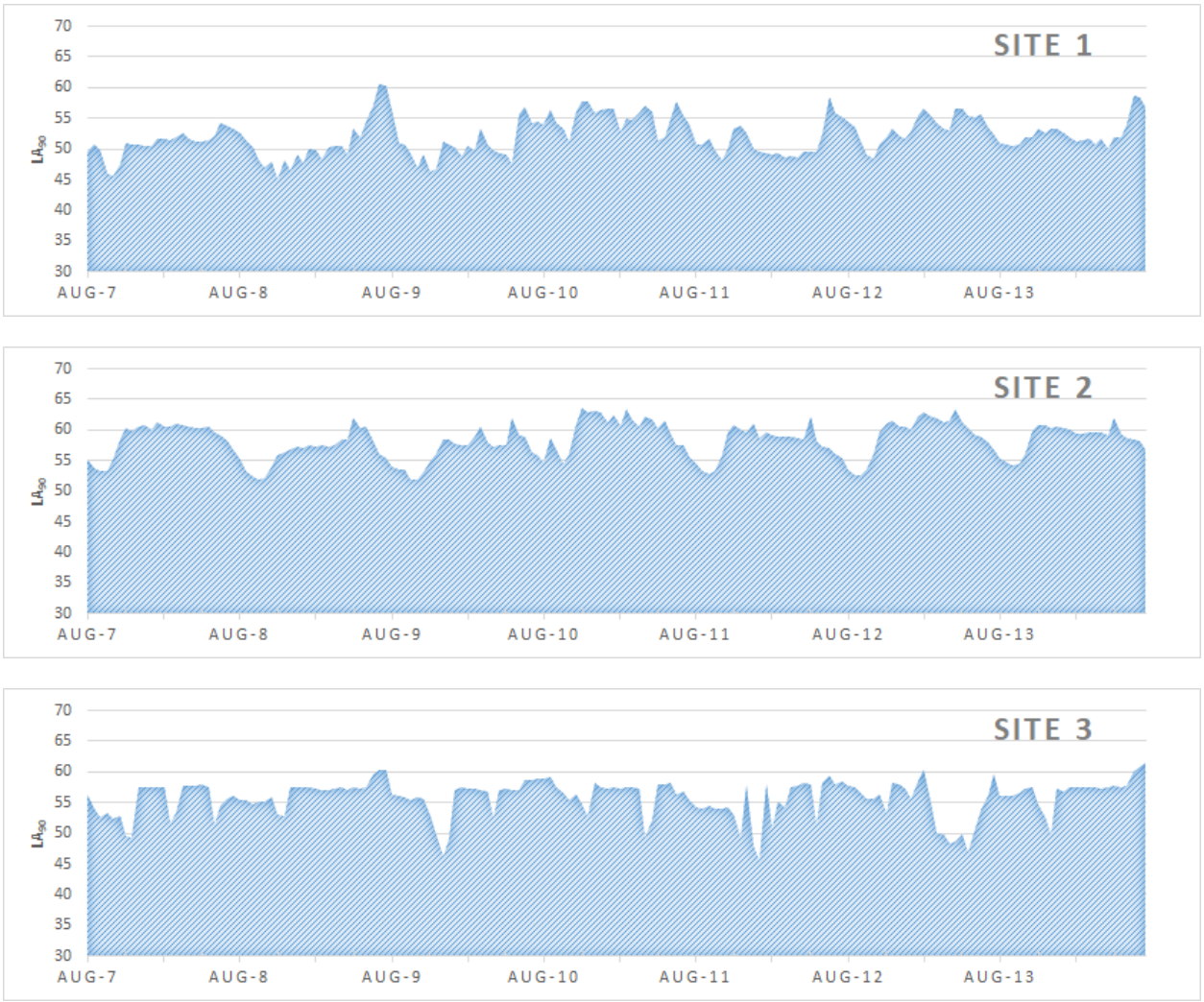
## Background Sound Levels

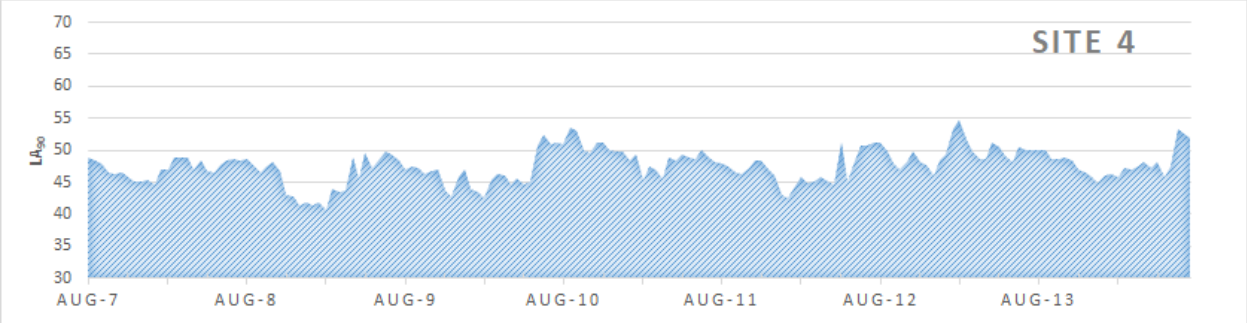
Sounds are continuously emitted around us by sources we cannot always see, such as wind, mechanical equipment, insects, freeways, etc. Because these sounds vary in intensity and frequency, the sound levels fluctuate from second-to-second and from hour-to-hour. Background levels are important when observing and comparing sound sources to achieve objectivity.

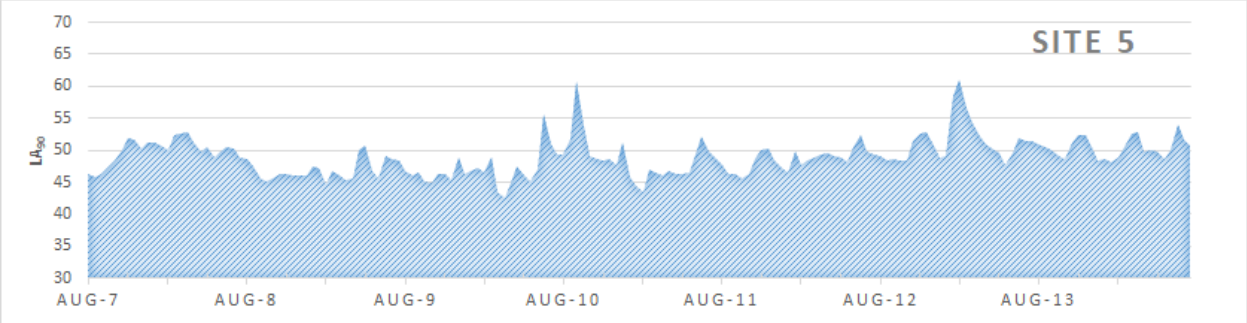
A common method to estimate the background sound level is to use a statistical metric called the $LA_{90}$, which is the A-Weighted sound level that is exceeded 90 percent of the time. In this study, we measured the hourly $LA_{90}$ for each field-measurement site throughout the study period. Figure 3.7 shows the $LA_{90}$ levels measured at each site during the study period.

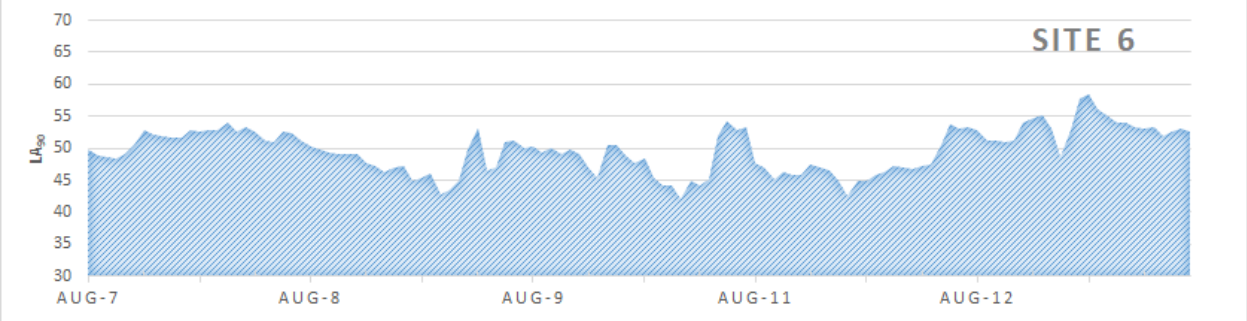
The $LA_{90}$ levels were highest in the vicinity of Site 2 on August 10 with 63.7 dB during the 6 A.M. hour and 63.4 dB during the 1:00 P.M. hour. Site 2 also had an $LA_{90}$ level of 63.4 dB on August 12 during the 5 P.M. hour. As represented by valleys in the charts below, nighttime background sound levels are typically lower.

Figure 3.7: Hourly Average Background Sound Levels




SITE 4
70
65
60
55
50
45
40
35
30
LA90
AUG-7
AUG-8
AUG-9
AUG-10
AUG-11
AUG-12
AUG-13


SITE 5
70
65
60
55
50
45
40
35
30
LA90
AUG-7
AUG-8
AUG-9
AUG-10
AUG-11
AUG-12
AUG-13


SITE 6
70
65
60
55
50
45
40
35
30
LA90
AUG-7
AUG-8
AUG-9
AUG-11
AUG-12

# 4.0 Sound Modeling

In addition to field monitoring, STP aircraft activity from August 7-13, 2020 was modeled using the FAA's modeling tool, AEDT, Version 3b. The FAA notes in a recent report to Congress,

> "… while the DNL metric is FAA's decision-making metric, other supplementary metrics can be used to support further disclosure and aid in the public understanding of community noise effects."

With actual monitoring, as noted above, events are documented when the analyzer detects a sound level over 65 dBA for four seconds or longer. Due to the nature of environmental monitoring, MACNOMS must take measures to attempt to filter out community and other ambient sounds before assigning aircraft sound events to a specific operation. The AEDT model does not have community ambient sounds to consider.

Conversely, AEDT must make assumptions about aircraft performance, flap configurations, engine settings, aircraft model types, weight, and weather. AEDT uses standard aircraft thrust settings, standard departure climb-rates as well as standard arrival descent rates, which may not represent actual operating characteristics. Additionally, certificated sound data are available for many aircraft types in the model, however all aircraft operating at STP are not represented. In those situations, modeling requires aircraft substitutions be used to represent missing aircraft types.

The goal of conducting field measurement studies and producing modeling results are similar and will often time produce the same sound metric results; however, differences between field measurements and sound modeling will result in variances between the data due to community sounds, measurement parameters, and necessary model assumptions.

The AEDT model can produce various sounds metrics. Two metric options available are the Number Above Noise Level and Time Above Noise Level. For this analysis, MAC staff evaluated the number of operations at or above 65 dB at a specific grid point and their duration.

This modeled sound analysis depicts aircraft sound events from actual aircraft activity at STP from August 7, 2020 through August 13, 2020 using model inputs such as runway use, aircraft fleet mix, aircraft performance and thrust settings, topography, and atmospheric conditions. Quantifying aircraft-specific sound characteristics in AEDT is accomplished using a comprehensive database developed by the FAA under 14 CFR Part 36. As part of the airworthiness certification process, aircraft manufacturers are required to subject aircraft to a battery of sound tests. Using federally-adopted and endorsed algorithms, this aircraft-specific sound information is used in the generation of model outputs. Justification for such an approach is rooted in national standardization of sound quantification at airports. Appendix A.4 includes the fleet mix and Appendix A.5 includes weather data utilized in the AEDT model for this analysis.

AEDT uses a grid pattern of individual noise measurement points, known as receptors, and calculates sound at each of these points. The grid pattern for this study included 22,500 unique points spaced 0.1 nautical miles apart for a range of 15 miles.

Additionally, AEDT uses standard weather inputs that are typically available for a study comprising a full year of data. For this study, standard weather inputs were changed to represent the average weather conditions for the study period. These inputs are available in Appendix A.5, Table A.1.

Figure 4.1 shows the modeled grid points by average number of events per day during the study period. Grid points with the highest number of events per day are all located within airport property.

Table 4.1 below provides the total number of sound events above 65 dBA modeled to occur at a field measurement location during the STP study period. The table also provides the number of measured sounds events above 65 dBA correlated to aircraft during the study period for comparison.

**Table 4.1 Measured Vs Modeled Number Above Sound Levels**

| Site | $N^{65}$ Measured | $N^{65}$ Modeled | Difference |
|---|---|---|---|
| **1** | 9 | 13 | 4 |
| **2** | 29 | 88 | 59 |
| **3** | 27 | 70 | 43 |
| **4** | 11 | 32 | 21 |
| **5** | 26 | 92 | 66 |
| **6** | 36 | 62 | 26 |

Figure 4.2 shows the modeled grid points by average time spent above 65 dBA per day during the study period. Grid points that exceeded 65 dBA for more than 90 minutes per day are located within airport property.

Table 4.2 below provides the total amount of time sound levels were above 65 dBA modeled to occur at a measurement location during the study period. The table also provides the total monitored time above 65 dBA correlated to aircraft during the study period for comparison.

**Table 4.2 Measured Vs Modeled Time Above Sound Level**

| Site | $TA^{65}$ Measured (min) | $TA^{65}$ Modeled (min) | Difference (min) |
|---|---|---|---|
| **1** | 1.9 | 1.8 | -0.1 |
| **2** | 8.2 | 18.6 | 10.4 |
| **3** | 4.2 | 22.7 | 18.5 |
| **4** | 2.3 | 6.5 | 4.2 |
| **5** | 5.2 | 19.3 | 14.1 |
| **6** | 6.3 | 14.7 | 8.4 |

Figure 4.3: Number of Events Above 65 dB per Day

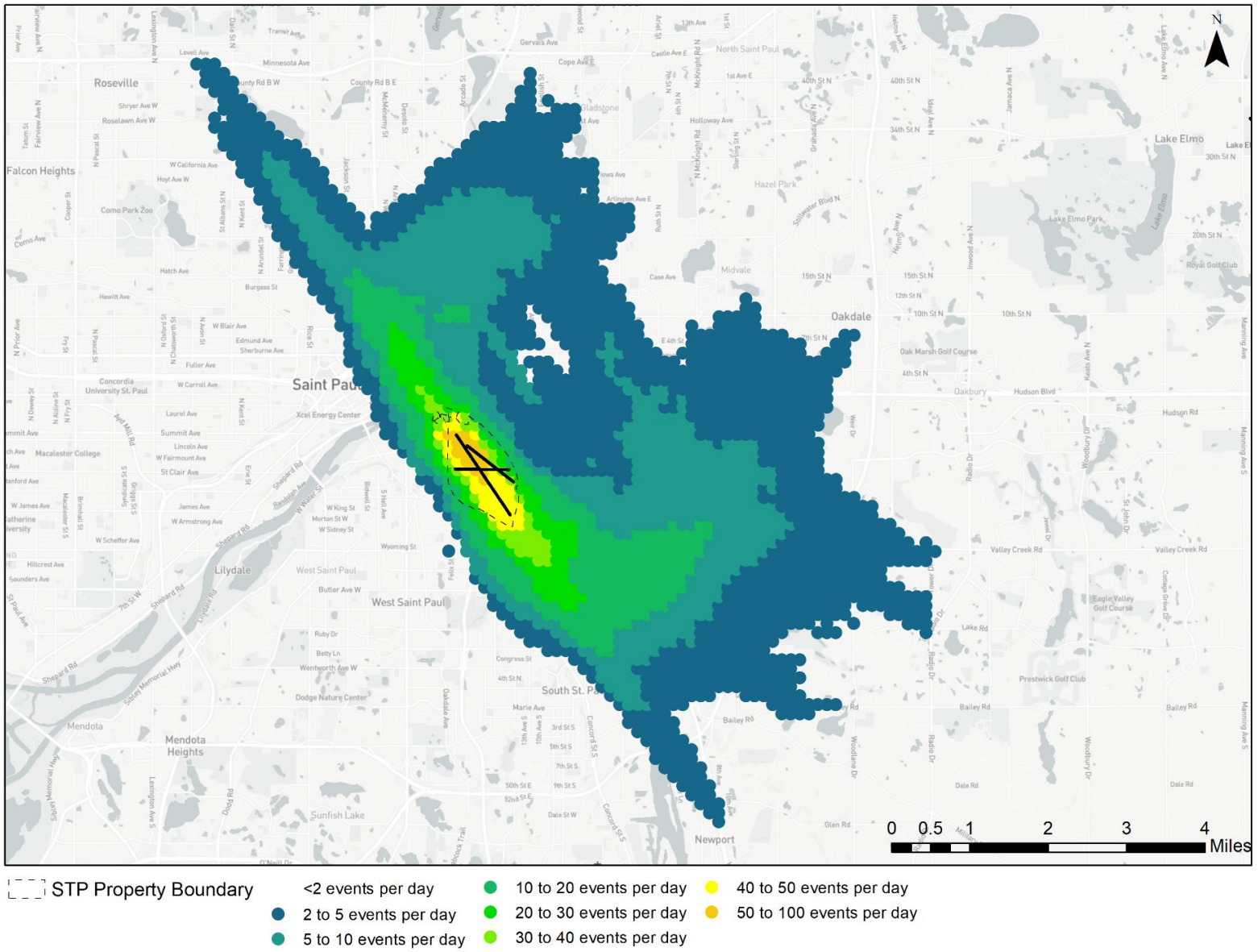
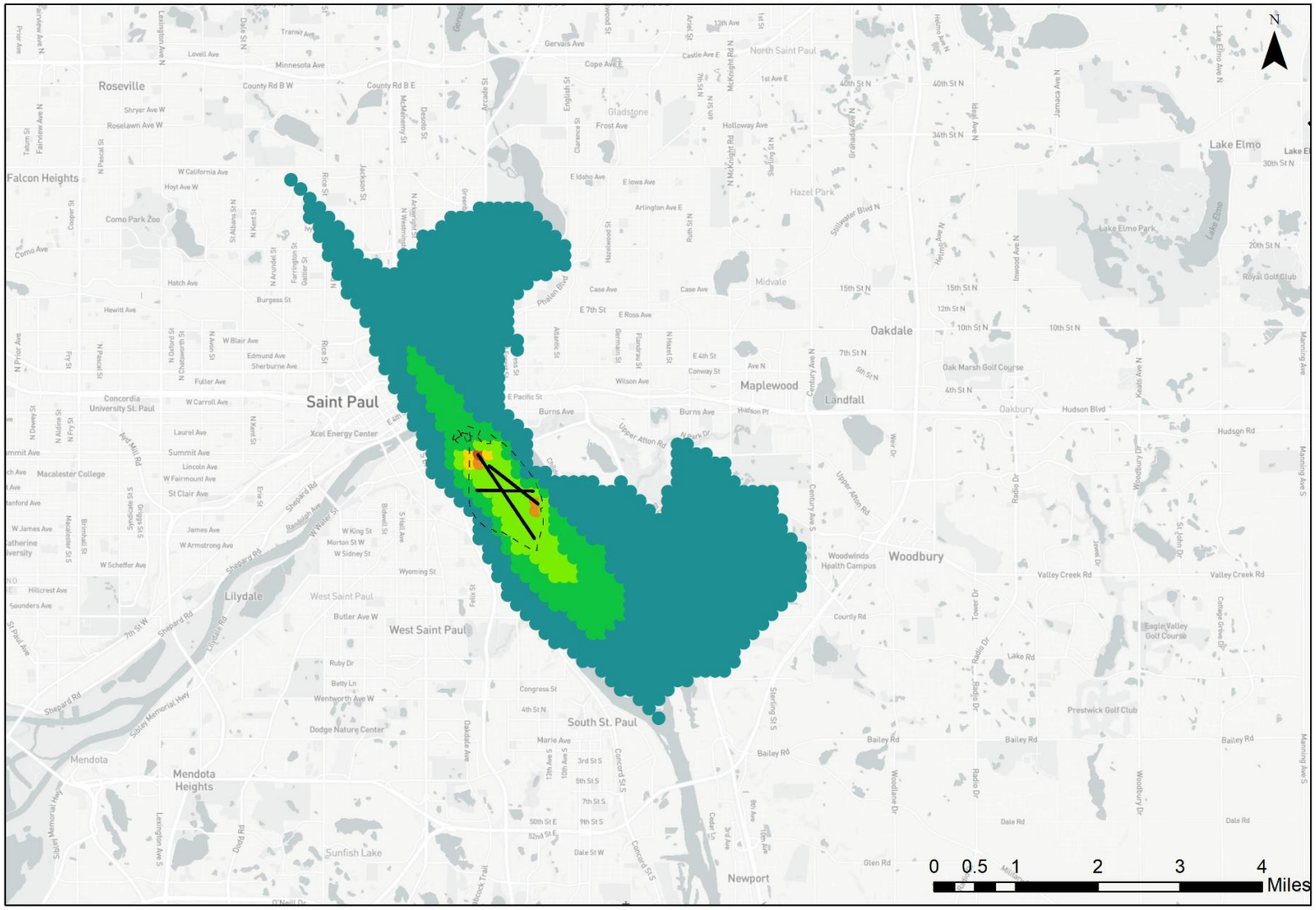


Figure 4.2: Time Above 65 dB (minutes per day)



# 5.0 Noise Complaints

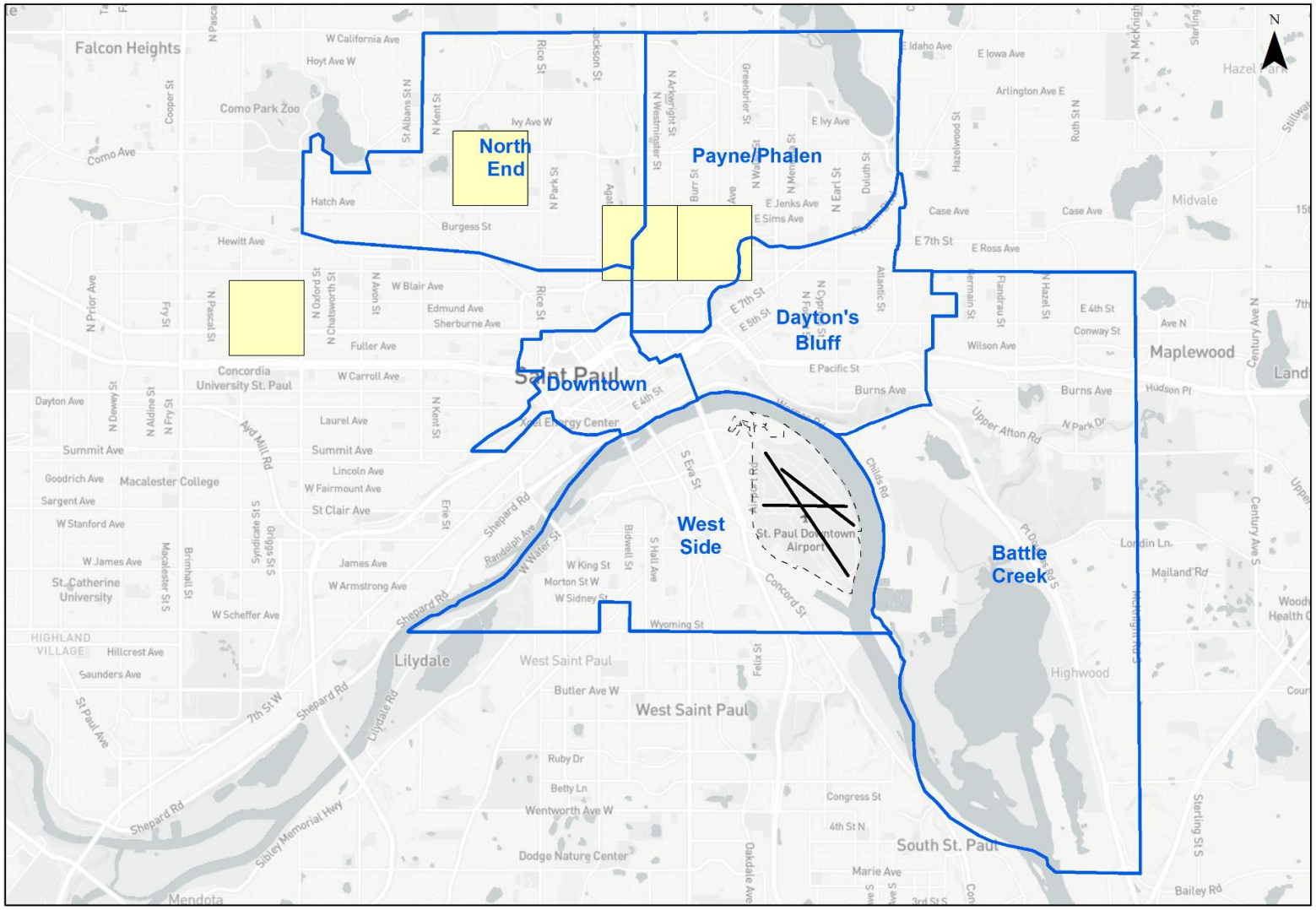
During the study period, six complaints were received from five households. One complaint was received during nighttime hours, between 10:00 P.M. and 7:00 A.M. Table 4.2 illustrates the complaints with correlated operations by aircraft type. Piston aircraft operated the most flights during the study period and received the greatest number of complaints.

**Table 5.1 Complaints and Operations**

| **Aircraft Type** | Operations | Complaints |
|---|---|---|
| Commercial | 2 | 0 |
| Helicopter | 32 | 0 |
| Jet | 152 | 4 |
| Piston | 80 | 2 |
| Turbo-Prop | 73 | 0 |
| Unknown | 44 | 0 |
| **Total** | **383** | **6** |

Figure 5.1 shows a complaint heat map representing the number of complaints within a grid square. Figure 5.2 shows complaints and the number of events above 65 dB.

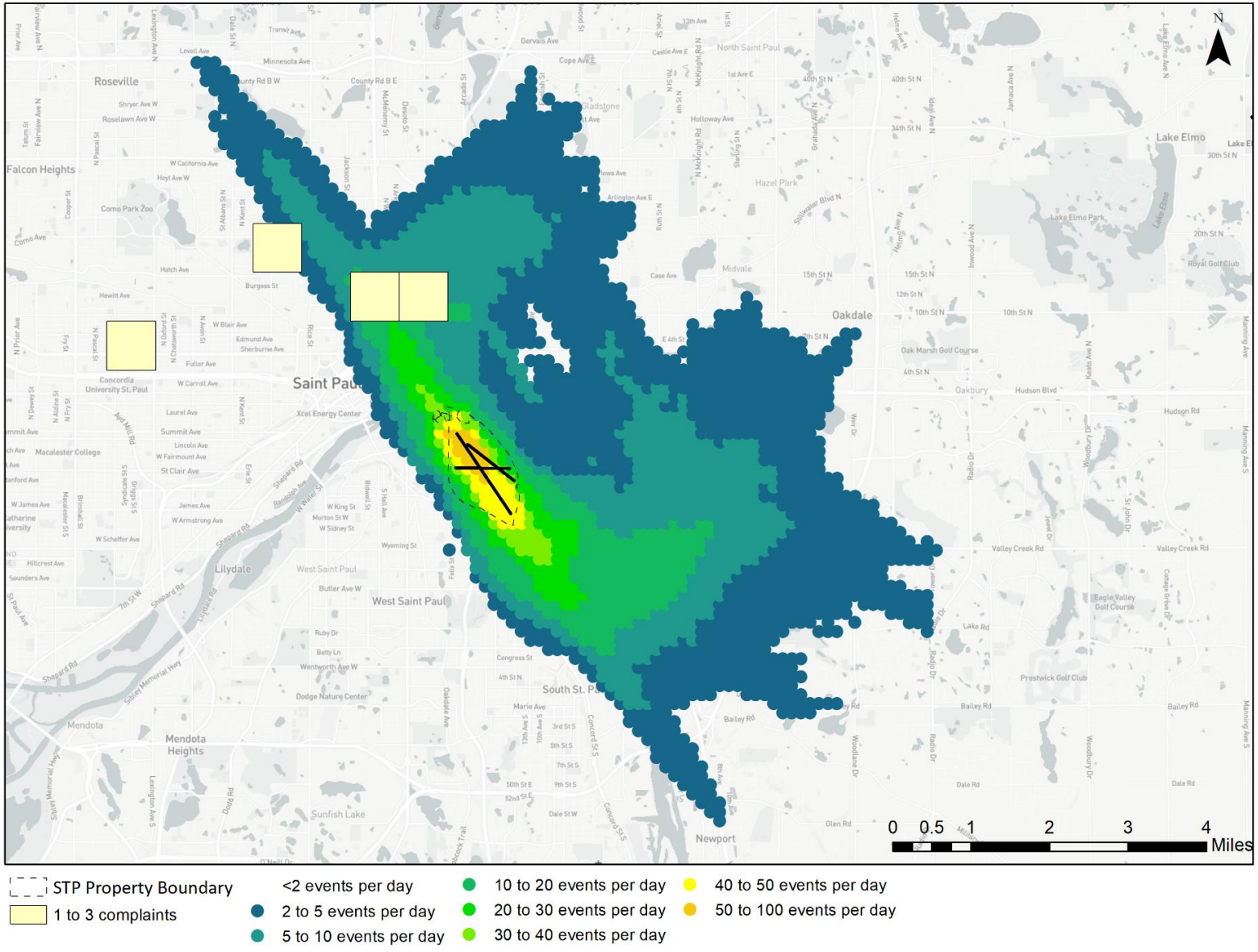
Figure 5.1: STP Study Period Complaint Heat Map




STP Property Boundary
St. Paul Neighborhood DACC District Councils
1 to 3 complaints

0 0.5 1 2 3 4 Miles

Figure 5.2: STP Study Period Complaint Heat Map with Number of Events Above 65 dB



# Appendix

## A.1 MAC Mobile Sound Monitoring Request Guidelines

Mobile equipment sites are located to measure sounds near known aircraft flight paths:

- Located where flight operations are at altitudes, concentrations, and configurations creating aircraft sound levels above community sound levels.
- Away from known community sound sources (such as large arterial roads, train tracks, factories, transit centers, natural and other gathering spots) that may interfere with gathering aircraft sound data.
- Availability of power source(s).
- On MAC or public owned property (preferred).

## A.2 Field-Measured Sound Data: Aircraft and Community DNL

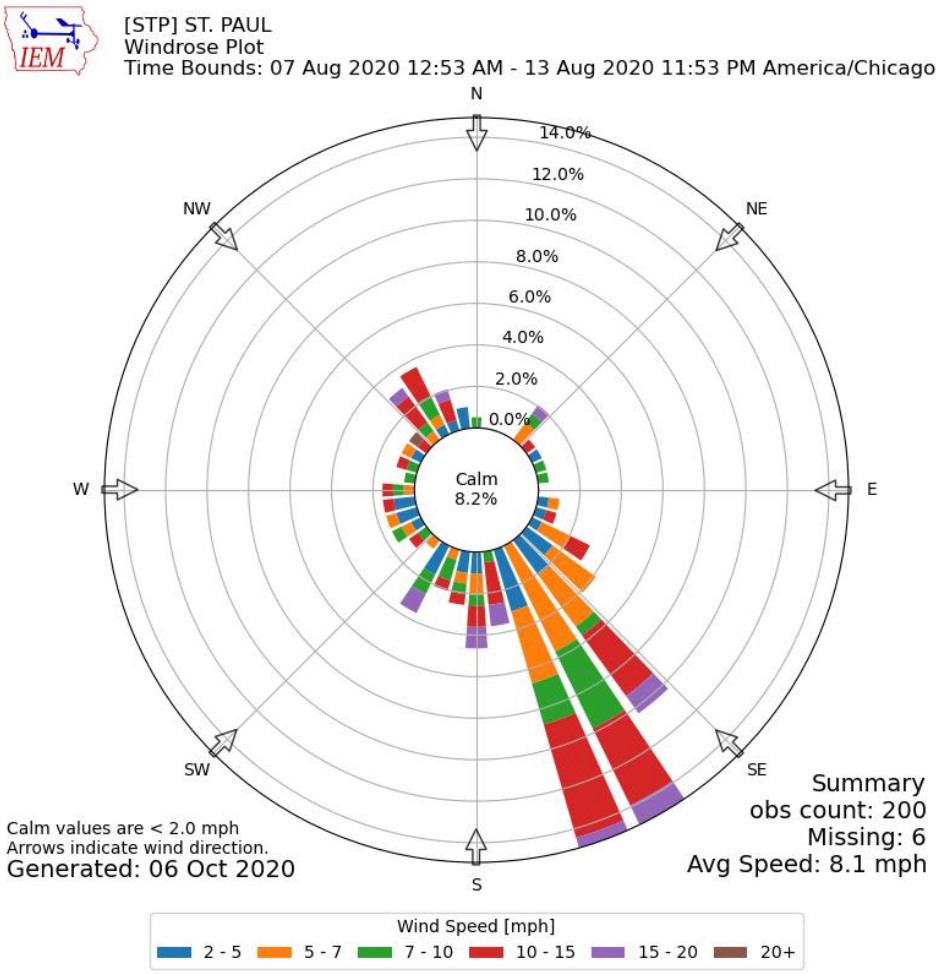
| Site | Date | ADNL | CDNL | Combined DNL |
|---|---|---|---|---|
| 1 | 8/7/2020 | 32.6 | 56.5 | 56.5 |
| 1 | 8/8/2020 | 0.0 | 61.4 | 61.4 |
| 1 | 8/9/2020 | 0.0 | 59.5 | 59.5 |
| 1 | 8/10/2020 | 48.2 | 64.8 | 64.9 |
| 1 | 8/11/2020 | 0.0 | 59.0 | 59.0 |
| 1 | 8/12/2020 | 36.3 | 59.6 | 59.6 |
| 1 | 8/13/2020 | 34.6 | 60.5 | 60.5 |
| 2 | 8/7/2020 | 32.2 | 64.5 | 64.5 |
| 2 | 8/8/2020 | 41.9 | 62.2 | 62.2 |
| 2 | 8/9/2020 | 0.0 | 62.4 | 62.4 |
| 2 | 8/10/2020 | 40.4 | 69.9 | 69.9 |
| 2 | 8/11/2020 | 49.4 | 64.2 | 64.3 |
| 2 | 8/12/2020 | 36.0 | 64.8 | 64.8 |
| 2 | 8/13/2020 | 47.1 | 64.7 | 64.8 |
| 3 | 8/7/2020 | 34.2 | 62.0 | 62.0 |
| 3 | 8/8/2020 | 26.4 | 63.7 | 63.7 |
| 3 | 8/9/2020 | 31.2 | 63.0 | 63.0 |
| 3 | 8/10/2020 | 37.7 | 65.1 | 65.1 |
| 3 | 8/11/2020 | 41.0 | 62.3 | 62.3 |
| 3 | 8/12/2020 | 0.0 | 63.5 | 63.5 |
| 3 | 8/13/2020 | 40.7 | 64.3 | 64.3 |
| 4 | 8/7/2020 | 0.0 | 55.2 | 55.2 |
| 4 | 8/8/2020 | 0.0 | 54.8 | 54.8 |
| 4 | 8/9/2020 | 25.0 | 55.5 | 55.5 |
| 4 | 8/10/2020 | 35.5 | 60.9 | 60.9 |
| 4 | 8/11/2020 | 41.1 | 56.4 | 56.5 |
| 4 | 8/12/2020 | 42.1 | 56.8 | 56.9 |
| 4 | 8/13/2020 | 28.3 | 56.6 | 56.6 |
| 5 | 8/7/2020 | 43.9 | 57.3 | 57.5 |
| 5 | 8/8/2020 | 37.4 | 55.6 | 55.7 |
| 5 | 8/9/2020 | 33.1 | 56.1 | 56.1 |
| 5 | 8/10/2020 | 42.3 | 62.2 | 62.2 |
| 5 | 8/11/2020 | 35.5 | 56.6 | 56.6 |
| 5 | 8/12/2020 | 43.2 | 58.4 | 58.5 |
| 5 | 8/13/2020 | 43.8 | 57.8 | 58.0 |
| 6 | 8/7/2020 | 41.6 | 60.8 | 60.9 |
| 6 | 8/8/2020 | 39.8 | 57.4 | 57.5 |
| 6 | 8/9/2020 | 43.3 | 58.7 | 58.8 |
| 6 | 8/11/2020 | 36.4 | 57.3 | 57.3 |
| 6 | 8/12/2020 | 43.9 | 60.2 | 60.3 |

## A.4 Modeled Aircraft Distribution

| Aircraft Type | Arrival | Departure | Touch and Go | Total Operations |
|---|---|---|---|---|
| **Jet** | **87.7** | **90.0** | **4.4** | **182.2** |
| Boeing 737-700 Series | 1.1 | 1.1 | | 2.2 |
| Bombardier Challenger 300 | 5.6 | 7.8 | | 13.3 |
| Bombardier Learjet 25 | 1.1 | 1.1 | | 2.2 |
| Bombardier Learjet 35 | | 1.1 | | 1.1 |
| Bombardier Learjet 45 | 2.2 | 3.3 | | 5.6 |
| Bombardier Learjet 60 | 2.2 | 1.1 | | 3.3 |
| Cessna 525A CitationJet | 1.1 | 1.1 | | 2.2 |
| Cessna 525B CitationJet | 2.2 | 1.1 | | 3.3 |
| Cessna 525C CitationJet | 3.3 | 3.3 | | 6.7 |
| Cessna 550 Citation II | 1.1 | 1.1 | | 2.2 |
| Cessna 560 Citation Excel | 12.2 | 12.2 | 1.1 | 25.5 |
| Cessna 680 Citation Sovereign | 3.3 | 3.3 | | 6.7 |
| Cessna 750 Citation X | 3.3 | 2.2 | 1.1 | 6.7 |
| CESSNA CITATION 510 | 2.2 | 1.1 | | 3.3 |
| Dassault Falcon 2000 | 5.6 | 6.7 | | 12.2 |
| Dassault Falcon 900 | 1.1 | 1.1 | | 2.2 |
| Embraer 500 | 7.8 | 8.9 | | 16.7 |
| Embraer Legacy 450 (EMB-545) | 2.2 | 2.2 | | 4.4 |
| Falcon 7X | | 1.1 | | 1.1 |
| Gulfstream G150 | 1.1 | | | 1.1 |
| Gulfstream G280 | 1.1 | 2.2 | | 3.3 |
| Gulfstream G400 | 1.1 | | | 1.1 |
| Gulfstream G500 | 10.0 | 8.9 | | 18.9 |
| Raytheon Beechjet 400 | 10.0 | 11.1 | 1.1 | 22.2 |
| Raytheon Hawker 800 | 5.6 | 5.6 | 1.1 | 12.2 |
| Raytheon Premier I | 1.1 | 1.1 | | 2.2 |
| **Piston** | **70.0** | **61.1** | **54.4** | **185.5** |
| **Single Engine** | **67.8** | **57.8** | **54.4** | **179.9** |
| Bellanca 8 Scout Super Decathlon (FAS) | 1.1 | 1.1 | | 2.2 |
| Cessna 140 (FAS) | 1.1 | 1.1 | | 2.2 |
| Cessna 150 Series | 1.1 | 1.1 | | 2.2 |
| Cessna 152 (FAS) | 3.3 | 1.1 | 10.0 | 14.4 |
| Cessna 172 Skyhawk | 16.7 | 15.5 | 23.3 | 55.5 |
| Cessna 182 | 7.8 | 2.2 | | 10.0 |
| Cessna 206 | 1.1 | 1.1 | | 2.2 |
| Cirrus SR22 | 6.7 | 6.7 | 3.3 | 16.7 |
| Cirrus SR22 Turbo (FAS) | 4.4 | 3.3 | | 7.8 |
| Grumman AA-5A/B (FAS) | 1.1 | 1.1 | | 2.2 |
| Mooney M20-K | 3.3 | 3.3 | | 6.7 |
| North American T-6 Texan (FAS) | 1.1 | | | 1.1 |
| Piper PA-28 Cherokee Series | 11.1 | 12.2 | 17.8 | 41.1 |
| Piper PA-32 Cherokee Six | 3.3 | 3.3 | | 6.7 |
| Raytheon Beech Bonanza 36 | 2.2 | 2.2 | | 4.4 |
| Vans RV6 (FAS) | 1.1 | 1.1 | | 2.2 |
| Vans RV9 (FAS) | 1.1 | 1.1 | | 2.2 |
| **Multi Engine** | **2.2** | **3.3** | | **5.6** |
| Aerostar PA-60 | 1.1 | 1.1 | | 2.2 |
| Cessna 414 | 1.1 | 2.2 | | 3.3 |
| **Turboprop** | **36.7** | **40.0** | **15.5** | **92.2** |

| Aircraft Type | Arrival | Departure | Touch and Go | Total Operations |
|---|---|---|---|---|
| **Single Engine** | **13.3** | **17.8** | **2.2** | **33.3** |
| Cessna 180 (FAS) | | 1.1 | | 1.1 |
| Cessna 208 Caravan | 3.3 | 3.3 | 2.2 | 8.9 |
| EADS Socata TBM-700 | | 3.3 | | 3.3 |
| EPIC LT/Dynasty | 1.1 | 1.1 | | 2.2 |
| Maule MT-7-235 | 1.1 | 1.1 | | 2.2 |
| Pilatus PC-12 | 5.6 | 5.6 | | 11.1 |
| Socata TBM-9 (FAS) | 2.2 | 2.2 | | 4.4 |
| **Multi Engine** | **23.3** | **22.2** | **13.3** | **58.9** |
| Embraer EMB120 Brasilia | 1.1 | 1.1 | | 2.2 |
| Raytheon King Air 90 | 3.3 | 3.3 | 5.6 | 12.2 |
| Raytheon Super King Air 200 | 10.0 | 10.0 | 5.6 | 25.5 |
| Raytheon Super King Air 300 | 8.9 | 7.8 | 2.2 | 18.9 |
| **Helicopter** | **11.1** | **16.7** | **0.0** | **27.8** |
| **Single Engine** | **1.1** | **0.0** | **0.0** | **1.1** |
| Bell 206B-3 | 1.1 | | | |
| **Multi Engine** | **10.0** | **16.7** | **0.0** | **26.7** |
| Agusta A-109 | 2.2 | 2.2 | 0.0 | 4.4 |
| Bell 407 / Rolls-Royce 250-C47B | 5.6 | 6.7 | | 12.2 |
| Bell 429 | 2.2 | 1.1 | | 3.3 |
| Eurocopter EC-155B1 | | 1.1 | | 1.1 |
| Robinson R44 Raven / Lycoming O-540-F1B5 | | 5.6 | | 5.6 |
| **Grand Total** | **205.5** | **207.7** | **74.4** | **487.6** |

## A.5 STP Weather Details

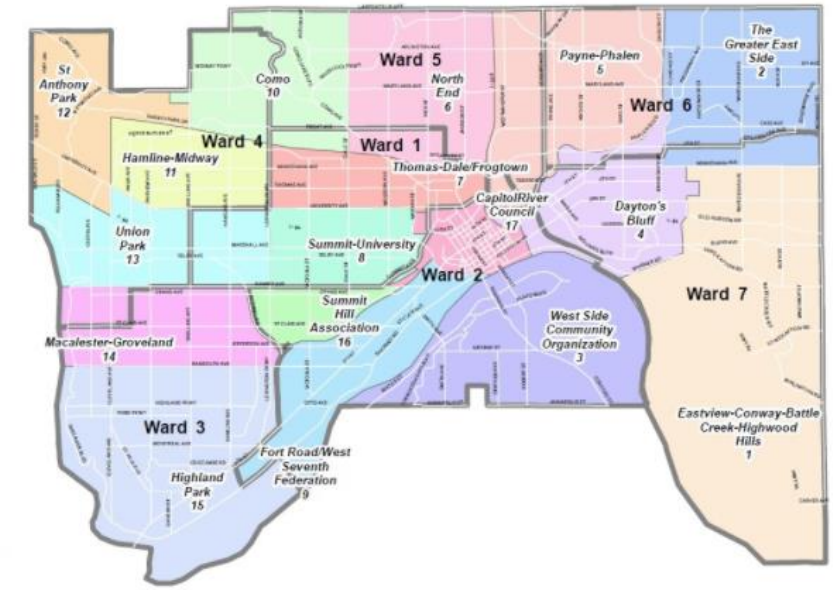



Source:
http://mesonet.agron.iastate.edu/sites/dyn_windrose.phtml?station=STP&network=MN_ASOS&bin0=2&bin1=5&bin2=7&bin3=10&bin4=15&bin5=20&units=mph&nsector=36&fmt=png&dpi=100&year1=2020&month1=8&day1=7&hour1=0&minute1=0&year2=2020&month2=8&day2=13&hour2=23&minute2=59

| Table A.1: Model Weather Inputs | |
|---|---|
| Average Temp | 74.3 |
| Average Wind Speed | 8.9 |
| Average Dew Point | 64.4 |
| Average Sea Level Pressure (SLP) | 986.3 |
| Average Relative Humidity | 72.8 |
| Average SLP (millibar) | 986.3 |

## A.6 Saint Paul District Council Map and Details

# District Council Directory




| District | Neighborhood | District Council |
|---|---|---|
| 1 | Eastview - Conway - Battle Creek - Highwood Hills | District 1 Community Council |
| 2 | Greater East Side | District 2 Community Council |
| 3 | West Side | West Side Community Organization |
| 4 | Dayton's Bluff | Dayton's Bluff Community Council |
| 5 | Payne-Phalen | Payne Phalen Community Council |
| 6 | North End | North End Neighborhood Organization |
| 7 | Thomas-Dale/Frogtown | Frogtown Neighborhood Association |
| 8 | Summit-University | Summit-University Community Council |
| 9 | West 7th/Fort Road | Fort Road Federation |
| 10 | Como | District 10 Como Community Council |
| 11 | Hamline-Midway | Hamline Midway Coalition |
| 12 | St. Anthony Park | St. Anthony Park Community Council |
| 13 | Union Park | Union Park District Council |
| 14 | Macalaster-Groveland | Macalester Groveland Community Council |
| 15 | Highland | Highland District Council |
| 16 | Summit Hill | Summit Hill Association |
| 17 | Downtown | Capitol River Council |

Source: https://www.stpaul.gov/residents/live-saint-paul/neighborhoods/district-councils/district-council-directory

## A.7 Supplemental Conditions of Agreement

# METROPOLITAN AIRPORTS COMMISSION

Minneapolis-Saint Paul International Airport
6040 - 28th Avenue South • Minneapolis, MN 55450-2799
Phone (612) 726-8100

TO WHOM IT MAY CONCERN:

On June 19, 2006 the following action took place at the Metropolitan Airports Commission full Commisson meeting regarding the St. Paul Downtown Airport – Flood Protection Update:

**COMMISSIONER MARS MOVED AND COMMISSIONER LANNERS SECONDED TO INCREASE THE AMOUNT FOR THE PROJECT IN THE CAPITAL IMPROVEMENT PROGRAM FROM $28.5 MILLION TO $29.3 MILLION AND AUTHORIZE STAFF TO INCLUDE THE CONDITIONS THAT WERE PRESENTED TO THE COMMITTEE IN THE ZONING APPLICATION WHEN RESUBMITTED TO THE CITY. FURTHER THAT STAFF WORK WITH PUBLIC AND PRIVATE PARTIES THAT WILL DIRECTLY BENEFIT FROM THE FLOOD PROTECTION PROJECT TO RAISE REVENUES TO OFFSET THE COST INCREASE.**

**The Motion passed unanimously by the following roll call vote:**

**Commissioners:** **Berman, Boivin, Harris, Landy, Lanners, Mars, McGee, Rehkamp, Sigel, Warner, Williams and Chair McKasy**

**Absent:** **Commissioners Foley and Stenerson**

**Sallye Douma, Commission Secretary**

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Runway Length MAC will not take any action to increase the length of the runways at the Airport in excess of the current length, unless required to do so by State law, provided that MAC will not initiate, promote or otherwise support enactment of such law.

Pavement Strength MAC will not take any action to increase the Runway Pavement Weight-Bearing Capacity at the Airport beyond the maximum presently available, unless required to do so by State law, provided that MAC will not initiate, promote or otherwise support enactment of such law.

Cargo Operations MAC represents that, based on operational and space limitations, major air cargo transfer/sortation operations (such as Federal Express, UPS and other similar companies) are not able to use the Airport, nor will MAC take action to accommodate such activity.

Airport Noise Abatement Plan MAC will, in consultation and collaboration with the City and other interested parties (agreed to by MAC and the City), immediately initiate an update of the St. Paul Downtown Airport Noise Abatement Plan to include the following elements:

- Use of the runways at the Airport.
- Appropriate flight tracks for aircraft arriving at, or departing from, the Airport.
- Voluntary restraint on night-time aircraft operations and recommended procedures for any such operations that must occur.
- Voluntary restraint on night-time aircraft engine runups.
- Implementation of a pilot/FBO information and education program designed to inform Airport Users and Fixed Base operators of the elements contained in the Noise Abatement Plan.
- Completion of an annual study of aircraft noise in the areas surrounding the Airport.
- Incorporation of limitations regarding runway length, runway strength and cargo operations.
- Public Input.

As necessary, MAC will seek Federal Aviation Administration approval of the updated noise abatement plan. MAC shall use its best efforts to secure federal approval of the plan or any portion of the proposed plan.

Endangered/Threatened Species MAC will coordinate with the City of St. Paul and other appropriate agencies to complete an updated survey of threatened/endangered species within the project area.

Vegetation/Revegetation Plan MAC will coordinate with the City of St. Paul and other interested parties to review and make recommendations regarding a vegetation/revegetation plan for the project area. MAC will implement these recommendations if they are determined to be compatible with Airport operations.

Treatment of Contaminated Soils MAC will complete additional soil sampling and testing in the area proposed for compensatory excavation, including testing for PAH's and inorganics. MAC will also monitor excavated material from the compensatory excavation per a Testing and Disposal Plan. Any contaminated soils will be properly disposed of in a licensed facility approved for such disposal.

Stormwater Discharge MAC will complete a sampling/testing protocol for subdrain discharge, as may be required by the Minnesota Pollution Control Agency.

## A.8 Glossary

**Aircraft Operation**

Aircraft arriving or departing from STP, or an aircraft that performed both an arrival and departure (touch and go).

**A-Weighting**

A-Weighting is a standard filter used by acoustic measurement devices and can be applied to acoustic measurements. It is frequency filter that attempts to emulate the way human hear.

**Day-Night Level (DNL)**

The FAA established DNL as the primary metric for aircraft noise analysis and expressing aircraft noise exposure in the United States. "DNL" is the acronym for Day-Night Average Sound Level, which represents the total accumulation of all sound energy, with a 10-decibel penalty applied for each sound event between 10:00 P.M. and 7:00 A.M. DNL has been widely accepted as the best available method to describe aircraft noise exposure and is the industry standard for use in aircraft noise exposure analyses and noise compatibility planning. It also has been identified by the U.S. Environmental Protection Agency as the principal metric for airport noise analyses.

**Decibel (dB/dBA)**

Sound levels are measured in Decibels, a logarithmic scale of energy referenced to human hearing. Sound levels are reported in dB; dBA is the Decibel value after the A-Weighting filter is applied.

**$LA_{eq}$ (Equivalent Sound Level) Equivalent sound level**

The representation of a time-varying sound as an equivalent steady state A-weighted sound level for the period or interval of interest.

**$LA_{max}$ (Maximum A-weighted Sound Level)**

This is maximum A-Weighted Sound Level observed for the period, event, or interval of interest.

**$LA_{90}$ (Sound Level Exceeded 90 Percent of the Time)**

The LA90 is a common and typical method to estimate the background sound levels or sound levels seen most of the time. It is a statistical based metric which provides us with which A-Weighted sound level that is exceeded 90 percent of the time.

**Number Above**

The "Number Above", also referred to as N-level sound metric or Count Above, is the total number of aircraft sound events that exceeded a specified sound level threshold ($LA_{max}$). This report contains a

count of departure events and arrival events recorded with field-measurement equipment when the maximum sound level of those events exceeds 65, 80, 90, and 100 dB levels.

**SEL (Sound Exposure Level)**

Sound Exposure Level is the total sound energy expressed in one second. Numerically, the energy is equivalent but allows for the comparison of sound events with varying durations.

**Time Above Metric**

The "Time Above" noise metric measures the total time or percentage of time that the A-weighted aircraft noise level exceeds an indicated level. Time Above data are summarized for arrival and departure events based on one-second intervals.


**Metropolitan Airports Commission**

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