Quarterly Noise Monitoring Report

October – December 2015

Metropolitan Oakland International Airport

HMMH Report No. 302551.004.003-2
June 2016

Prepared for:

Port of Oakland
Oakland, California

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Prepared for:

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Executive Summary

The California Airport Noise Regulation (California Code of Regulations, Title 21, Section 50025, County Report) requires the quarterly report include use of a standard information format provided by the California Department of Transportation "Department" (form DOA 617, dated 10/89). The information below fulfills this requirement.

CALIFORNIA FORM DOA 617

Summary of Statistical Information

For

California Department of Transportation

Oakland International Airport

Calendar Year 2015: Fourth Quarter 2015

1. Size of Noise Impact Area as defined in the Noise Standards (California Code of Regulations, Title 21, Chapter 2.5, Subchapter 6): 0 sq. miles
2. Estimated number of dwelling units included in the Noise Impact Area as defined by the Noise Standards: 0 dwelling units
3. Estimated number of people residing within the Noise Impact Area as defined by the Noise Standards: 0 people
4. Identification of aircraft type having highest takeoff noise level operating at this airport together with estimated number of operations by this aircraft type during the calendar quarter reporting period: F18 aircraft; SEL 121.1 dB; Estimated Operations: 40.
5. Total number of aircraft operations during the calendar quarter: 45,436 aircraft operations
6. Number of Commercial operations during the calendar quarter (not mandatory): 28,455 Commercial Jet operations
7. Percentage of Air Carrier operations by aircraft certified under Federal Aviation Regulation (FAR) Part 36, Stage III (not mandatory): 100% of air carrier/air cargo operations Stage III
8. Estimated number of operations by General Aviation aircraft during the calendar quarter (not mandatory): 9,967 General Aviation aircraft operations estimated from FAA tower counts
9. Estimated number of operations by Military aircraft during the calendar quarter (not mandatory): 37 Military aircraft operation

Per Title 21 requirements, the report must also include a map illustrating the location of the noise impact boundary, as validated by measurement, and the location of the measurement points (Figure 1 satisfies this requirement) and the daily measured CNEL values at each of the noise monitoring sites (Tables 1 through 3 satisfy this requirement).

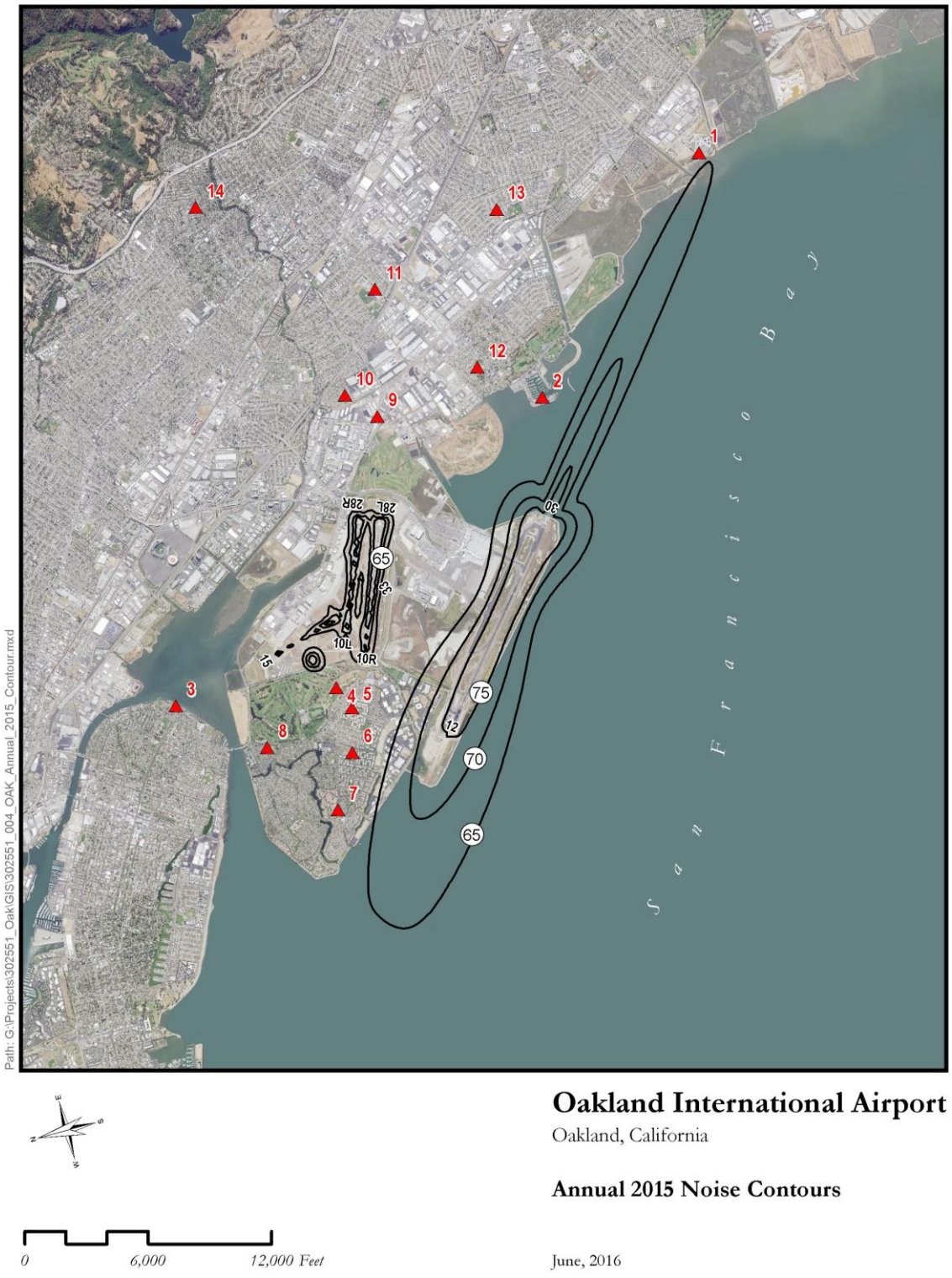

Figure 1 Noise Impact Boundary: 12-Month CNEL Contours for January 2015 – December 2015
Source: Port of Oakland ANOMS™ January 1, 2015 through December 31, 2015

Table 1 Measured Aircraft CNEL values, October 2015

October	RMT Location Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	64	57	53	55	57	59	60	53	52	53	44	50	44	47
2	64	59	47	54	56	58	59	57	49	48	41	48	32	43
3	60	54	49	54	57	58	59	49	46	45	44	40	42	30
4	61	54	52	68	69	68	64	65	52	58	63	49	49	60
5	63	56	47	58	59	58	60	50	62	54	57	53	44	44
6	63	57	52	57	57	59	60	51	52	51	52	50	49	44
7	63	56	47	55	58	59	59	50	54	50	48	48	40	45
8	63	54	50	67	76	75	71	61	64	56	59	48	42	46
9	64	55	48	70	72	69	61	59	61	54	57	52	48	52
10	59	51	49	70	73	70	62	57	62	57	59	46	44	46
11	61	54	49	67	72	65	61	62	55	51	59	46	41	53
12	61	55	46	65	76	72	62	47	52	53	43	50	33	40
13	63	57	49	60	65	64	60	50	53	52	46	49	34	41
14	63	59	44	58	57	58	60	53	53	50	43	57	37	43
15	63	59	49	59	59	60	61	51	54	52	47	52	37	45
16	63	60	49	55	56	58	59	50	50	46	41	56	35	44
17	60	52	41	52	55	58	59	47	45	44	37	57	25	42
18	61	52	47	53	55	57	58	57	47	46	38	46	33	33
19	62	53	42	52	55	56	58	55	50	46	43	46	39	39
20	64	54	46	55	58	59	62	47	52	57	45	50	37	46
21	64	58	44	55	57	58	60	50	52	53	49	49	47	49
22	64	59	45	57	57	59	60	50	54	53	49	50	35	45
23	64	55	45	55	57	59	59	49	50	51	49	48	36	44
24	60	51	39	52	56	57	58	42	47	44	40	42	35	24
25	61	53	44	53	55	57	59	46	48	42	40	41	23	35
26	62	53	41	52	55	55	57	46	51	46	47	49	34	42
27	64	56	47	58	59	59	61	53	50	50	45	51	31	45
28	64	55	47	55	58	59	59	50	54	49	44	55	34	42
29	65	60	43	54	59	59	60	52	55	53	46	54	37	42
30	64	58	45	54	57	59	59	46	50	52	40	51	40	48
31	60	54	43	51	54	57	61	45	49	44	37	38	33	N/A
Average	63	56	48	62	67	65	61	55	55	52	53	51	42	48
No. Day	31	31	31	31	31	31	31	31	31	31	31	31	31	30

Note: Values reported are aircraft measured CNEL values at each monitor.
N/A represents an error or incomplete data
Source: ANOMS™ October 1, 2015 through December 31, 2015

Table 2 Measured Aircraft CNEL values, November 2015

November	RMT Location Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	61	52	45	51	54	56	58	46	48	45	41	42	28	36
2	63	57	46	51	56	57	58	51	52	49	45	48	37	40
3	64	60	49	56	57	59	60	51	52	53	45	50	41	48
4	63	58	45	55	57	58	60	54	50	53	46	47	40	42
5	63	58	45	56	57	59	61	52	52	57	56	49	41	49
6	64	57	47	54	55	57	59	58	52	52	45	49	39	50
7	59	52	41	53	55	58	59	47	52	49	42	43	41	37
8	61	53	43	54	57	58	60	45	55	53	51	44	40	36
9	63	55	47	52	55	58	58	53	52	49	47	47	39	40
10	64	60	43	58	60	60	61	50	54	58	48	56	41	47
11	64	55	44	57	57	60	61	52	53	54	48	49	45	48
12	62	60	43	56	57	59	61	49	54	56	49	49	42	51
13	64	56	48	55	57	59	60	50	51	53	44	56	43	52
14	60	55	47	54	56	57	59	49	47	50	47	45	31	30
15	63	60	53	52	56	57	57	49	55	48	49	49	46	38
16	62	56	50	57	58	57	57	50	54	53	45	49	36	43
17	65	59	47	56	57	58	60	51	54	53	48	50	46	44
18	65	60	44	56	57	60	60	53	52	52	46	49	39	47
19	64	60	48	56	57	61	60	51	54	53	45	50	39	47
20	63	58	49	56	59	59	62	52	53	52	46	51	42	49
21	61	54	43	51	55	57	58	45	48	55	47	45	27	40
22	61	57	43	54	55	56	58	47	53	50	47	44	42	31
23	63	56	41	52	55	56	57	47	52	46	45	43	48	40
24	65	60	48	55	59	59	59	50	58	54	51	52	44	36
25	64	59	47	56	58	60	59	52	57	55	48	47	37	44
26	59	50	42	51	52	54	54	47	50	51	44	39	N/A	29
27	61	54	43	53	54	56	56	46	54	53	46	N/A	N/A	N/A
28	60	49	44	51	53	55	56	48	55	52	45	N/A	N/A	N/A
29	60	51	47	53	54	56	56	47	56	52	48	N/A	N/A	N/A
30	63	55	43	54	54	56	57	46	58	55	51	N/A	N/A	N/A
Average	63	57	47	55	56	58	59	51	54	53	48	49	42	46
No. Day	30	30	30	30	30	30	30	30	30	30	30	26	25	26

Note: Values reported are aircraft measured CNEL values at each monitor.
N/A represents an error or incomplete data
Source: ANOMS™ October 1, 2015 through December 31, 2015

Table 3 Measured Aircraft CNEL values, December 2015

December	RMT Location Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	64	55	49	57	57	59	59	50	59	56	51	49	36	44
2	64	57	44	56	61	59	59	50	57	52	48	48	35	36
3	64	62	42	57	59	59	59	53	57	55	50	52	46	40
4	64	60	51	56	58	61	60	52	58	56	51	56	45	49
5	61	57	45	56	57	58	58	52	55	51	47	44	35	29
6	63	61	44	58	59	59	58	50	57	52	49	50	53	41
7	63	55	42	55	57	57	57	52	55	46	47	50	29	33
8	66	59	47	57	58	60	58	51	58	50	50	50	30	45
9	65	56	44	56	62	68	60	53	60	52	52	48	34	40
10	66	62	51	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	66	58	47	N/A	60	60	60	58	58	59	51	51	41	44
12	60	57	43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	63	61	49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	64	55	51	52	60	59	57	50	59	52	52	49	34	46
15	64	59	47	57	58	61	58	48	58	56	49	50	36	40
16	64	57	46	57	59	60	59	54	58	53	52	49	39	36
17	64	57	45	57	58	60	60	53	59	56	52	49	36	43
18	66	61	50	59	61	61	60	54	59	55	52	54	49	41
19	63	56	46	58	58	60	60	50	60	55	58	50	37	46
20	60	61	40	57	59	58	56	55	52	52	34	52	44	36
21	68	64	35	55	60	59	58	56	58	53	50	54	47	N/A
22	69	64	57	56	61	61	60	51	62	56	56	50	53	32
23	66	60	51	57	59	61	59	48	60	51	60	47	38	42
24	64	59	48	54	58	60	60	51	56	50	58	46	38	37
25	58	52	41	48	51	54	54	43	53	50	47	40	32	40
26	61	52	41	51	53	54	54	49	56	53	50	43	31	43
27	61	53	45	52	55	57	59	41	55	49	48	44	23	36
28	64	58	44	53	54	56	57	50	56	53	51	47	37	39
29	64	61	46	56	58	61	62	51	58	55	51	48	34	44
30	64	57	45	57	60	60	59	48	59	55	51	46	35	45
31	62	52	48	56	56	57	57	50	58	56	58	46	39	44
Average	64	59	48	56	59	60	59	52	58	54	53	50	44	42
No. Day	31	31	31	27	28	28	28	28	28	28	28	28	28	27

Note: Values reported are aircraft measured CNEL values at each monitor.
N/A represents an error or incomplete data
Source: ANOMS™ October 1, 2015 through December 31, 2015

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1 Introduction

HMMH prepared the Fourth Quarter of 2015 (4Q2015) Noise Monitoring Report. This quarterly noise monitoring report provides the aircraft noise levels and airport operations at Metropolitan Oakland International Airport (OAK) for the periods from October 1, 2015 to December 31, 2015 and satisfies the California Division of Aeronautics Noise Standards[1], Section 5025 requirements. California's Division of Aeronautics and Alameda County received copies of this report.

According to the California Noise Standards, hereinafter Title 21, a county may declare an airport within its boundaries to have a noise problem and shall enforce Title 21 requirements. Alameda County has declared OAK a "noise problem" airport. In as such, the County must provide quarterly to the California Department of Transportation "the department" a report containing at least the following information:

- A map illustrating the noise impact boundary; see Figure 1 in the Executive Summary
- The annual noise impact area and the estimated number of dwelling units and people residing with the noise impact area; see Form DOA 617 in the Executive Summary
- Daily CNEL measurements, number of aircraft operations, and estimated number of operations of the highest noise level aircraft type during the calendar quarter; see Form DOA 617 in the Executive Summary
- Form DOA 617; see the Executive Summary

This report meets and exceeds Title 21's reporting requirements for 4Q2015. The following sections provide the methodology used to obtain the information reported and further details illustrating the aircraft operations and noise exposure from those operations in the OAK environs. This report is organized as follows:

Section 2: Aircraft Noise and Operations Measurements

Section 3: Airport Operations

Section 4: Preparation of Annual CNEL Contours

Section 5: Validation of Noise Exposure Map

[1] State of California Department of Transportation Division of Aeronautics, Title 21, Subchapter 6, Noise Standards, Register 90, No. 10—3-10-90.

2 Aircraft Noise and Operations Measurements

On September 14, 1990 the Port of Oakland (Port), as the airport proprietor, installed a state-of-the-art noise and operations monitoring system (NOMS)[2], which automatically collects flight track data and flight identification data for a majority of all operations at the airport as well as measure and report noise levels at specific locations. In 2006, the Port received an upgrade to their NOMS with ANOMS8 software. In order to maintain the most up-to-date technologically, the Port received another upgrade to ANOMS8 in 2011 with Version 8.11.2 software and Brüel & Kjaer 3639-E noise monitors.

OAK's NOMS is currently configured with fourteen (14) Remote Monitoring Terminals (RMTs) dispersed in the communities surrounding OAK to assist in evaluating compliance with OAK's established flight pattern and aircraft noise abatement procedures, and to assess the noise impact in residential areas from OAK aircraft operations. ANOMS™ correlates recorded noise events at each RMT with aircraft flight track records obtained from SkyTrac and the National Offload Program (NOP).

The SkyTrac and NOP data is used to separate aircraft and non-aircraft noise events recorded at the RMT's. ANOMS™ also excludes noise events due to aircraft overflights from other airports (such as San Francisco International) using the aircraft identification information included in the SkyTrac and NOP data. Figure 1 shows the RMT locations.

The 14 RMTs located in the community are Brüel & Kjaer Noise Monitoring Terminal 3639-E Precision Integrating Sound Level Meters fitted with B&K Type 4952 outdoor microphone assemblies. The meters are housed in weatherproof cabinets, and the microphones are placed on booms at least 20 feet above the ground surface or at least 10 feet above neighboring roof tops, whichever is higher, and has a clear line of sight to the path of aircraft in flight. The meters report the maximum A-weighted sound level (L_{max}), the duration of a noise event at a pre-programmed measurement threshold level, and the Single Event Noise Exposure Level (SENEL) for single noise events. The RMT's pre-programmed parameters were determined from previous field observations of aircraft and background noise levels at each measurement site. ANOMS™ also reports the Hourly Noise Level (HNL) and Community Noise Equivalent Level (CNEL) based on both overall noise levels and single noise events exceeding the selected measurement threshold levels.

The sound level meters' internal calibration system performs daily checks using an acoustic actuator. The meters are externally calibrated periodically using an acoustical calibrator certified to be consistent with National Bureau of Standards (NBS) reference levels. The measurement systems meet all pertinent specifications of the American National Standards Institute (ANSI) and the International Electrotechnical Commission (IEC) for Type 1 Precision sound level meters and microphones, and comply with all applicable requirements of Title 21.

[2] The OAK system utilizes ANOMS™, which is a product of Brüel & Kjaer EMS, Inc.

3 Airport Operations

Title 21 requires the reporting of the total number of airport operations during the calendar quarter. Table 4 provides a summary of the monthly activity for October through December 2015 as captured in ANOMS™, along with the previous quarter totals. Table 4 indicates a decrease in regional jets, propeller, helicopter, and unknown aircraft. Military aircraft activities significantly increased from 6 operations in the third quarter to 37 operations in the fourth quarter. The Oakland International Airport was proud to welcome the Blue Angeles (a high performance Naval air team) to the Bay Area for Fleet Week in October. The Blue Angles perform each year during Fleet Week and were based at OAK for the second year in a row. The military activity surrounding Fleet Week is what spiked the Military Aircraft operation in October and the 4th quarter overall Turboprops have also increased by 18.7% compared to the previous quarter. Commercial and corporate jet activity was up 2.8% and 4.6%, respectfully for an overall total increase in operations of 1.9% during the fourth quarter of 2015 compared to the third quarter of 2015.

Table 4 Monthly Aircraft Operational Activity – Fourth Quarter 2015

Aircraft Category	Monthly Arrivals and Departures					Percent Change
	Oct	Nov	Dec	Total	3Q2015	
Commercial Jets	9,115	9,158	10,182	28,455	27,684	2.8%
Regional Jets	633	611	603	1,847	2,122	-13.0%
Corporate Jets	1,792	1,752	1,718	5,262	5,030	4.6%
Turboprops	1,544	1,502	1,558	4,604	3,879	18.7%
Propeller	1,728	1,432	969	4,129	4,641	-11.0%
Helicopters	308	219	215	742	758	-2.1%
Military	32	0	5	37	6	516.7%
Unknown	143	110	107	360	471	-23.6%
Total	15,295	14,784	15,357	45,436	44,591	1.9%

Note: "Unknown" aircraft category implies ANOMS™ did not have aircraft type associated with flight track.
Source: Port of Oakland ANOMS™ July 1, 2015 through December 31, 2015.

Aircraft operating at OAK are arranged in one of eight categories; corporate jets, helicopters, commercial jets, military, propeller, regional jets, turbo-propeller (turboprops), and unknown. Commercial jets are primarily large jets consisting of both passenger carriers and freight operators as defined in FAA Order 7210.3. Regional jets are primarily small commercial jets while corporate jets have fewer seats and passengers are typically flown as charter operations. Commuter and charter operators use turboprops for most air taxi services but, may also use regional or corporate jets for these services. The military category contains both propeller and jet aircraft.

Airport operations determine noise exposure in the OAK environs as described by the CNEL metric, which by definition is a daily noise exposure. To determine the average daily noise exposure from OAK operations, additional information is required for determining aircraft fleet mix, runway use, and time of day of the operations as CNEL weights evening (7pm to 10pm) and night (10pm to 7am) noise levels.

4 Preparation of Annual CNEL Contours

CNEL can be measured or estimated through modeling. Most airport noise studies use computer-generated CNEL estimates, in terms of equal-exposure noise contours (much as topographic maps present equal-elevation contours). Title 21, Section 5012, Airport Noise Standard, indicates that the "noise impact area" is based on the standard of 65 dB CNEL.

The FAA Integrated Noise Model (INM) incorporates a comprehensive set of computer routines for calculating airport noise exposure contours. HMMH used the most current release of the model, INM Version 7.0d, to prepare the 12-month contours ending with the fourth quarter 2015.

HMMH used the Port of Oakland's flight track files and noise level measurement data collected by ANOMS™ as the basis for predicting aircraft noise at OAK using the INM. Data for aircraft activity, aircraft fleet mix including helicopters, and airport configuration used in the noise modeling process were obtained from ANOMS™ for the time period of January 1, 2015 through December 31, 2015. The following sections provide the summary of the data, methods and assumptions used to prepare the Annual CNEL noise exposure map.

4.1 INM Required Data

The INM requires data in three principal categories: (1) aircraft noise and performance data, (2) airport layout, and (3) aircraft operational data.

4.1.1 Aircraft noise and performance data

The INM includes a database of noise and performance data for a broad range of representative aircraft types. Noise data cover a range of distances (from 200 feet to 25,000 feet) for specific thrust levels. Performance data include thrust, speed, and altitude profiles for takeoff and landing operations. The INM database contains standard noise and performance data for more than three hundred different aircraft types. The program automatically accesses the applicable noise and performance data for departure and approach operations by those aircraft. For aircraft not included in the database, the FAA maintains a list of acceptable "substitutes".

Airfield elevation and average temperature have an effect on aircraft performance; these are accounted for in INM 7.0d. Aircraft departing from a high altitude airport and/or at high temperatures must use more thrust than at lower elevations and temperatures. The performance data used by the INM define the length of the takeoff roll (based on aircraft takeoff weight), the climb rate, and speeds for each flight segment.

4.1.2 Airport layout

The INM requires the following airfield layout related inputs:

- Runway orientations
- Runway lengths
- Runway end elevations
- Start-of-takeoff-roll points on each runway
- Landing touchdown points on each runway
- Runway threshold crossing heights
- Runway approach slopes
- Annual average temperature, pressure, relative humidity, and runway-specific headwinds

4.1.3 Aircraft operational data

The INM requires the following aircraft operational inputs:

- Number of aircraft operations
- Aircraft fleet mix
- Day-night split of operations
- Runway utilization
- Flight track geometry and utilization

For accurate determination of daily noise exposure using actual aircraft operations for modeling purposes, the ANOMS™ database provided complete and accurate information for approximately 172,959 operations on 365 days[3]. These operations represent the majority of all aircraft operations at OAK and are a large "sample" with an extremely high statistical reliability.

4.2 Preparation of INM-input Files

As directed by the Port, HMMH prepared the INM input files through the use of our proprietary INM pre-processor, "RealContours"™, which takes maximum possible advantage of both the INM's capabilities and the investment that the Port has made in operations monitoring with ANOMS™. RealContours automates the process of preparing the INM inputs directly from the flight operations monitoring results, to permit airports to model the full diversity of activity as precisely as possible. Rather than modeling a single annual-average day, RealContours allowed the determination of daily noise exposure from actual OAK flight operations for a total of 365 days. The following subsections summarize the noise modeling inputs for January 1, 2015 through December 31, 2015 operations at OAK.

4.2.1 Annual-average airport operations, aircraft fleet mix and time of day

RealContours assigned INM types based on the FAA code associated with each flight. For commercial operations, selection of the specific INM aircraft type was accomplished by using the fleet mix of each airline. This information permits a rational and representative selection of INM aircraft types. In cases where multiple INM types are available for a single FAA code, RealContours chooses the INM type using a random process, with weightings corresponding to the number of each aircraft type operated by that particular airline.

To take into account the penalties applied to evening and nighttime operations, all INM input must be coded as occurring either in the day, evening or at night. RealContours used the time recorded in the operations data for calculating sound exposure. Operations between 7 a.m. and 7 p.m. are un-weighted. When the time of the operation is between 7 p.m. and 10 p.m., the operation is considered to be an evening operation and a weighting factor of 3 times the noise energy is added in the computation of CNEL by the INM. When the time of the operation is between 10 p.m. and 7 a.m., the operation is considered to be a nighttime operation and a weighting factor of 10 is added in the computation of CNEL by the INM.

[3] RealContours™, an Integrated Noise Model (INM) preprocessor, successfully processed 365 days of complete and accurate flight track data to determine the average daily noise exposure. Traditional modeling techniques determine daily noise exposure from a single day of "annual-average" activity.

4.2.2 Annual runway utilization

Runway use was determined from the actual flight track data acquired in ANOMS™. Table 5 summarizes the observed runway utilization rates, collapsed into major aircraft type categories: (1) commercial jet, (2) regional jet, (3) corporate jet, (4) turbo-propeller, (5) piston propeller aircraft, (6) military and (7) helicopters, respectively. RealContours modeled each aircraft operation on the individual flight track found in the ANOMS™ sample, thus each aircraft type has unique runway utilization.

Table 5 summarizes the annual arrival and departure activity during January 1, 2015 through December 31, 2015.

Table 5 Annual Aircraft Operational Activity – January 1, 2015 through December 31, 2015

Aircraft Category	RWY 30	RWY 12	South Field Total	RWY 28R/L	RWY 33	RWY 10R/L	RWY 15	PAD 1	North Field Total	Grand Total
Aircraft Landings										
Commercial Jets	51,261	1,306	**52,567**	183	5	1	4	0	**193**	**52,760**
Regional Jets	3,326	93	**3,419**	405	1	2	1	0	**409**	**3,828**
Corporate Jets	646	231	**877**	9,526	16	100	11	0	**9,653**	**10,530**
Turboprops	1,295	49	**1,344**	5,995	47	189	68	0	**6,299**	**7,643**
Propeller	46	1	**47**	6,392	293	54	279	0	**7,018**	**7,065**
Military	6	0	**6**	18	0	2	1	0	**21**	**27**
Helicopters	0	0	**0**	43	5	1	5	1,247	**1,301**	**1,301**
Unknown	289	10	**299**	1,629	134	11	117	0	**1,891**	**2,190**
Total	**56,869**	**1,690**	**58,559**	**24,191**	**501**	**360**	**486**	**1,247**	**26,785**	**85,344**
Aircraft Departures										
Commercial Jets	50,979	1,489	**52,468**	102	4	16	0	0	**122**	**52,590**
Regional Jets	3,782	88	**3,870**	20	4	11	0	0	**35**	**3,905**
Corporate Jets	9,244	40	**9,284**	865	81	370	4	0	**1,320**	**10,604**
Turboprops	1,086	38	**1,124**	5,646	292	222	5	0	**6,165**	**7,289**
Propeller	48	41	**89**	4,428	2,510	341	82	0	**7,361**	**7,450**
Military	5	0	**5**	12	0	1	0	0	**13**	**18**
Helicopters	0	0	**0**	40	9	7	0	935	**991**	**991**
Unknown	430	39	**469**	759	370	98	23	0	**1,250**	**1,719**
Total	**65,574**	**1,735**	**67,309**	**11,872**	**3,270**	**1,066**	**114**	**935**	**17,257**	**84,566**
Touch & Go Operations										
Total	36	5	**41**	2,759	186	58	5	0	**3,008**	**3,049**
Total Operations	**122,479**	**3,430**	**125,909**	**38,822**	**3,957**	**1,484**	**605**	**2,182**	**47,050**	**172,959**

Note: "Unknown" aircraft category implies ANOMS™ did not have aircraft type associated with the flight track
Source: Port of Oakland ANOMS™ January 1, 2015 through December 31, 2015

4.2.3 Flight track geometry and utilization

The RealContours approach uses every available flight track in the radar sample as a pre-processor to the Integrated Noise Model (INM). As discussed in Section 4.1.3, the OAK ANOMS database includes flight tracks with associated flight identification data for 172,959 operations from a total of 365 days modeled. RealContours converts each day of radar data into INM noise model inputs and generates a daily CNEL contour. The daily CNEL contours are then combined to produce the annual contours.

4.2.4 Annual-average weather conditions

Weather data were obtained from the National Oceanic and Atmospheric Administration; National Climatic Data Center for a 1-year period for OAK and these values were used in the INM for computing the annual noise exposure map.

4.3 Annual Noise Exposure Map

The INM was used to prepare the OAK 12-month CNEL noise exposure map shown in Figure 1 based on the aircraft noise level and airport operational factors described in the previous sections. RealContours developed INM input files for each day of radar data, 365 total modeled days. These input files were run through the INM and then the results are stored for use by the system.

The predicted 65 dB CNEL contour was plotted on an ArcView map of the area surrounding the airport, as shown by Figure 1. The CNEL contours prepared for current annual average operations at OAK describe the airport noise environment within the requirements of the California Airport Noise Regulations.

The contour map was used to determine the number of dwelling units included within the Noise Impact Boundary defined by the California Airport Noise Regulations. For this analysis, it was assumed that a parcel was affected if it included an incompatible land use, and if any portion of the parcel was included in the 65 dB CNEL contour. Land use was determined from the AutoCAD parcel map prepared by the Port of Oakland, which was imported into ArcView. Based upon these data and in congruence with the previous reports, no incompatible residences exist within the current Noise Impact Boundary.

5 Validation of Noise Exposure Map

The INM calculated the predicted 2015 data CNEL values at each of the current noise monitoring sites as described in the section above. Table 6 compares the measured CNEL values for the 12 months ending December 31, 2015 to the predicted CNEL values at each RMT location for calendar year 2015.

Since only one location is within proximity of the 65 dB CNEL contour (RMT 1), it is difficult to determine the validity of the noise impact boundary with only the RMTs measuring an annual CNEL of 65 dB. Therefore, we also reviewed results at RMT 2, 5, 6, 7, and 9 to assist with the assessment of the noise impact boundary as modeled using INM 7.0d. Regardless, RMT 1 provided a conservative validation of the maximum extent of the noise impact boundary to the east of the South Field as the modeled level exceeded the measured level by approximately 1 dB.

Table 6 Measured and Predicted Aircraft Annual CNEL Values

RMT No.	RMT Name	Measured CNEL (A)	Modeled[1] CNEL (B)	Difference (B-A)
1	Oro Loma San. Dist	63	64	1.2
2	San Leandro Marina	57	55	-1.8
3	Fernside	48	49	0.8
4	Godfrey Park	56	60	3.5
5	Garden Isle	60	60	-0.1
6	Wake Lane	60	60	0.1
7	Fire Station	59	61	1.8
8	Earhart School	52	53	1.1
9	Doolittle Drive	56	58	1.6
10	Tudor Court	51	50	-1.0
11	John Muir School	51	51	0.1
12	Garfield School	49	50	1.4
13	SLUSD Admin Office	39	45	5.5
14	Washington School	44	41	-2.8

Notes: 1 Modeled using INM 7.0d and RealContours™ 4Q2015 Model.
Source: Port of Oakland ANOMS™ January 1, 2015 through December 31, 2015

5.1 South Field Contour Validation

RMT 1 measured an annual CNEL that was 1.2 dB less than the modeled CNEL at that location. Therefore, the lobe extending to the east southeast (predominant south runway arrival lobe) is slightly larger than measured. RMT 2 measured an annual CNEL approximately 2 dB higher than the modeled CNEL and is beyond the 65 dB CNEL contour location with a measured level of 57 dB.

Since no RMT's exist within the 65 dB CNEL contour on the opposite side of the airport (the predominant departure end of the south runway), we used the 60 dB contour to compare to measured levels at RMT 5, 6 and 7 to validate the shape and size of the predominant departure lobe. As shown in Table 6, the measured noise levels were in close agreement or less (at Site 7) than the 2015 modeled noise levels at these RMT locations by as much as 1.8 dB. Since the modeling produces a noise impact

boundary that includes no noise sensitive properties, OAK opts to report the larger boundary as modeled. Therefore, the size and shape of the 65 dB CNEL is validated for South Field.

5.2 North Field Contour Validation

Due to the relatively small noise impact boundary associated with North Field operations, only RMT location 9 is used to validate the 65 dB contour for North Field. RMT 9 is to the east of North Field and has measured annual noise levels of around 56 dB. The modeled annual noise level is about 2 dB higher than the measured level at RMT 9. OAK opts to report the larger boundary as modeled. Therefore, the size and shape of the 65 dB CNEL is validated for North Field.

5.3 Single-Event Aircraft Noise Levels

ANOMS™ enables the airport to monitor the highest measured single-event noise levels for aircraft operations at all 14 permanent noise monitors. The highest measured single-event noise level for operations for the calendar quarter from October 1, 2015 through December 31, 2015 is presented below in Table 7. The loudest measured single-event noise level (121.1 dB SEL) was produced by an F18 Hornet military aircraft at RMT No. 6.

Table 7 Highest Takeoff Noise Levels by Aircraft Type

Aircraft Type	Total Operations[1]	Highest Measured SEL (dB)[1]	Correlated RMT No.
F18	40	121.1	6

Note: Information is based on 4th Quarter 2015 data.
Source: 1. Port of Oakland ANOMS™ October 1, 2015 through December 31, 2015.