



CITY OF SUNNYVALE

JULY 14, 2020

**Casper Airport Solutions Inc.
Portable Noise Monitoring Analysis Report**



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1 Process to Date

1.1 Summary

On March 13, Casper delivered a document titled “Final Noise Monitor Site Selection Report.” This document contained an analysis of eight (8) properties identified during the project kick-off meeting held at City Hall on February 24th as being potentially suitable for the installation of a permanent noise monitoring terminals (NMT). The eight (8) sites were surveyed by the project team consisting of Gregory Maxwell-Casper Project Manager, Dan Furton-City Parks Manager, and representatives from our two consultants Sanchez Industrial Design (SID) and Vibro-Acoustic Consultants (VACC) the following day. The purpose of the site survey was to identify specific locations within each property that could be compatible and meet the list of siting requirements for placement of an NMT.

The siting requirements in order of importance were:

- The location must be a City-owned parcel
- The location must be close to arrival/departure paths at San Jose (KSJC), Moffett Field (KNUQ), Palo Alto (KPAO), and San Carlos (KSQL) airports
- The location must have low ambient noise levels to permit reliable capture of aircraft noise events
- The location must be suitable for solar power
- The location must minimize disruption to public use of facilities
- The location should not detract from the aesthetics of park landscaping and open space

Based on these requirements, the team located preferred sites on seven of the eight properties which met all of the requirements outlined. Greenwood Manor Park was eliminated from consideration due to the small size of the parcel and overhead powerlines. The Losse Well Site was determined to be unsuitable for solar power due to surrounding tall trees. The report provided specific details about each site, and it made recommendations to the City about which four of the remaining seven sites surveyed should be considered as the primary sites for installation.

1.2 Portable Noise Monitoring

To further validate the compatibility of these sites, the City exercised its option to have Casper conduct seven days of portable noise monitoring at each of the seven-candidate sites. The goals of the monitoring exercise in order of importance were:

- To ensure the background noise level at each site would allow for consistent and reliable capture of aircraft noise events
- Determine what types of aircraft events the City could expect to capture from each location
- Use the information to help determine the final site selection for the four permanent NMTs.

VACC, Casper's local contractor, was tasked with executing the portable noise monitoring project.

VACC rented seven identical Larson Davis LXT1 noise monitors with battery capacity for seven days of continuous noise monitoring. The devices were placed in the field over the span of two days, beginning the morning of Tuesday, June 16, and concluding on the afternoon of Wednesday, June 17. The monitors were retrieved by VACC on the afternoon of Wednesday, June 24, and the data was downloaded by VACC and made available to Casper the afternoon of Friday, June 26.

2 Data Analysis Parameters

2.1 Limitations

Before we describe the parameters and outcome of the project we want to discuss a few limitations in the dataset and how we have addressed those. We encountered the following (data) issues during our temporary noise measurements:

- The data collected did not include one-second data as we usually use in Casper Noise, but one-minute average noise data. As we will describe in section 2.3, using an alternative calculation method, we have overcome this constraint.
- Three of the seven noise monitors exhausted their batteries before recording a full seven days of noise event data. Even though measurements were taken over a shorter period for some monitors, we have collected more than enough data for an accurate analysis.
- The Ortega Park monitor didn't record one-minute data. Only hourly summary data is available for analysis at this location.

Overall, looking at the dataset, we feel we have a sound basis for a thorough analysis given the goals established for the project. In the next sections, we will describe the various measurement parameters used for our analysis.

2.2 Ambient Noise Level Determination

The one-minute average noise measurements collected by the noise monitors were more than sufficient to calculate an hourly LEQ and accurately determine the average background noise level over the duration of the weeklong period at each of the seven locations.

LEQ or Equivalent Sound Level is defined as the energy average sound level over a specified period, usually 1, 8, or 24 hours. The LEQ metric represents the total acoustical energy associated with the fluctuating sound level during a set period, which is equal to the total acoustical energy related to the steady sound level of LEQ for the same period. By calculating an hourly LEQ, Casper can determine the hourly average sound level at a particular location over the course of the full seven-day monitoring period. For the analysis, Casper considered both the hourly and 24-hour LEQ values in assessing the suitability of a particular site.

The hourly LEQ's help to illustrate how the average noise level at a particular location change throughout the day in response to changes in community activity. The 24-hour LEQ allows for comparisons of days across the entire span of the monitoring period. This measurement helps to establish a baseline for the background noise level for every 24 hours and also calls attention to any changes to the noise environment on a single day that is outside the normal range. 24-hour LEQs in the mid 50 to low 60s are ideal for the capture of aircraft noise events because they ensure that the majority of aircraft events should be clearly detected and won't be masked by high ambient background noise levels.

Community Noise Equivalent Level (CNEL) is a standard noise metric used in California to model noise exposure. It takes into account community annoyance in two ways. Similar to the DNL metric, the CNEL metric includes a ten-decibel penalty for all noise events that occur during night-time hours between 10:00 pm and 07:00 am. However, it also adds a five-decibel penalty for noise events that occur during Evening hours between 19:00-22:00.

2.3 Aircraft Noise Event Correlation

Casper Noise uses one-second noise data to determine if a particular event fits the parameters of an aircraft noise event, i.e., that the event rises above the ambient noise level trigger and remains above this value for a minimum period and falls back below the trigger threshold after no longer than two minutes. If the event meets the criteria established, it is then compared to flight tracks to try to find the best flight match.

The timestamp of the event duration and peak noise level is compared to flight tracks that penetrated a cylinder with a defined radius and altitude around the NMT, usually 1 mile and 10,000 feet. If the timestamp of the flight entry and exit time fits within the time frame of the recorded noise event, then the system matches it to a flight. A typical aircraft noise event peak depending on the altitude, operation type (arrival, departure, or overflight) and type of aircraft can range from 65-85 dBA.

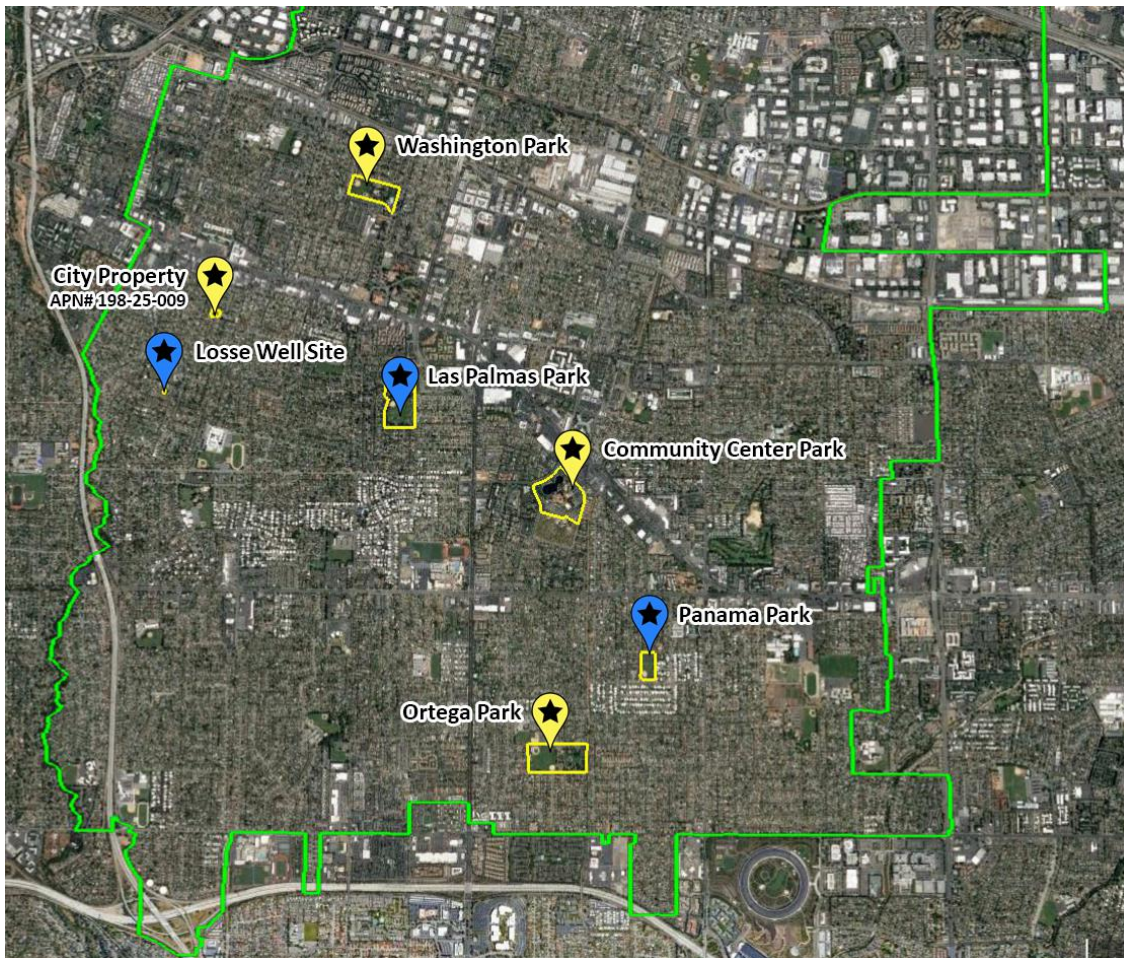
Without one-second data, Casper Noise cannot correlate flight tracks to noise events. To address this limitation, Casper used the same technique as described above with a slight modification, a cylinder with a radius of 0.5 miles and an altitude ceiling of 5,000 feet was created around each NMT. The radius and altitude were both reduced by $\frac{1}{2}$, and only flight activity at KSJC, KNUQ, KPAO, and KSQL airports was considered to limit the scope of the manual data analysis.

Using this analysis method Casper was able to state that an aircraft flew close to the monitor during a particular minute. Without one-second data, Casper was unable to determine from the one-minute data whether the peak noise level recorded by the sound level meter was caused by an aircraft or a community noise source such as a person or a car.

2.4 Preferred Sites

The four "Preferred" sites indicated by yellow markers on the map below were previously identified by Casper in the report issued on March 13 as being the best potential locations for the installation of a permanent NMT based on the requirements outlined in Section 1.1.

- SYV-01: Ortega Park (636 Harrow Way)
- SYV-02: City Property (Dona Avenue - APN# 198-25-009)
- SYV-03: Community Center Park (550 E Remington Drive)
- SYV-04: Washington Park (840 W Washington Avenue)



2.5 Alternative Sites

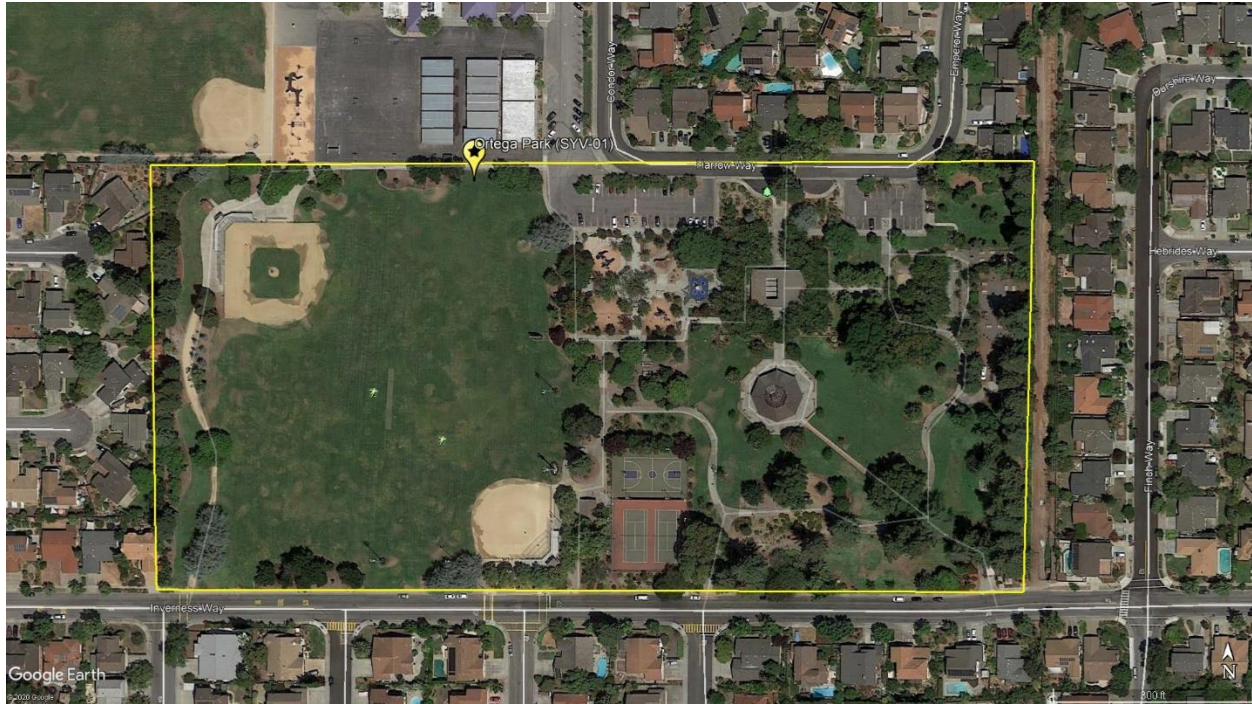
The three "Alternative" sites indicated by blue markers on the map above were previously identified by Casper in the report issued on March 13 as being acceptable potential locations for the installation of a permanent NMT based on the requirements outlined in Section 1.1. The Loose Well Site is not a candidate for solar due to tall trees.

- SYV-02A: Losse Well Site (1118 Jamestown Drive)
- SYV-03A: Panama Park (801 Dartshire Way in Sunnyvale)
- SYV-04A: Las Palmas Park (850 Russet Drive)

3 Preferred Site Analysis

3.1 Ortega Park

Ortega Park is located at 636 Harrow Way in Sunnyvale, California. It is a 19-acre multi-use park, adjacent to the RNAV (RNP) Z Runway 12R Approach path at SJC Airport. Residential streets surround the park on three sides, and it backs up to Louis E. Stocklmeir Elementary School.



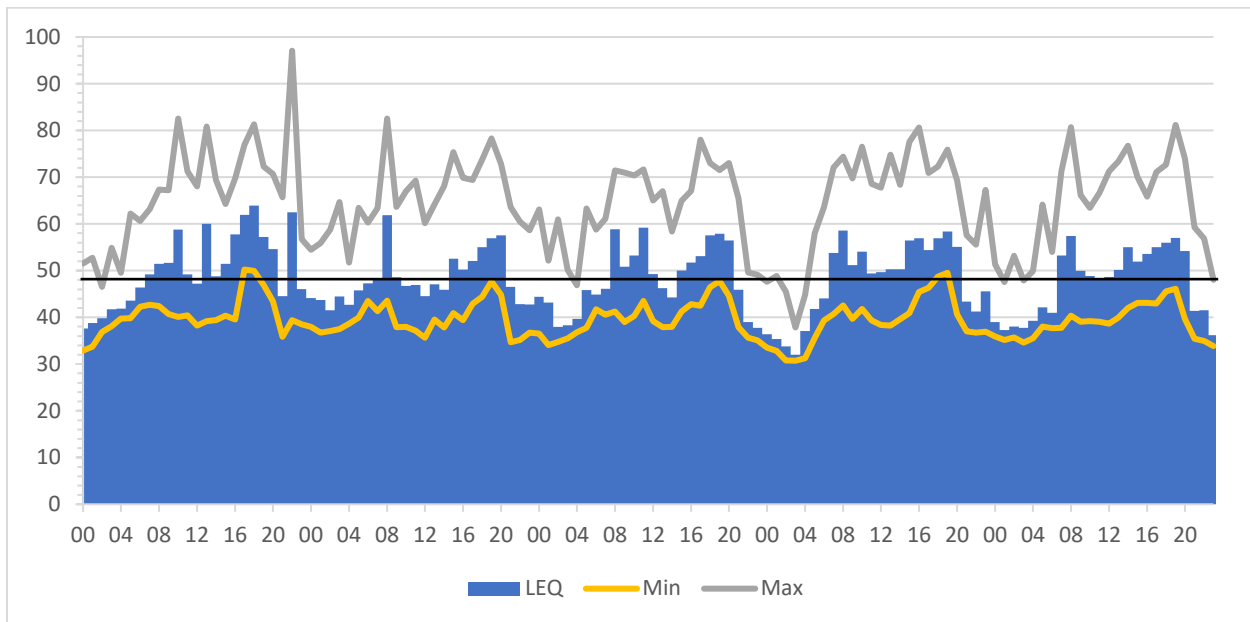
Aerial Overview of Ortega Park, showing the proposed location of the permanent NMT

The approximate coordinates of the proposed NMT (SYV-01) within Ortega Park:

Latitude = 37.342985, Longitude = -122.026235

The portable noise monitor was placed near the coordinates of the proposed permanent NMT. Due to an undocumented issue, the sound level meter failed to record one-minute data samples and only produced hourly LEQ measurement. The hourly noise data collected by the portable NMT at Ortega Park allowed Casper to calculate a 24-hour LEQ and California Noise Equivalent Level (CNEL) level.

Hourly LEQ Calculations at the Ortega Park Portable NMT



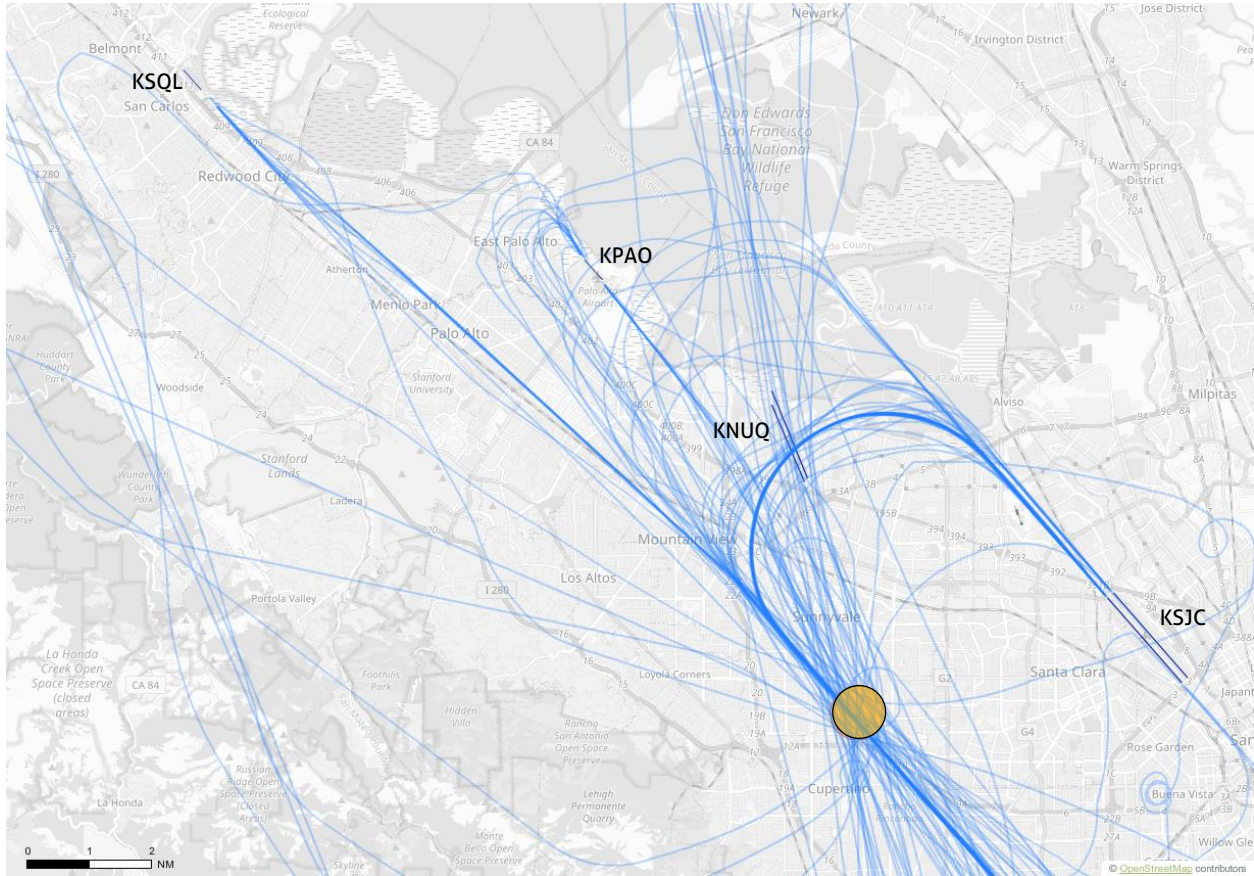
The portable noise monitor installed at Ortega Park captured data for a full five-day period from 06/17 through 06/21. Analysis of the data shows that the average LEQ for the period was 48.3 dBA, as indicated by the black line. A minimum hourly LEQ of 32.0 dBA was registered on 6/20 at 03:00, and a maximum LEQ of 63.9 dBA was recorded on 06/17 at 18:00. The yellow and grey lines on the chart indicate the minimum and maximum recorded noise level measured during a particular hour. As a reference point, a conversation between two people measured at three feet is around 60 dBA.

We would expect the peak noise level of a typical aircraft events to register between 65-80 dBA depending on the altitude of the flight at the time it passes over the monitor. A 24-hour LEQ measurement below 60 dBA is good for an urban environment. It supports Casper's initial conclusion that the ambient noise levels in Ortega Park will allow for consistent capture of aircraft noise events.

24-Hour Calculated Noise Metrics from the Ortega Park Portable NMT

Date	24-Hour LEQ	24-Hour CNEL
6/17	56.1	60.8
6/18	52.2	55.5
6/19	52.6	55.3
6/20	52.8	55.1
6/21	51.6	53.9

Casper analyzed the flight activity around the Ortega Park monitor using the parameters outlined in Section 2.3 with a cylinder of 0.5-mile radius and a ceiling of 5,000 feet.



Flight activity in the proximity of the Ortega Park portable NMT

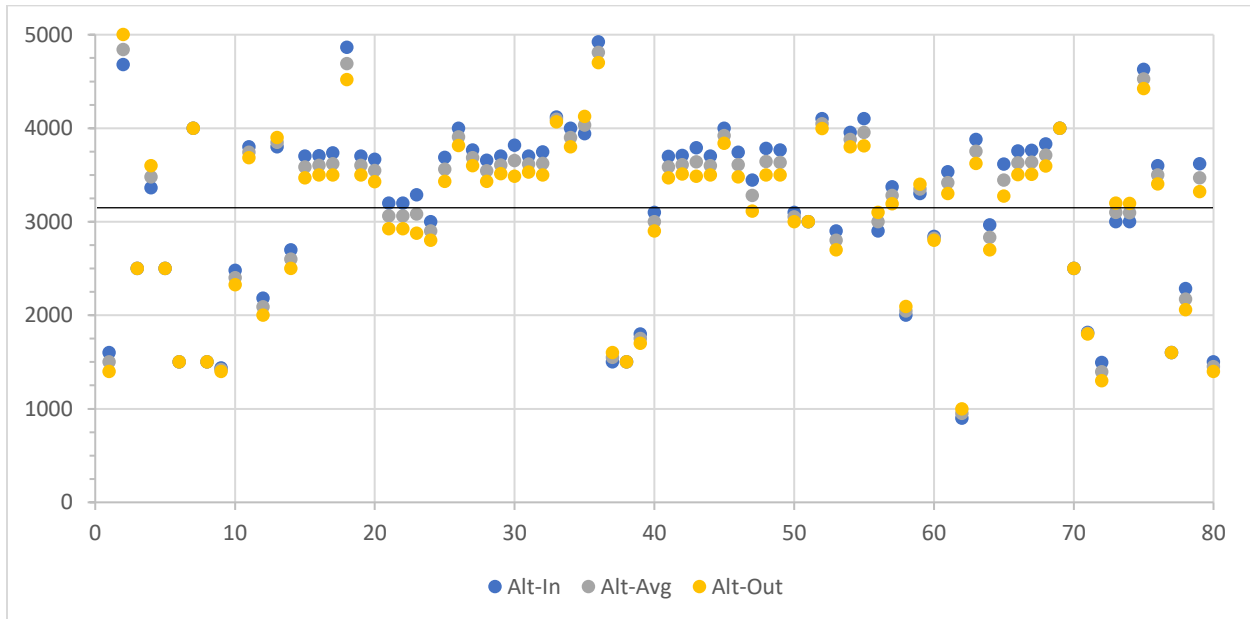
Analysis of flight track activity associated with the Ortega Park monitor in Casper Noise revealed that 81 individual flights flew within 0.5 miles of the location, at or below 5,000 feet during the five days noise measurements were collected. These flights were associated with arrivals, departures, and touch-and-go operations at KSJC, KNUQ, KSQL and KPAO airports.

Flight Activity Captured within the Vicinity of Ortega Park Portable NMT

Airport	Arrivals	Departures	Touch-and-Go's	Total
KSJC	44	1	0	45
KNUQ	3	0	0	3
KPAO	10	13	0	23
KSQL	9	1	0	10
Total	66	15	0	81

This particular NMT is positioned primarily to capture south flow arrivals to KSJC, specifically RNP approaches to Runway 12R. Of the 66 total landings captured, 44 were associated with south flow arrivals to KSJC. Eighteen were Runway 12R RNP Z approaches, 16 were Runway 12R ILS/GPS approaches, eight were Runway 12L ILS/GPS approaches, and two were Runway 30L ILS/GPS approaches. Of the remaining 22 landings, ten were associated with the Runway 31 approach to KPAO, nine with the Runway 30 approach to KSQL, and three with the Runway 32L approach to KNUQ.

Altitude Dispersion of Flights over the Ortega Park Portable NMT

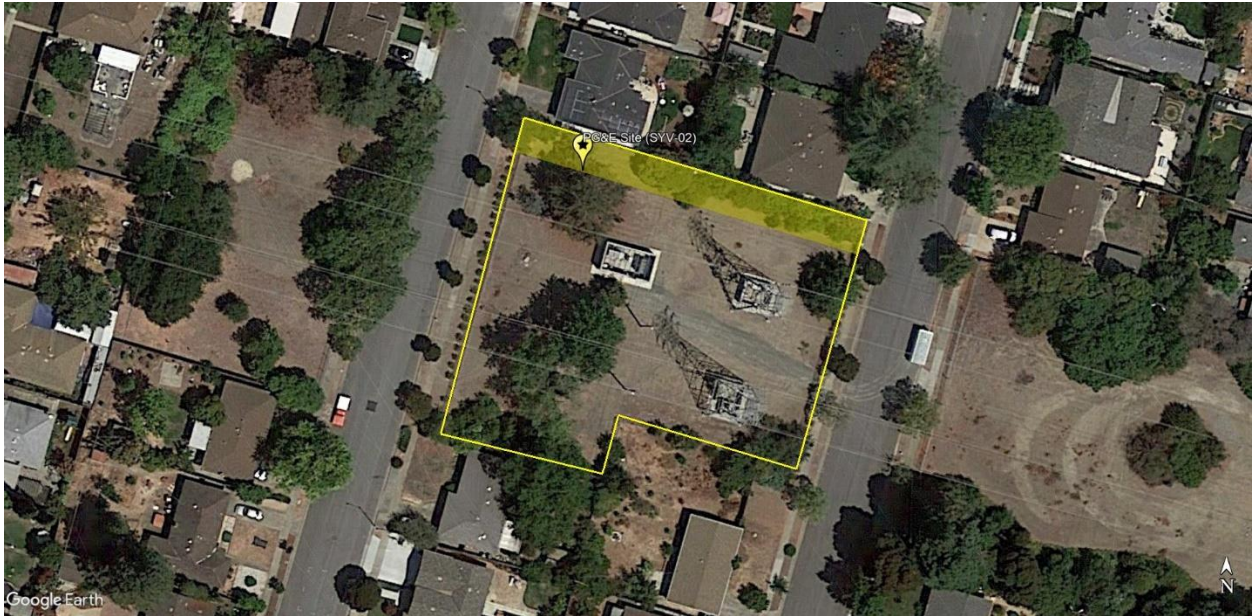


Casper Noise in analyzing penetrations of areas set up in the application calculates both an entry altitude (shown in blue) and exit altitude (shown in yellow) from the surveillance area based on the trajectory of the flight tracks and the altitude of the radar points on either side of the area boundary penetration. An average altitude (shown in grey) was derived by comparing the entry and exit altitudes for each flight. The average altitude for all 81 flights over the Ortega Park site was 3,157 feet MSL, as shown by the black line.

Based on the hourly-noise data measured and the flight tracks analyzed, Casper concludes this site is an excellent candidate for a permanent noise monitor. The site meets all the criteria referenced in Section 1.1, has consistent low ambient noise levels, and is well-positioned to capture KSJC south flow arrivals as well as approaches to KPAO and KSQL airports.

3.2 City Property APN# 198-25-009

The City property is located between 756 and 782 Dona Avenue in Sunnyvale, California. It is on parcel APN# 198-25-009, adjacent to the RNAV (RNP) Z Runway 12R Approach path at SJC Airport. Residential streets surround the parcel on two sides, and it is close to Greenwood Manor Park.



Aerial Overview of Dona Avenue Site, showing the proposed location of the permanent NMT

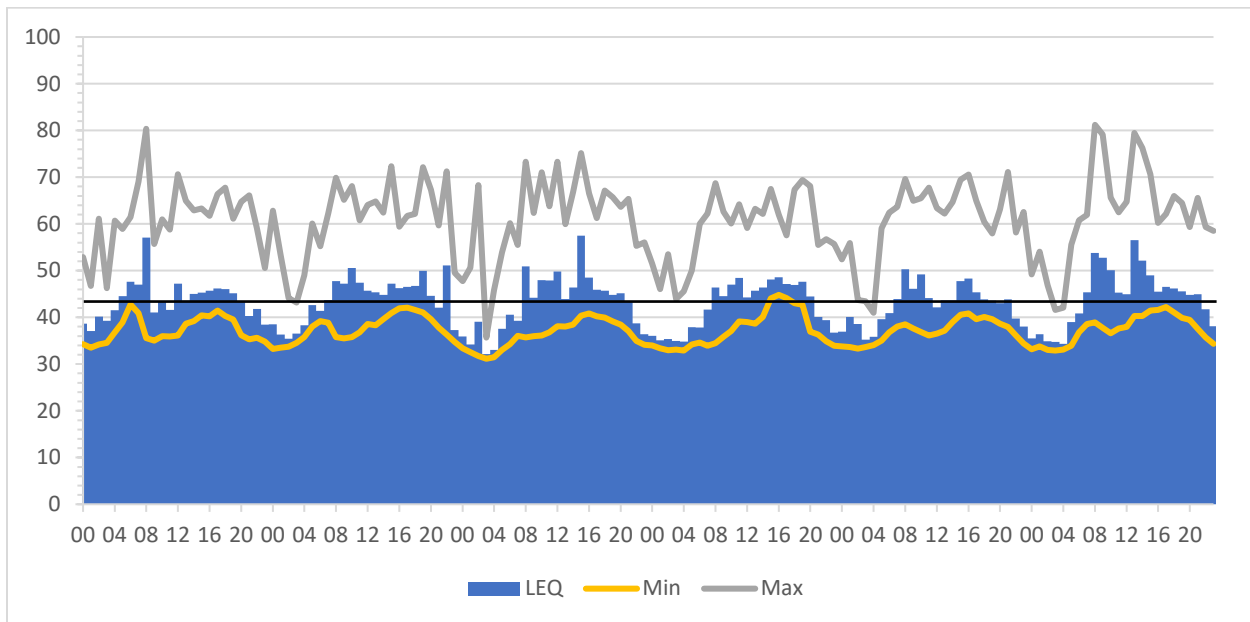
The approximate coordinates of the proposed NMT (SYV-02) within the City Property:

Latitude = 37.369664 Longitude = -122.053023

The proposed location of the Dona Avenue monitor has been slightly revised from the March 13 document to move it north to lie within the City's 20-foot property boundary (APN# 198-25-009), depicted by the yellow rectangle in the above image. Analysis by Casper staff has shown that the revised site should be a good candidate for solar, and the move will have no impact on the capture of aircraft events.

The sound level meter recorded one-minute data samples and calculated an hourly LEQ measurement. The hourly noise data collected by the portable NMT at the Dona Avenue Site allowed Casper to calculate a 24-hour LEQ and California Noise Equivalent Level (CNEL) level.

Hourly LEQ Calculations at the Dona Avenue (APN #198-25-009) NMT



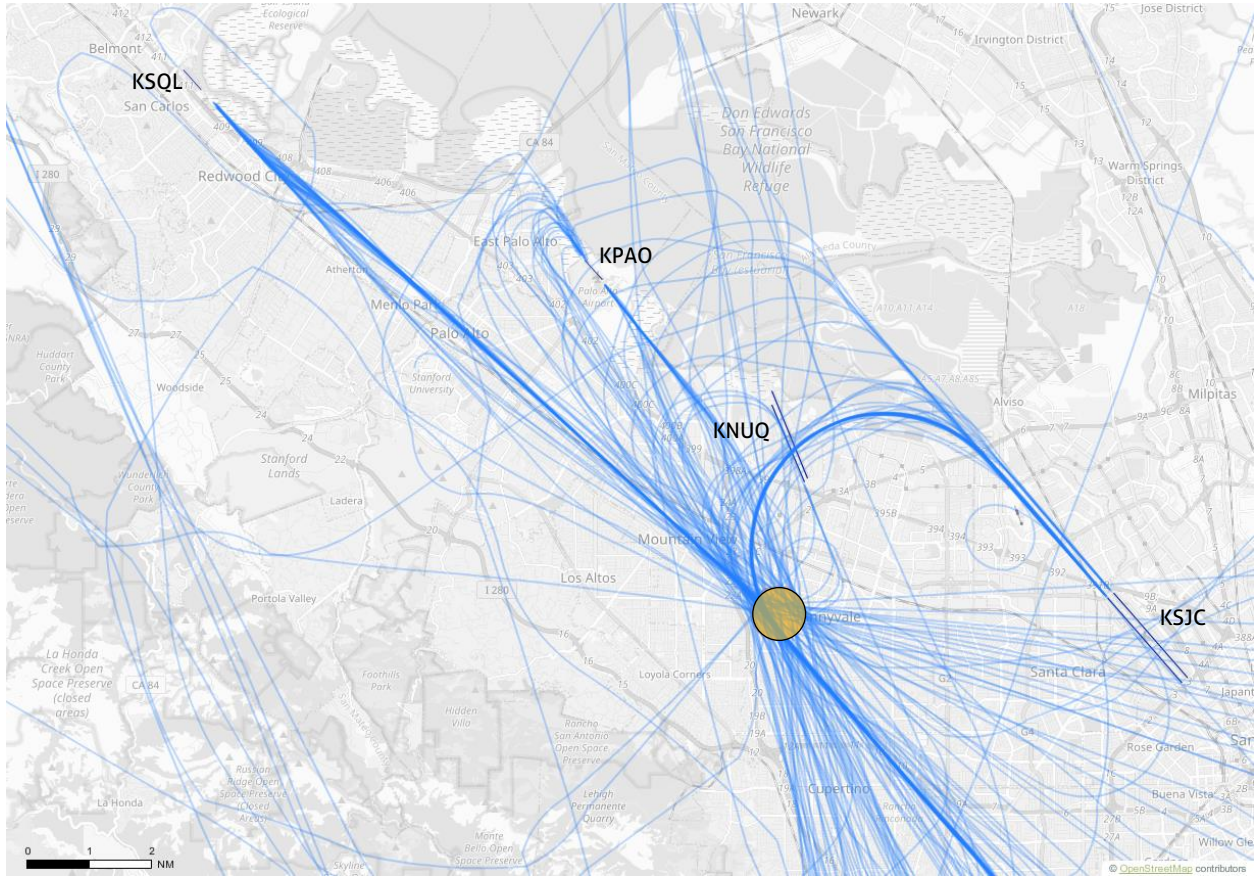
The portable noise monitor installed at the Dona Avenue site captured data for a full six-day period from 06/18 through 06/23. Analysis of the data shows that the average LEQ for the period was 43.2 dBA, as indicated by the black line. A minimum hourly LEQ of 32.1 dBA was registered on 6/20 at 03:00, and a maximum LEQ of 57.5 dBA was recorded on 06/20 at 15:00. The yellow and grey lines on the chart indicate the minimum and maximum recorded noise level measured during a particular hour. As a reference point, a conversation between two people measured at three feet is around 60 dBA.

We would expect the peak noise level of a typical aircraft events to register between 65-80 dBA depending on the altitude of the flight at the time it passes over the monitor. A 24-hour LEQ measurement below 60 dBA is good for an urban environment. It supports Casper's initial conclusion that the ambient noise levels at the Dona Avenue site will allow for consistent capture of aircraft noise events.

24-Hour Calculated Noise Metrics from the Dona Avenue (APN# 198-25-009) Portable NMT

Date	24-Hour LEQ	24-Hour CNEL
6/18	46.6	50.4
6/19	45.9	50.9
6/20	47.3	49.0
6/21	44.6	47.3
6/22	44.4	47.7
6/23	48.2	49.9

Casper analyzed the flight activity around the Dona Avenue monitor using the parameters outlined in Section 2.3 with a cylinder of 0.5-mile radius and a ceiling of 5,000 feet.



Flight activity in the proximity of the Dona Avenue (APN# 198-25-009) Portable NMT

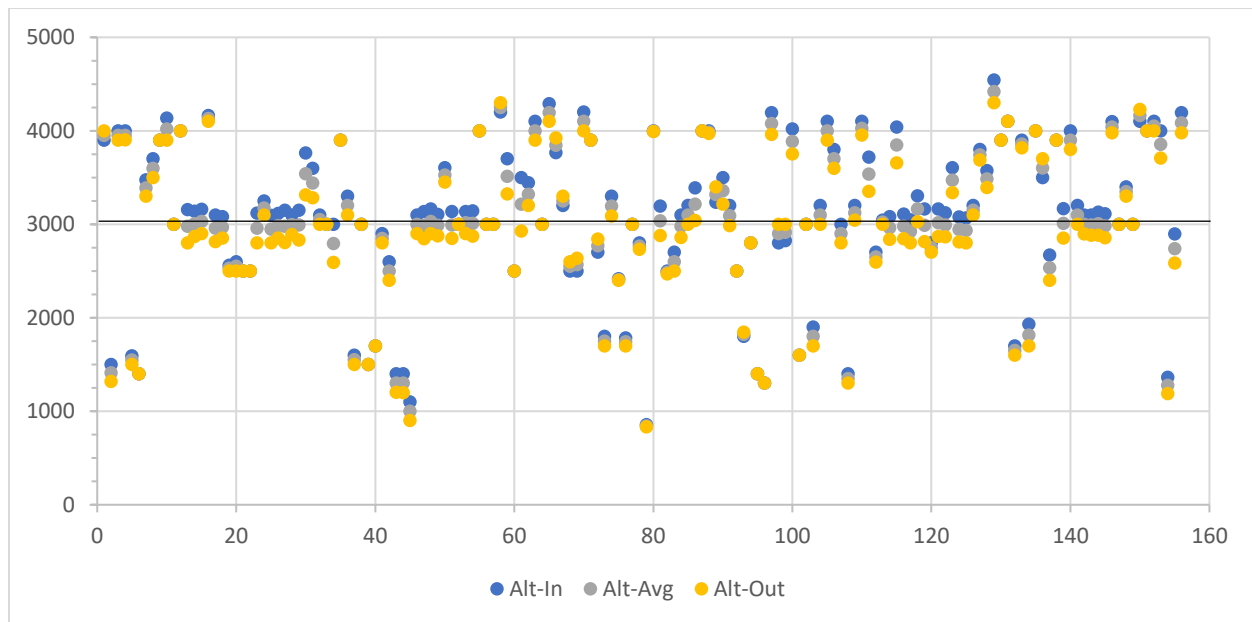
Analysis of flight track activity associated with the Dona Avenue monitor in Casper Noise revealed that 155 individual flights flew within 0.5 miles of the location, at or below 5,000 feet during the six days noise measurements were collected. These flights were associated with arrivals, departures, and touch-and-go operations at KSJC, KNUQ, KSQL and KPAO.

Flight Activity Captured within the Vicinity of the Dona Avenue Portable NMT

Airport	Arrivals	Departures	Touch-and-Go's	Total
KSJC	69	0	0	69
KNUQ	2	0	3	5
KPAO	15	14	3	32
KSQL	49	0	0	49
Total	135	14	6	155

This particular NMT is positioned primarily to capture south flow arrivals to KSJC, specifically RNP approaches to Runway 12R. Of the 135 total landings captured, 69 were associated with south flow approaches to KSJC. Thirty-three were Runway 12R RNP Z approaches, 25 were Runway 12R ILS/GPS approaches, and 11 were Runway 12L ILS/GPS approaches. Of the remaining 66 landings, 49 were associated with the Runway 30 approach to KSQL, 15 with the Runway 31 approach to KPAO, and two with the Runway 32L approach to KNUQ.

Altitude Dispersion of Flights over the Dona Avenue (APN# 198-25-009) Portable NMT

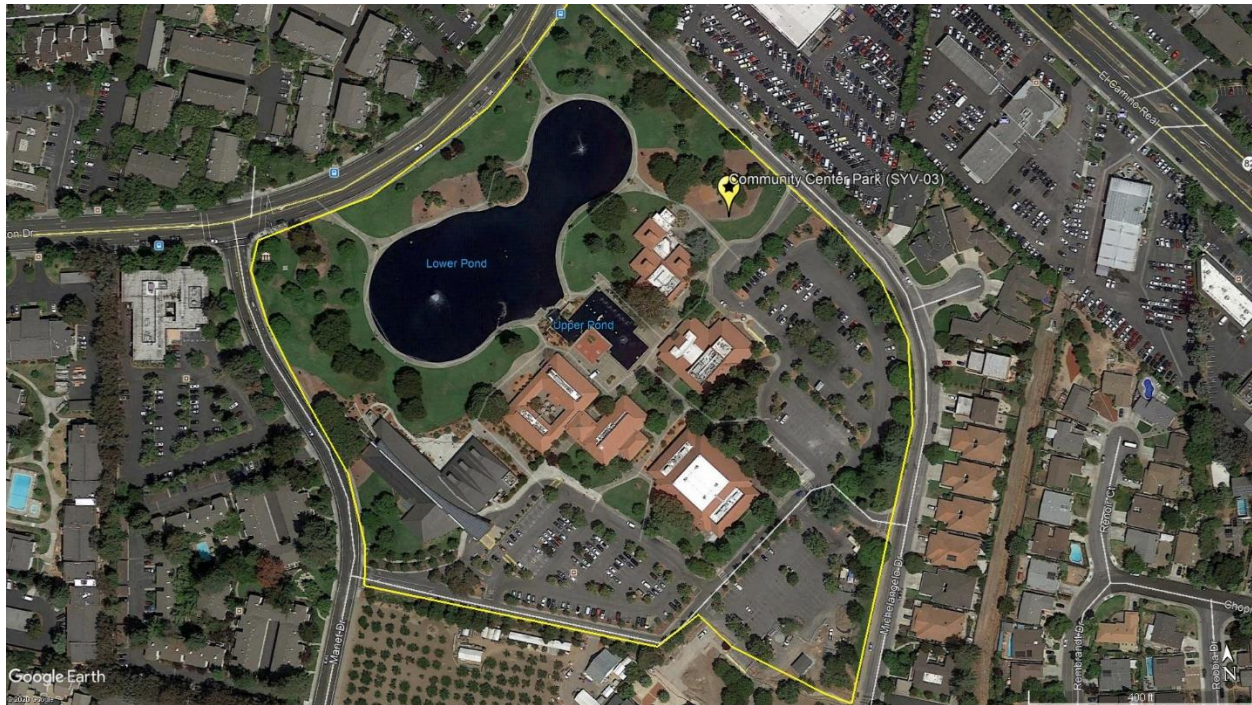


Casper Noise in analyzing penetrations of areas set up in the application calculates both an entry altitude (shown in blue) and exit altitude (shown in yellow) from the surveillance area based on the trajectory of the flight tracks and the altitude of the radar points on either side of the area boundary penetration. An average altitude (shown in grey) was derived by comparing the entry and exit altitudes for each flight. The average altitude for all 155 flights over the Dona Avenue site was 3,035 feet MSL, as shown by the black line.

Based on the hourly-noise data measured and the flight tracks analyzed, Casper concludes this site is an excellent candidate for a permanent noise monitor. The site meets all the criteria referenced in Section 1.1, has consistent low ambient noise levels, and is well-positioned to capture KSJC south flow arrivals as well as approaches to KPAO and KSQL airports.

3.3 Community Center Park

Community Center Park is located at 550 E Remington Drive in Sunnyvale, California. It is a 21-acre multi-use park, under the downwind leg of the approach path to Runway 12R at SJC Airport. Residential streets surround the park on two sides, and a car dealership on the northeast side.

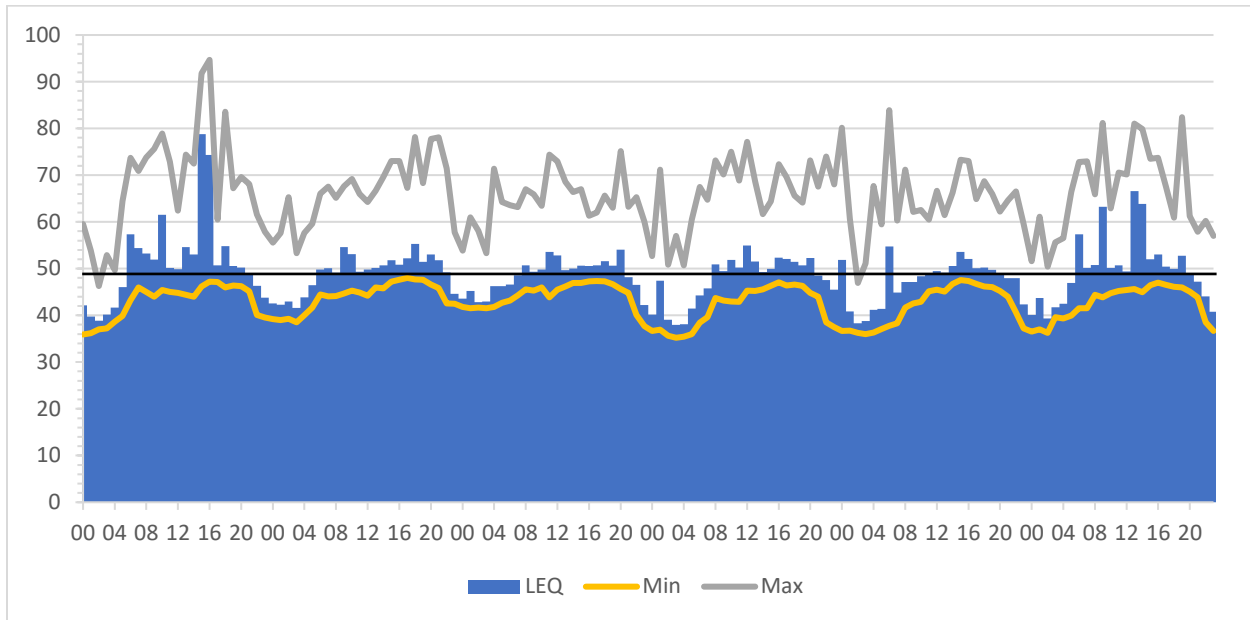


Aerial Overview of Community Center Park, showing the proposed location of the permanent NMT

The approximate coordinates of the proposed NMT (SYV-03) within Community Center Park:
Latitude = 37.358894 Longitude = -122.024706

The portable noise monitor was placed near the coordinates of the proposed permanent NMT. The sound level meter recorded one-minute data samples and calculated an hourly LEQ measurement. The hourly noise data collected by the portable NMT at Community Center Park allowed Casper to calculate a 24-hour LEQ and California Noise Equivalent Level (CNEL) level.

Hourly LEQ Calculations at the Community Center Park Portable NMT



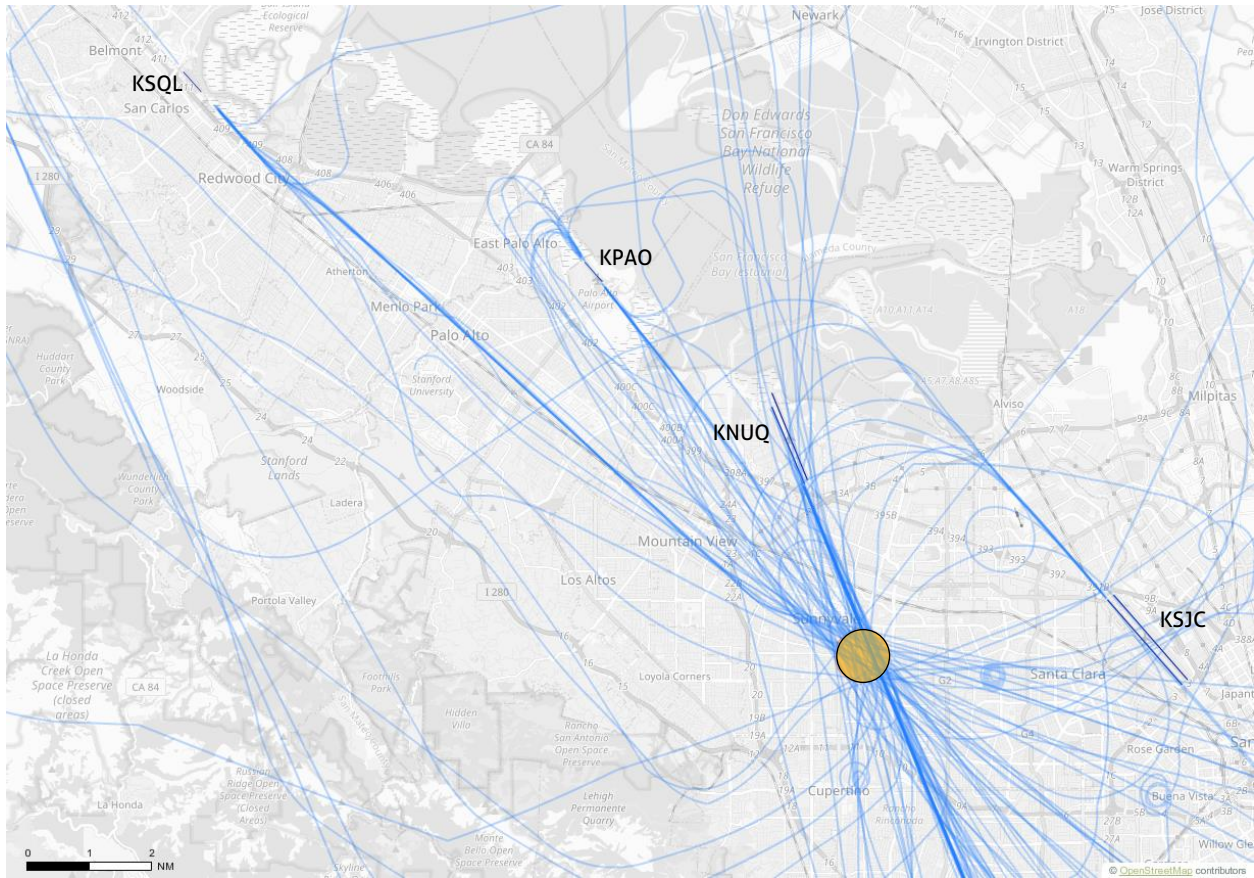
The portable noise monitor installed at Community Center Park captured data for a full six-day period from 06/17 through 06/22. Analysis of the data shows that the average LEQ for the period was 48.9 dBA, as indicated by the black line. A minimum hourly LEQ of 38.1 dBA was registered on 6/20 at 04:00, and a maximum LEQ of 78.8 dBA was recorded on 06/17 at 15:00. The yellow and grey lines on the chart indicate the minimum and maximum recorded noise level measured during a particular hour. As a reference point, a conversation between two people measured at three feet is around 60 dBA.

We would expect the peak noise level of a typical aircraft events to register between 65-80 dBA depending on the altitude of the flight at the time it passes over the monitor. A 24-hour LEQ measurement below 60 dBA is good for an urban environment. It supports Casper's initial conclusion that the ambient noise levels in Community Center Park will allow for consistent capture of aircraft noise events.

24-Hour Calculated Noise Metrics from the Community Center Park Portable NMT

Date	24-Hour LEQ	24-Hour CNEL
6/17	66.5	66.8
6/18	50.5	54.6
6/19	49.6	53.8
6/20	49.6	53.1
6/21	49.2	53.1
6/22	56.7	58.8

Casper analyzed the flight activity around the Community Center Park monitor using the parameters outlined in Section 2.3 with a cylinder of 0.5-mile radius and a ceiling of 5,000 ft.



Flight activity in the proximity of the Community Center Park portable NMT

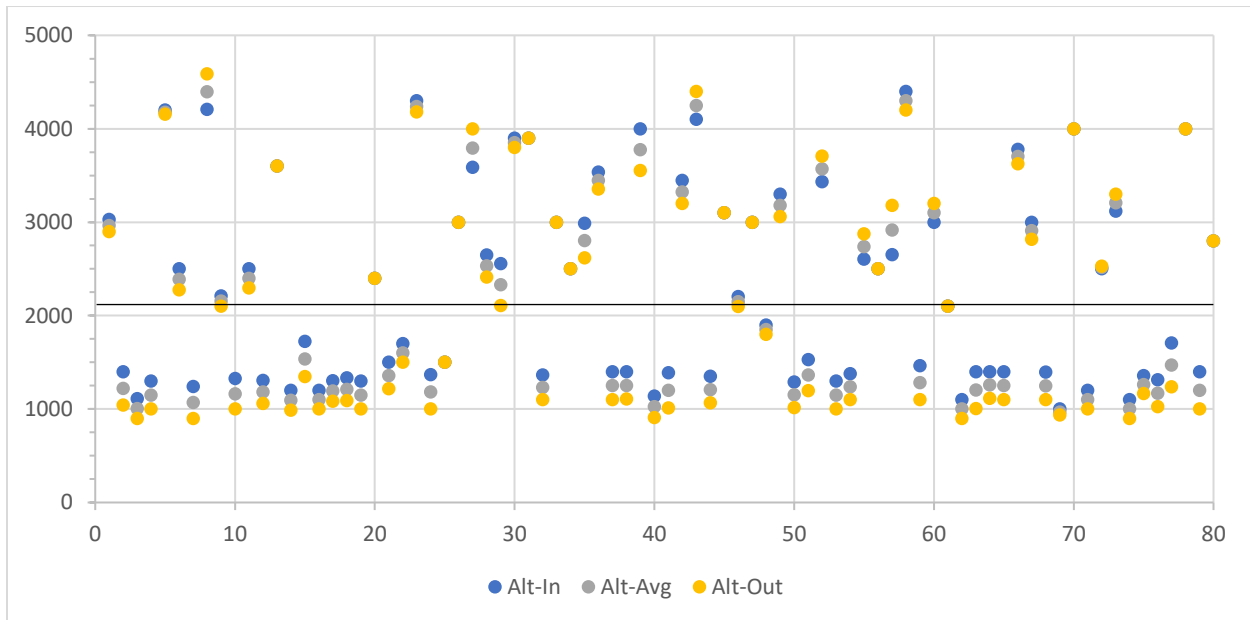
Analysis of flight track activity associated with the Community Center Park monitor in Casper Noise revealed that 101 individual flights flew within 0.5 miles of the location, at or below 5,000 feet during the six days noise measurements were collected. These flights were associated with arrivals, departures, and touch-and-go operations at KSJC, KNUQ, KSQL and KPAO airports.

Flight Activity Captured within the Vicinity of the Community Center Park Portable NMT

Airport	Arrivals	Departures	Touch-and-Go's	Total
KSJC	12	3	0	15
KNUQ	43	4	1	48
KPAO	13	11	1	25
KSQL	12	0	1	13
Total	80	18	3	101

This particular NMT is positioned primarily to capture landings to KNUQ Runways 32L and 32R, and secondarily south flow arrivals to KSJC and approaches to KPAO and KSQL. Of the 80 total landings captured, 43 were associated with the Runway 32L approach to KNUQ. Of the remaining 37 arrivals, 11 were associated with the Runway 12R ILS/GPS approach to KSJC, 13 with the Runway 31 approach to KPAO, 12 with the Runway 30 approach to KSQL, and one with the Runway 32L ILS/GPS approach to KSJC.

Altitude Dispersion of Flights over the Community Center Park Portable NMT

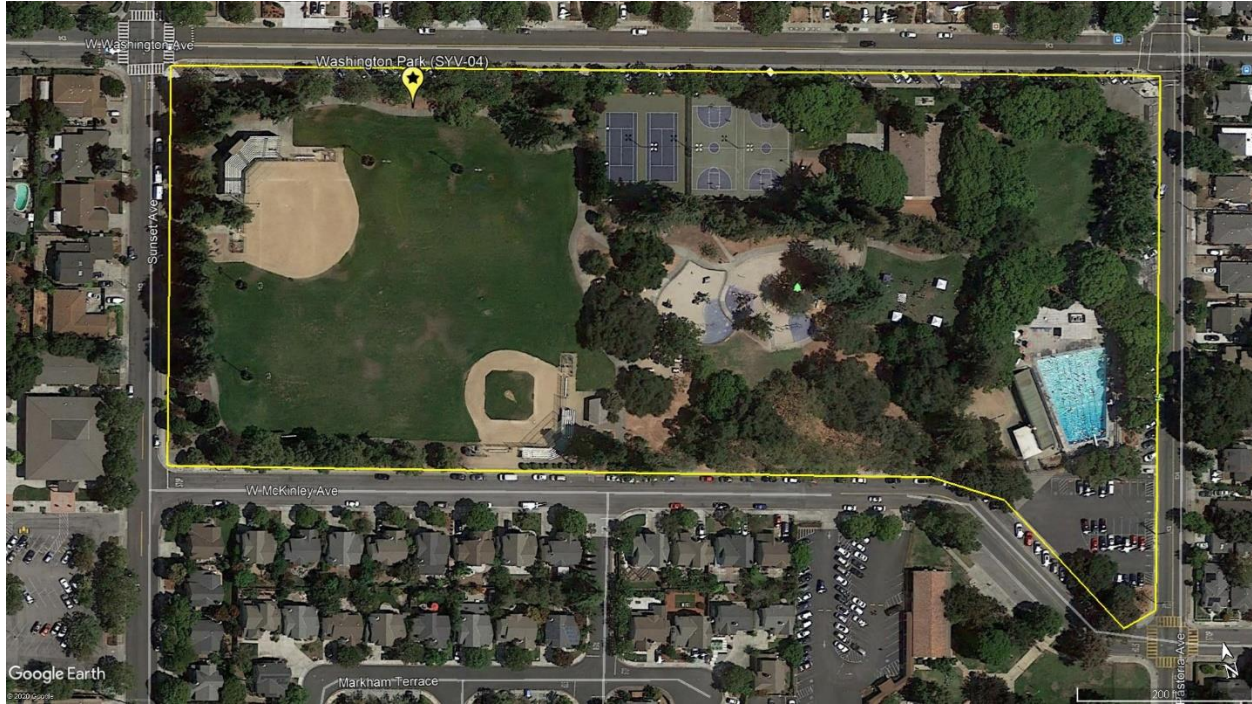


Casper Noise in analyzing penetrations of areas set up in the application calculates both an entry altitude (shown in blue) and exit altitude (shown in yellow) from the surveillance area based on the trajectory of the flight tracks and the altitude of the radar points on either side of the area boundary penetration. An average altitude (shown in grey) was derived by comparing the entry and exit altitudes for each flight. The average altitude for all 101 flights over the Community Center Park site was 2,177 feet MSL, as shown by the black line.

Based on the hourly-noise data measured and the flight tracks analyzed, Casper concludes this site is an excellent candidate for a permanent noise monitor. The site meets all the criteria referenced in Section 1.1, has consistent low ambient noise levels, and is well-positioned to capture approaches to KNUQ as well as south flow arrivals to KSJC and landings to KPAO and KSQL airports.

3.4 Washington Park

Washington Park is located at 840 W Washington Avenue in Sunnyvale, California. It is a 12-acre multi-use park, located under the downwind leg of the approach path to Runway 12R at SJC Airport. Residential streets surround the park on all four sides.



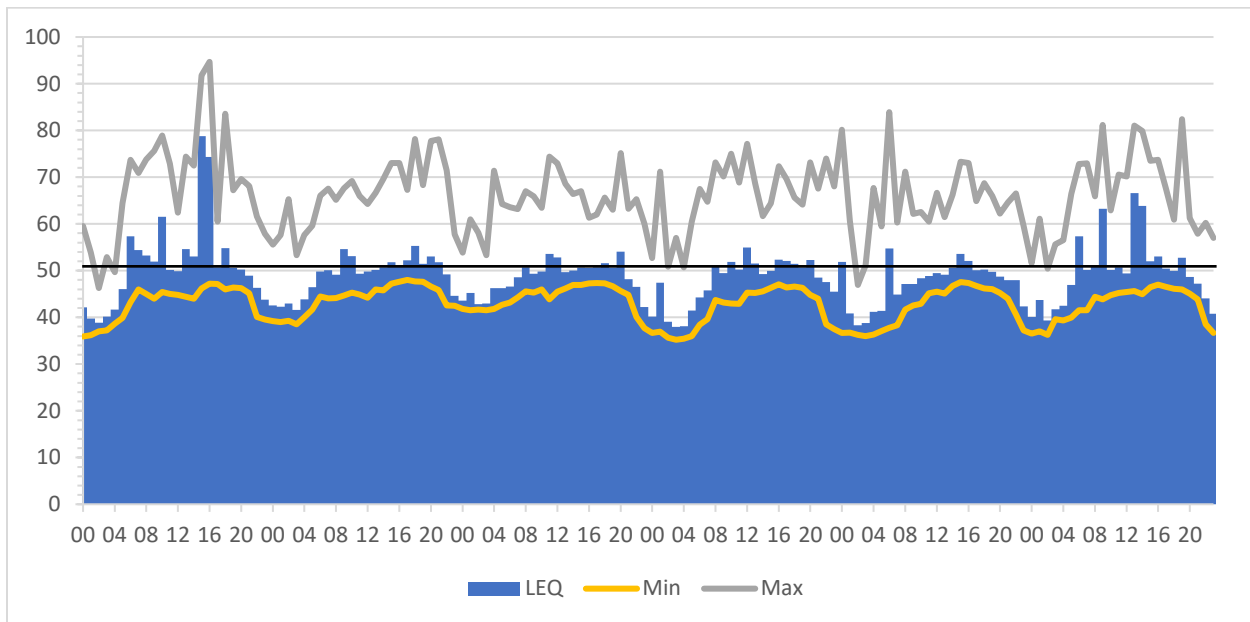
Aerial Overview of Washington Park, showing the proposed location of the permanent NMT

The approximate coordinates of the proposed NMT (SYV-04) within Washington Park:

Latitude = 37.378121 Longitude = -122.041340

The portable noise monitor was placed near the coordinates of the proposed permanent NMT. The sound level meter recorded one-minute data samples and calculated an hourly LEQ measurement. The hourly noise data collected by the portable NMT at Washington Park allowed Casper to calculate a 24-hour LEQ and California Noise Equivalent Level (CNEL) level.

Hourly LEQ Calculations at the Washington Park Portable NMT



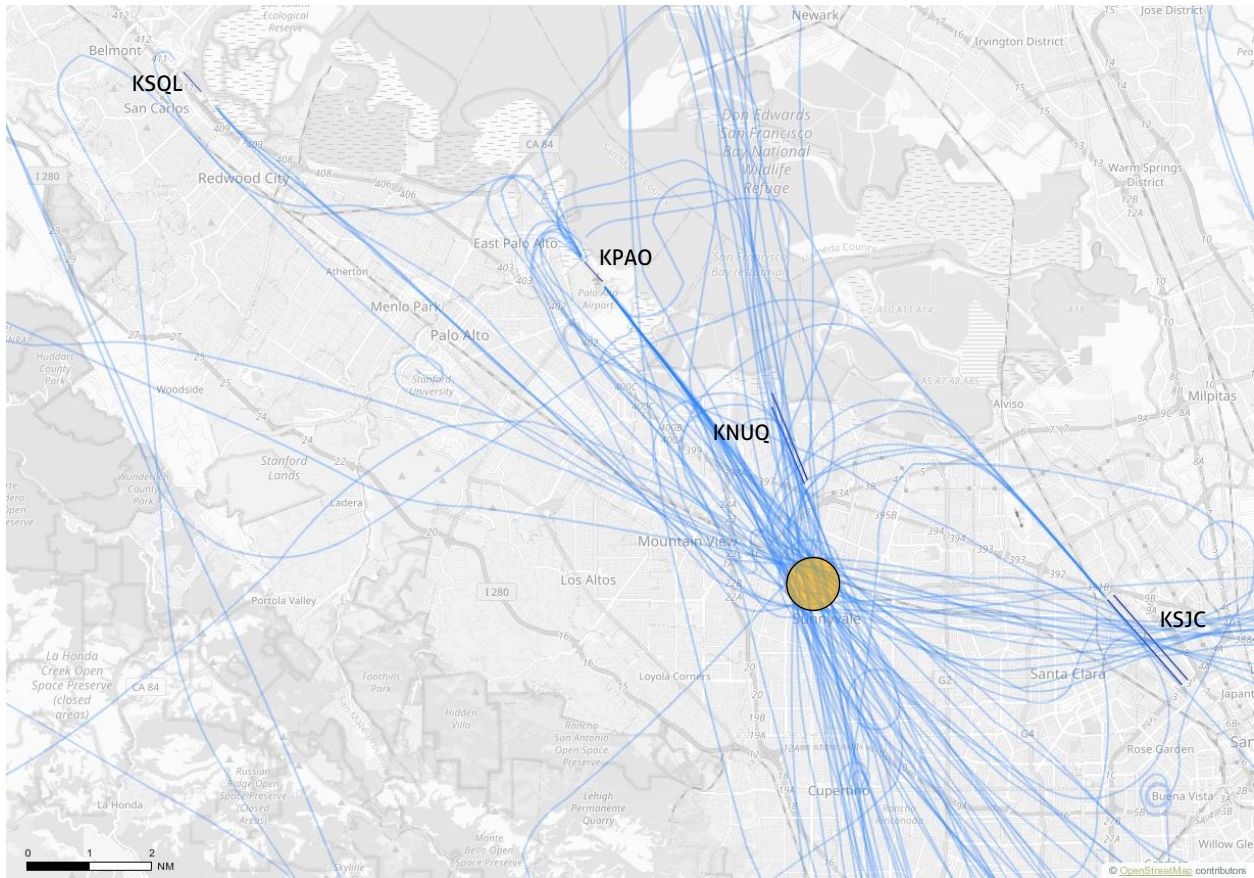
The portable noise monitor installed at Washington Park captured data for a full six-day period from 06/17 through 06/22. Analysis of the data shows that the average LEQ for the period was 51.3 dBA, as indicated by the black line. A minimum hourly LEQ of 37.4 dBA was registered on 6/21 at 03:00, and a maximum LEQ of 60.4 dBA was recorded on 06/18 at 22:00. The yellow and grey lines on the chart indicate the minimum and maximum recorded noise level measured during a particular hour. As a reference point, a conversation between two people measured at three feet is around 60 dBA.

We would expect the peak noise level of a typical aircraft events to register between 65-80 dBA depending on the altitude of the flight at the time it passes over the monitor. A 24-hour LEQ measurement below 60 dBA is good for an urban environment. It supports Casper's initial conclusion that the ambient noise levels in Washington Park will allow for consistent capture of aircraft noise events.

24-Hour Calculated Noise Metrics from the Washington Park Portable NMT

Date	24-Hour LEQ	24-Hour CNEL
6/17	53.2	57.2
6/18	54.4	61.8
6/19	52.9	57.2
6/20	53.6	57.7
6/21	50.7	54.4
6/22	52.6	57.7

Casper analyzed the flight activity around the Washington Park monitor using the parameters outlined in Section 2.3 with a cylinder of 0.5-mile radius and a ceiling of 5,000 feet.



Flight activity in the proximity of the Washington Park portable NMT

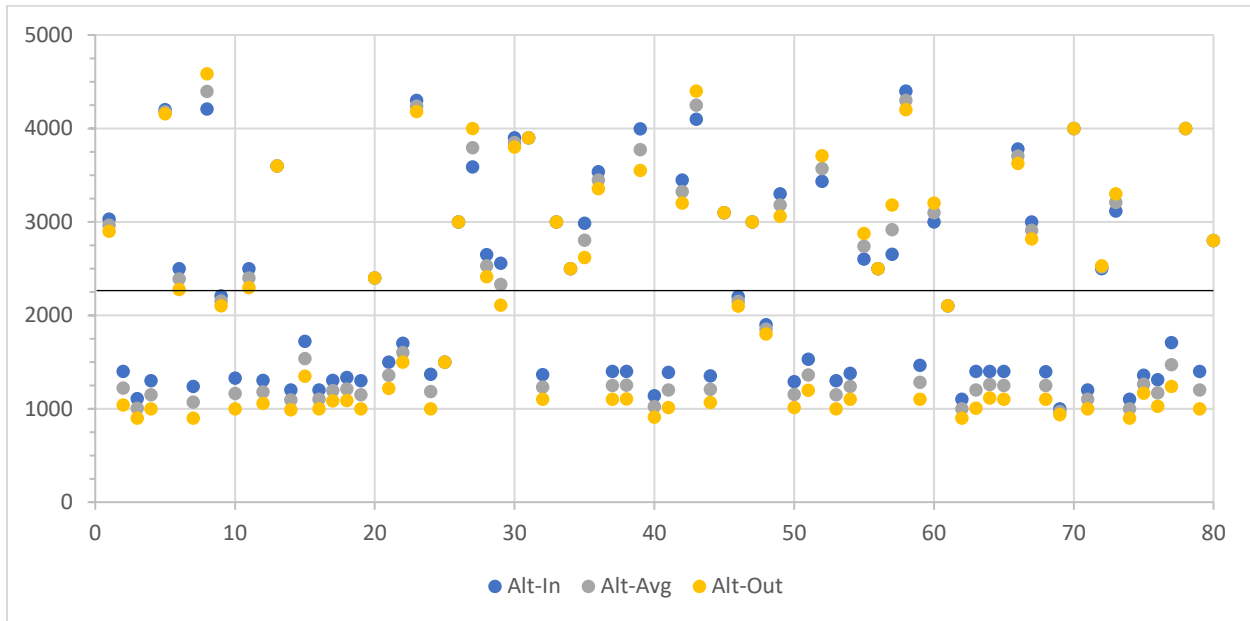
Analysis of flight track activity associated with the Washington Park monitor in Casper Noise revealed that 54 individual flights flew within 0.5 miles of the location, at or below 5,000 feet during the six days noise measurements were collected. These flights were associated with arrivals, departures, and touch-and-go operations at KSJC, KNUQ, KSQL and KPAO airports.

Flight Activity Captured within the Vicinity of the Washington Park Portable NMT

Airport	Arrivals	Departures	Touch-and-Go's	Total
KSJC	10	2	0	12
KNUQ	4	0	2	6
KPAO	19	10	3	32
KSQL	4	0	0	4
Total	37	12	5	54

This particular NMT is positioned primarily to capture landings to KPAO and secondarily south flow arrivals to KSJC and approaches to KNUQ and KSQL. Of the 37 total landings captured, 19 were associated with the Runway 31 approach to KPAO. Of the remaining 18 arrivals, ten were related to the ILS/GPS 12R approach to KSJC, four with the Runway 32L approach at KNUQ, and four with the Runway 30 approach at KSQL.

Altitude Dispersion of Flights over the Washington Park Portable NMT



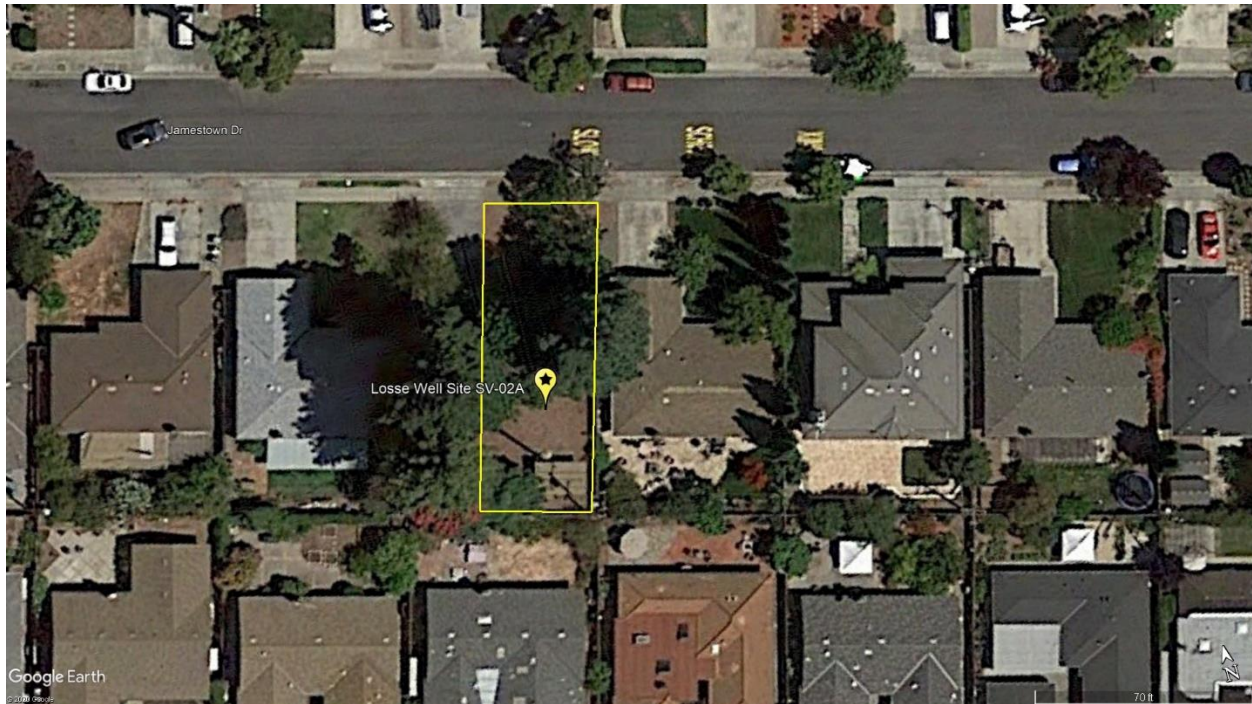
Casper Noise in analyzing penetrations of areas set up in the application calculates both an entry altitude (shown in blue) and exit altitude (shown in yellow) from the surveillance area based on the trajectory of the flight tracks and the altitude of the radar points on either side of the area boundary penetration. An average altitude (shown in grey) was derived by comparing the entry and exit altitudes for each flight. The average altitude for all 54 flights over the Washington Park site was 2,236 feet MSL, as shown by the black line.

Based on the hourly-noise data measured and the flight tracks analyzed, Casper concludes this site is an excellent candidate for a permanent noise monitor. The site meets all the criteria referenced in Section 1.1, has consistent low ambient noise levels, and is well-positioned to capture approaches to KPAO as well as south flow arrivals to KSJC and landings to KNUQ and KSQL airports.

4 Alternative Site Analysis

4.1 Losse Well Site

The Losse Well Site, located at 1118 Jamestown Drive in Sunnyvale, California. It is a 0.1-acre municipal utility parcel, adjacent to the RNAV (RNP) Z Runway 12R Approach path at SJC Airport. Residential homes surround the parcel on three sides.

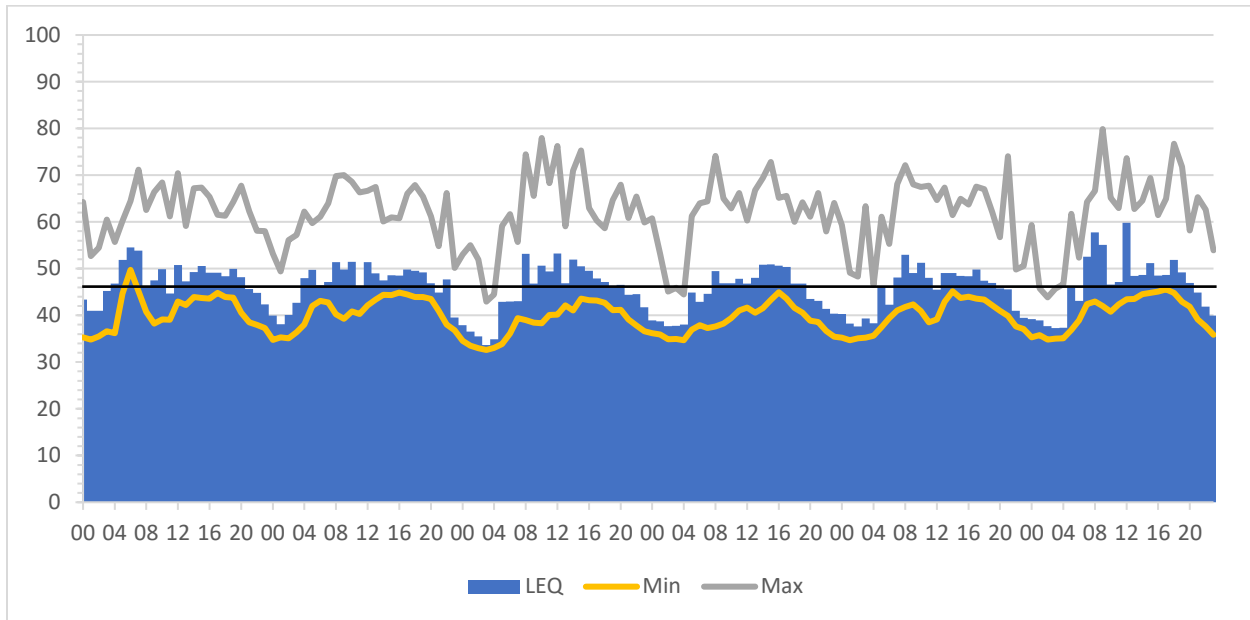


Aerial Overview of Losse Well Site, showing the proposed location of the permanent NMT

The approximate coordinates of the proposed NMT (SYV-02A) within the Losse Well Site:
Latitude = 37.364415 Longitude = -122.056760

The portable noise monitor was placed near the coordinates of the proposed permanent NMT. The sound level meter recorded one-minute data samples and calculated an hourly LEQ measurement. The hourly noise data collected by the portable NMT at the Losse Well Site allowed Casper to calculate a 24-hour LEQ and California Noise Equivalent Level (CNEL) level.

Hourly LEQ Calculations at the Losse Well Site Portable NMT



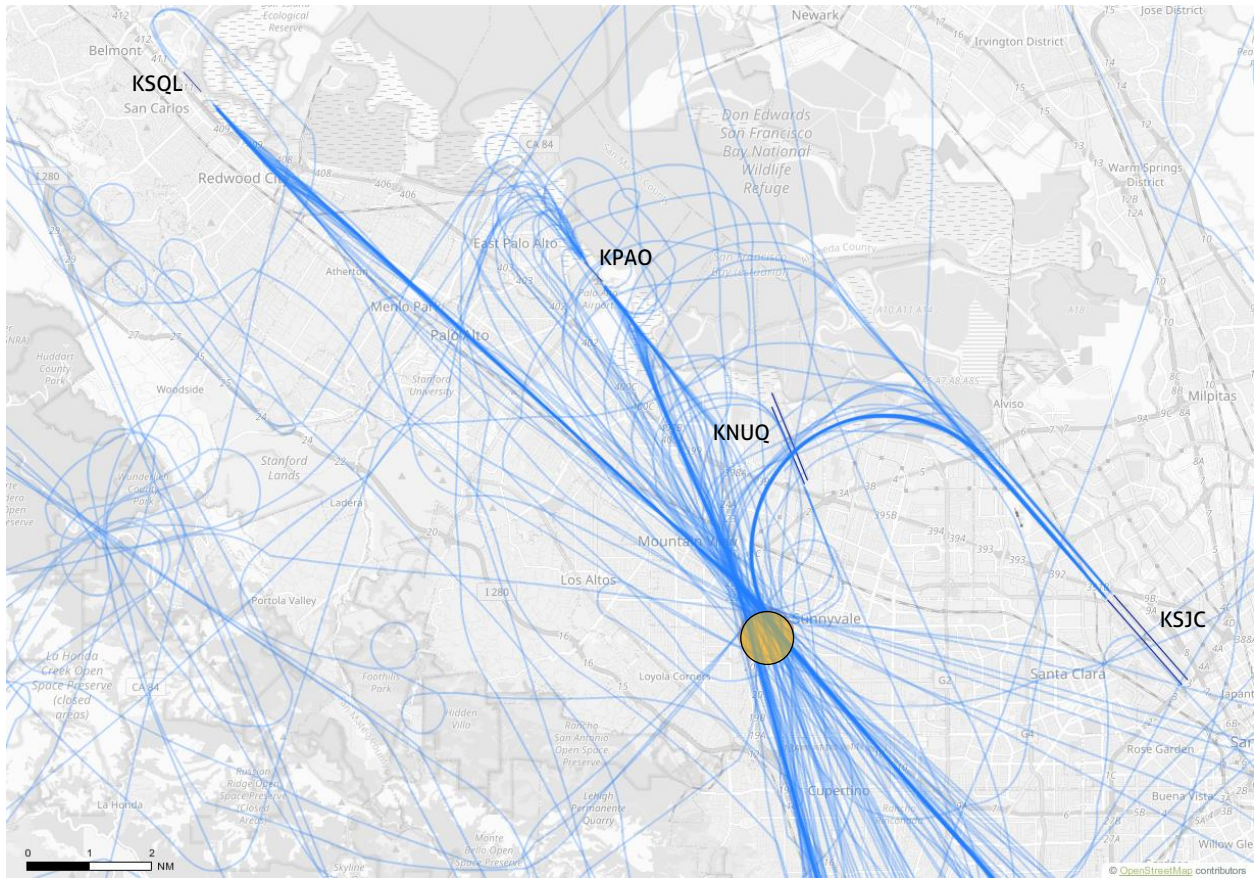
The portable noise monitor installed at Losse Well Site captured data for a full six-day period from 06/18 through 06/23. Analysis of the data shows that the average LEQ for the period was 46.0 dBA, as indicated by the black line. A minimum hourly LEQ of 33.6 dBA was registered on 6/20 at 03:00, and a maximum LEQ of 59.8 dBA was recorded on 06/23 at 12:00. The yellow and grey lines on the chart indicate the minimum and maximum recorded noise level measured during a particular hour. As a reference point, a conversation between two people measured at three feet is around 60 dBA.

We would expect the peak noise level of a typical aircraft events to register between 65-80 dBA depending on the altitude of the flight at the time it passes over the monitor. A 24-hour LEQ measurement below 60 dBA is good for an urban environment. It supports Casper's initial conclusion that the ambient noise levels at the Losse Well Site will allow for consistent capture of aircraft noise events.

24-Hour Calculated Noise Metrics from the Losse Well Site Portable NMT

Date	24-Hour LEQ	24-Hour CNEL
6/18	49.0	55.1
6/19	48.1	52.9
6/20	47.7	50.3
6/21	46.6	49.8
6/22	47.2	50.3
6/23	51.0	52.7

Casper analyzed the flight activity around the Losse Well Site monitor using the parameters outlined in Section 2.3 with a cylinder of 0.5-mile radius and a ceiling of 5,000 feet.



Flight activity in the proximity of the Losse Well Site portable NMT

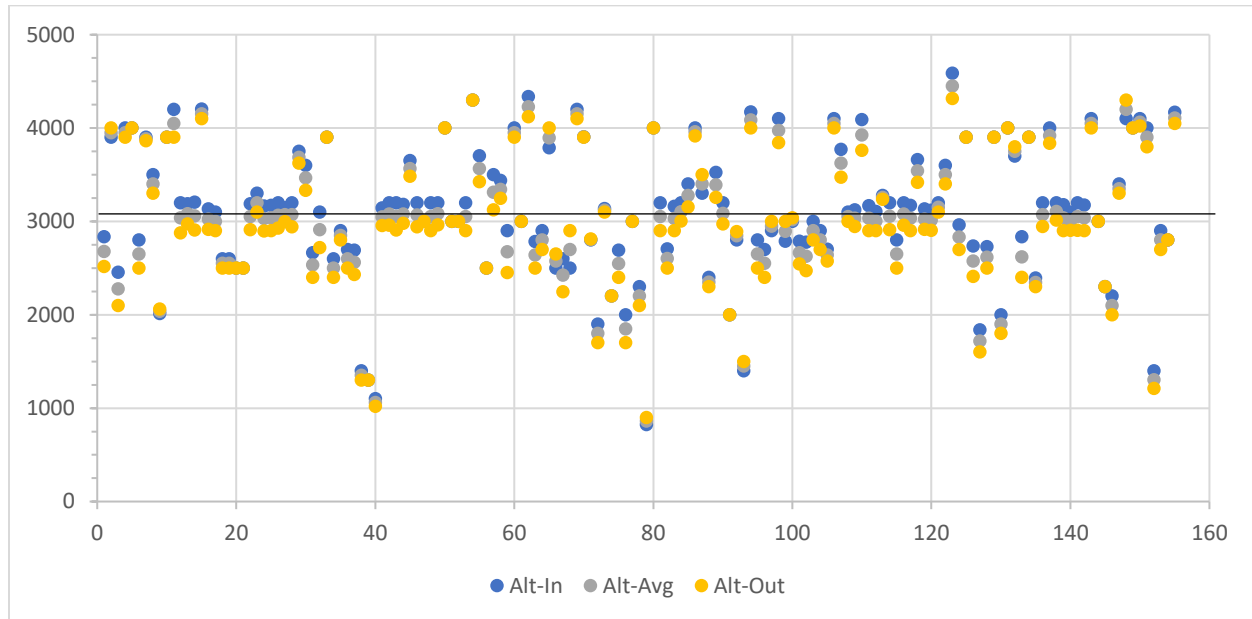
Analysis of flight track activity associated with the Losse Well Site monitor in Casper Noise revealed that 155 individual flights flew within 0.5 miles of the location, at or below 5,000 feet during the six days noise measurements were collected. These flights were associated with arrivals, departures, and touch-and-go operations at KSJC, KNUQ, KSQL and KPAO airports.

Flight Activity Captured within the Vicinity of the Losse Well Site Portable NMT

Airport	Arrivals	Departures	Touch-and-Go's	Total
KSJC	62	0	0	62
KNUQ	2	0	3	5
KPAO	29	11	8	48
KSQL	38	1	1	40
Total	131	12	12	155

This particular NMT is positioned primarily to capture south flow arrivals at KSJC; specifically, RNP approaches to Runway 12R and secondarily landings at KSQL and KPAO. Of the 131 total landings captured, 62 were associated with south flow approaches to KSJC. There were 33 Runway 12R RNPZ approaches, 18 Runway 12R ILS/GPS approaches, and 11 Runway 12L ILS/GPS approaches. Of the remaining 69 landings, 38 were associated with the Runway 30 approach at KSQL, 29 with the Runway 31 approach at KPAO, and two with the Runway 32L approach to KNUQ.

Altitude Dispersion of Flights over the Losse Well Site Portable NMT



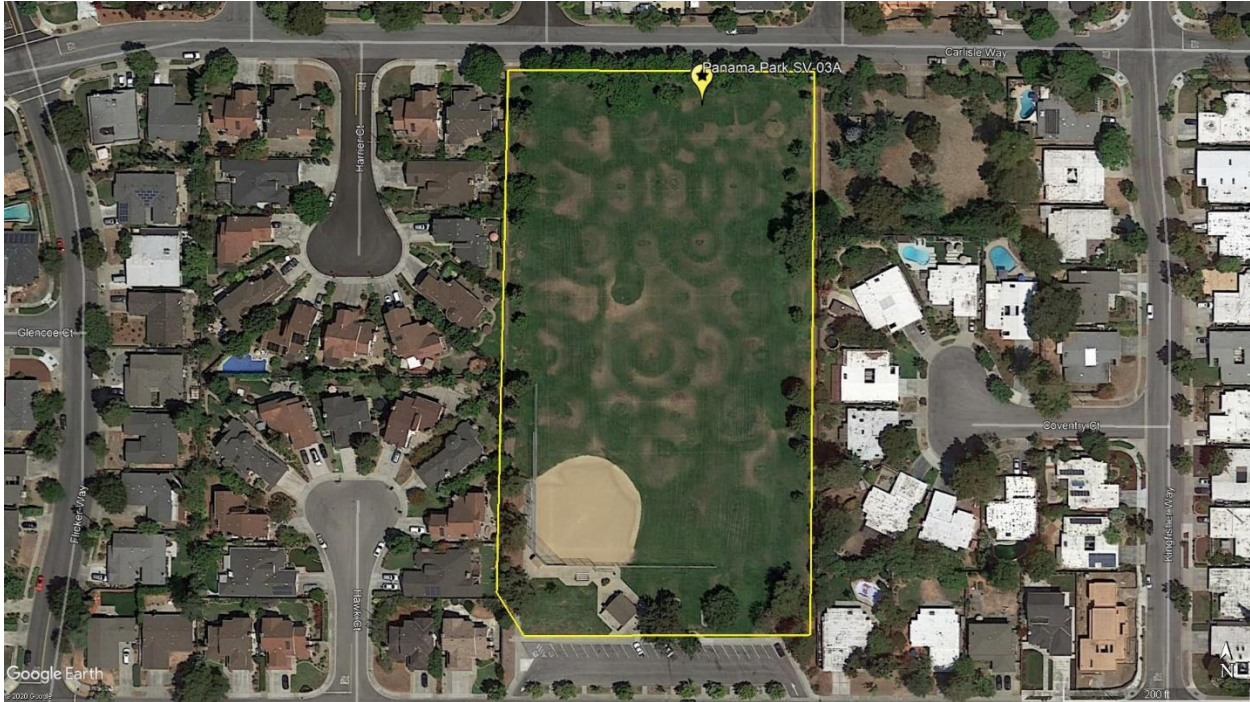
Casper Noise in analyzing penetrations of areas set up in the application calculates both an entry altitude (shown in blue) and exit altitude (shown in yellow) from the surveillance area based on the trajectory of the flight tracks and the altitude of the radar points on either side of the area boundary penetration. An average altitude (shown in grey) was derived by comparing the entry and exit altitudes for each flight. The average altitude for all 155 flights over the Losse Well site was 3,051 feet MSL, as shown by the black line.

This site is an acceptable candidate for a permanent noise monitor; it meets most of the siting criteria referenced in Section 1.1 except for solar compatibility. Tall trees could dampen noise events, and the proximity of other structures could cause sound reflection issues that could distort the measured sound levels. However, the site has consistent low ambient noise levels. It is well-positioned to capture south flow arrivals to KSJC and landings to KPAO and KSQL airports.

Casper doesn't recommend this site as a preferred location due to the lack of solar compatibility and potential sound reflection issues by surrounding houses and noise dampening caused by the tall trees.

4.2 Panama Park

Panama Park, located at 801 Dartshire Way in Sunnyvale, California. It is a 4-acre park, under the downwind leg of the approach path to Runway 12R at SJC Airport. Residential streets surround the park on all four sides.



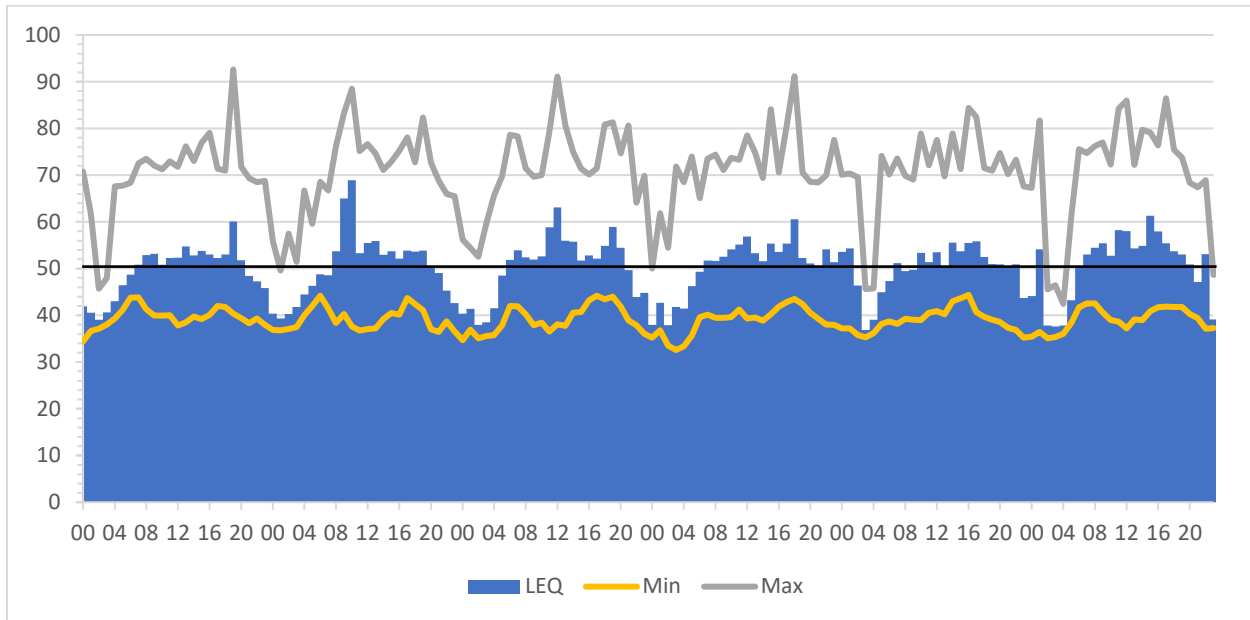
Aerial Overview of Panama Park, showing the proposed location of the permanent NMT

The approximate coordinates of the proposed NMT (SYV-03A) within Panama Park:

Latitude = 37.348533 Longitude = -122.018510

The portable noise monitor was placed near the coordinates of the proposed permanent NMT. The sound level meter recorded one-minute data samples and calculated an hourly LEQ measurement. The hourly noise data collected by the portable NMT at Panama Park allowed Casper to calculate a 24-hour LEQ and California Noise Equivalent Level (CNEL) level.

Hourly LEQ Calculations at the Panama Park Portable NMT



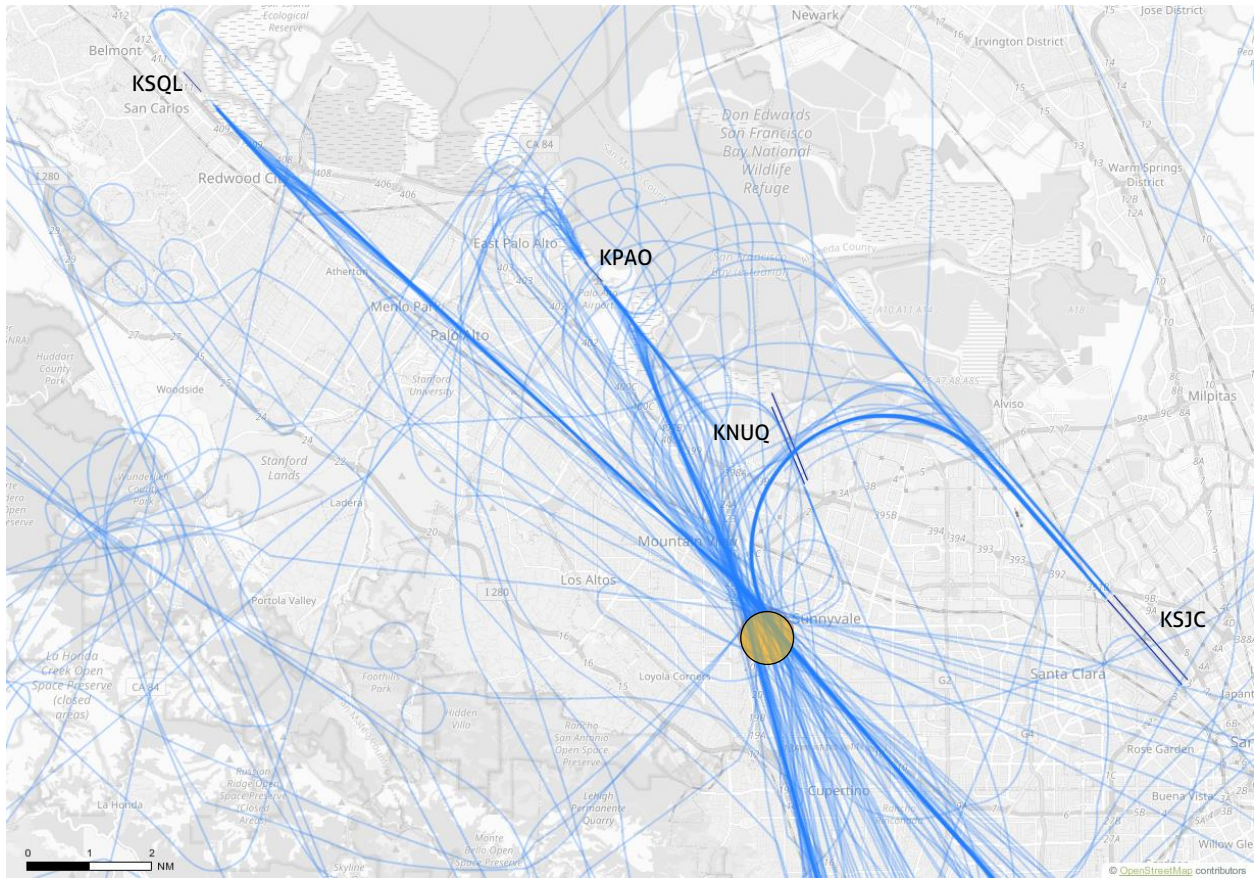
The portable noise monitor installed at Panama Park captured data for a full six-day period from 06/17 through 06/22. Analysis of the data shows that the average LEQ for the period was 50.2 dBA, as indicated by the black line. A minimum hourly LEQ of 36.9 dBA was registered on 6/21 at 03:00, and a maximum LEQ of 68.9 dBA was recorded on 06/18 at 10:00. The yellow and grey lines on the chart indicate the minimum and maximum recorded noise level measured during a particular hour. As a reference point, a conversation between two people measured at three feet is around 60 dBA.

We would expect the peak noise level of a typical aircraft events to register between 65-80 dBA depending on the altitude of the flight at the time it passes over the monitor. A 24-hour LEQ measurement below 60 dBA is good for an urban environment. It supports Casper's initial conclusion that the ambient noise levels in Panama Park will allow for consistent capture of aircraft noise events.

24-Hour Calculated Noise Metrics from the Panama Park Portable NMT

Date	24-Hour LEQ	24-Hour CNEL
6/17	52.0	55.7
6/18	57.6	58.5
6/19	54.4	57.0
6/20	53.2	56.7
6/21	51.8	56.8
6/22	54.3	57.4

Casper analyzed the flight activity around the Panama Park monitor using the parameters outlined in Section 2.3 with a cylinder of 0.5-mile radius and a ceiling of 5,000 feet.



Flight activity in the proximity of the Panama Park portable NMT

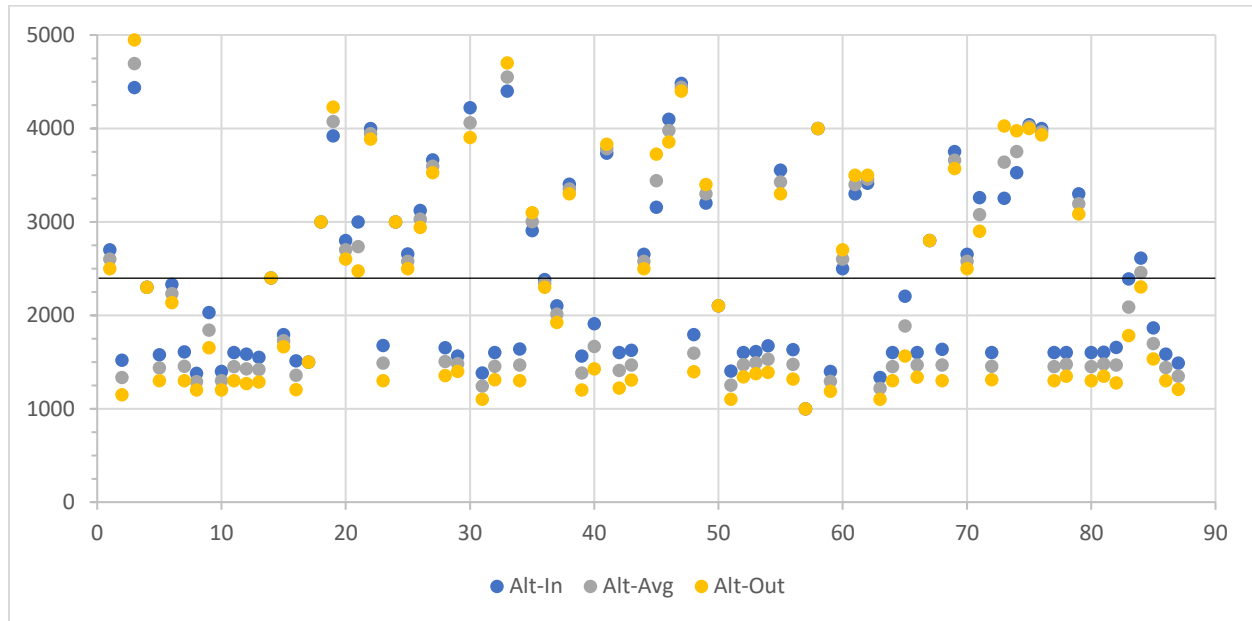
Analysis of flight track activity associated with the Panama Park monitor in Casper Noise revealed that 87 individual flights flew within 0.5 miles of the location, at or below 5,000 feet during the six days noise measurements were collected. These flights were associated with arrivals, departures, and touch-and-go operations at KSJC, KNUQ, KSQL and KPAO airports.

Flight Activity Captured within the Vicinity of the Panama Park Portable NMT

Airport	Arrivals	Departures	Touch-and-Go's	Total
KSJG	12	3	0	15
KNUQ	38	3	0	41
KPAO	12	11	1	24
KSQL	7	0	0	7
Total	69	17	1	87

This particular NMT is positioned primarily to capture landings at KNUQ and secondarily south flow arrivals to KSJC and approaches to KPAO and KSQL. Of the 69 total landings captured, 38 were associated with the Runway 32L approach to KNUQ. Of the remaining 31 arrivals, 12 were associated with the Runway 12R ILS/GPS approach at KSJC, 12 with the Runway 31 approach at KPAO, and seven with the Runway 30 approach at KSQL.

Altitude Dispersion of Flights over the Panama Park Portable NMT



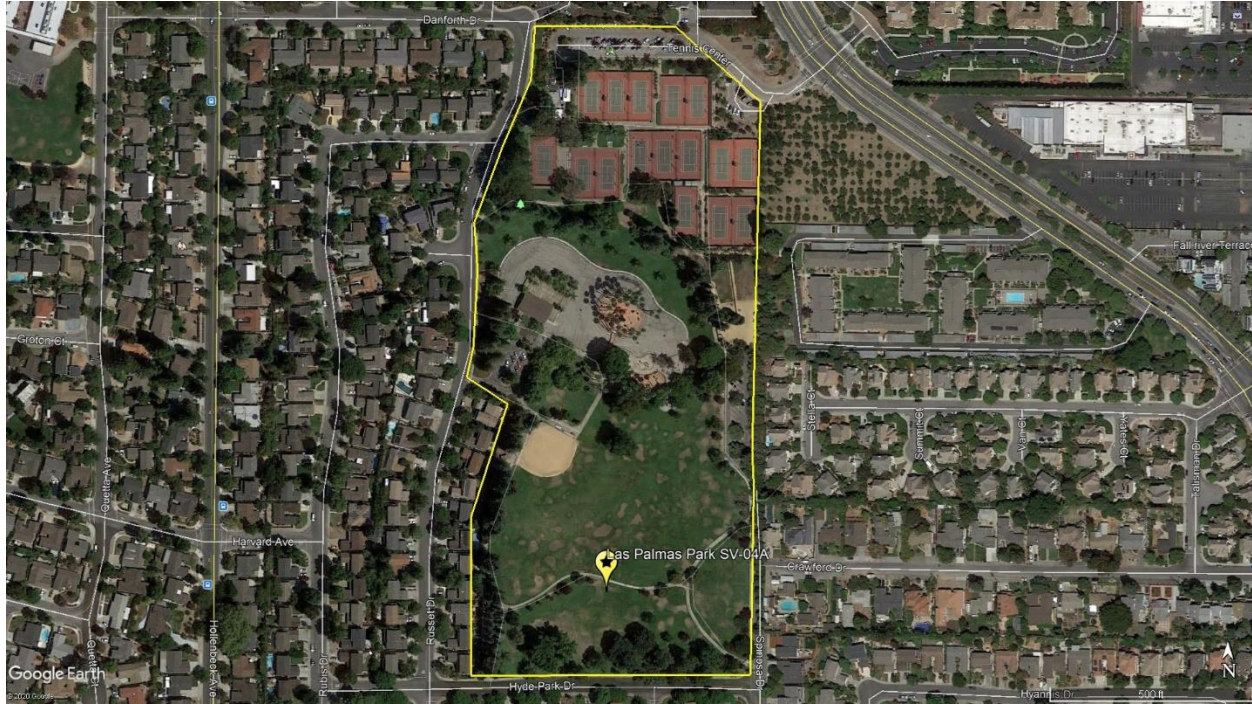
Casper Noise in analyzing penetrations of areas set up in the application calculates both an entry altitude (shown in blue) and exit altitude (shown in yellow) from the surveillance area based on the trajectory of the flight tracks and the altitude of the radar points on either side of the area boundary penetration. An average altitude (shown in grey) was derived by comparing the entry and exit altitudes for each flight. The average altitude for all 87 flights over the Panama Park site was 2,321 feet MSL, as shown by the black line.

This site is an acceptable candidate for a permanent noise monitor. It meets all of the siting criteria referenced in Section 1.1, has consistent low ambient noise levels, and is well-positioned to capture approaches to KNUQ, and south flow arrivals to KSJC and landings to KPAO airports.

Casper is neutral on this site. We don't recommend it as a preferred site but have no real objections to using this location. It could be a good site based on our analysis and all the available evidence.

4.3 Las Palmas Park

Las Palmas Park, located at 850 Russet Drive in Sunnyvale, California. It is a 23-acre park, under the downwind leg of the approach path to Runway 12R at SJC Airport. Residential streets surround the park on all four sides.

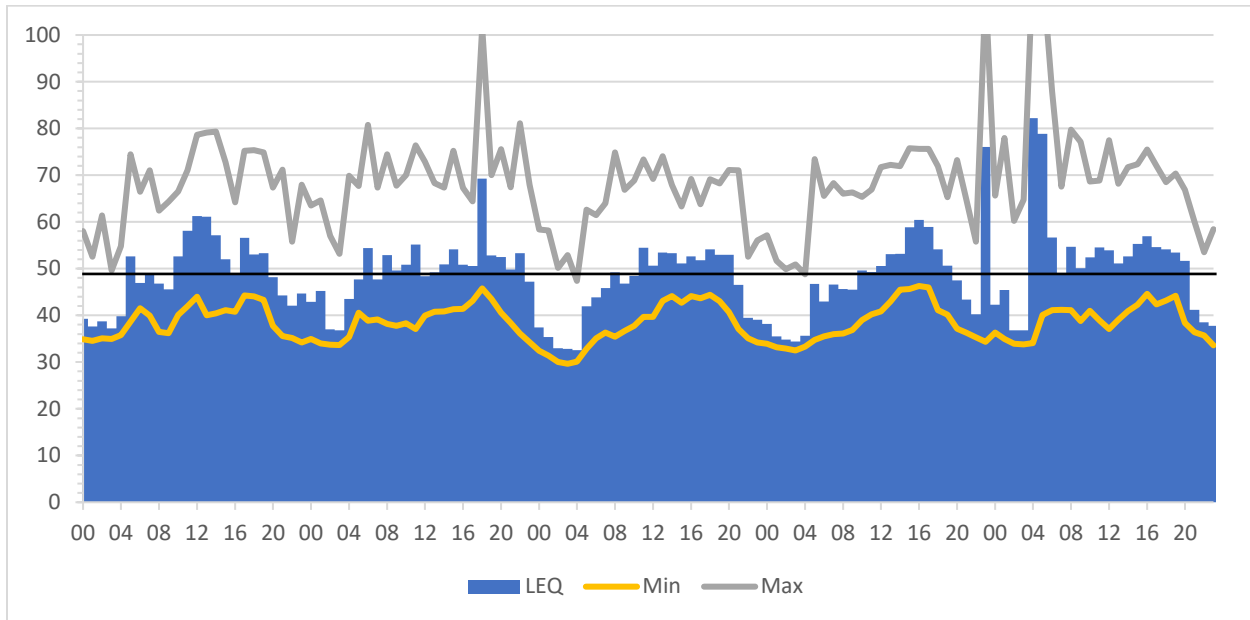


Aerial Overview of Las Palmas Park, showing the proposed location of the permanent NMT

The approximate coordinates of the proposed NMT (SYV-04A) within Las Palmas Park:
Latitude = 37.362910 Longitude = -122.038243

The portable noise monitor was placed near the coordinates of the proposed permanent NMT. The sound level meter recorded one-minute data samples and calculated an hourly LEQ measurement. The hourly noise data collected by the portable NMT at Las Palmas Park allowed Casper to calculate a 24-hour LEQ and California Noise Equivalent Level (CNEL) level.

Hourly LEQ Calculations at the Las Palmas Park Portable NMT



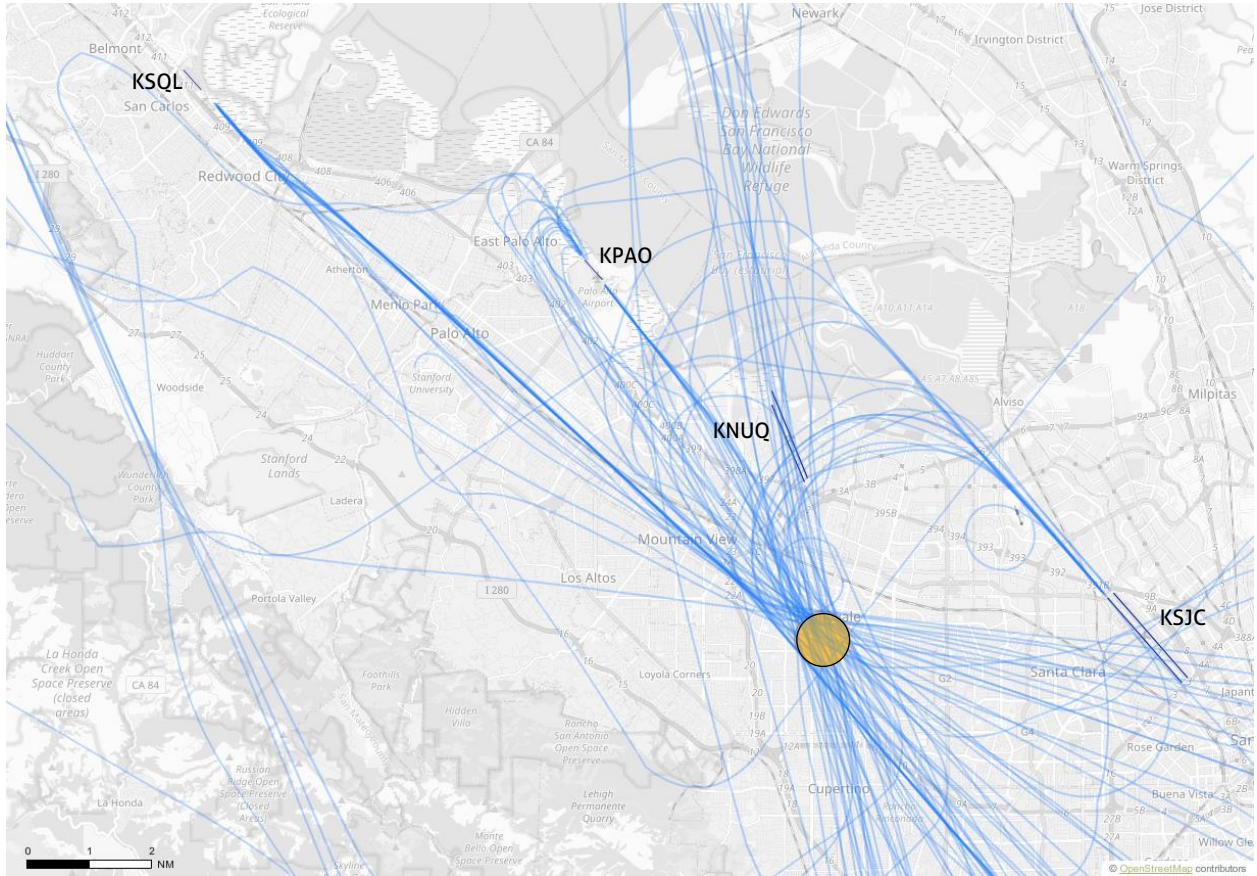
The portable noise monitor installed at Panama Park captured data for a full five-day period from 06/18 through 06/22. Analysis of the data shows that the average LEQ for the period was 48.8 dBA, as indicated by the black line. A minimum hourly LEQ of 32.6 dBA was registered on 6/20 at 04:00, and a maximum LEQ of 82.2 dBA was recorded on 06/22 at 04:00. The yellow and grey lines on the chart indicate the minimum and maximum recorded noise level measured during a particular hour. As a reference point, a conversation between two people measured at three feet is around 60 dBA.

We would expect the peak noise level of a typical aircraft events to register between 65-80 dBA depending on the altitude of the flight at the time it passes over the monitor. A 24-hour LEQ measurement above 70, while entirely normal for an urban environment, is not ideal for aircraft noise measurements. The hourly and 24-hour summary data without additional monitoring does not support Casper's initial conclusion that the ambient noise levels in Las Palmas Park will allow for consistent capture of aircraft noise events.

24-Hour Calculated Noise Metrics from the Las Palmas Portable NMT

Date	24-Hour LEQ	24-Hour CNEL
6/18	53.7	55.8
6/19	56.7	58.8
6/20	49.8	52.1
6/21	62.6	72.3
6/22	70.1	80.0

Casper analyzed the flight activity around the Las Palmas Park monitor using the parameters outlined in Section 2.3 with a cylinder of 0.5-mile radius and a ceiling of 5,000 feet.



Flight activity in the proximity of the Las Palmas Park portable NMT

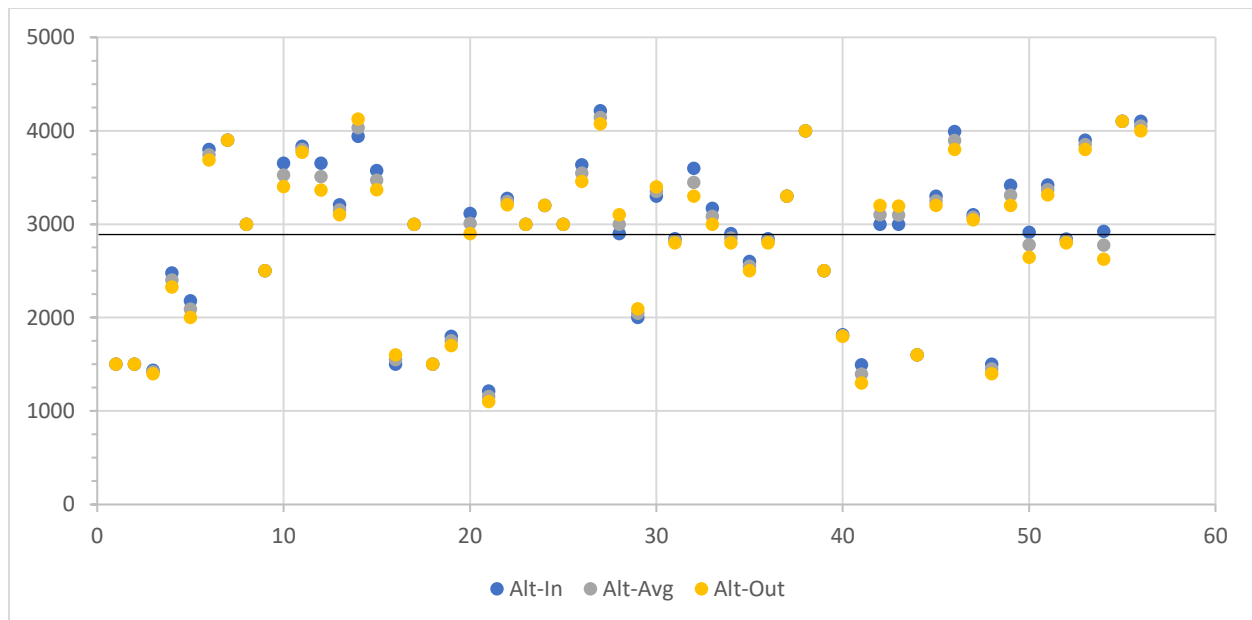
Analysis of flight track activity associated with the Las Palmas Park monitor in Casper Noise revealed that 56 individual flights flew within 0.5 miles of the location, at or below 5,000 feet during the six days noise measurements were collected. These flights were associated with arrivals, departures, and touch-and-go operations at KSJC, KNUQ, KSQL and KPAO airports.

Flight Activity Captured within the Vicinity of the Las Palmas Park Portable NMT

Airport	Arrivals	Departures	Touch-and-Go's	Total
KSJC	18	0	0	18
KNUQ	0	0	1	1
KPAO	10	10	1	21
KSQL	16	0	0	16
Total	44	10	2	56

This particular NMT is positioned primarily to capture south flow arrivals to KSJC and secondarily approaches to KSQL and KPAO airports. Of the 44 total landings captured, 16 were associated with south flow approaches to KSJC. Thirteen were Runway 12R ILS/GPS approaches, three were Runway 12L ILS/GPS approaches, and two were Runway 12R RNP Z approaches. Of the remaining 26 landings, 16 were associated with the Runway 30 approach to KSQL and ten with the Runway 31 approach at KPAO.

Altitude Dispersion of Flights over the Las Palmas Park Portable NMT



Casper Noise in analyzing penetrations of areas set up in the application calculates both an entry altitude (shown in blue) and exit altitude (shown in yellow) from the surveillance area based on the trajectory of the flight tracks and the altitude of the radar points on either side of the area boundary penetration. An average altitude (shown in grey) was derived by comparing the entry and exit altitudes for each flight. The average altitude for all 56 flights over the Las Palmas Park site was 2,878 feet MSL, as shown by the black line.

Casper has concerns with this site, based on the high LEQ measurements observed on the 21st and 22nd. Extremely high ambient noise levels were recorded that exceeded 100 decibels in the middle of the night. While it is very likely that this high noise level was caused by an environmental anomaly such as birds, LEQ values in the '80s are not desirable.

To achieve an hourly LEQ of 80 requires sustained high noise levels. Casper would recommend further measurements at this site if the City is seriously considering it. The site is, however, well-positioned to capture south flow arrivals to KSJC, and landings to KPAO and KSQL airports.

5 Conclusions

After analyzing the one-minute summary noise data, hourly LEQ, 24-hour LEQ, and aircraft overflights the data support Casper's initial conclusion that the Preferred sites are the best potential locations for the installation of a permanent noise monitor.

NMT Location	One-Hour Average LEQ	24-Hour Average LEQ	Aircraft Overflights
Ortega Park (preferred)	48.3 dBA	53.1 dBA	KSJC=45 KNUQ=3 KPAO=23 KSQL=10 Total=81
Dona Ave. APN# 198-25-009 (preferred)	43.2 dBA	46.2 dBA	KSJC=69 KNUQ=5 KPAO=32 KSQL=49 Total=155
Community Center Park (preferred)	48.9 dBA	53.7 dBA	KSJC=15 KNUQ=48 KPAO=25 KSQL=13 Total=101
Washington Park (preferred)	51.3 dBA	52.9 dBA	KSJC=12 KNUQ=6 KPAO=32 KSQL=4 Total=54
Losse Well Site (alternative)	46.0 dBA	48.3 dBA	KSJC=62 KNUQ=5 KPAO=48 KSQL=40 Total=155
Panama Park (alternative)	50.2 dBA	53.9 dBA	KSJC=15 KNUQ=41 KPAO=24 KSQL=7 Total=87
Las Palmas Park (alternative)	48.8 dBA	58.6 dBA	KSJC=18 KNUQ=1 KPAO=21 KSQL=16 Total=56

All four sites are compatible with solar power, have consistently low ambient noise levels, and provide the opportunity to capture a wide range of aircraft activity from the four key airports of interest identified by the City.

Casper's final recommendation is unchanged from the March 13th report that the City should place two NMTs under the RNP Z approach to Runway 12R and two under the Runway 12L and 12R ILS/GPS approach paths for SJC south flow arrivals. These four locations allow the potential for the maximum capture of aircraft noise events over the largest geographic area. This arrangement will enable the NMTs to capture south flow approaches to San Jose as well as traffic into Moffett Field, San Carlos, and Palo Alto and even higher-level overflight traffic into Oakland and San Francisco airports.

In examining the alternative sites, Casper has concluded that Panama Park is also an acceptable site. It was not chosen as a Preferred site due to its proximity to the Ortega Park site. Casper felt there was too much potential overlap in placing two monitors that close together. We feel that the City is better served to have the four monitors spread out across the city which the four preferred sites allow for. The Losse Well Site and Las Palmas Parks have some challenges that make them less than ideal for the installation of a permanent NMT.

Casper understands the final decision on the location of the four NMTs is at the City's discretion, and there may be no acoustical factors that could dictate siting decisions. We hope that this report assists the City in making its final decision in regards to where to place the permanent NMTs. If you have any additional questions regarding this analysis, please don't hesitate to contact us.