Palos Verdes Noise Study

Prepared for:

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on Noise Abatement Flight Procedures

Prepared by:

Los Angeles World Airports
Noise Management Bureau

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Executive Summary

The Federal Aviation Administration's (FAA) Southern California Task Force on Noise Abatement Flight Procedures (Task Force) has been investigating existing and alternative aircraft operations over the Palos Verdes Peninsula since the Task Force's inception in early-1998. Community officials have requested that the Task Force also conduct a study of the aircraft noise over the Peninsula. In March, 1999, the Task Force requested that Los Angeles World Airports (LAWA) Noise Management Bureau (NMB) staff conduct the requested noise study and to include an analysis of the anticipated noise changes resulting from various alternatives that would relocate LAX-generated air traffic away from the Peninsula.

NMB staff investigated numerous potential sites on the Peninsula for noise monitoring suitability and ultimately selected nine sites in five political jurisdictions. Noise monitoring was conducted for roughly two hours at each site during April, 1999. At all sites, ambient and aircraft noise levels were monitored. Aircraft noise levels were generally found to be no louder than the loudest non-aircraft noise sources. Aircraft noise was found to result from many sources, including LAX turboprop departures, LAX jet departures, non-LAX fixed-wing aircraft, and helicopters. Often, the loudest aircraft events were not related to LAX departures.

The noise comparison methodology that NMB used in this analysis employed the FAA's Integrated Noise Model (INM), a computer program that enables the calculation and comparison of noise levels generated by different flight procedure alternatives. The consistency of the INM-calculated noise levels for different airplanes operating under different conditions is assured because the INM operates on fixed mathematical assumptions. Actual airplane operations were measured by type, location, and altitude and were then compared to the noise levels of airplanes operating under identical flight conditions in the INM. This was done to determine differences, if any, between the pre-determined and standard INM noise level predictions and the actual measured noise levels for a particular airplane type at a particular altitude over a particular location on the Peninsula. Differences were noted and compensated for in the noise evaluations.

NMB staff used INM to predict individual aircraft noise levels as well as average noise levels at all sites. The INM predicted single-event noise levels were the same as measured noise levels at some sites, and were below measured noise levels at other sites. All sites had current average noise levels less than 50 dB CNEL, far below the State of California's regulatory standard of significance (65 dB CNEL). The same finding holds even after correcting for the under-prediction at applicable sites. All measured and predicted noise levels in the study were well below regulatory noise levels (i.e., 65 LDN or CNEL). The study validates continued use of INM as a reasonable and reliable predictor of current and future noise levels in Task Force studies. This study has also demonstrated that long-term noise monitoring is not needed to supplement use of the INM.

Study Results:

On February 10, 1999, the FAA initiated a Demonstration Program to route turboprop departures offshore and around the Peninsula whenever safety permits. The subsequent INM noise analyses of that procedure, indicated that there has been little improvement as a result of this modification. Only one of eight noise monitoring sites was estimated to have a "measurable" (i.e., greater than 1.5 dB CNEL) benefit from this program, and half of the eight sites are experiencing increased noise as a result of the procedure.

FAA also developed four alternatives for routing turboprop and jet aircraft that would substantially reduce the aircraft overflights and noise over the Peninsula. Each of the four would route all San Diego and Carlsbad traffic offshore, and three of the four would also route all turboprops offshore. Jet routes are relocated as necessary. The following table indicates, for each alternative route, the average CNEL improvement, in decibels, relative to the existing conditions (effective February 10).

Alternative	Average CNEL Improvement
Conditions prior to February 10, 1999	-0.1
San Diego turboprops offshore	1.6
Turboprops one-mile offshore	5.5
Turboprops three-miles offshore	9.3
Turboprops five-miles offshore	11.1

Moving the LAX turboprop aircraft offshore would result in a significant noise benefit to all areas of the Peninsula, and greater benefits are realized for greater moves out to sea. The three-mile offshore alternative is recommended for further study as it is the most appropriate approach for reducing noise on the Palos Verdes peninsula.

Table of Contents

List of Tables

List of Figures

Introduction

At the request of the Federal Aviation Administration's (FAA) Southern California Task Force on Noise Abatement Flight Procedures (Task Force), Los Angeles World Airports (LAWA) Noise Management Bureau (NMB) conducted an investigation of airport noise impact on the Palos Verdes Peninsula (Peninsula).

The Peninsula is comprised of six political jurisdictions: the cities of Palos Verdes Estates, Rancho Palos Verdes, Rolling Hills, and Rolling Hills Estates, a portion of the City of Los Angeles (San Pedro), and limited areas of unincorporated Los Angeles County. The Peninsula regularly experiences aircraft noise from several sources, however the scope of this report is limited to impacts from Los Angeles International Airport (LAX). LAX impact on the Peninsula is primarily attributable to four different types of LAX departures. These are illustrated on the attached Figure 1, and are described below:

- Turboprop aircraft that depart to the west, turn south and then east, over-flying the Peninsula enroute to the FAA's Seal Beach navigational aid (SLI);
- Turboprop aircraft that depart to the west, turn south and then southeast, skirting the edge of the Peninsula enroute to FAA's San Diego navigational aid (SAN) or Carlsbad navigational aid (CRQ);
- Jet aircraft that depart LAX to the west, turn south and pass the Peninsula five miles offshore to the west, then turn east and pass the Peninsula three miles offshore to the south; and
- Jet aircraft that depart LAX to the west, turn south and pass the Peninsula five miles offshore to the west, then turn northeast and overfly the Peninsula at altitudes greater than 13000 feet enroute to SLI.

The primary purposes of this report are to provide information regarding the existing aircraft noise impacts on the Peninsula, and to quantify the anticipated noise benefits of three alternative air traffic patterns, each designed to reduce turboprop flights over the Peninsula. By comparing the resultant noise levels associated with each flight procedure alternative, the Task Force is in a position to select a reasonable course of mitigation, as warranted. A second purpose of the study was to compare the use of field noise monitoring and computer noise modeling techniques in order to validate the use of the FAA's Integrated Noise Model (INM) as the appropriate analytical tool to calculate and predict aircraft noise. The field noise measurement efforts also reveal whether or not the noise impact of LAX operations on the Peninsula is enough to be considered significant based on current regulations (i.e., 65 CNEL or greater).

Methodology

Resources

Tools

A Brüel & Kjær Type 2236 Precision Integrating Sound Level Meter (SLM, serial number 1914118) was used to conduct all noise monitoring surveys for this study. This SLM fulfills the relevant standards for sound level meters (IEC 651-1979 Type 1, IEC 804-1985 Type 1, ANSI S1.4-1983 Type S 1, and ANSI S.143-199X Type 1 – Draft 9/92). Brüel & Kjær is certified under ISO 9001 and was so certified at the time this equipment was manufactured. The Manufacturer's ISO 9001 Certificate of Conformance is on file at LAWA.

The SLM was regularly calibrated using a Brüel & Kjær Type 4231 Acoustical Calibrator (serial number 1897626). The Calibrator fulfills the relevant IEC 942-1988 Class 1 and ANSI S1.40-1984 standards.

SLM data was transferred to a personal computer and was analyzed using Brüel & Kjær Type 7694 Reporter software, version 1.21. Additional analysis and calculations were performed in Microsoft Excel 97.

Geographic data for noise monitoring locations was collected using a Garmin GPSII Plus (serial number 40610971) Geographic Positioning System (GPS) unit.

Flight operations data originated in the FAA's Automated Radar Terminal System (ARTS) radar at the Southern California Tracon in San Diego, California. The data was obtained using Dimension International, Inc.'s ARTS Collection and Editing System (ACES). This computer hardware/software package directly connects to FAA's ARTS Gateway radar computers and collects pertinent aircraft flight information, and transmits that data to a personal computer in LAWA's offices at LAX. Using standard LAWA procedures, this data was automatically loaded into LAWA's Noise and Operations Monitoring and Analysis Display (NOMAD) software version 4.5, which permits review and summarization of in-flight aircraft operations. The NOMAD core software was originally developed by The Flood Group for LAWA; NOMAD is now maintained exclusively by and for LAWA staff.

LAWA staff used the FAA's Integrated Noise Model (INM) software, version 5.2a, to do all noise modeling associated with this study. The most recent version of the software was developed for FAA by ATAC, Inc., and is the premier tool for predicting aircraft noise. The model allows prediction of noise levels at discrete points, and prediction of noise contours across a wide area.

Regional topographic data was used to more accurately represent noise impacts on the Peninsula. Commercially-available digitized United States Geologic Survey topographic data was obtained on CD-ROM from Micropath Corporation for development of noise contours.

Personnel

Two LAWA staff members were jointly responsible for the noise measurement and analysis work contributing to this study.

Mark Adams is a graduate of the California Institute of Technology, with a degree in Engineering and Applied Sciences (Environmental Engineering emphasis). He has been continuously involved in environmental monitoring and computer modeling since 1984. He has been exclusively involved in airport noise issues at LAWA since 1992, with supervisory responsibility over all noise management programs, including noise monitoring and modeling efforts for all LAWA airports. Prior to 1992, he had extensive professional and academic experience in air quality monitoring, air dispersion modeling, and urban airshed modeling. He completed noise monitoring training from Brüel & Kjær in October, 1992 ("Principles of Acoustics and Measurement of Sound"), and has been using the INM to assess noise and aircraft operations impacts around LAWA airports for nearly seven years. He was jointly responsible for the introduction of the ACES and NOMAD systems at LAWA in 1994, and has been primarily responsible for the use and operation of these systems at LAWA since that time.

Scott Tatro is a graduate of U. C. L. A., with a degree in Geography. He has been exclusively involved in airport noise issues at LAWA since 1994, where his duties have included serving as a project manager for noise monitoring and modeling efforts for all LAWA airports. Prior to 1994, he had professional experience in air quality and noise modeling, and the preparation of environmental reports and documentation. He completed noise monitoring training from Brüel & Kjær in 1994 and completed INM training from Harris, Miller, Miller, and Hanson in 1996. He has been involved in noise monitoring and the use of INM, ACES, and NOMAD since 1994.

Noise Monitoring

The noise monitoring conducted during the study involved the collection of representative ground-level noise samples for in-flight commercial aircraft at nine locations on the Palos Verdes Peninsula. Aircraft over the Peninsula normally fly at a variety of altitudes and on a variety of trajectories. No special air traffic procedures were instituted during the monitoring period to specifically influence the location or altitude of aircraft. The measured aircraft, therefore, represented a reasonable variety of aircraft types, altitudes, and trajectories. Collected samples were used to determine the validity of INM as a predictor of single-event noise levels.

Site Selection

Site surveys were conducted on March 24 and March 31, 1999 to evaluate potential sites for noise monitoring. In response to an FAA inquiry, several site suggestions were provided by community officials, and these were forwarded to LAWA on March 30. LAWA staff selected the sites based on several preferences: low ambient noise level, topographical diversity, geographical diversity, jurisdictional diversity, variety of probable aircraft impact (aircraft types, routes, and altitudes), good aircraft visibility, proximity to community-suggested locations, and public or institutional property. The following sites were ultimately chosen. Attached Figure 2 is a map showing the location of these monitoring locations.

1. North end of Paseo del Mar in Palos Verdes Estates
2. Property adjacent to Rancho Palos Verdes City Hall
3. Fire Station #56 in Rolling Hills
4. Vista Grande Elementary School in Rancho Palos Verdes
5. South Shores Elementary School in San Pedro
6. Highridge Park in Rolling Hills Estates
7. Marymount Palos Verdes College campus in Rancho Palos Verdes
8. Vicinity of Via Gabriel and Via Sonoma in Palos Verdes Estates
9. Springcreek Road, between Mossbank and Flambeau Roads in R. P. V.

Monitoring Procedures

During the initial site evaluations, sample noise readings were taken to determine the manner in which noise monitoring may be feasibly conducted. Due to the fact that non-aircraft events (e.g., automobile or truck noise) were often louder than aircraft, it was determined that aircraft noise was not consistently high enough (above ambient) to allow for unattended noise monitoring. Furthermore, LAWA's NOMAD system doesn't process data for Visual Flight Rules aircraft (small propeller aircraft and helicopters not related to LAX), meaning that many non-LAX aircraft noise events would be overlooked if unattended noise monitoring were used. Unattended noise monitoring would produce a collection of noise events that would not necessarily be attributable to LAX or other aircraft noise sources. Thus, in order to accurately differentiate aircraft noise from non-aircraft noise, a member of the study team was on-site to identify and log noise event sources while the SLM recorded noise levels.

Prior to monitoring, Palos Verdes flight data was analyzed to determine periods of heavy traffic. The purpose of this was to determine those two-hour blocks during the day when flights were more likely on particular routes. Each site was measured at a time period it was expected to experience comparatively heavy air traffic, based on each site's proximity to the current air traffic patterns. Special efforts were made to measure certain sites during the evening and early morning hours when those periods corresponded to the hours of heavy traffic.

At each site, exact site location was recorded using the GPS unit, and GPS time was noted as the "official" time. The SLM was calibrated prior to commencing measurement. Date and time stored in the SLM was checked, and corrected if necessary. At each site, any stored data from previous measurements were cleared from the SLM's memory before starting the measurements. The SLM was configured to log one-second Leq values, essentially the average sound pressure level for each second. The SLM was mounted on a Velbon video tripod, with a microphone height of between five and six feet to provide consistent measurements. Several minutes of observations and measurement were used to determine and note the ambient noise level (without aircraft noise), weather conditions, and visibility prior to starting the SLM. During this period (and during equipment tear-down after monitoring), one or more aircraft may have been observed and noted, but accurate noise levels were not recorded.

SLM data logging was run for a period of approximately two hours at each location. As indicated above, the time of measurement was selected to coincide with anticipated air traffic movement. While the SLM recorded 1-second-average noise values, the observer recorded all significant events on log sheets. All audible aircraft events were noted on the log sheets. To the extent possible, the observer noted aircraft type, airline, and any other pertinent information. The observer also noted potential sources of non-aircraft noise (especially those causing noise sample contamination), pauses in data collection (e.g., battery changes), and, to the extent possible, observed but inaudible aircraft.

Upon completion of the data collection, the observer returned to the LAWA office and transferred the data to a personal computer using the Reporter software. The observer compared the site log to the SLM-recorded noise logs to determine the Lmax (peak sound level) and SEL (cumulative sound level) for all observed noise events, aircraft or non-aircraft. In accordance with normal procedures, LAWA received FAA's ARTS flight operations data, consisting of flight tracks and identification information, for the monitoring period after a mandated three-day delay, and this data was loaded into the NOMAD system. The observer used the NOMAD system to compare the site logs to the flight operations data to determine aircraft identification, altitude, and track for each aircraft noise event. The result was a site log indicating the time, source, and level of all noise events, together with aircraft identification, altitude, and route for aircraft noise events.

Monitoring Schedule

The nine sites were monitored in the described manner as shown in Table 1.

Table 1 – Noise Monitoring Schedule

Site Description	Site Designator	Date & Time of Monitoring
North End of Paseo del Mar	PDM	4/12/99 16:48 – 22:02
Rancho Palos Verdes City Hall	RPV	4/13/99 20:00 – 22:00
Fire Station #56	RHF	4/14/99 8:25 – 10:03
Vista Grande Elementary	VGE	4/14/99 16:15 – 18:11
South Shores Elementary	SSE	4/14/99 20:18 – 22:39
Highridge Park	HRP	4/15/99 12:17 – 15:00
Marymount College	MMC	4/19/99 20:36 – 22:20 4/20/99 5:55 – 8:04
Via Gabriel	VGB	4/20/99 18:44 – 20:18
Springcreek Road	SCR	4/20/99 20:30 – 21:30

Noise Modeling

INM is a tool for predicting noise levels based on input aircraft operations data. INM excels at predicting cumulative or average noise levels, but can also be used to predict the single-event noise level from an individual aircraft. The user of the model must define aircraft tracks over the ground, number of operations by aircraft type, and other information that effect noise exposure on the ground. Topography is an optional input to the model that LAWA enabled in this study. The noise levels produced by certain types of aircraft have been programmed into the model, as are standard operations procedures (e.g., thrust levels and climb rates). The user has the option to alter these noise levels and procedures, but, for consistency between studies, it is NMB policy to avoid altering these FAA assumptions if at all possible.

One methodological task of this study was to determine the comparative accuracy, and thus the validity, of using INM to predict the actual and maximum noise levels for individual aircraft at the monitoring sites described above. INM predicts that a specific type of aircraft under uniform conditions will always be at the same altitude and will always make the same noise at a location on the ground. This is, of course, a simplification of reality. INM predicts a “typical” single-event noise level made by each type of airplane at a specific altitude. Actual measured noise levels may be higher or lower than the predicted noise level, with the predicted noise level being the average of the measured noise values. The validity of using the INM to estimate maximum airplane noise levels is determined by the overall proximity of the predicted noise levels to the field-measured noise levels taken by observers using SLMs.

Another necessary methodological task of this study was to use INM to determine the cumulative or average aircraft noise on the Peninsula. That noise value was compared to regulatory standards, and was used to compare the relative noise benefit of several aircraft routing alternatives. By design, the INM is a consistent and reliable tool to use in comparing the noise impact of alternative flight procedures.

In general, the objective of this study was to analyze the comparative noise environment under different aircraft track alternatives. As a result, numbers of operations, aircraft types, and altitudes are generally held constant in this study, while the aircraft tracks are changed between different alternatives. In this manner, we were able to effectively compare the impact of, for example, moving all turboprops one-mile offshore.

Existing Air Traffic Conditions

Aircraft Track Considerations

The existing condition was modeled in such a way as to accurately depict current operations. In reality, actual operations involve as many tracks as operations, with one aircraft on each track. Accurate noise modeling, though, can be accomplished by aggregating hundreds of individual aircraft movements onto a handful of defined tracks, with multiple operations per track. This involved the establishment of a limited number of INM tracks, dispersed across the Peninsula in such a way as to represent the actual dispersal of aircraft.

Two INM cases were developed to analyze the present condition. One of these used aircraft tracks based on the existing conditions–in place since February 10, 1999. The other used aircraft tracks based on conditions prior to February 10, when most turboprops were flying over the Peninsula. In both cases actual aircraft flight tracks for all aircraft types were analyzed using LAWA's NOMAD system and representative track vectors were constructed in INM.

San Diego-bound turboprops were approximated using three subtracks (PVMP1-3). Attached Figure 3 illustrates the tracks used to model noise for the existing conditions and Figure 4 illustrates the tracks used to model noise prior to February 10. Based on an analysis of aircraft tracks, 40% of San Diego-bound turboprops were allocated to track PVMP1, 35% to PVMP2, and 25% to PVMP3.

Seal Beach-bound turboprops were approximated using six subtracks (PVLP1-6, see Figure 5). Based on an analysis of aircraft tracks, 30% of Seal Beach-bound turboprops were allocated to track PVLP1, 20% to PVLP2, 20% to PVLP3, 10% to PVLP4, 15% to PVLP5, and 5% to PVLP6.

Jets were approximated using four tracks, one track that stayed an appropriate distance offshore (PVJ) and three subtracks that turn northeast toward Seal Beach, which are primarily used at night when use of the LAX Loop departure procedure is not permitted (see PVJD1-3, see Figure 6). Based on an analysis of aircraft tracks, 40% of Daggett-bound jets were allocated to track PVJD1, 30% to PVJD2, and 30% to PVJD3. An LAX Loop Departure track with 144 daily aircraft operations was added to an INM test case to determine the additive effect of these operations on the Peninsula.

Altitude Considerations

INM includes a default departure procedure for each model of aircraft that specifies the thrust, flap settings, and climb rate for the aircraft. These recreate a full-power climb for each aircraft type studied. When applied, these default procedures predict that all aircraft of a particular model share an identical profile, and are all at the same altitude over a particular point on the ground. Based on personal observations and a review of the radar data, aircraft are at many different elevations when flying over the Peninsula.

To compensate for this, two additional departure procedures were created for each turboprop aircraft type. One procedure portrays a climb at somewhat reduced power settings that would result in the aircraft climbing over the Peninsula at a lower altitude. The other procedure portrays a climb to 5000 feet followed by level flight, which is used frequently for aircraft bound for Seal Beach. Thus, for each model of turboprop over the peninsula, three departure profiles were modeled: full-power climb, reduced-power climb, and level-at-5000 feet.

Aircraft Type Considerations

The INM aircraft database contains over 100 aircraft types, but contains a relatively limited number of turboprop aircraft. Nevertheless, we were able to reliably match jet aircraft operations to the appropriate INM type. For example, radar data indicates a type "B733" for a Boeing 737-300, which is included in INM as type 737300. Other substitutions are specified in FAA documentation for INM (e.g., Airbus 340 becomes INM type DC870) The matching table used for jet aircraft operations is shown below in Table 2.

Table 2 – Radar to INM Aircraft Type Look-up Table

FAA Radar Type	INM Type
A306	A310
A310	A310
A319	A320
A320	A320
A330	A310
A340	DC870
B721	727Q7
B722	727D17
B72Q	727EM2
B731	737QN
B732	737D17
B733	737300
B734	737400
B735	737500
B737	737400
B738	737400
B742	74720B
B743	74720B
B744	747400
B74S	74720B
B757	757PW
B767	767CF6
B777	777200
BA46	BAE146
C550	MU3001
C650	CIT3
C750	CL600
CL60	CL600
CL64	CL600
DC10	DC1030
DC87	DC870
DC9	DC9Q9
F900	FAL20
FA20	FAL20
GLF2	GIIB

GLF3	GIIB
GLF4	GIV
H25B	LEAR25
H25C	LEAR35
L101	L1011
L29A	LEAR25
LJ25	LEAR25
LJ35	LEAR35
LR60	LEAR35
MD11	MD11PW
MD80	MD83
SBR1	LEAR25

As indicated above, INM contains relatively few turboprop aircraft, and the "best" match must be substituted for the actual aircraft. There are three types of turboprop aircraft in regular use out of LAX that were modeled in this study. The Saab-Fairchild 340 flown by American Eagle is directly included in the INM database (type SF340). The Embraer 120 flown by Skywest is not included in the INM database, but the INM documentation instructs the user to substitute the DeHavilland Dash 8 (type DHC8) as an equivalent. The Jetstream 32 flown by Trans States is also not included in the model and the FAA documentation offers no guidance on its equivalent type. Based on weight and civilian use, two candidate types are the DeHavilland Dash 6 (type DHC6) and the Cessna Conquest (CNA441). We ultimately chose to use the CNA441 type for this study, based on the similarity of engine model of the Jetstream 32 and a better correlation to measured Palos Verdes noise levels. The CNA441 was also used for the limited operations conducted by other operators.

Aircraft Operations Assumptions

Predictions of cumulative and average noise levels are heavily dependent on the number of aircraft in the noise model. Aircraft operations over and near Palos Verdes are reasonably consistent. Dozens of days of operations since February 10 were reviewed, and two consecutive days were selected that seemed to offer a typical volume and location of aircraft overflights (March 2-3, 1999). Operational statistics for these two days were averaged to create an "average" day as an input to INM.

The following tables show the number of average daily flights along each major route, by time of day:

Table 3 – San Diego-bound turboprop operations (most not over Palos Verdes Peninsula)

INM Type	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total
DHC8	33	8	3.5	44.5
SF340	16	2.5	3	21.5
CNA441	10	2	2	14.0
Total	59.0	12.5	8.5	80.0

Table 4 – Seal Beach-bound turboprops (all over Palos Verdes Peninsula)

INM Type	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total
DHC8	32	9.5	5.5	47.0
SF340	6	1	1	8.0
CNA441	2.5	1	2.5	6.0
Total	40.5	11.5	9.0	61.0

Table 5 – Jets around Palos Verdes Peninsula (not including Seal Beach-bound jets)

INM Type	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total
727D17	7.5	2.5	3	13
727EM2	2.5	0	0.5	3
727Q7	0.5	1	0	1.5
737300	38	5.5	2	45.5
737400	9	1.5	1.5	12
737500	6	3	0.5	9.5
737D17	4	0	0	4
737QN	1	1	0.5	2.5
74720B	3	0.5	0.5	4
747400	3	0.5	0	3.5
757PW	29	3	18.5	50.5
767CF6	14.5	0.5	8.5	23.5
777200	2	0	0	2
A310	1.5	1	0.5	3
A320	25	2	10	37
BAE146	0	0	0	0
CIT3	0	0	0.5	0.5
CL600	1.5	0	0	1.5
DC1030	3.5	1.5	1	6
DC870	0.5	3	0.5	4
DC9Q9	8.5	0.5	0	9
FAL20	1.5	0	0	1.5
GIIB	0.5	0	0.5	1
GIV	1	0	0.5	1.5

L1011	5	0	0	5
LEAR25	0.5	2	0.5	3
LEAR35	2	0	0.5	2.5
MD11PW	1.5	1	0	2.5
MD83	27	2.5	5.5	35
MU3001	0.5	0	0	0.5
Total	200	32.5	55.5	288

Table 6 - Seal Beach-bound jets (most over Palos Verdes Peninsula, crossing shoreline at or above 13,000 feet)

INM Type	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total
727D17	0	0	0	0
727EM2	0	0	0.5	0.5
727Q7	0	0	0	0
737300	0.5	1	3.5	5
737400	0	0.5	1	1.5
737500	0	0	1	1
737D17	0	0.5	0.5	1
737QN	0	0	0	0
74720B	0	0	0.5	0.5
747400	0	0	1	1
757PW	0	0	6	6
767CF6	0.5	0	1.5	2
777200	0	0	0	0
A310	0	0	1	1
A320	0.5	0.5	3.5	4.5
BAE146	1	0	0	1
CIT3	0	0	0	0
CL600	0	0	0	0
DC1030	0	0.5	1.5	2
DC870	0	0.5	0.5	1
DC9Q9	0	0	1	1
FAL20	0	0	0	0
GIIB	0.5	0	0	0.5
GIV	0	0	0	0
L1011	0	0.5	2	2.5
LEAR25	0	0	0	0
LEAR35	0	0	0.5	0.5
MD11PW	0.5	0	0	0.5
MD83	0	0	3	3
MU3001	0	0	0	0
Total	3.5	4	28.5	36

Alternative Air Traffic Conditions

Hypothetical conditions were modeled using four tracks within each alternative: (1) turboprops bound for Seal Beach, (2) turboprops bound for San Diego, (3) offshore jets around the Peninsula, and (4) jets that turn toward Seal Beach and Daggett. The tracks were constructed using navigational points or "fixes" provided by FAA on April 20, 1999. Single tracks representing the centerline of expected aircraft tracks were used in these INM cases. It is unnecessary to disperse subtracks over the ocean, as we did with existing-condition turbprops over the Peninsula. If implemented, some aircraft will be closer to, and some will be farther from, the shoreline. The long-term noise statistics, though, will balance out, provided that the aircraft are equally distributed around the new track's centerline over the ocean. Each alternative used a distinct set of tracks. Other operational statistics (numbers of operations, altitude, etc.) were held constant. Four INM cases were modeled using these hypothetical alternatives, which are described below.

San Diego / Carlsbad Offshore Case

This INM case used FAA-proposed fixes to describe the routes for jets and for turboprops bound for San Diego, and used existing condition tracks for turboprops bound for Seal Beach. This case is similar to the existing condition, and primarily differs by routing all San Diego- and Carlsbad-bound turboprops are off-shore. Figure 7 shows the flight tracks utilized in this case.

1-Mile, 3-Mile, and 5-Mile Offshore Cases

These three INM cases used FAA-proposed fixes to describe potential future alternatives where all LAX turboprop departures are routed offshore. By comparing noise levels between these cases and present-day conditions, the relative noise benefit of moving the aircraft offshore was estimated. Figures 8, 9, and 10 show the flight tracks utilized in the 1-mile, 3-mile, and 5-mile cases, respectively.

Results

Noise Monitoring

Noise monitoring was conducted at nine sites for the purpose of validating the INM's ability to predict single-event noise levels and to get a general sense of the ambient noise and aircraft noise levels at each site. This section summarizes the results and findings on a site-by-site basis. The results are presented chronologically, in the order that the sites were monitored.

All noise levels are monitored in decibels using the standard A-weighting scale – indicated by the abbreviation dBA – which is designed to approximate human hearing response. The peak noise level for each noise event (Lmax) is expressed in terms of the highest one-second average sound level, and represents the maximum measured sound pressure level for the event. In comparing noise model estimates to actual values, though, the cumulative noise energy for the entire overflight is used (SEL, or Sound Exposure Level). SEL accounts both for the magnitude and duration of an aircraft noise event. SEL values predicted by the model are compared to SEL values calculated from SLM monitoring records. Each SEL value represents the total noise energy for a multi-second event, normalized to a duration of one second. Event SEL is calculated from the individual sound pressure levels measured during an aircraft overflight using the following equation, where N is the number of seconds during the noise event and L_i is the measured one-second sound pressure level during the noise event in dBA.

$$EventSEL = 10 * \log(\sum_{i=1}^{N} \log^{-1} \frac{L_i}{10})$$

Cumulative noise levels are calculated from single event levels by adding the SEL values for individual aircraft events, thus calculating a total Sound Exposure Level, using the following equation for N noise events. As with Event SEL, the Total SEL is based on the total noise energy for the day, normalized to a duration of one second. In this equation, N is the number of noise events, and SEL_i is the Event SEL for each noise event.

$$TotalSEL = 10 * \log(\sum_{i=1}^{N} \log^{-1} \frac{SEL_i}{10})$$

Daily equivalent sound levels (DLeq) are used to represent the average sound level, and are calculated from total sound level using the following equation, where 86,400 is the number of seconds in a day.

$$DLeq = 10 * \log\{\frac{1}{86{,}400}(\sum_{i=1}^{n} \log^{-1} \frac{SEL_i}{10})\}$$

In accordance with standards established by the State of California, daily average noise level is to be estimated using the Community Noise Equivalent Level or CNEL. The CNEL is essentially the same as the Leq, except that each noise event during the evening hours (7:00 p.m. to 10 p.m., local) is penalized three-fold, and each noise event during the night hours (10 p.m. to 7 a.m., local) is penalized ten-fold. These penalty factors have been established to account for the fact that noise during the evening and night hours is generally more impactful. The State has established that a value of 65 CNEL is considered significant, and the following equation is used to calculate CNEL. In this equation, SEL_i is the Event SEL for each noise event, and *Nd*, *Ne*, and *Nn* represents the number of daytime, evening, and nighttime noise events respectively.

$$CNEL = 10 * \log\{\frac{1}{86,400}[(\sum_{i=1}^{Nd}\log^{-1}\frac{SEL_i}{10}) + 3*(\sum_{i=1}^{Ne}\log^{-1}\frac{SEL_i}{10}) + 10*(\sum_{i=1}^{Nn}\log^{-1}\frac{SEL_i}{10})]\}$$

Paseo del Mar (PDM)

The PDM site was characterized by a fairly high ambient noise level due to automobile and truck traffic, but provided excellent opportunities to observe in-flight aircraft from LAX and other origins. This site is near the northwest corner of the Peninsula, directly under the climbing turboprop aircraft at their lowest altitude. As a result, the measured noise from turboprop departures at this location should be as loud as any location near the coast, and perhaps louder than many inland locations further along the flight path. This location is located at the top of a coastal cliff, approximately 200 feet above the shoreline, which reduces background surf noise. This location is located within several hundred feet of a hillside, further inland, which may serve to increase local noise levels somewhat by reflection. Due to this combination of factors, this site is exposed to LAX aircraft noise levels as loud as any position along the coast.

The ambient noise level was typically between 50 and 58 dBA, with occasional peaks over 60 dBA. Most aircraft noise events typically peaked at less than 60 dBA. The average noise level throughout the monitoring period, from all sources, was 55.4 dBA. As a result, aircraft noise at this location is largely indistinguishable from non-aircraft noise; thus, unattended monitoring at this location would not produce reliable results.

The loudest non-aircraft noise event detected peaked at 67.9 dBA, made by a loud truck on Palos Verdes Drive West. The loudest aircraft noise event detected was 68 dBA, attributable to a north-bound helicopter along the coast, not related to LAX. The loudest fixed-wing aircraft was 63.6 dBA, made by a general aviation aircraft N7244B, a BE35 at 4900 feet altitude flying southbound along the coast, also not related to LAX. The loudest LAX-related aircraft at the site was 62.7 dBA, attributable to a Jetstream 32 at 4900 feet altitude, traveling along subtrack PVMP1.

Several different types of aircraft noise events were audible at PDM. As mentioned above, the loudest events detected were not related to LAX aircraft. The loudest LAX-related events were turboprop departures directly overhead. However, certain jet Loop departures were also audible, particularly those that were farther to the south. The loudest Loop departure peaked at 61.3 dBA, attributable to a Boeing 777 that crossed the shoreline over Hermosa Beach.

At PDM, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 7 – Maximum INM-predicted turboprop Event SEL values at PDM

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441	65.2	65.1	64.5	65.1	62.2	63.4	62.8	63.2	65.1
DHC8	65.3	65.5	64.3	65.1	61.0	63.8	61.3	61.7	63.1
SF340	68.4	68.4	67.3	68.1	64.5	66.6	64.9	64.9	67.6

Measured SEL values for Jetstream 32 aircraft (modeled as CNA441) were 74.8 on PVMP1 and 69.4 on PVLP6. Measured SEL values for Embraer 120 aircraft (modeled as DHC8) ranged from 68.6 to 72.7 on PVMP1, 71.7 to 72.0 on PVLP2, and 66.7 on PVLP3. Measured values for Saab 340 aircraft (modeled as SF340) ranged from 66.8 to 72.8 on PVMP1. Thus, the measured noise values were 2 to 12 dB louder than the modeled values at this site. This discrepancy may be due to additive effects of ambient noise and may also have been exacerbated by the reflection conditions described above.

The INM predicts average noise levels of 37.7 dB DLeq and 42.0 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are under-predicted by 2 to 12 dB, the average noise levels are estimated to be similarly under-predicted. Using a typical under-prediction value of 6 dB for single-event noise levels at this site, the adjusted estimate of DLeq is 43.3, and the adjusted estimate of CNEL is 48.0. Using a worst-case under-prediction value of 12 dB for single-event noise levels at this site, the adjusted estimate of DLeq is 49.9, and the adjusted estimate of CNEL is 54.0. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Rancho Palos Verdes City Hall (RPV)

The RPV site was characterized by a fairly low ambient noise level that would, for the most part, allow clear differentiation with aircraft noise events. Occasional intrusive noise was caused by louder-than-normal automobile traffic. This site provided good visibility for in-flight traffic from LAX and other sources. This site is on the southwest corner of the Peninsula at a relatively low elevation. Only those turboprop aircraft on the northern-most SLI departures were not visible from this location, and the San Diego departures were most easily viewed. Visibility declined at the site during the monitoring period due to increasing cloud cover.

The ambient noise level ranged from 38 to 45 dBA due to a fairly steady traffic flow on Palos Verdes Drive and to a lesser extent on Hawthorne Blvd., with occasional ambient levels reaching 50 dBA due to louder automobiles and motorcycles. The average noise level throughout the monitoring period, from all sources, was 45.8 dBA. The loudest non-aircraft noise event was 51 dBA caused by a motorcycle on Palos Verdes Drive. Aircraft noise events from LAX-based operations peaked at 55 dBA or less, while the loudest aircraft event was caused by a helicopter approximately one-half mile east of the site that reached 69dBA. The loudest fixed-wing aircraft noise event at the site was an LAX-based Saab 340 directly overhead that reached 55 dBA.

The majority of aircraft observed were LAX-based turboprops following the SAN departure routing either offshore or at the shoreline, with occasional SAN departures further inland or SLI departures to the north of the site. An occasional LAX jet departure on the SLI routing was audible, however most were below the ambient noise level. LAX Loop departures were visible but not audible from this location.

At RPV, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 8 – Maximum INM-predicted turboprop Event SEL values at RPV

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441		58.6		62.1		63.9	63.6	64.0	61.9
DHC8		59.2		62.9		65.0	64.5	64.9	62.5
SF340	59.4	60.7	59.4	65.1	59.4	67.3	66.7	67.4	64.7

Measured SEL values for Jetstream 32 were 65.0 on PVMP2. Measured SEL values for Embraer 120 aircraft ranged from 60.7 to 65.8 on PVMP1, were 66.3 on PVMP2, and 66.1 on PVLP4, and ranged from 60.2 to 62.0 on PVLP6. Measured values for Saab 340 aircraft were 66.9 to 67.1 on PVMP1, and 67.3 on PVMP2. Thus, the measured values ranged from 3.8 dBA quieter to 5.9 dBA louder than the predicted values. The average SEL for all of the measured aircraft noise events was 0.06 more than the predicted SELs.

The INM predicts average noise levels of 38.2 dB DLeq and 43.1 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are accurate, the DLeq and CNEL values are also considered accurate. Using the maximum under-prediction value of 5.9 dBA in predicting single-event noise levels at this site, the worst-case estimate of CNEL is 49.0. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Fire Station #56 (RHF)

The RHF site was characterized by a low ambient noise level, punctuated by intermittent higher level events due to truck traffic on Crest Road, gardeners, and other community activities. This site is near the center of the Peninsula, directly under some turboprop aircraft. This site is located at one of the highest points of the Peninsula, on the edge of a canyon, at over 1100 feet above sea level. Thus, there is good aircraft visibility, and aircraft noise may be locally increased by reflection from the adjacent canyon.

The ambient noise level was typically between 40 and 50 dBA, with peaks exceeding 55 dBA. The average noise level throughout the monitoring period, from all sources, was 49.4 dBA. Almost all aircraft noise events peaked at less than 55 dBA. A significant number of aircraft noise readings were contaminated by non-aircraft sources (trucks, birds, leaf blowers, etc.) estimated to be as loud as or louder than the aircraft. As a result, aircraft noise at this location is largely indistinguishable from non-aircraft noise; thus, unattended monitoring at this location would not produce reliable results.

The loudest non-aircraft noise event detected peaked at 62.4 dBA, made by a loud truck passing on Crest Drive. The loudest aircraft noise event detected was 67 dBA, attributable to a passing south-bound helicopter, not related to LAX. The loudest fixed-wing aircraft peaked at 55.9 dBA, attributable to an Embraer 120 at 7200 feet altitude, traveling along subtrack PVLP4.

Several different types of aircraft noise events were audible at RHF. As mentioned above, the loudest event detected was not related to LAX aircraft. The loudest LAX-related events were turboprop departures directly overhead. In addition, Visual Flight Rules aircraft traffic not related to LAX was frequently audible at this site, and several departures from Torrance Airport were noticed and measured at noise levels up to 52.3 dBA, attributable to a Cessna 172. With respect to jet aircraft noise, one unseen LAX jet aircraft was heard distinctly and peaked at 51.3 dBA; upon investigation it was found to be a Boeing 747-200 on a Loop departure that flew an exceptionally wide turn. Additional jet aircraft noise was faintly heard at ambient and sub-ambient levels, including at least one north-bound Boeing 737 aircraft from John Wayne Airport at relatively high altitude (peak sound level 51.4 dBA).

At RHF, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 9 – Maximum INM-predicted turboprop Event SEL values at RHF

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441	61.2	65.3	57.2	61.4	53.7	57.2	54.2	56.0	61.5
DHC8	61.8	65.4	58.5	62.6	55.4	59.3	56.4	57.9	62.2
SF340	64.2	67.6	60.0	64.0	54.8	59.2	55.4	57.8	64.3

The measured SEL value for a Jetstream 32 aircraft was 65.0 on PVLP2. Measured SEL values for Embraer 120 aircraft ranged from 59.8 to 60.7 on PVMP1, 65.2 on PVLP1, and 63.1 on PVLP4. Measured values for Saab 340 aircraft ranged from 60.9 on PVMP1, 64.1 on PVMP2, and 64.9 on PVLP2. Thus, the measured noise values were 0 to 6 dB louder than the modeled values at this site. This discrepancy may be due to additive effects of ambient noise and may also be exacerbated by the reflection conditions described above.

The INM predicts average noise levels of 35.3 dB DLeq and 40.7 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are under-predicted by 0 to 6 dB, the average noise levels are estimated to be similarly under-predicted. Using a typical under-prediction value of 3 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 43.7. Using a worst-case under-prediction value of 6 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 46.7. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Vista Grande Elementary School (VGE)

A variable ambient noise level characterized the VGE site. At times the ambient level was higher than the aircraft noise events. At other times, or during particularly close aircraft overflights, the related noise events were easily distinguishable from the ambient values. Ambient variability was due, in part, to bird activity for extended periods of time and to automobile traffic. Visibility at this location was limited due to cloud cover, and was further reduced due to a thick fog engulfing the entire area. This site is situated on the west-facing slope of the Peninsula at approximately 700 feet altitude, and directly under climbing aircraft flying over the Peninsula. Aircraft passing along the shoreline or offshore would, without fog, have been easily visible, and were clearly audible. At this location, aircraft noise may be locally increased by reflection from the adjacent hillside.

Initially, the ambient noise level ranged from 40 to 45 dBA. The ambient noise level increased dramatically to up 50 dBA due to constant bird noise, and then again decreased to below 40 dBA. The average noise level throughout the monitoring period, from all sources, was 45.7 dBA. The loudest non-aircraft event noise event detected was 58.2 dBA, made by a barking dog at a residence adjacent to the school property. The loudest aircraft noise event peaked at 57.9 dBA, and was caused by a LAX-based Saab 340 aircraft flying along PVMP2.

The majority of aircraft events that occurred were LAX turboprop departures on the SAN route offshore or at the shoreline, and SLI departures over and east of the site. One Loop departure was clearly audible at 56.2 dBA passing in very close proximity to the Peninsula, and crossed the shoreline at Hermosa Beech. Most Loop departures were not audible at this location.

At VGE, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 10 – Maximum INM-predicted turboprop Event SEL values at VGE

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441	62.4	64.7	59.9	64.7		63.9	61.9	62.8	65.0
DHC8	62.6	64.8	59.9	65.4		64.4	61.9	62.9	65.7
SF340	65.3	68.2	61.9	67.9	60.5	66.8	64.0	65.0	68.8

The measured SEL value for Jetstream aircraft was 56.7 on PVMP1. Measured SEL values for Embraer 120 aircraft ranged from 60.9 to 63.2 on PVMP1, 60.9 to 63.6 on PVMP2, was 62.7 on PVLP2, 61.7 on PVLP4, and 68.2 on PVLP6. The measured SEL value for Saab 340 aircraft was 69.8 on PVMP2. Thus, the measured values ranged from 5.2 dBA quieter to 4.8 dBA louder than the predicted values. The average SEL for all of the measured aircraft noise events is 0.3 dBA more than the predicted SELs.

The INM predicts average noise levels of 37.4 dB DLeq and 41.9 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are accurate, the DLeq and CNEL values are also considered accurate. Using the maximum under-prediction value of 4.8 dBA in predicting single-event noise levels at this site, the worst-case estimate of CNEL is 46.7. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

South Shores Elementary School (SSE)

At the time of measurement, the SSE site was characterized by a low ambient noise level, except for infrequent higher level events caused by automobile traffic on nearby streets. This site is in the southeast corner of the Peninsula. Unlike many sites on the Peninsula, it is as significantly affected by jet overflights as by turboprops, particularly at night when the Loop departure is not available. Turboprops are generally at a higher altitude and have dispersed somewhat when reaching SSE. This site is located on a slope rising gradually from the sea, at an elevation of approximately 250 feet above sea level. Under good weather conditions, there is good aircraft visibility.

The ambient noise level was typically less than 40 dBA, largely attributable to the time of day that monitoring occurred. This would be far less likely during the day, when activity at the school would result in much higher ambient noise levels. The average noise level throughout the monitoring period, from all sources, was 43.8 dBA. Aircraft noise events all peaked at less than 57 dBA. When present, automobile traffic would often exceed 55 dBA. As a result, aircraft noise at this location during the day is largely indistinguishable from ambient noise; thus, unattended monitoring at this location would not produce reliable results.

The loudest non-aircraft noise event detected was 68.8 dBA, made by a loud automobile passing on 35th Street. The loudest aircraft noise event peak was 55.6 dBA, attributable to a Boeing 737-200 departure from LAX at 11900 feet altitude, traveling on subtrack PVJD3. The loudest turboprop measured peaked at 53.3 dBA, attributable to an Embraer 120 at 7200 feet altitude, traveling along subtrack PVLP4.

Several different types of aircraft noise events were audible at SSE. As mentioned above, the loudest event detected was not related to aircraft. Turboprop and jet departures from LAX were both among the loudest measured aircraft events. In addition, Visual Flight Rules aircraft traffic not related to LAX was frequently audible at this site, and a jet departure from Long Beach Airport was measured at peak noise levels of approximately 50 dBA, attributable to a Boeing 737-200.

At SSE, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 11 – Maximum INM-predicted turboprop Event SEL values at SSE

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441	50.4	54.9		60.2		62.6	53.8	56.4	59.1
DHC8	52.4	59.8	50.2	61.9		63.1	55.9	57.3	62.3
SF340	51.9	57.5		63.7		64.5	55.7	56.6	64.2

No Jetstream 32 aircraft were measured at SSE. Measured SEL values for Embraer 120 aircraft (modeled as DHC8) ranged from 54.6 to 61.3 on PVMP1, 57.6 to 62.1 on PVMP2, 62.5 on PVLP2, and 56.0 on PVLP3. The only values for Saab 340 aircraft (modeled as SF340) were contaminated by coincident jet aircraft noise. Thus, the measured noise values were 0 to 5 dB louder than the modeled values at this site. This discrepancy may be due to additive effects of ambient noise and may also be exacerbated by the potential but unverified reflection conditions from the hills north of the site.

INM predicts the SEL for the loudest jet aircraft (737-200) as 66.6, and a value of 70.0 was measured. INM predicts the SEL for the loudest of all aircraft as 76.2, for a Stage 2 DC9 on subtrack PVJD3, but none of these were observed. INM over-predicted some aircraft noise events by up to 7.6 decibels, and under-predicted others by up to 10.6 decibels, but, on average, predicted jet aircraft noise events within 1 decibel at this site.

The INM predicts average noise levels of 38.6 dB DLeq and 45.4 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual turboprop noise levels are under-predicted by 0 to 5 dB, the average noise levels are estimated to be similarly under-predicted. Using a typical under-prediction value of 2 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 47.4. Using a worst-case under-prediction value of 5 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 50.4. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Highridge Park (HRP)

The HRP site was characterized by a fairly low ambient noise level that would, for the most part, allow clear differentiation with aircraft noise events. Occasional intrusive noise was caused by automobile traffic on the roadway adjacent to the park, as well as by children and other persons in the park. This site is located centrally on the Peninsula at one of its highest points. At over 1100 feet in elevation, this location provided excellent visibility of all LAX and non-LAX based aircraft crossing the Peninsula, as well as those aircraft following the PVMP routes. Aircraft events were typically very long in duration as they often proceeded south and then east around the park with no buffering between the aircraft and the noise microphone, potentially leading to higher SEL values.

Ambient noise levels ranged from 40 to 46 dBA depending upon the nature of activity both at the park itself and at the adjacent school, and automobile activity. The average noise level throughout the monitoring period, from all sources, was 45.7 dBA. A significant number of aircraft noise events were contaminated by non-aircraft sources (children, birds, cars, etc.) estimated to be as loud or louder than the aircraft. As a result, aircraft noise at this location would be, in part, indistinguishable from non-aircraft noise; thus, unattended monitoring at this location would not produce reliable results.

The loudest non-aircraft activity recorded was 59.1 dBA caused by a motorcycle. The loudest aircraft noise event was a helicopter that produced 60.9 dBA passing directly over the park. The loudest non-LAX fixed-wing aircraft events peaked at 58.2 dBA and were caused by two separate prop aircraft; one of which passed directly over the park and the other which proceeded southbound to the west of the park. The loudest LAX-based aircraft peaked at 59.8 dBA along the PVMP2 route.

Several different types of aircraft noise events were audible at HRP. As indicated above, many of the loudest aircraft noise events were not related to LAX aircraft. Several private props and helicopters crossed very close to the park area at relatively low altitudes. The loudest LAX-related events were turboprop departures either directly overhead or passing southbound along the shoreline. LAX Loop departures were visible and audible, but typically below ambient levels.

At HRP, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 12 – Maximum INM-predicted turboprop Event SEL values at HRP

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441	61.5	65.1	58.2	63.7		59.2	57.8	59.1	64.3
DHC8	62.1	65.1	58.4	64.6		59.5	58.7	60.0	64.1
SF340	65.0	67.9	60.6	67.1	56.1	63.4	59.5	61.0	66.6

Measured SEL values for Jetstream 32 aircraft were 61.9 on PVMP1 and 63.8 on PVLP6. Measured SEL values for Embraer 120 aircraft ranged from 64.8 to 66.6 on PVMP1, 67.4 to 71.7 on PVMP2, 63.2 to 66.7 on PVLP1, and was 69.1 on PVLP2. The measured SEL for Saab 340 aircraft was 63.0 on PVMP1. Thus, the measured noise values were 2.2 to 11.7 decibels louder than the predicted.

The INM predicts average noise levels of 36.3 dB DLeq and 40.9 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are under-predicted by 2.2 to 11.7 dB, the average noise levels are estimated to be similarly under-predicted. Using a typical under-prediction value of 7 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 47.9. Using a worst-case under-prediction value of 11.7 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 52.6. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Marymount College (MMC)

The MMC site was measured on two occasions, once in the evening and once in the early morning, to determine any potential differences attributable to time-of-day. The MMC site was characterized by a relatively high ambient noise level on the western portion of the campus due to the close proximity to automobile traffic on a very hilly roadway that provides access to the site. The eastern portion of the site had a low ambient noise level with intermittent automobile traffic and campus activity. Yet, many aircraft events were below or only slightly above ambient levels, especially in the evening hours. Unlike many sites on the Peninsula, it is as significantly affected by jet overflights as by turboprops, particularly at night when the Loop departure is not available. Turboprops are generally at a higher altitude and have dispersed somewhat when reaching MMC. The site is located on the southeastern portion of the Peninsula. The site lies on the southern facing slopes of the Peninsula, at an elevation of over 840 feet above sea level, with a significant hillside to the north and dropping off dramatically to the south.

The ambient noise level on the west side of the campus was about 50 dBA in the evening and clearly drowned out any aircraft noise events that occurred. Upon relocating to the eastern side of the campus, the ambient levels were reduced to a range of 36 to 44 dBA with intermittent interruptions from campus activities along with some dogs barking. The average noise level throughout the evening monitoring period, from all sources, was 41.4 dBA. In the early morning hours, the ambient noise level was typically about 40 dBA, rising throughout the monitoring period. The ambient rose abruptly after 8 a.m. due to the arrival of students and college staff. The average noise level throughout the morning monitoring period, from all sources, was 44.5 dBA. A significant number of aircraft noise events in the evening were contaminated by non-aircraft sources (campus activity, dogs barking, cars, etc.) estimated to be as loud as or louder than the aircraft. As a result, aircraft noise at this location would be, in part, indistinguishable from non-aircraft noise; thus, unattended monitoring at this location would not produce reliable results.

The loudest non-aircraft event was the people yelling and clapping at the playhouse on campus. The loudest aircraft noise event was 55.3 dBA, made by a VFR aircraft not related to LAX. The loudest aircraft noise event related to LAX was a Saab 340 aircraft on the PVLP4 departure at approximately 5800 feet which registered 53.1 dBA. The loudest jet peaked at 50.4 dBA, an L1011 at 12400 feet on the PVJD1 subtrack.

Several aircraft could be heard from this location, including SAN and SLI turboprops, and SLI jets. Many of the SLI jets and several north-bound jets departing John Wayne Airport were observed, but were inaudible or at ambient levels, and one LAX arrival inbound over SLI was clearly audible. Most jets did not exceed 45 dBA and were therefore indistinguishable from ambient noise levels. LAX-based turboprops on the SAN departures often were also at or below ambient levels, yet were clearly visible. SLI bound turboprop aircraft were far more easily distinguishable.

At MMC, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 13 – Maximum INM-predicted turboprop Event SEL values at MMC

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441		59.2		64.2		58.5	54.6	55.5	60.8
DHC8	55.4	60.9	52.5	64.4		61.3	56.8	58.4	60.8
SF340	56.1	62.3	52.2	66.0		62.2	56.3	58.2	63.4

The measured SEL value for Jetstream 32 aircraft was 56.9 on PVLP4. The measured SEL values for Embraer 120 aircraft were from 65.8 to 67.0 on PVMP2, 57.4 to 62.2 on

PVMP3, 62.4 on PVLP2, and 57.6 on PVLP6. The measured SEL values for Saab 340 aircraft were from 58.7 to 63.9 on PVMP2, and 66.0 on PVLP4. Thus, the measured noise values ranged from 7.3 dBA quieter to 9 dBA louder than the predicted values. The average difference in the SELs for all of the measured aircraft noise events was approximately equal to the predicted SELs.

The SEL for the loudest jet aircraft overflight measured was 65.9 (L1011, described above), for which INM predicts an SEL of 65.6. Two jet aircraft events were captured during the evening measurement period: a B733 on PVJD3 which registered 61.6 dBA and a B762 on PVJD1 which registered 60.8 dBA. Sixteen LAX jets with SELs between 58.2 and 65.4 were detected during the morning measurement period. INM predicts the SEL for the loudest of all aircraft as 75.8, for a Stage 2 DC9 on subtrack PVJD3, but none of these were observed. INM over-predicted some aircraft noise events by up to 8.5 decibels, and under-predicted others by up to 10.4 decibels, but, on average, predicted jet aircraft noise events were within 3 decibels of average at this site (generally on the side of under-predicting).

The INM predicts average noise levels of 37.4 dB DLeq and 43.9 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are accurate, the DLeq and CNEL values are also considered accurate. Using the maximum under-prediction value of 10.4 dBA in predicting single-event noise levels at this site, the worst-case estimate of CNEL is 54.3. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Via Gabriel (VGB)

The VGB site was characterized by a low ambient noise level intermittently interrupted by local traffic. The site is located on a hillside sloping downward, in a northwesterly direction toward the ocean, and provided excellent visibility for aircraft out over the ocean. The site is located on the northwest portion of the Peninsula directly under climbing turboprop aircraft. There are rolling hills surrounding the site that may serve to increase local noise levels due to reflection. An echoing effect was also noticeable at this location. Due to its close proximity to oncoming aircraft and being at approximately 1000 feet altitude, this site receives some of the loudest LAX aircraft noise of any site monitored.

The ambient noise level was typically between 38 to 42 dBA, with occasional peaks of up to 70 dBA for passing local automobile traffic. The average noise level throughout the monitoring period, from all sources, was 47.0 dBA. Passing automobile traffic caused the loudest non-aircraft events. A significant number of aircraft noise events were contaminated by non-aircraft sources (cars) which were clearly louder than the aircraft. As a result, potential additive noise from non-aircraft sources would skew the readings at this location; thus, unattended monitoring at this location would not produce reliable results.

The loudest aircraft event was caused by an Embraer 120 aircraft on the PVLP1 route that reached 60.2 dBA, and passed directly overhead at 5000 feet. Several non-LAX related aircraft events were recorded; the loudest of which registered 53 dBA.

Several different types of aircraft noise events were visible and/or audible at VGB, including LAX turboprops operations, LAX jet Loop departures, as well as local props and helicopters from Torrance. As mentioned above, the loudest aircraft events were LAX turboprop departures overhead. However, certain jet Loop departures were also audible. The loudest Loop departure was 49.0 dBA, attributable to a Boeing 737-300.

At VGB, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 14 – Maximum INM-predicted turboprop Event SEL values at VGB

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441	65.2	64.5	64.7	61.8	61.9		57.5	58.1	61.5
DHC8	65.8	64.4	65	62.1	61.9		57.2	57.9	61.7
SF340	68.9	67.8	68.2	64.1	64.1		59.7	59.7	63.8

Measured SEL values for Jetstream 32 aircraft were 58.1 on PVMP1, and 66.7 on PVLP2. The measured SEL values for Embraer 120 aircraft were from 58.1 to 63.3 on PVMP1, from 64.8 to 68.2 on PVMP2, from 67.0 to 70.7 on PVLP1, 68.2 on PVLP2, and from 65.5 to 66.2 on PVLP3. The measured SEL values for Saab 340 aircraft were from 61.2 to 64.6 on PVMP1 and 67.0 on PVLP3. Thus, the measured noise values ranged from 0.5 dBA to 10.3 dBA louder than the predicted values. The average difference in the SELs for all of the measured aircraft noise events was 3.7 dBA more than the predicted SELs. This discrepancy may be accounted for, at least in part, by the reflection conditions described above.

The INM predicts average noise levels of 35.7 dB DLeq and 40.2 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are under-predicted by 0 to 10.3 dB, the average noise levels are estimated to be similarly under-predicted. Using a typical under-prediction value of 4 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 44.2. Using a worst-case under-prediction value of 10.3 dB for single-event noise levels at this site, the adjusted estimate of CNEL is 50.5. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Springcreek Road (SCR)

The SCR site was characterized by a low ambient noise level intermittently interrupted by local automobile traffic. The site is located on a hillside sloping downward to the north facing the City of Torrance, and provided excellent visibility northward. In addition, aircraft passing along the shoreline west of the site were also visible and audible. The site is located on the northwest portion of the Peninsula directly under climbing turboprop aircraft on the PVLP1 route. Being located adjacent to a hillside may serve to increase local noise levels due to reflection. Due to its close proximity to oncoming aircraft and being at approximately 1100 feet altitude, this site received some of the loudest LAX aircraft noise of any site monitored.

The ambient noise level was typically between 40 to 44 dBA, with intermittent peaks of up to 75 dBA for passing local automobile traffic. The average noise level throughout the morning monitoring period, from all sources, was 53.1 dBA. The automobile traffic caused the loudest non-aircraft events. A significant number of aircraft noise events were contaminated by non-aircraft sources (cars) which were clearly louder than the aircraft. As a result, potential additive noise from non-aircraft sources would skew the readings at this location; thus, unattended monitoring at this location would not produce reliable results.

Several different types of aircraft noise events were visible and/or audible at SCR, including LAX turboprops operations, LAX jet Loop departures, as well as local props and helicopters from Torrance. Several jet Loop departures were audible, but only those that were turning farther to the south registered higher-than-ambient noise levels. The loudest jet aircraft was a Loop departure at 60.0 dBA, attributable to a Boeing 737-500 that crossed the shoreline at Hermosa Beach at 12,900 feet. The loudest turboprop aircraft reached 59.2 dBA, while the loudest non-LAX-related aircraft reached 46.7 dBA.

At SCR, the noise model predicted the following maximum SEL values for turboprop departures along the studied tracks, based on several alternate departure procedures.

Table 15 – Maximum INM-predicted turboprop Event SEL values at SCR

ACFT	PVLP1	PVLP2	PVLP3	PVLP4	PVLP5	PVLP6	PVMP1	PVMP2	PVMP3
CNA441	65.2	64.8	63.9	62.5	60.3	59.8	57.5	58.2	62.5
DHC8	65.8	65.4	64.4	62.9	60.5	60.3	57.5	58.4	62.5
SF340	68.9	68.3	67.4	65.2	62.3	61.8	59.1	59.3	65.0

The measured SEL value for Jetstream 32 aircraft was 66.4 on PVMP3. The measured SEL values for Embraer 120 aircraft were from 65.8 to 66.3 on PVMP3. The measured SEL value for Saab 340 aircraft was 66.7 on PVMP3. Thus, the measured noise values ranged from 1.7 dBA to 3.9 dBA louder than the predicted values. This discrepancy may be accounted for by the reflection conditions described above.

The INM predicts average noise levels of 35.9 dB DLeq and 40.3 dB CNEL at this site. These predictions are considered to be as accurate as the INM predictions of single event noise levels. Since individual noise levels are under-predicted by 1.7 to 3.9 dB, the average noise levels are estimated to be similarly under-predicted. Using a typical under-prediction value of 3 dB in predicting single-event noise levels at this site, the revised estimate of CNEL is 43.3. Using a worst-case under-prediction value of 3.9 dB in predicting single-event noise levels at this site, the revised estimate of CNEL is 44.2. Note that these CNEL values are far less than the 65 CNEL criteria level established by the State of California as the threshold of significance.

Noise Modeling

In addition to the single event noise level predictions described in the sections above, the noise model was used to determine CNEL levels at each site under each of six aircraft track alternatives. Assuming that the measured values are more often higher than the predicted values for single events, it would be appropriate to assume that CNEL values are under-predicted by a similar amount. However, comparisons between different INM cases can still be used to reliably predict the change in noise environment between two alternatives, since INM is consistent between its comparisons.

The reduced-power climb profile described above best approximated the altitude and noise level for turboprop departures over the Peninsula. As a result, this profile was used to determine all existing-condition noise contours and CNEL levels.

Under the existing conditions, Loop Departures were found to increase noise across the entire Peninsula by less than 1 dB CNEL. When 144 Loop Departures were included in the model, CNEL values increased 0.2 dB at site PDM, and 0.1 dB at sites VGB and SCR. CNEL values remained constant at all other monitoring sites. None of the alternatives under consideration proposes to modify the Loop departure procedure. In the alternatives where other aircraft are moved out to sea, reduced noise from other sources results in Loop Departures playing a larger role, but their impact never increase the noise level at any site by more than 1.1 dB CNEL.

Attached Figure 11 shows the noise contours predicted by INM for the existing condition, including the 30, 40, and 50 dB CNEL noise contours. The table below shows site information and the cumulative noise metrics calculated for each site.

Table 16 – CNEL Noise Levels for Existing Condition

Site	Latitude	Longitude	Elev.	CNEL	DLeq	TotalSEL
HRP	33.76722	-118.38250	1179.6	40.9	36.3	85.7
MMC	33.73528	-118.33444	840.4	43.9	37.4	86.7
PDM	33.78908	-118.41013	211.7	42.0	37.7	87.0
RHF	33.75672	-118.35412	1197.0	40.7	35.3	84.7
RPV	33.74444	-118.40528	219.1	43.1	38.2	87.6
SCR	33.78111	-118.38583	1066.7	40.3	35.9	85.2
SSE	33.72250	-118.32111	252.0	45.4	38.6	88.0
VGB	33.78667	-118.38722	958.0	40.2	35.7	85.1
VGE	33.77056	-118.40083	712.7	41.9	37.4	86.8

Attached Figures 12, 13, 14, and 15 show the same noise contours predicted for the 1-mile Offshore, 3-mile Offshore, 5-mile Offshore, and San Diego Offshore alternatives, respectively. The following tables show the CNEL noise values predicted at eight monitoring sites under each flight track alternative, and the relative change from the existing condition. (Site VGB is not included as it was a last-minute addition to the noise monitoring effort, requested by FAA, but the results are expected to be similar to those at site SCR.)

Table 17 – CNEL Noise Levels for Each Airspace Alternative

Site	Since 2/10	Prior to 2/10	SAN/CRQ Off	1-mile Off	3-mile Off	5-mile Off
HRP	40.9	42.0	39.4	34.9	31.4	29.5
MMC	43.9	43.8	41.2	38.2	34.3	32.5
PDM	42.0	42.3	40.9	37.0	34.1	33.0
RHF	40.7	41.8	38.8	34.6	31.2	29.6
RPV	43.1	40.3	41.8	39.1	34.3	31.5
SCR	40.3	42.2	39.4	33.2	29.9	28.4
SSE	45.4	44.8	43.3	40.4	36.2	34.5
VGE	41.9	41.7	40.3	36.8	32.8	30.8

Table 18 – CNEL Noise Levels Difference Relative to Existing Conditions (negative numbers indicate a reduction in noise from the existing condition)

Site	Prior to 2/10	SAN/CRQ Off	1-mile Off	3-mile Off	5-mile Off
HRP	1.1	-1.5	-6.0	-9.5	-11.4
MMC	-0.1	-2.7	-5.7	-9.6	-11.4
PDM	0.3	-1.1	-5.0	-7.9	-9.0
RHF	1.1	-1.9	-6.1	-9.5	-11.1
RPV	-2.8	-1.3	-4.0	-8.8	-11.6
SCR	1.9	-0.9	-7.1	-10.4	-11.9
SSE	-0.6	-2.1	-5.0	-9.2	-10.9
VGE	-0.2	-1.6	-5.1	-9.1	-11.1
Average Change	0.1	-1.6	-5.5	-9.3	-11.1

Note that the demonstration program in place since February 10 actually results in increased noise levels in most coastal areas (RPV, SSE, and MMC). There are common assumptions that a "measurable" change in noise impact is one of 1.5 dB CNEL or more, and that a "noticeable" change in noise impact is one of greater than 3 dB CNEL. Using these assumptions, the February 10 changes have had a measurable but unnoticeable impact at only two sites: RPV, where noise increased by 2.8 dB CNEL, and SCR, where noise decreased by 1.9 dB CNEL. Using the same assumptions, three of the four off-shore proposals (1-mile, 3-mile, and 5-mile Offshore) offer a noticeable noise impact improvement when compared to current existing conditions.

Under all alternatives, the benefits to be realized rely on certain corollary improvements in jet aircraft noise. Based on the offshore routes defined by FAA, jets on an SLI departure will still cross the southeastern Peninsula shoreline if they stay on the prescribed track until some point between the new Pevee and Holtz navigational fixes. In other words, based on the FAA route definitions for the airspace alternatives, SLI jets will cross the shoreline in the same place, only at a higher altitude than currently. However, if SLI jets are, in the future, allowed to turn off the defined track at or prior to the Pevee fix, after attaining a specific altitude, predicted and desired noise benefits could be compromised by jet aircraft crossing the Peninsula shoreline at new locations above 13000 feet.

A significant benefit is realized at all sites by moving all turboprop aircraft 1-mile offshore and jet aircraft further out to sea. Each progressive increment of moving aircraft away from the shoreline also represents a progressive improvement in noise at each site, although in certain instances the improvement is only marginally significant. For example, the relative difference between the 3-mile Offshore and 5-mile Offshore alternatives is less than 2 dB CNEL at six of eight sites. This difference, while measurable based on common assumptions, may not always be clearly distinguishable to a human observer.

The INM-predicted noise levels were favorably compared to the measured, absolute noise levels. Both of these were compared to the regulatory maximum-allowed levels to determine if any exceeded the regulatory levels, accounting for differences between the measured and predicted levels. None did. All noise levels over the Peninsula, both measured and predicted, were well below regulatory levels.

Discussion

Current Noise Levels in Palos Verdes

The noise model is a reasonable, but not precise, predictor of single event noise levels on the Palos Verdes Peninsula. Predictions at some sites are very consistent with measured single-event noise levels, while measured single-event noise levels at other sites are higher than the INM-predicted levels by up to 10 decibels. Those sites that were under-predicted by INM were consistently under-predicted, regardless of aircraft type, altitude, etc. In no case did the measured, predicted, or estimated "worst-case" noise levels exceeded any regulatory standard of significance.

Despite the fact that measured noise levels were oftentimes higher than the noise model predictions, there is still insufficient evidence to justify long-term noise monitoring on the Peninsula in an effort to provide more reliable average noise levels than are now provided by INM. Average noise levels from all sources were between 40 and 55 dB on the Peninsula (depending on site and time-of-day), noise exposure from LAX aircraft was below 50 dB CNEL, and peak aircraft noise levels from LAX aircraft rarely exceeded 60 dBA. The validated modeling predictions and sound level measurements made as part of this study were consistent and confirm that long-term noise modeling would only yield more of the same results. Thus, there seems to be little, if any, value to establishing a long-term monitoring program on the Peninsula, since occasional use of the INM would adequately monitor changes. Furthermore, no evidence exists that a long-term monitoring program would reveal that there is a significant noise impact, as defined under current regulatory standards.

Noise Levels under Alternatives

As of 1998, numerous turboprop aircraft depart LAX and fly directly over the Peninsula. Figure 16 shows land use on the Peninsula, at it is clear that there is no way to fly over the Peninsula that avoids potentially sensitive land uses. On February 10, 1999, FAA instituted a Demonstration Program that routed many, but not all, of these aircraft away from the center of the Peninsula. As a result, noise levels have risen along the coast and dropped in the interior of the Peninsula, but all changes have been relatively insignificant. FAA is now considering three alternatives which would route all LAX turboprop departures offshore, around the Peninsula. Many aircraft (non-LAX and VFR traffic) would likely remain over the Peninsula and it would be wrong to believe that the airspace over and near the Peninsula would become a "no-fly zone" under any of the proposed alternatives.

Nevertheless, moving the LAX turboprop aircraft offshore would have a significant noise benefit to all areas of the Peninsula, and greater benefits are realized for greater moves out to sea. Should these air traffic modifications be given additional consideration, noise impact analysis of LAX departures on areas away from the Peninsula (along the coast in northern Orange County, for example) may be desired. As an example of the potential impacts, Figure 17 shows the land use underlying the tracks associated with the 3-mile offshore alternative near Seal Beach and Huntington Beach. Additional analysis of relocated Tandy arrivals to John Wayne and Long Beach airports should also be done. Such analysis, though, was neither necessary nor feasible for inclusion in this necessarily focused study.

Recommendation

3-mile Offshore Alternative

Results for the 1-mile, 3-mile, and 5-mile offshore alternatives all indicate a significant improvement in noise levels on the community. The 3-mile alternative represents a significant improvement over the 1-mile alternative, and results in all sites with a CNEL less than 40 dB CNEL. This level is approximately the ambient CNEL level at very quiet locations on the Peninsula. The 5-mile alternative is mathematically quieter than the 3-mile alternative, but does not necessarily represent a perceivable improvement since the average aircraft noise level would be near or below the ambient average noise level in both the 3-mile and 5-mile cases. In addition, the additional airspace modifications required to implement the 5-mile alternative would be more extensive and are more likely to increase noise levels elsewhere. Therefore, the 3-mile offshore alternative is recommended for further study.

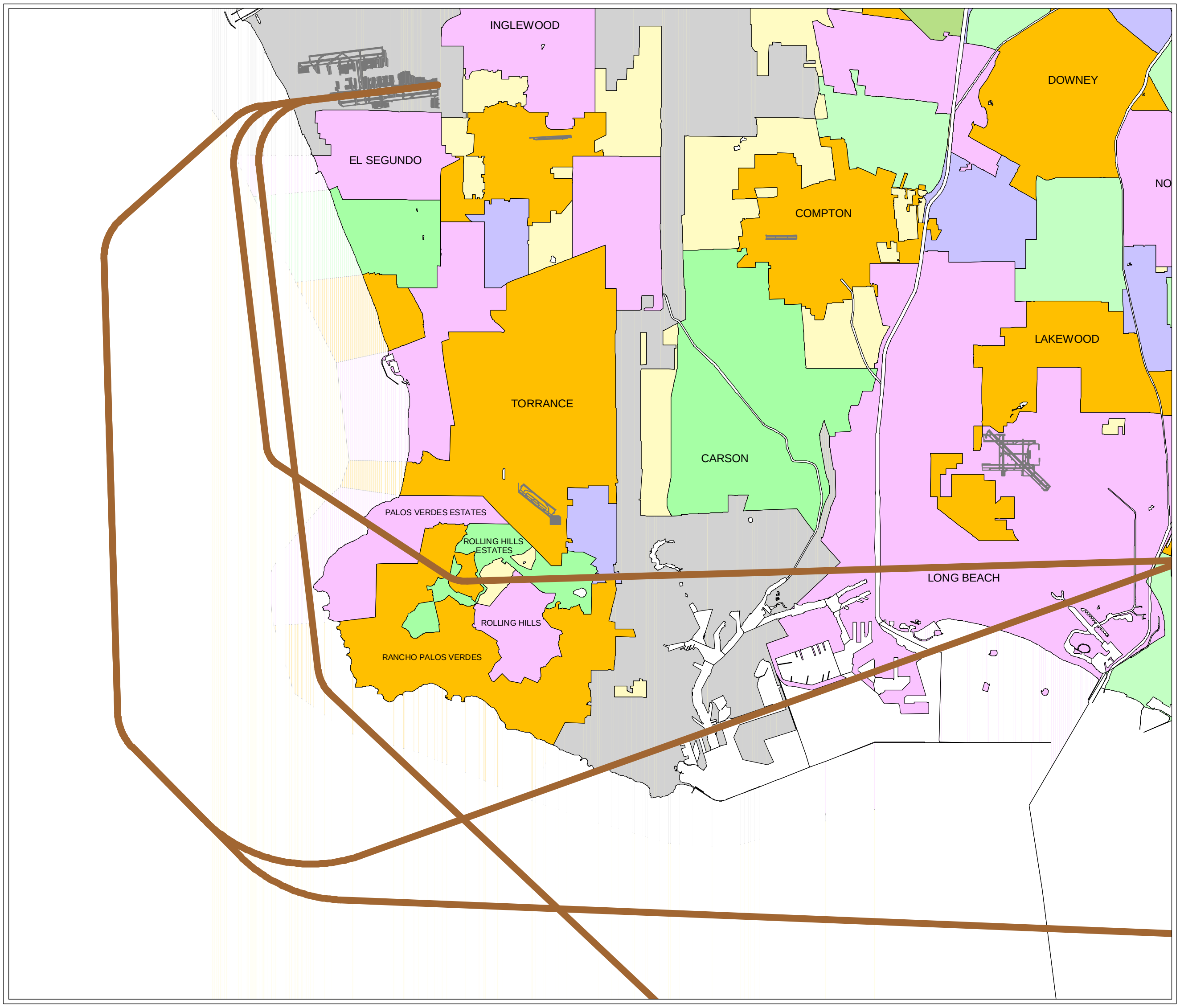

Figure 1 - Typical LAX Departure Routes Affecting Palos Verdes Peninsula

N

LAX
Los Angeles World Airports

PV Typical Routes
Departure Tracks

3 0 3 6 Miles

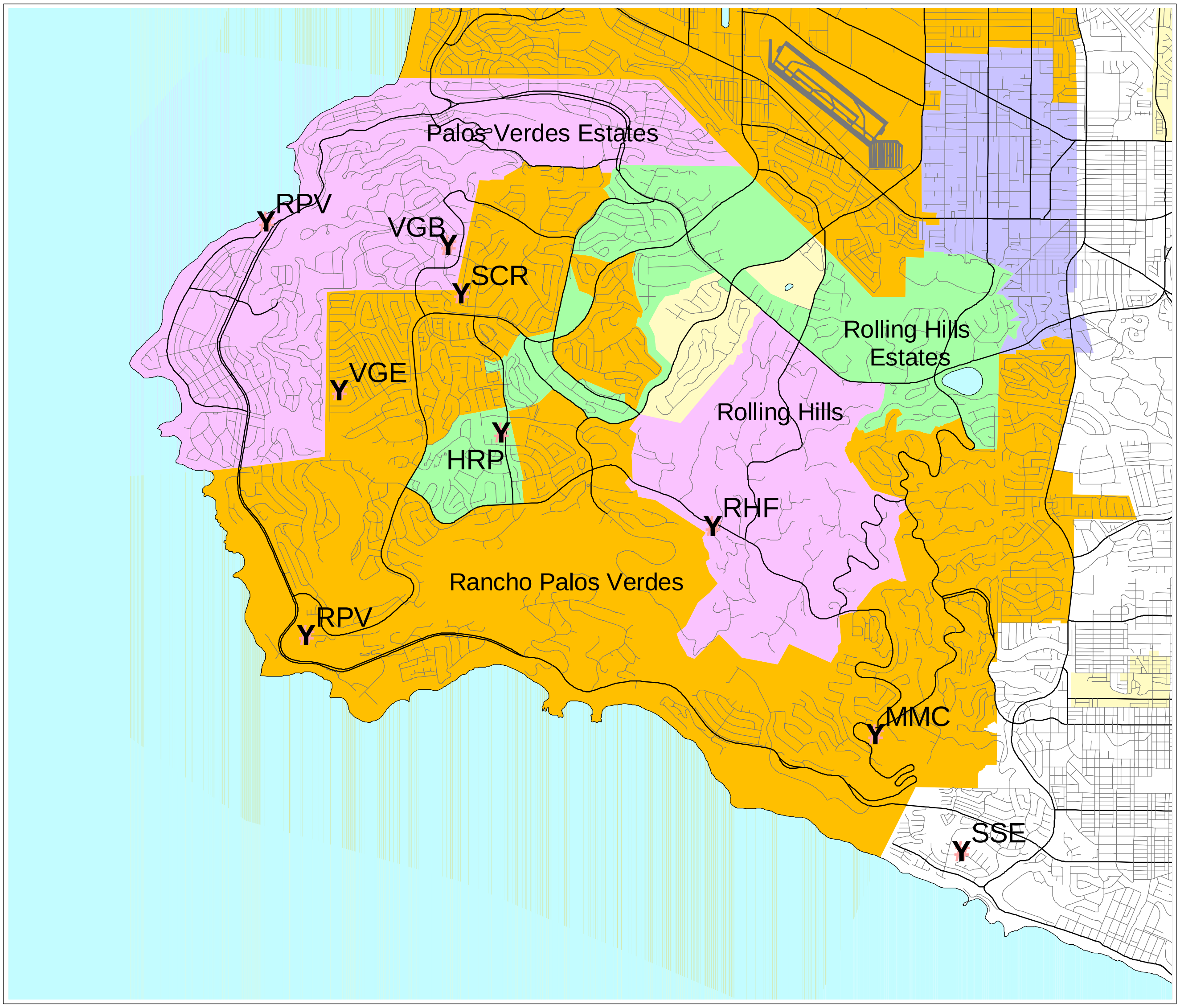

Figure 2 - Noise Monitoring Sites

LAX
Los Angeles World Airports

1 0 1 2 Miles

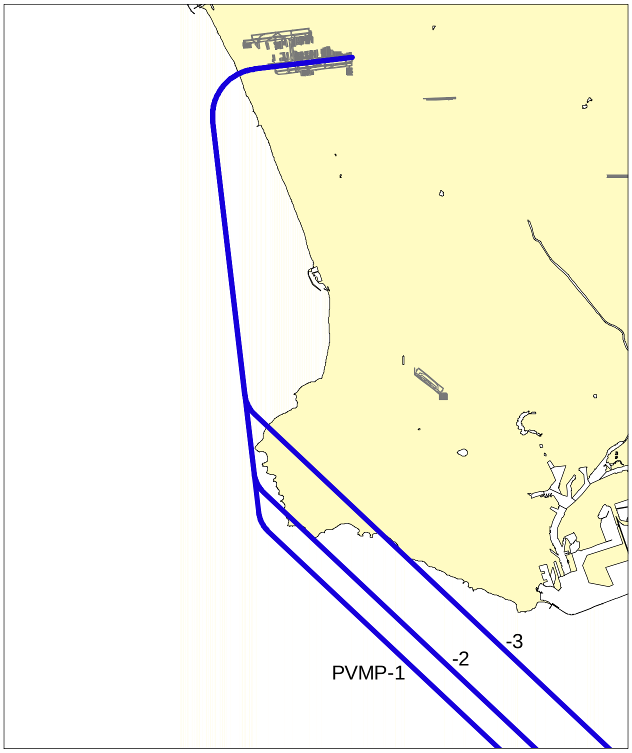

Figure 3 - LAX Turboprop INM Departure Tracks; SAN/CRQ Departures during Demonstration Program

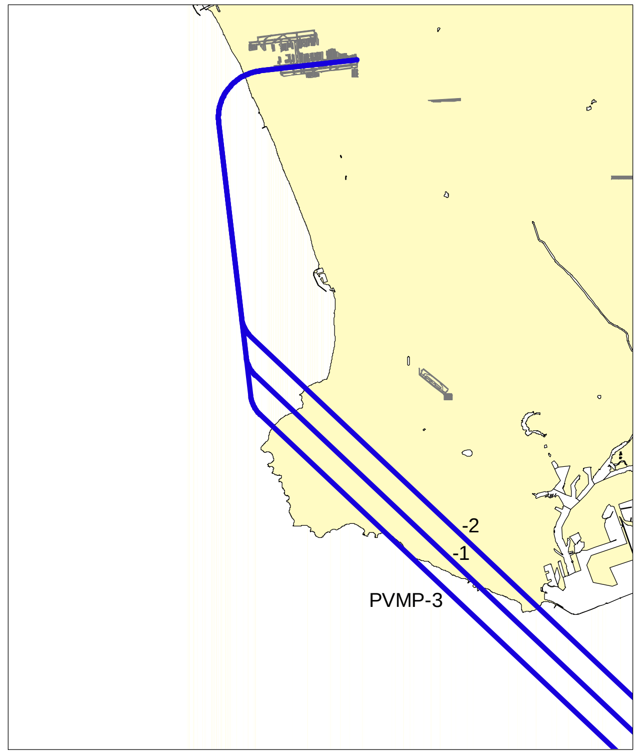

Figure 4 - LAX Turboprop INM Departure Tracks; SAN/CRQ Departures prior to Demonstration Program

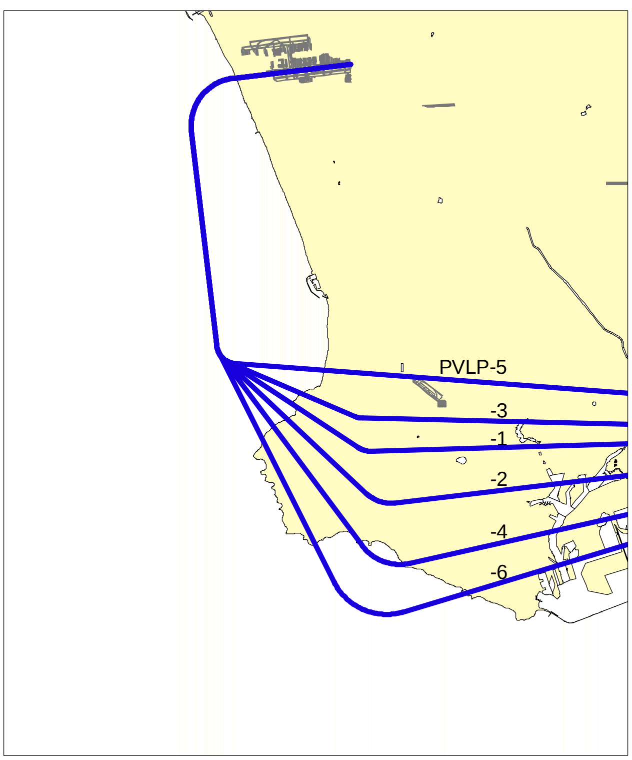

Figure 5 - LAX Turboprop INM Departure Tracks; SLI Departures

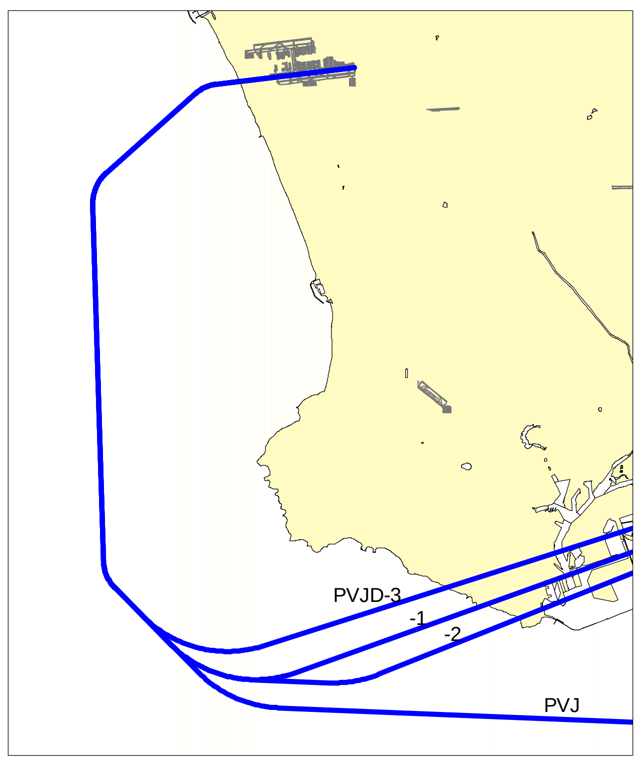

Figure 6 - LAX Jet INM Departure Tracks

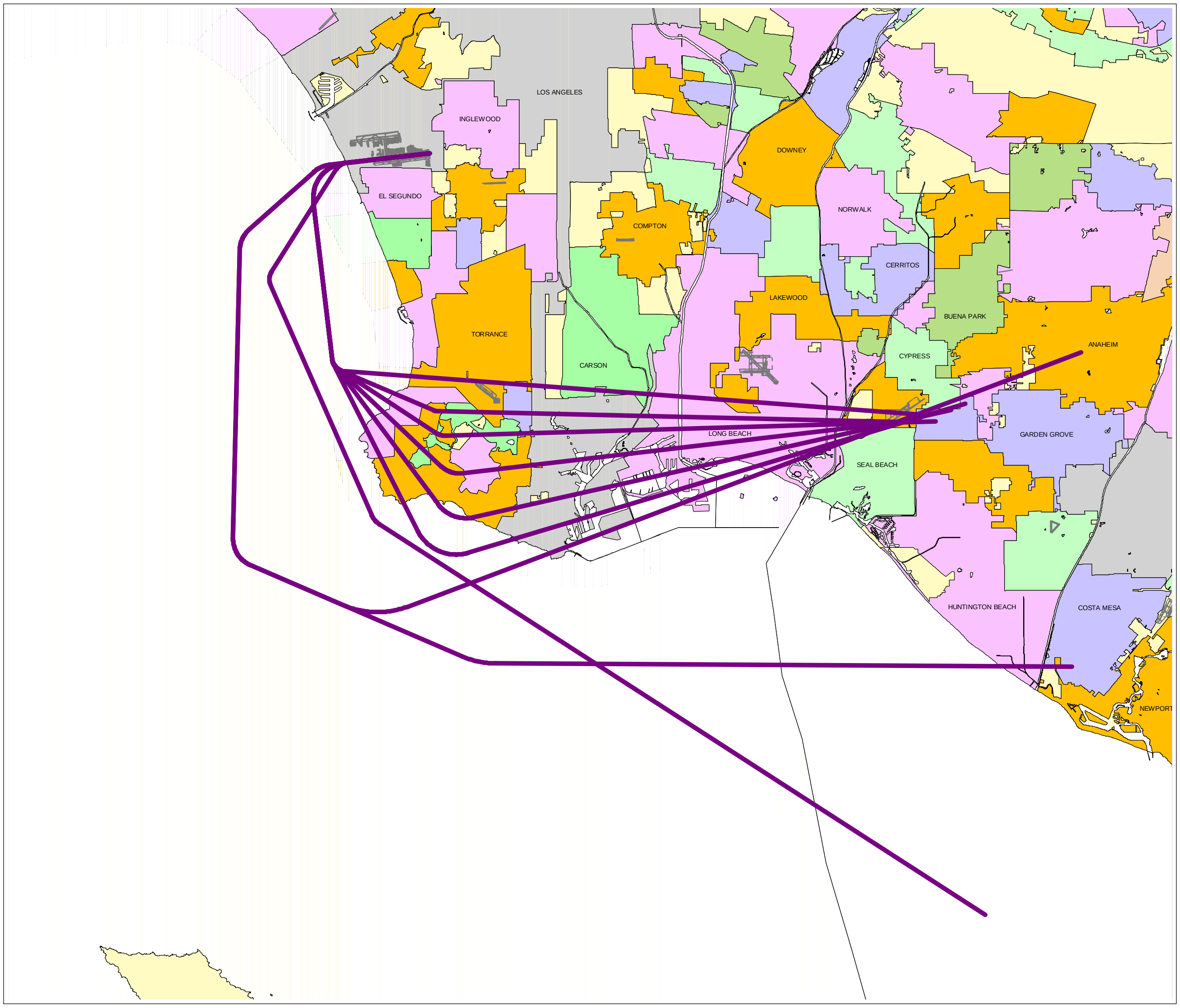

Figure 7 - INM Departure Tracks "San Diego Offshore" Alternative

N

LAX

Los Angeles World Airports

PV SAN/CRQ Offshore Departure Tracks

5 0 5 10 Miles

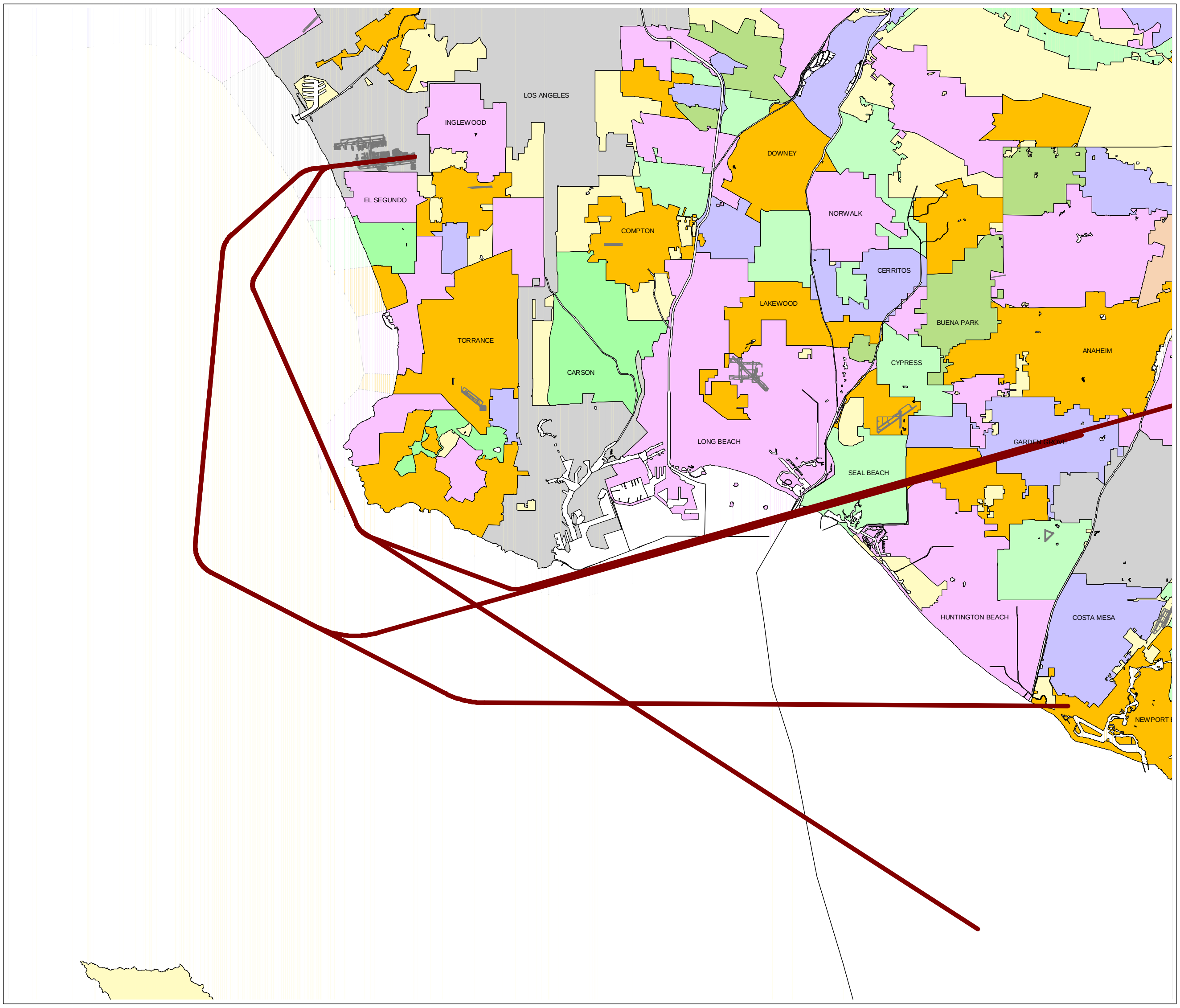

Figure 8 - INM Departure Tracks "One-Mile Offshore" Alternative

N

LAX
Los Angeles World Airports

PV One-Mile Offshore Departure Tracks

5 0 5 10 Miles

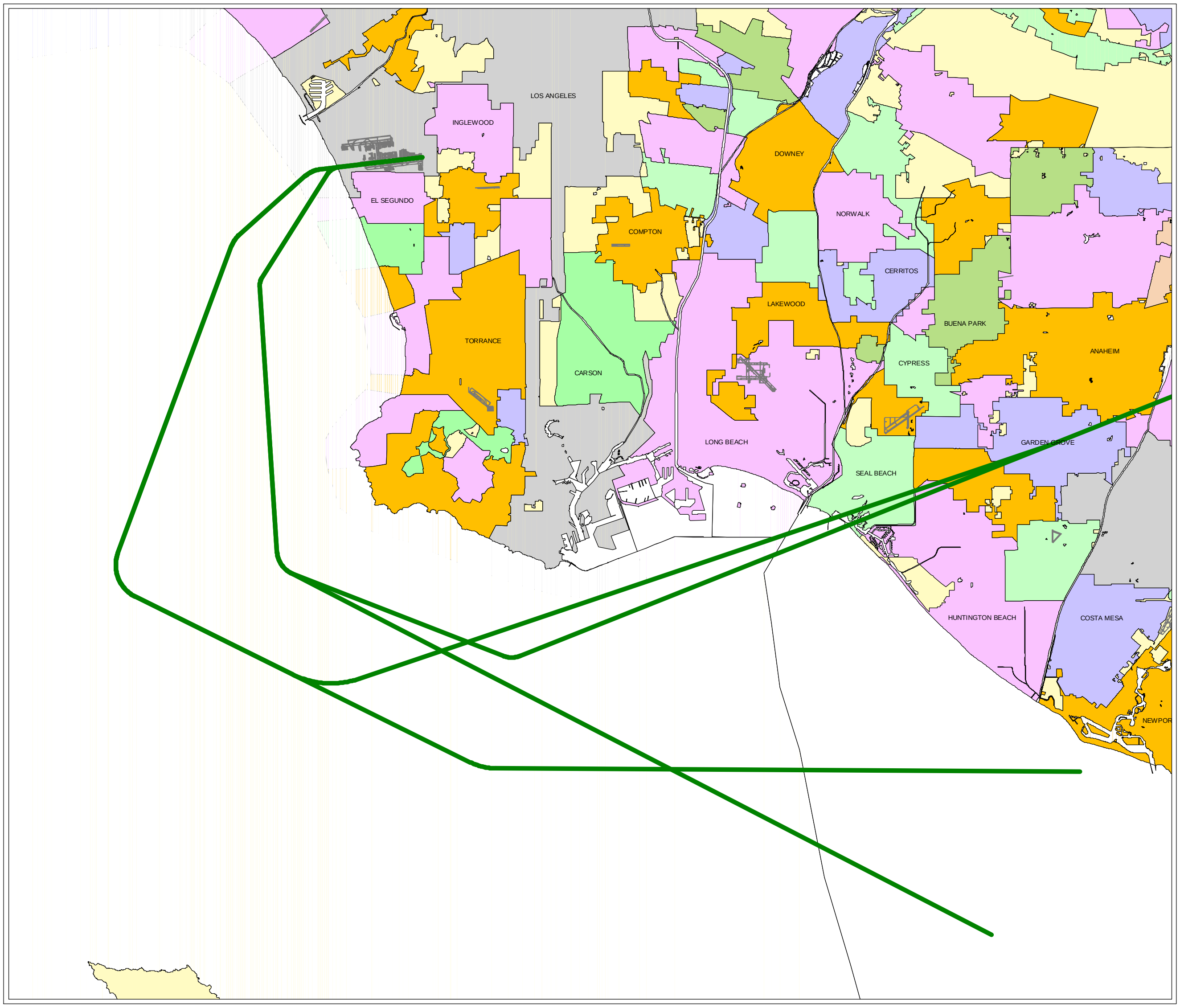

Figure 9 - INM Departure Tracks "Three-Mile Offshore" Alternative

N

LAX
Los Angeles
World Airports

PV Three-Mile Offshore
Departure Tracks

5 0 5 10 Miles

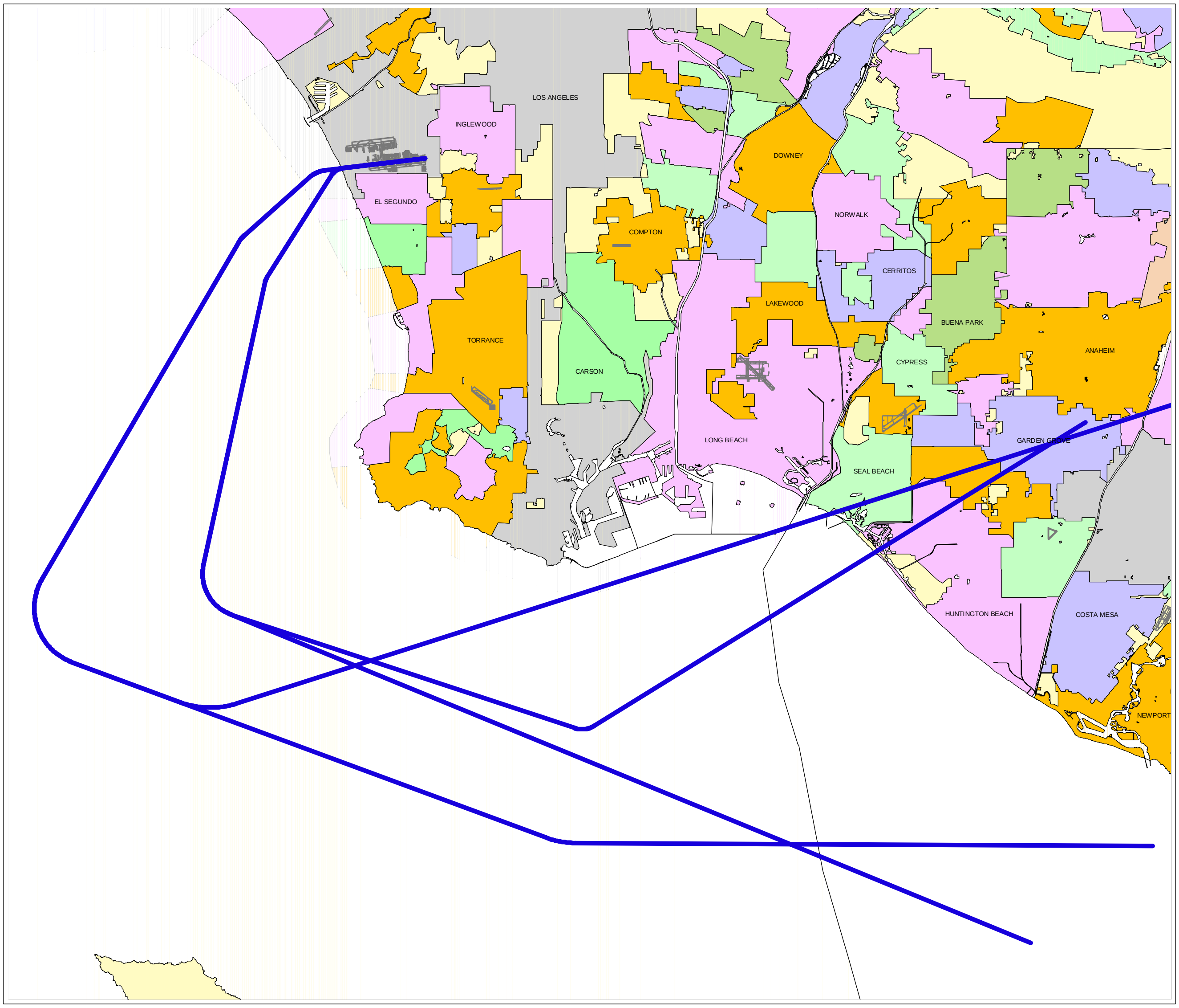

Figure 10 - INM Departure Tracks "Five-Mile Offshore" Alternative

N

LAX

Los Angeles World Airports

PV Five-Mile Offshore Departure Tracks

5 0 5 10 Miles

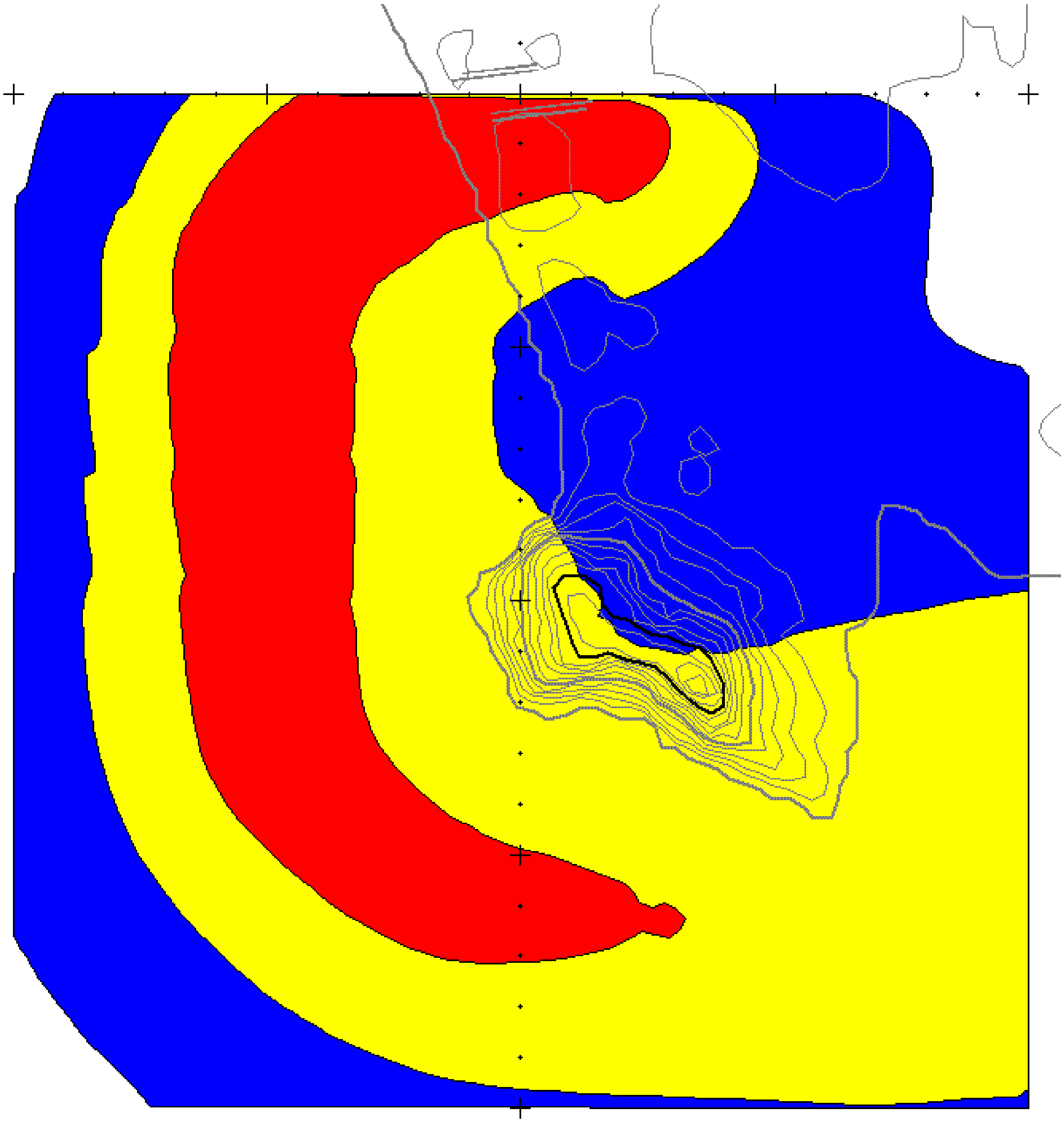

Figure 11 - INM Noise Contours for Existing Conditions; 30, 40, and 50 dB CNEL

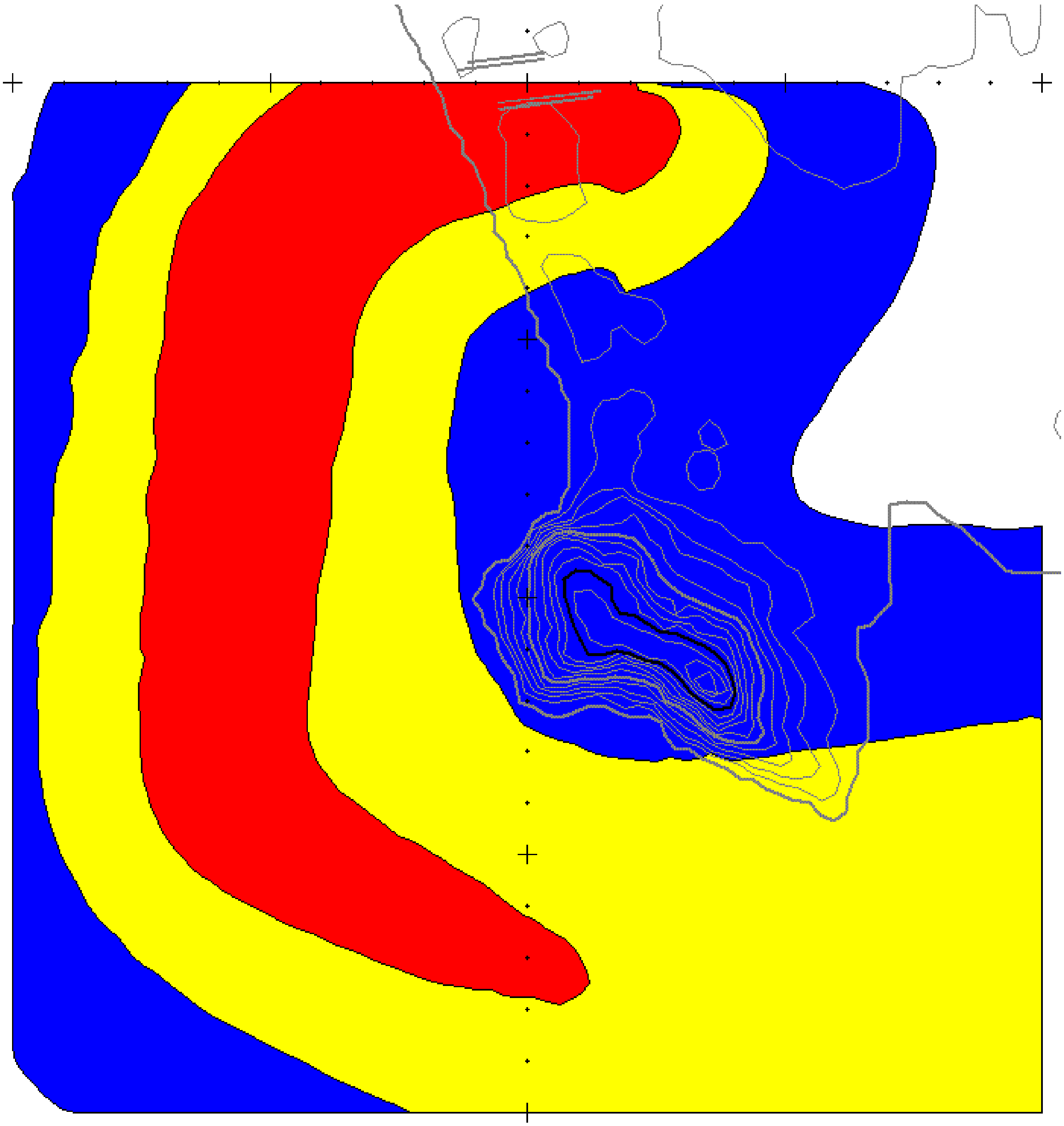

Figure 12 - INM Noise Contours for 1-mile Offshore Alternative; 30, 40, and 50 dB CNEL

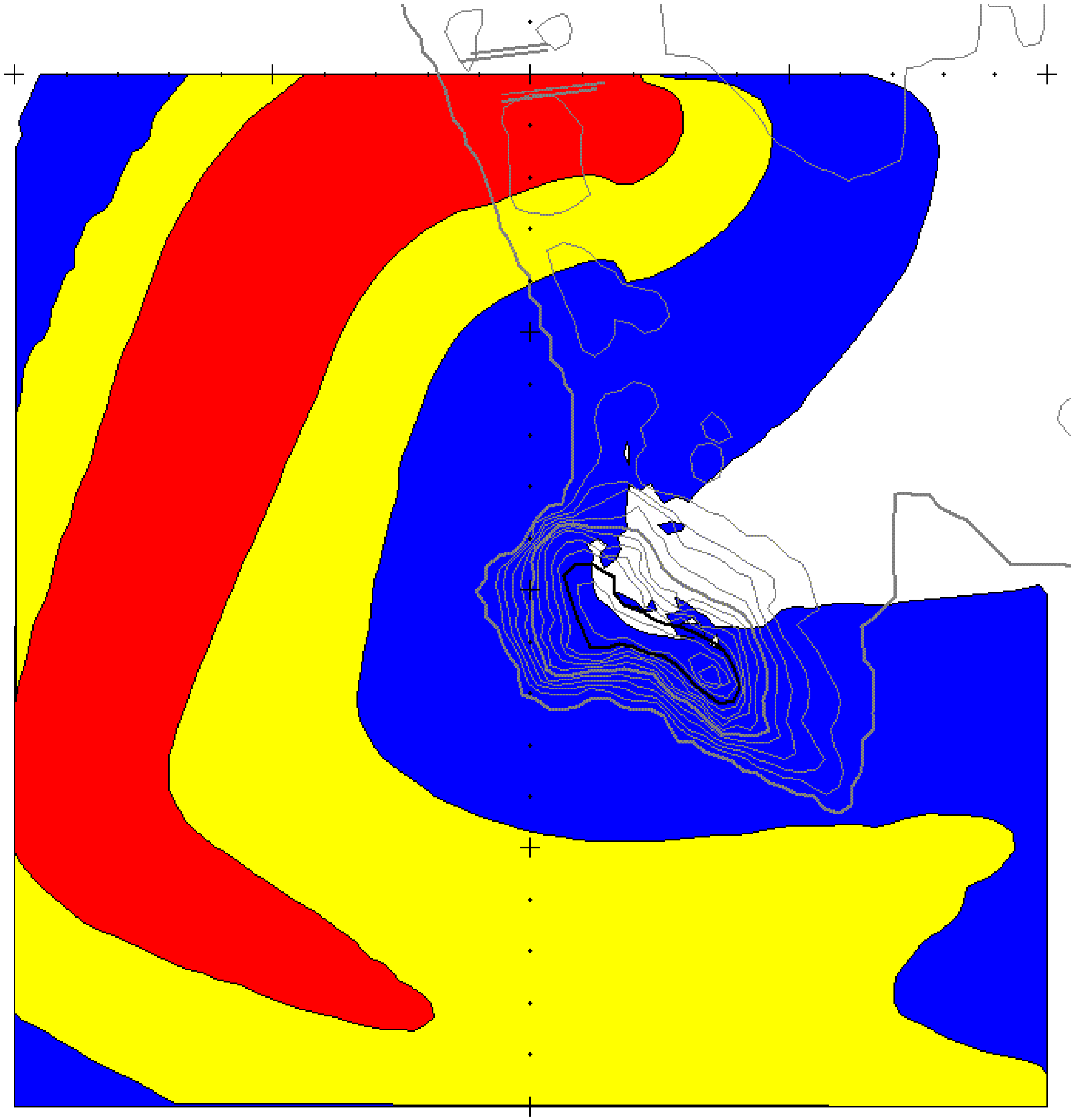

Figure 13 - INM Noise Contours for 3-mile Offshore Alternative; 30, 40, and 50 dB CNEL

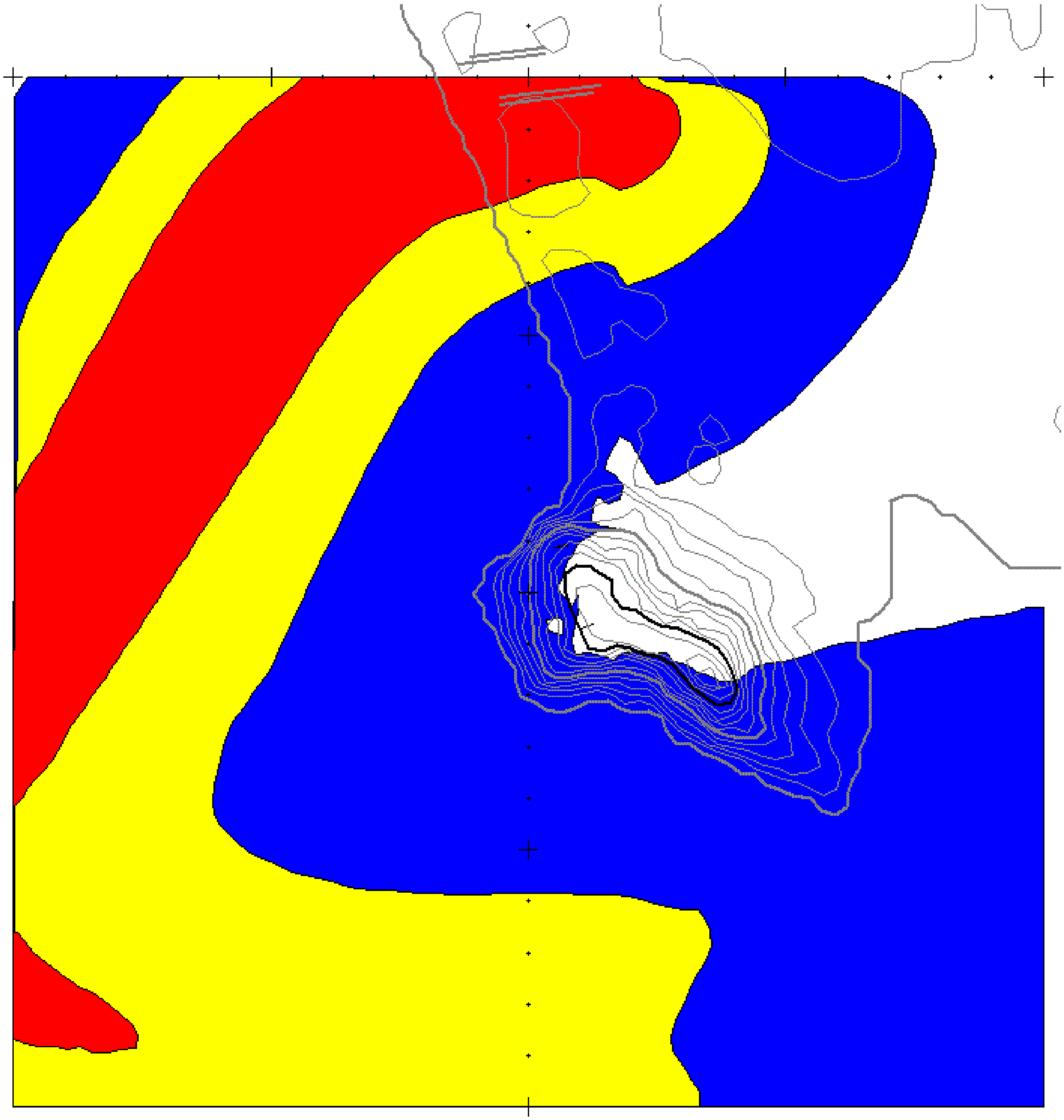

Figure 14 - INM Noise Contours for 5-mile Offshore Alternative; 30, 40, and 50 dB CNEL

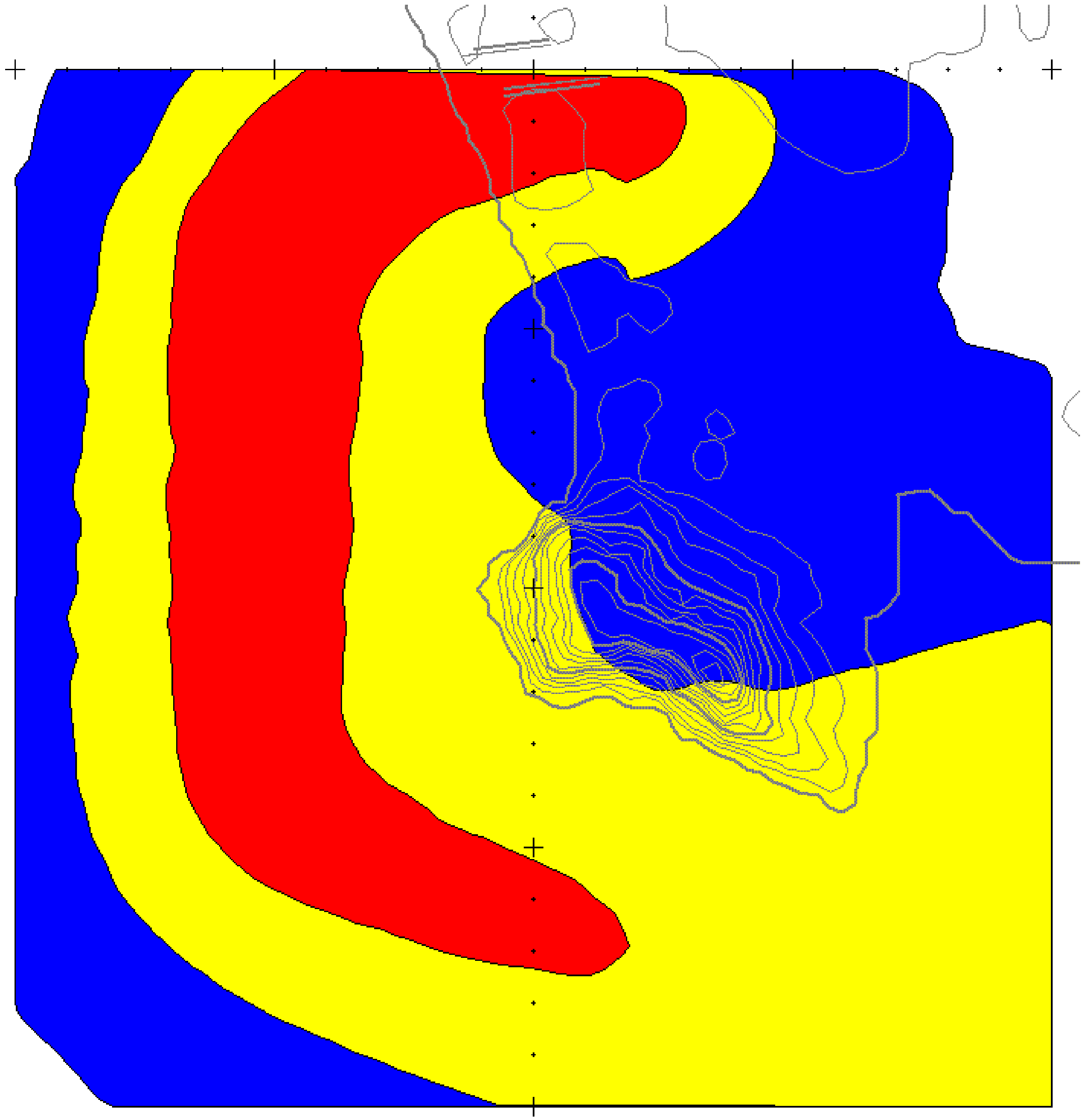

Figure 15 - INM Noise Contours for San Diego / Carlsbad Offshore Alternative; 30, 40, and 50 dB CNEL

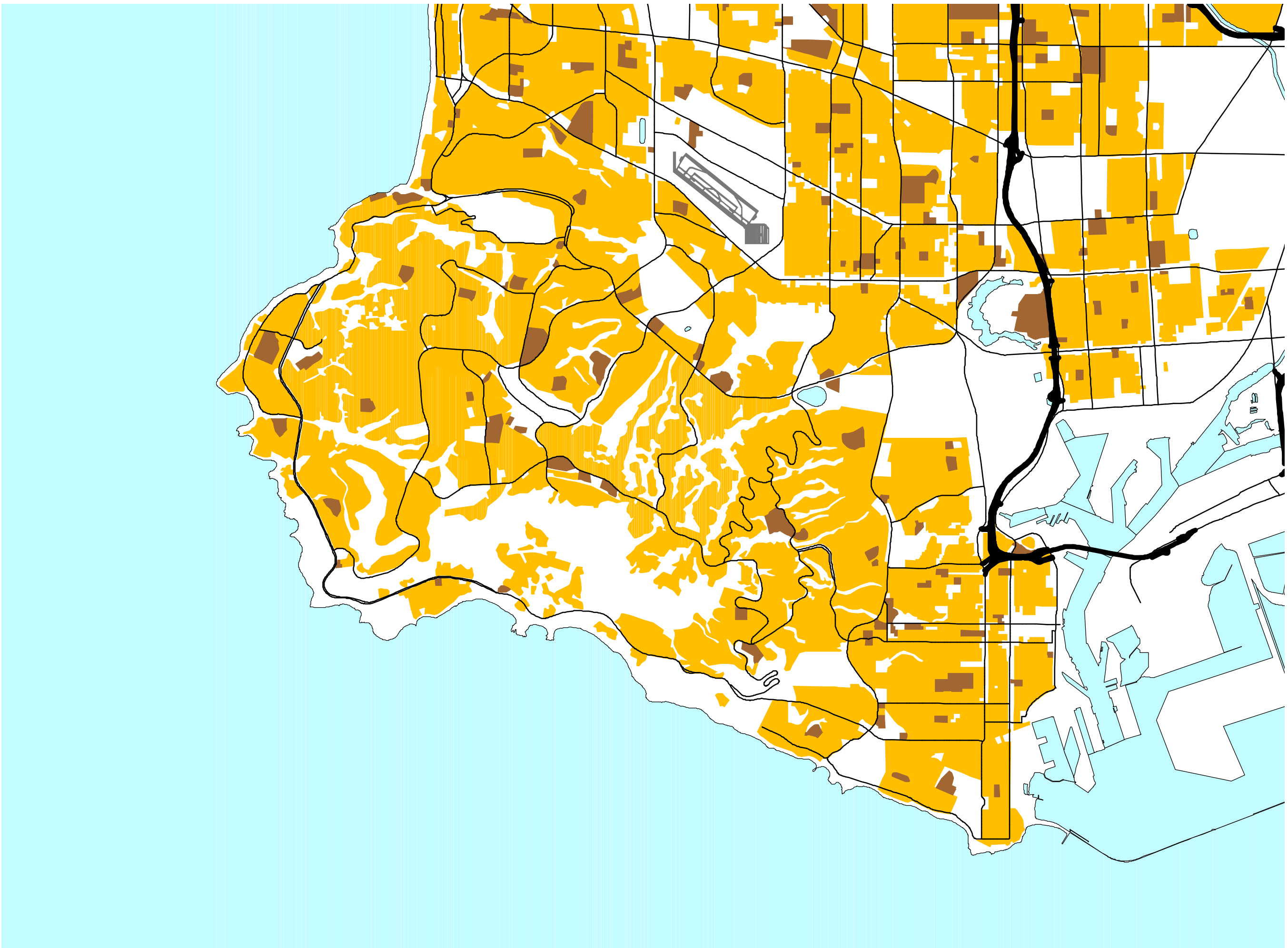

Figure 16 - Palos Verdes Peninsula Land Use

N

LAX
Los Angeles
World Airports

Land Use (SCAG)
- Residential
- School, Church, Hospital
- Other / Compatible

1 0 1 2 3 4 Miles

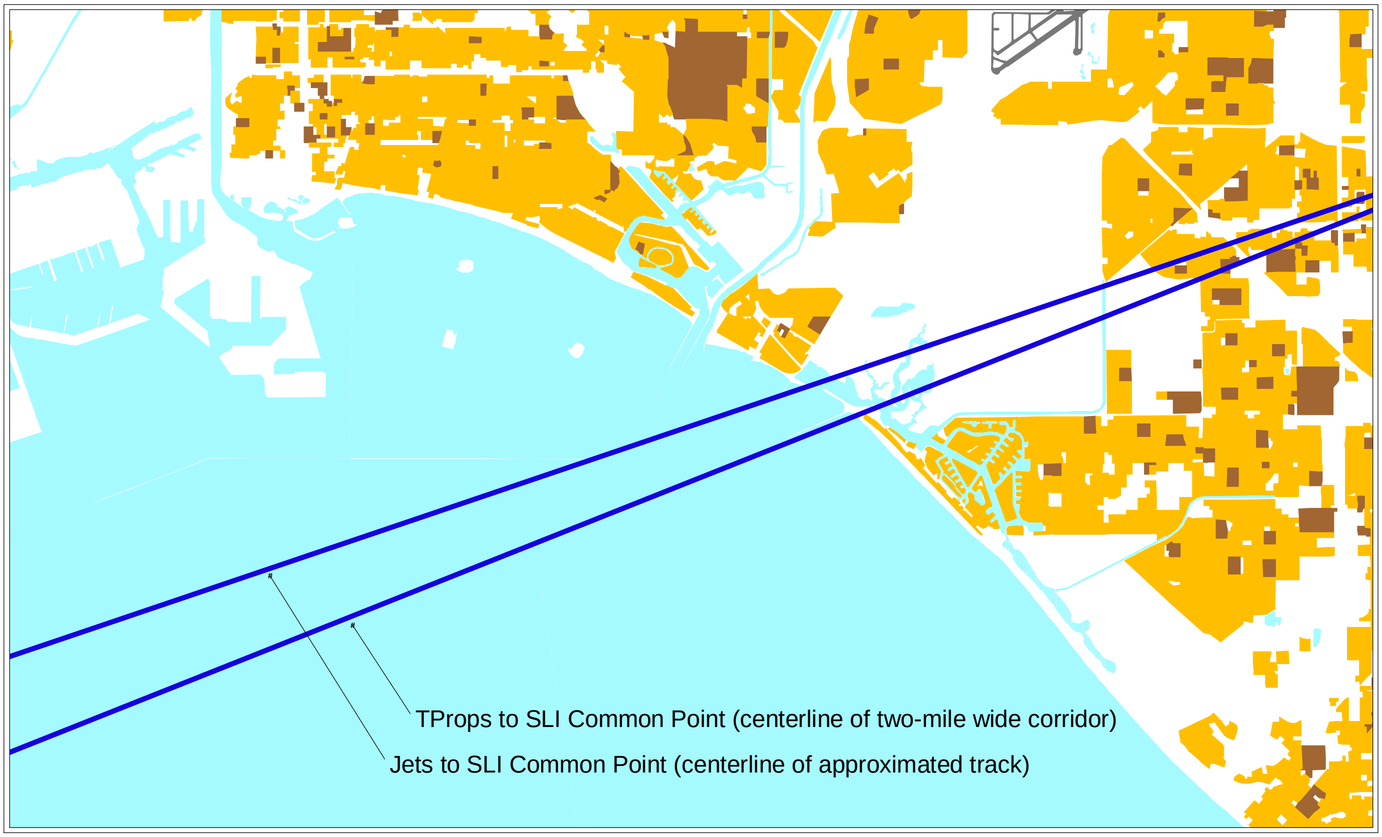

Figure 17 - LAX Departure Tracks, 3-Mile Offshore Alternative

N

"3-mile Offshore" Tracks
Land Use (SCAG)
Residential
School, Church, Hospital
Other / Compatible

1 0 1 2 3 4 Miles

LAX
Los Angeles
World Airports