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Analysis of the Neighborhood Environmental Survey

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16. Abstract

The Federal Aviation Administration (FAA) has undertaken a multi-year research effort to quantify the impacts of aircraft noise exposure on communities around commercial service airports in the United States (US). The goal of this research effort was to develop an updated and nationally representative civil aircraft dose-response curve, quantifying the relationship between aircraft noise exposure and community annoyance. To characterize this relationship, the research team designed and conducted the Neighborhood Environmental Survey (NES), which collected information from a statistically representative number of adult residents living around a balanced sample of 20 US. Airports — objectively chosen to reflect the nation as a whole. From the survey data, a national dose-response curve was derived that describes the relationship between aircraft noise exposure [in terms of Day-Night Average Sound Level (DNL)] and the percentage of individuals reported as being highly annoyed by aircraft noise.

Aircraft noise exposure levels were modeled using the FAA Integrated Noise Model (INM), version 7.0d; based on 12-month sets of aircraft flight tracking data collected between 2012 and 2014 for each NES airport. Community response data was collected through a mail survey questionnaire, designed to follow the recommendations of the International Commission on the Biological Effects of Noise (ICBEN) (Fields et al. 2001), requesting respondents to rank on a scale from 1 to 5 (with 5 being most): "*Thinking about the last 12 months or so, when you are here at home, how much does [noise from aircraft] bother, disturb or annoy you?*" Responses of either 4 or 5 where then considered as "highly annoyed."

Just over 10,000 people completed and returned the mail questionnaire (resulting in a response rate of 40 percent); administered in six separate "waves" over a 12-month period beginning in October 2015. Logistic regression analysis of the "highly-annoyed" responses from the mail questionnaire and their associated aircraft noise exposure levels were used to generate the national dose-response curve. The percentage of those surveyed who were highly annoyed by aircraft noise increased monotonically with increasing noise exposure. In comparison to prior studies on this topic, the NES's national curve shows substantially more people highly annoyed for a given DNL aircraft noise exposure level.

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23	Table 6-1, footnote superscripts made visible/corrected.
E-16 (Appendix E)	Figure E-1 replaced.
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List of Acronyms and Abbreviations

Acronym*	Definition
AAPOR	American Association for Public Opinion Research
ACE	Central Region
ACRP	Airport Cooperative Research Program
ACS	American Community Survey
AEA	Eastern Region
AEDT	Aviation Environmental Design Tool
AEE	FAA's Office of Environment and Energy
AFE	Above Field Elevation
AGL	Above Ground Level (altitude) or Great Lakes Region
ANE	New England Region
ANM	Northwest Mountain Region
ARTCC	Air Route Traffic Control Center
ASNA	Aviation Safety and Noise Abatement Act
ASO	Southern Region
ASW	Southwest Region
ATADS	Air Traffic Activity Data System
ATCT	Air Traffic Control Tower
AWP	Western Pacific Region
BTS	Bureau of Transportation Statistics
CART	Categorization and Regression Tree
CATI	Computer-Assisted Telephone Interviewing
CDD	Cooling Degree Days
CDSF	Computerized Delivery Sequence File
CFR	Code of Federal Regulations
CI	Confidence Interval
CSV	Comma-separated Value
CTL	Community Tolerance Level
dB	Decibel, A-weighted
DM	Data Management
DNL	Day-Night Average Sound Level
EO	Executive Order
EFA	Exploratory Factor Analysis
EPA	Environmental Protection Agency
ETMS	Enhanced Traffic Management System
F or °F	Fahrenheit
FAA	Federal Aviation Administration
FAQ	Frequently Asked Question
FICAN	Federal Interagency Committee on Aviation Noise
FICON	Federal Interagency Committee on Noise
FWA	Federalwide Assurance
GPS	Global Positioning System

Acronym*	Definition
GSSD	Global System for Sustainable Development
HA	Highly Annoyed
HDD	Heating Degree Days
HMMH	Harris Miller Miller & Hanson Inc.
ICR	Information Collection Request
Intl	International
ICBEN	International Commission on Biological Effects of Noise
IFR	Instrument Flight Rules
INM	Integrated Noise Model
IRB	Institutional Review Board
ISO	International Organization for Standardization
L_{max}	Maximum A-weighted Sound Level
LMS	Learning Management System
MSL	Mean Sea Level
NA	Number of Events (at or) Above a Specified (single-event) Sound Level
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NES	Neighborhood Environmental Survey
NM or nm	Nautical Miles
NOAA	National Oceanic and Atmospheric Administration
NOP	National Offload Program
OHRP	Office for Human Research Protection
OMB	Office of Management and Budget
PAF	Principle Axis Factoring
Percent HA	Percent Highly Annoyed
PDARS	Performance Data Analysis and Reporting System
PII	Personally Identifiable Information
PND	Postal Non-Deliverable
PO	Post Office
PRA	Paperwork Reduction Act
PUF	Public Use File
QC	Quality Control
RNAV	Area Navigation
RNP	Required Navigation Performance
RR1	Response Rate 1
RR2	Response Rate 2
RSS	Residual Sum of Squares
RUF	Restricted Use File
SEL	Sound Exposure Level
SID	Standard Instrument Departure
SQL	Structured Query Language
STAR	Standard Terminal Arrival Route

Acronym*	Definition
TCH	Arrival Threshold Crossing Height
TFMS	Traffic Flow Management System
TFMSC	Traffic Flow Management System Counts
TNO	Netherlands Organisation for Applied Scientific Research
TOW	Takeoff Weight
TRACON	Terminal Radar Approach Control Facility
TRC	Telephone Research Center
VFR	Visual Flight Rules
US	United States
USGS	United States Geological Survey
USPS	United States Postal Service
UTC	Coordinated Universal Time
WBAN	Weather Bureau Army Navy

*See Table 3-1 for airport abbreviations.

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Executive Summary

The Federal Aviation Administration (FAA) has undertaken a multi-year research effort to quantify the impacts of aircraft noise exposure on communities around commercial service airports in the United States (US). Community annoyance is the impact of interest covered by this report. Researchers typically determine an individual's annoyance to noise through sociological surveys that measure subjective reactions to cumulative noise exposure. To be a scientifically valid evaluation of aircraft noise, the survey and resulting analysis should query respondents experiencing a wide range of noise exposure from airports with variations in aircraft operations using an identical methodology (i.e., survey timeframe, survey instruments, and survey focus). Such efforts typically provide a dose-response curve that pairs the surveyed annoyance of many individuals to their noise exposure.

The Federal Interagency Committee on Noise (FICON) performed the most recent in-depth US Government agency review of human annoyance to noise in 1992. The dose-response curve that FICON developed in 1992 confirmed the appropriateness of Federal policy at that time. The FICON curve suggests that 12.3 percent of persons are "highly annoyed" by a Day-Night Average Sound Level (DNL) of 65 dB (FICON 1992). Research published in the two decades since the release of the FICON report suggests the FICON curve might under-estimate annoyance due to aircraft noise exposure. More recent dose-response curves from data collected outside the US have shown increased levels of annoyance at a given noise exposure level; further, the FICON curve included multiple modes of transportation, not just aircraft.

The overall goal of this research effort was to produce an updated and nationally representative civil aircraft dose-response curve for the US. To meet this goal, the research team designed and conducted a national survey, known as the Neighborhood Environmental Survey,[1] with an appropriate number of residents around an objectively selected sample of airports in the US. This report provides details on the Neighborhood Environmental Survey as well as an analysis of the mail questionnaire administered as a part of the Neighborhood Environmental Survey. The result of this effort is an update to the scientific evidence on the relationship between aircraft noise exposure and the annoyance of individuals living in airport communities.

The number of airports, and the mail survey sample size for each airport, were selected to provide an accurate estimation of the dose-response curve describing the relationship between annoyance (in terms of percent highly annoyed) and aircraft noise exposure. With criteria specified by the FAA, a multi-stage and statistically rigorous process was used to select a representative sample of US airports. Eligibility criteria were established to define a sampling frame consisting of airports in the contiguous US with at least 100 annual average daily jet operations, at least 100 people exposed to DNL greater than or equal to 65 dB, and at least 100 people exposed to DNL between 60 dB and 65 dB. Applying the eligibility criteria to all airports in the contiguous US resulted in a sampling frame of 95 airports. A subset of 20 airports was selected from the 95-airport set using a balanced sampling approach on a set of FAA-chosen factors. The Federal Interagency Committee on Aviation Noise (FICAN) reviewed the methods used to select the 20 surveyed airports and stated, "the balanced sampling methodology that was employed is the correct choice given the purpose of the study and the number and range of airports available for selection" (FICAN 2013).

The national survey utilized multiple independent reviews of the employed methods as well as a pilot study. Airport Cooperative Research Program (ACRP) Project 02-35 (Miller et al. 2014a) was a pilot study that enabled real-world testing of the methods used in the national survey. In addition to the FICAN review of the national survey's methodology, external review groups examined the methods underlying the data collection and analysis process and the resulting data. These reviews took place at three separate points during the ACRP study and during this research effort. Further, the statistical analysis methodologies were approved by the Bureau of

[1] Although the survey issued to respondents was titled the "Neighborhood Environment Survey", the official title as recorded by the Federal Office of Management and Budget (OMB) is the "Neighborhood Environmental Survey", i.e., "environmental" instead of 'environment'. The official OMB record of the survey can be found under OMB Control Number: 2120-0762 at: https://www.reginfo.gov/public/do/PRAViewICR?ref_nbr=201409-2120-002.

Transportation Statistics (BTS) and data collection was approved the Office of Management and Budget (OMB). Finally, an Institutional Review Board also reviewed all the methodologies used in conducting the national survey.

The research team used the FAA Integrated Noise Model (INM), version 7.0d, to compute the aircraft noise exposure for the 20 airports selected for the national survey.[2] The computations used a twelve-month sample of radar flight tracks and associated flight specific information, (e.g., aircraft type, time of operation, distance flown). DNL contours were computed for each airport based on operational data spanning June 2012 to May 2013 [November 2013 to October 2014 for Chicago O'Hare International Airport (ORD)]. The noise contours were used by the research team to stratify residential locations around each airport into groups based on DNL ranges. Five DNL strata were developed based on contour lines of DNL 50, 55, 60, 65 and 70 dB. The DNL values ultimately paired with the survey responses to create the dose response curve were computed for each respondent location by adjusting for the calendar year 2015 operations counts from the FAA's Air Traffic Activity Data System (ATADS). The radar flight tracking data analysis for the 2012-2013 period (the 2013-2014 period for ORD) was applied to the modeling for 2015.

Two survey instruments were administered to adult residents within the Neighborhood Environmental Survey: a mail questionnaire and a follow-up telephone interview for the mail respondents. A previous test survey of populations around three US airports, conducted by the research team through the ACRP Project 02-35, was used to inform the survey methods used here. The ACRP Project 02-35 results indicated that the response rate for the mail survey was greater and the cost was less than a phone survey. While the ACRP 02-35 results were inconclusive in determining if the mail survey data was significantly different from the telephone survey data, the mail survey was chosen to maximize the number of responses that could be attained for the funding available for the overall effort. The Neighborhood Environmental Survey's resultant national dose-response curve was based solely on the annoyance responses from the mail survey. The mail survey was administered to the individuals in the selected airport communities in six separate "waves" over a 12-month period starting in October 2015. The use of a 12-month period ensured seasonal effects did not influence the resulting dose-response curve.

All mail survey respondents were invited to complete a follow-up telephone interview, which asked detailed questions on several areas including respondents' opinions on noise, exposure to aircraft noise, relationship to the airport, concerns about aircraft operations, views on airport community relations, among others. The telephone survey data could aide in understanding why some people are highly annoyed by aircraft noise at a particular noise exposure while others at the same noise exposure are not; further, the information may help explain differences in annoyance responses among airports. The detailed questions used for the phone questionnaire were not appropriate for the mail questionnaire because the subject matter would have disclosed the purpose of the survey and potentially biased responses to the aircraft annoyance question. The phone survey data was not used to calculate the national dose-response curve as all responding households were already represented in the mail survey.

The mail questionnaire followed the recommendations of the International Commission on the Biological Effects of Noise (ICBEN) (Fields et al. 2001) and used a single question that read: "Thinking about the last 12 months or so, when you are here at home, how much does [noise from aircraft] bother, disturb or annoy you?" This primary question was embedded among 13 other questions on various sources of noise and other aspects of the respondent's community to mask the purpose of the survey and minimize potential response bias. Consistent with ICBEN recommendations, the respondent was given choices of "not at all," "slightly," "moderately," "very," or "extremely." A respondent was identified to be 'highly annoyed' if they answered either of the latter two choices. Over 10,000 people responded and completed the mail questionnaire – a response rate of 40 percent. Bias checks were conducted during and after the data collection and none was detected.

[2] Although INM was superseded in 2015 by the FAA's Aviation Environmental Design Tool (AEDT), the initial phases of this project had started prior to 2015. Further, INM had been used to select the respondents. The use of INM was maintained for consistency throughout the project.

Analysis of the 'highly annoyed' responses and the associated DNL was used to generate dose-response curves for each individual airport and a national dose-response curve. The analysis used the same form of the logistic regression model used by FICON in 1992, not only for historic consistency but because it was found to require the fewest assumptions, offer the greatest flexibility, and provide a good fit[3] to the observed data. The research team deemed the choice of logistic regression the most appropriate, compared to other curve fitting techniques. The national curve is applicable in the range of DNL 50 dB to DNL 75 dB; however, caution should be exercised in predicting annoyance for DNL greater than 70 dB, due to the relative lack of respondents at these exposure levels.

The dose-response curve created from the mail questionnaire shows considerably more people are highly annoyed by aircraft noise at a given noise exposure level compared to historical FICON data. In general, between 9 and 22 percent of those surveyed for the Neighborhood Environmental Survey were highly annoyed by the various items listed in the mail questionnaire. However, 42 percent of the respondents were highly annoyed by aviation noise (at any DNL). The percentage of those surveyed who were highly annoyed by aircraft noise increased monotonically with increasing noise exposure. The national dose-response curve shows that nearly two-thirds of people are highly annoyed at DNL 65 dB. The national dose-response curve also has a greater percent highly annoyed for a given noise exposure than recent European standards from the Netherlands Organization for Applied Scientific Research (TNO, see Janssen and Voss, 2011) and the International Organization for Standardization (ISO) (2016). While the national dose-response curve shows more people being highly annoyed at a given noise exposure level than the historical FICON data or more recent international standards, it is similar to results obtained in Europe since 2000. Caution should be exercised when comparing the national dose-response curve to the TNO and ISO standards, as the national curve provides the community response for a recent time frame whereas the TNO and ISO standards incorporate survey data taken over the last 50 years. As previously mentioned, the FICON data, which is included in the newer European standards, shows a lower level of percent highly annoyed for a given noise exposure. Differences between the national curve and the dose-response curves taken previously could be due to changes in people's attitudes toward noise; changes in the nature of the noise exposure; differences in the cultures of those being surveyed; differences in study design, implementation, or measurement; or a combination of these factors.

This report also presents several additional analyses to explore the heterogeneity of the individual airport relationships. The six factors analyzed were climate, three flight event characteristics, race/ethnicity, and income.[4] The 'Noticeable' flight event characteristic, (i.e., the number of events having a maximum sound level at or above 50 dB, $NA50L_{max}$), demonstrated marginal significance and should be investigated further because of the high correlation of $NA50L_{max}$ with DNL. None of the other five factors showed a statistically significant relationship with percent highly annoyed after accounting for the noise exposure as measured by DNL.

Overall, this research effort accomplished its goal, as it provides an updated and nationally representative dose-response curve of civil aircraft noise exposure and community annoyance for the US.

[3] "Fitting" or "fit" refers to the process whereby statistical techniques are used to produce a curve that best represents or "fits" the underlying data.

[4] Climate was characterized in terms of "degree days." The three flight event characteristics were (1) whether the aircraft was 'visible' at its point of closest approach to the respondent, (2) whether an event was 'noticeable' (related to the event's maximum sound level), and (3) the aircraft noise event's 'relative importance' (whether the event's DNL was part of the hierarchical list of events which contributed all but 1 dB of the respondent's total DNL). Income was characterized by percentage of population below the poverty level. For race/ethnicity, each respondent was characterized as minority (Hispanic, black or African American, American Indian, or Alaska Native, Asian, or Native Hawaiian or Other Pacific Islander) or nonminority (white non-Hispanic).

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1 Introduction

Research published by Schultz (1978) informs several aspects of aviation noise policy in the United States (US). This includes land-use compatibility guidelines around airports and the factors that determine noise mitigation funding. Schultz developed a correlation between transportation noise exposure levels in terms of a relatively large range of Day-Night Average Sound Levels (DNL) and the percent of the population highly annoyed (the so-called "Schultz curve") using social surveys on noise annoyance conducted in the 1960s and 1970s from a variety of countries. Not only is Schultz's work 40 years old, but the research also included multi-modal transportation (air, rail, and road) and was conducted at a time when aircraft operations were louder and less frequent.

Through the Aviation Safety and Noise Abatement Act (ASNA) of 1979, Congress directed the Federal Aviation Administration (FAA) to establish a single metric for assessing land use compatibility with respect to noise from aircraft operations, and to establish standards and methods for assessing the noise environment associated with ongoing aircraft operations near airports. In 1981, the FAA implemented the ASNA provisions; these are published at 14 Code of Federal Regulations (CFR), Part 150 ("Part 150")[5]. This regulation adopted the DNL metric, established land use compatibility guidelines for aircraft noise, specifying 65 A-weighted decibels (dB) of DNL as a threshold of noncompatibility for certain land uses, including residential, and established standardized methods for assessing the noise environment (FAA 2007). Currently, the FAA uses DNL 65 dB to support a variety of policy objectives, including assessment, identification, and mitigation of noncompatible land uses in the vicinity of civil airports, and evaluation of environmental consequences, (i.e., changes to the noise setting), that would occur if changes to aircraft operations or airfield infrastructure near an airport were implemented.

In 1992, the Federal Interagency Committee on Noise (FICON) compared Schultz's polynomial curve fit[6] with a logistic regression curve fit of 400 points, consisting of Schultz's 161 points plus 239 additional points. FICON arrived at a curve with very similar shape within the range of commonly encountered aviation noise (FICON 1992). Equation (1.1) is the general expression for the logistic regression model used by FICON relating DNL to percentage "highly annoyed" (percent HA). FICON's curve, Equation (1.2), has β_0=-11.13 and β_1=0.141 and DNL is expressed in dB.

$$\text{Percent HA} = \frac{100\ \exp(\beta_0 +\ \beta_1 DNL)}{1+\exp(\beta_0 +\ \beta_1 DNL)}. \tag{1.1}$$

$$\text{Percent HA}_{\text{FICON 1992}} = \frac{100\ \exp(-11.13 +\ 0.141\ DNL)}{1+\exp(-11.13 +\ 0.141\ DNL)}. \tag{1.2}$$

From the FICON curve, a DNL of 65 dB corresponds to 12.3 percent of people being highly annoyed. FICON also re-evaluated the use of DNL as the primary descriptor for long-term noise exposure of civil and military aircraft operations, and the particular level of DNL 65 dB, and recommended its continued use for the purpose outlined in the ASNA. Note that several researchers, including Schultz, suggested that DNL 65 dB was the practical, feasible threshold for acceptable noise exposure in residential areas (EPA 1974). The FICON effort was the last in-depth government agency review on the metric and measure. FICON re-affirmed Schultz's work, yet stated, "This work is continuing and may provide a basis for an improved understanding of community response to noise."

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[5] 14 CFR Part 150 was first promulgated as an Interim Rule at 46 Federal Register (FR) 8316 on January 19, 1981. The Final Rule was published at 49 FR 49260. Subsequent clerical and substantive amendments have occurred in the intervening years, the most recent of which was published at 72 FR 68475 in 2007.

[6] "Fitting" or "fit" refers to the process whereby statistical techniques are used to produce a curve that best represents or "fits" the underlying data.

Before this research effort, the largest systematic scientific study of multiple airports in the US was conducted between 1967 and 1971 at nine airports, the so-called "Tracor" study in 1973 (Connor and Patterson 1973); which found substantial differences among human responses. More recent surveys of airport communities have been conducted largely on a case-by-case basis; survey results published through 2008 are cataloged (Fields 1991; Bassarab, Sharp, and Robinette 2009). A number of these surveys were performed to evaluate the effects of specific events such as runway repairs or noise abatement procedures (Fidell et al. 1985). Other surveys of airport communities were summarized in 2011 (Fidell et al. 2011). Recent studies in the US and in Europe suggest that the attitude towards noise may have changed with time (Janssen et al. 2011; Groothius-Oudshoorn and Miedema 2006; Miedema and Vos 1998; Fidell and Silvati 2004). In addition, continued negative public reactions to aircraft noise at exposures less than DNL 65 dB suggest that a re-examination of the dose-response relationship is appropriate.

Noise is often the most immediately objectionable community effect of aviation and one that the FAA continues to investigate ways to address. Therefore, it is crucial to the FAA to collect updated community annoyance data for US airports. An updated dose-response curve would also provide FAA the scientific background to make informed decisions regarding aviation noise.

The overall goal of this research effort was to produce an updated and nationally representative dose-response curve that quantifies the relationship of peoples' surveyed annoyance response to aircraft produced noise exposure in the US. The study surveyed people living near 20 airports in the contiguous US regarding their annoyance with aircraft noise – the Neighborhood Environmental[7] Survey (NES). By combining survey results with modeled aircraft noise exposures in terms of DNL at each respondent's location, the outcome of the NES permits derivation of a nationally applicable dose-response relationship between aircraft noise and annoyance. This relationship is conceptually similar to the "Schultz Curve." Additional information collected through the surveys may also provide information about underlying causes of annoyance, such as climate or attitudes toward the airport.

Historical surveys on aircraft annoyance (e.g., Schultz and others) were primarily administered by telephone. Technological and respondent behavior changes in recent years has become a concern as survey response rates for telephone surveys have dropped considerably, increasing the potential for bias. Concurrently, address-based sampling with high coverage of the US population has become viable through the commercial availability of US Postal Service data, such that mail survey response rates today are substantially higher than telephone survey response rates. In order to determine the best mode for this research, a test survey of populations around three US airports in Airport Cooperative Research Program (ACRP) Project 02-35 (Miller et al. 2014a) was conducted. ACRP Project 02-35 is hereafter referred to as "ACRP 02-35" or "the ACRP 02-35 study". ARCP 02-35 indicated that the response rate for the mail survey was three times greater than the telephone survey and at lower cost. Due to the study's small sample size, it was not possible to be fully conclusive, but the ACRP study did not indicate that there were statistically different annoyance responses between the mail and telephone surveys. Additionally, web and in-person methodologies were considered but ruled out due to viability and cost concerns, respectively. Therefore, the NES's resultant national dose-response curve was based solely on a mail survey.

This report documents the major technical components of the survey:

- Development of the survey instruments (Section 2),
- The statistical process of selecting the 20 airports from the relevant population (sampling frame) of US airports (Section 3),

[7] Although the survey materials issued to respondents were titled the "Neighborhood Environment Survey", the official title as recorded by the Federal Office of Management and Budget (OMB) is the "Neighborhood Environmental Survey", i.e., "environmental" instead of 'environment'. The official OMB record of the survey can be found under OMB Control Number: 2120-0762 at: https://www.reginfo.gov/public/do/PRAViewICR?ref_nbr=201409-2120-002.

- The sample design within airports wherein individual households were selected from the 20 airport communities (Section 4),
- Submission of survey method to the Office of Management and Budget (OMB) and Westat Institutional Review Board (IRB) (Section 5),
- The process used to sample residents, administer the questionnaires, and calculate response rates (Section 6),
- The process used to produce the aircraft noise exposure contours and respondent-specific noise levels (Section 7),
- The resultant national dose-response relationships (Section 8),
- Results of additional analyses attempting to explain differences among airports (Section 9), and
- Data files available for further analyses (Section 10).

A bibliography of the references cited herein and Appendices A through J containing supportive detailed information follows Section 10.

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2 Development of Survey Instruments

Carefully designed survey instruments were used to collect people's annoyance reactions to the aircraft noise they experience. The two instruments used in this 20-airport research effort – a mail questionnaire and a telephone questionnaire – were first developed and tested in ACRP 02-35. The selection of those two survey modes was based on considerations of cost, data quality, and complexity of the instrument and comparability of results with earlier annoyance surveys. The comparison assessed in-person, telephone, mail, and web survey formats. The in-person survey ranked highest in all considerations, including cost. The FAA judged the cost for the in-person mode too high for the current effort while mail and phone were rated acceptable in all categories.

Research of the success of web-based surveys concluded that a web survey, rather than a mail survey, would not permit adequate coverage of potential respondents that do not have access to the web. In addition, mail surveys yield significantly higher response rates than web surveys. Some consideration was given to providing the respondents a choice between a mail questionnaire and a web questionnaire. This was rejected because a number of studies have found that giving respondents a choice depresses response rates (Dillman, Smyth and Christian 2008; Messer and Dillman 2011; Manfreda et al. 2008; Millar and Dillman 2011).

A thorough review of the literature was conducted to support the selection and design of the instruments. The main annoyance questions used in the questionnaire were based on recommendations by the International Commission on Biological Effects of Noise (ICBEN) (Fields et al. 2001). The intent was to identify which factors are most likely to affect annoyance reactions to aircraft noise, and address these in the design of the instruments. Some broad conclusions about 30 hypotheses were reached. In general, demographic characteristics of residents (gender, age, education, socio-economic status, etc.) have no important impact on noise annoyance (Fields 1993; Miedema and Vos 1999). As a result, demographic characteristics do not explain differences between annoyance reactions in different geographical areas. Selected attitudes, on the other hand, have a consistently strong effect: fear of danger from the noise source, perception that authorities could better control the noise, and self-reported general sensitivity to noise. A change in noise exposure affects reactions for road traffic and railway noise, but the effect on aircraft noise annoyance is uncertain. Ambient noise levels and time spent at home do not have an important effect on annoyance (Miller et al. 2014b).

Two survey modes were developed and tested during ACRP 02-35: (1) a mail survey using a brief questionnaire, and (2) a telephone survey with an interview of approximately 20 minutes in duration. The mail questionnaire was shorter due to the exclusion of detailed questions on aircraft that would have been visible to respondents from the outset. Thus, their inclusion would have given away the nature of the survey and could have biased responses to the aircraft annoyance question. In the telephone survey, the annoyance questions were asked first, and thus not subject to bias from later questions about aircraft.

The ACRP 02-35 study proposed that a mail questionnaire should form the basis for an updated dose-response relationship because of the following reasons:

- The ACRP project's telephone survey had a response rate of only 12 percent compared to the mail survey's 35 percent;
- Mail surveys have fewer coverage issues compared to telephone;
- The majority of mail survey households adhered to the respondent selection protocol, providing evidence against the concern that those most annoyed would self-select into the survey;
- The mail survey respondents were closer to Census figures on demographic variables collected; and

- While acknowledging small sample sizes, there is no evidence that there was a difference in annoyance between respondents to the mail survey and respondents to the telephone survey. Further, in light of the above reasons, if any differences in annoyance existed, it could indicate improved data on the mail survey due to a more robust representation of the population.

The ACRP project also provided insight to the desired sample sizes. The number of addresses selected at each airport should be sufficient to determine a statistically significant difference (if there is one) between the revised relationship and the Schultz/FICON curve (Schultz 1978; FICON 1992). The derived dose-response relationship will certainly vary from airport to airport; consequently, the number of addresses selected must be sufficient to explore any heterogeneity across airports. A detailed analysis showed that 500 completed mail questionnaires are required for each of the 20 airports. Similar methods were used to determine the precision of responses to 100 completed telephone interviews for each of the 20 airports.[8]

All mail survey respondents were invited to complete a follow-up telephone interview, which asked detailed questions on a number of areas including respondents' opinions on noise, exposure to aircraft noise, relationship to the airport, concerns about aircraft operations, views on airport community relations, among others. The telephone survey data could aide in understanding why some people are highly annoyed at a particular noise exposure while others at the same noise exposure are not; further, the information may help explain differences in annoyance responses among airports. The detailed questions used for the phone questionnaire were not appropriate for the mail questionnaire because the subject matter would have disclosed the purpose of the survey and potentially biased responses to the aircraft annoyance question. The mail and Computer Assisted Telephone Interviewing (CATI) survey instruments used for this research effort are provided in Appendix A and Appendix B, respectively. The mail questionnaire contained 11 questions. The telephone questionnaire contained up to 51 questions.

Both the mail and telephone survey instruments are very similar to those used in the ACRP 02-35 study, though both have some changes and additions relative to the ones used during ACRP 02-35 work:

- The instruments used in this research effort have material describing the Paperwork Reduction Act that requires approval of all federal government surveys by the OMB. Race categories were revised to conform to OMB guidelines.
- ACRP 02-35's survey name was the "Community Attitude Survey" whereas the survey in this project is called the "Neighborhood Environmental Survey".
- The NES was conducted for and funded by the US Department of Transportation whereas the Community Attitude Survey was conducted for and funded by the National Academies of Sciences, Engineering and Medicine.
- The telephone instrument has several clarification changes of wordings and some question deletions.

Once the mail and telephone survey instruments were finalized, they and all other materials were translated into Spanish to allow the survey to be administered in Spanish, as was needed.

[8] For a complete discussion of the sample size determination see Supporting Statement for a New Collection RE: Neighborhood Environmental Survey, Part B, Section B.1, https://www.reginfo.gov/public/do/PRAViewDocument?ref_nbr=201409-2120-002

3 Airport Selection

A statistical process was used to select a representative sample of 20 airports from a sampling frame of 95 US airports. Section 3.1 describes the four criteria applied to construct the sampling frame of 95 airports. Balanced sampling was used to select a representative sample of 20 airports from the sampling frame using a set of balancing factors, as described in Section 3.2. The selections of individual addresses, based on DNL strata, is the subject of Section 4.

3.1 Sampling Frame

The sampling frame, from which the 20 airports for this research effort were selected, was based on four criteria. An eligible airport needed to:

1. Be located within the contiguous US,
2. Have at least 100 average daily jet operations as shown by FAA's Traffic Flow Management System Counts (TFMSC) for 2011,
3. Have at least 100 people exposed to DNL greater than or equal to 65 dB, and
4. Have at least 100 people exposed to DNL between 60 dB and 65 dB.

Criterion 1 reflects the fact that only airports in the 48 contiguous States were included.[9] Criterion 2 helped ensure there were sufficient operations to provide a minimum of noise exposure to the surrounding communities. Criteria 3 and 4 were to ensure the surveyed airports would have a sufficient number of people at all exposure levels of interest.

These criteria yielded the 95 airports listed in Table 3-1 and mapped in Figure 3-1. Of these, three airports had been previously sampled in the ACRP 02-35 study, (San Diego International Airport (SAN), Portland International Airport (PDX), and General Edward Lawrence Logan International Airport (BOS)), and were excluded from the sample.[10] Including any of these three airports in the NES sample would have meant re-sampling the same addresses.

The FAA designated three international airports for inclusion in the sample because of their large number of operations: Hartsfield-Jackson Atlanta International Airport (ATL), Chicago O'Hare International Airport (ORD), and Los Angeles International Airport (LAX). The remaining 17 airports in the sample were selected from the 89 airports that remained after excluding the directed airports (ATL, ORD, and LAX), and after excluding the three ACRP 02-35 airports (SAN, PDX, and BOS), from the list of 95 airports. The FAA further specified that one of the remaining 17 airports in the sample be chosen from the three major New York City-area airports (LaGuardia Airport (LGA), John F. Kennedy International Airport (JFK), or Newark Liberty International Airport (EWR)), and the sampling procedure ensure that any possible sample contained exactly one of these three airports.

[9] This criterion led to the exclusion of Honolulu International Airport as it met criteria 2-4. No other airports in Alaska or Hawaii met these criteria.

[10] However, the FAA may make the data available from ACRP 02-35 for further analysis.

Table 3-1. List of Airports Eligible for the Survey

Airport Identifier	Airport Name	Airport Identifier	Airport Name
ABQ	Albuquerque Intl Sunport	LIT	Bill and Hillary Clinton National Airport / Adams Field
ALB	Albany Intl	MCO	Orlando Intl
APA	Centennial	MDW	Chicago Midway Intl
ATL	Hartsfield-Jackson Atlanta Intl	MEM	Memphis Intl
AUS	Austin-Bergstrom Intl	MHT	Manchester
BDL	Bradley Intl	MIA	Miami Intl
BED	Laurence G Hanscom Field	MKE	General Mitchell Intl
BFI	Boeing Field / King County Intl	MSN	Dane County Regional
BHM	Birmingham Intl	MSP	Minneapolis-St. Paul Intl
BIL	Billings Logan Intl	MSY	Louis Armstrong New Orleans Intl
BNA	Nashville Intl	OAK	Metropolitan Oakland Intl
BOI	Boise Air Terminal / Gowen Field	OKC	Will Rogers World
BOS	General Edward Lawrence Logan Intl	OMA	Eppley Airfield
BTR	Baton Rouge Metropolitan, Ryan Field	ONT	Ontario Intl
BTV	Burlington Intl	ORD	Chicago O'Hare Intl
BUF	Buffalo Niagara Intl	ORF	Norfolk Intl
BUR	Bob Hope	PBI	Palm Beach Intl
BWI	Baltimore/Washington Intl Thurgood Marshall	PDK	Dekalb-Peachtree
CAE	Columbia Metropolitan	PDX	Portland Intl
CAK	Akron-Canton Regional	PHL	Philadelphia Intl
CHS	Charleston Air Force Base/Intl	PHX	Phoenix Sky Harbor Intl
CLE	Cleveland-Hopkins Intl	PIT	Pittsburgh Intl
CLT	Charlotte/Douglas Intl	PNS	Pensacola Gulf Coast Regional
CMH	Port Columbus Intl	PSP	Palm Springs Intl
CVG	Cincinnati/Northern Kentucky Intl	PVD	Theodore Francis Green State
DAL	Dallas Love Field	PWM	Portland Intl Jetport
DCA	Ronald Reagan Washington National	RDU	Raleigh-Durham Intl
DFW	Dallas/Fort Worth Intl	RIC	Richmond Intl
DSM	Des Moines Intl	RNO	Reno/Tahoe Intl
DTW	Detroit Metropolitan Wayne County	ROC	Greater Rochester Intl
ELP	El Paso Intl	SAN	San Diego Intl
EWR	Newark Liberty Intl	SAT	San Antonio Intl
FAT	Fresno Yosemite Intl	SAV	Savannah / Hilton Head Intl
FLL	Fort Lauderdale/Hollywood Intl	SBA	Santa Barbara Municipal
FSD	Joe Foss Field	SDF	Louisville Intl-Standiford Field
FXE	Fort Lauderdale Executive	SEA	Seattle-Tacoma Intl
GEG	Spokane Intl	SFO	San Francisco Intl
HOU	William P. Hobby	SJC	Norman Y. Mineta San Jose Intl
HPN	Westchester County	SNA	John Wayne Airport-Orange County
IAD	Washington Dulles Intl	STL	Lambert-St. Louis Intl
IAH	George Bush Intercontinental/Houston	SYR	Syracuse Hancock Intl
IND	Indianapolis Intl	TEB	Teterboro
JAX	Jacksonville Intl	TPA	Tampa Intl
JFK	John F. Kennedy Intl	TUL	Tulsa Intl
LAS	McCarran Intl	TUS	Tucson Intl
LAX	Los Angeles Intl	TYS	McGhee Tyson
LGA	LaGuardia	VNY	Van Nuys
LGB	Long Beach / Daugherty Field		

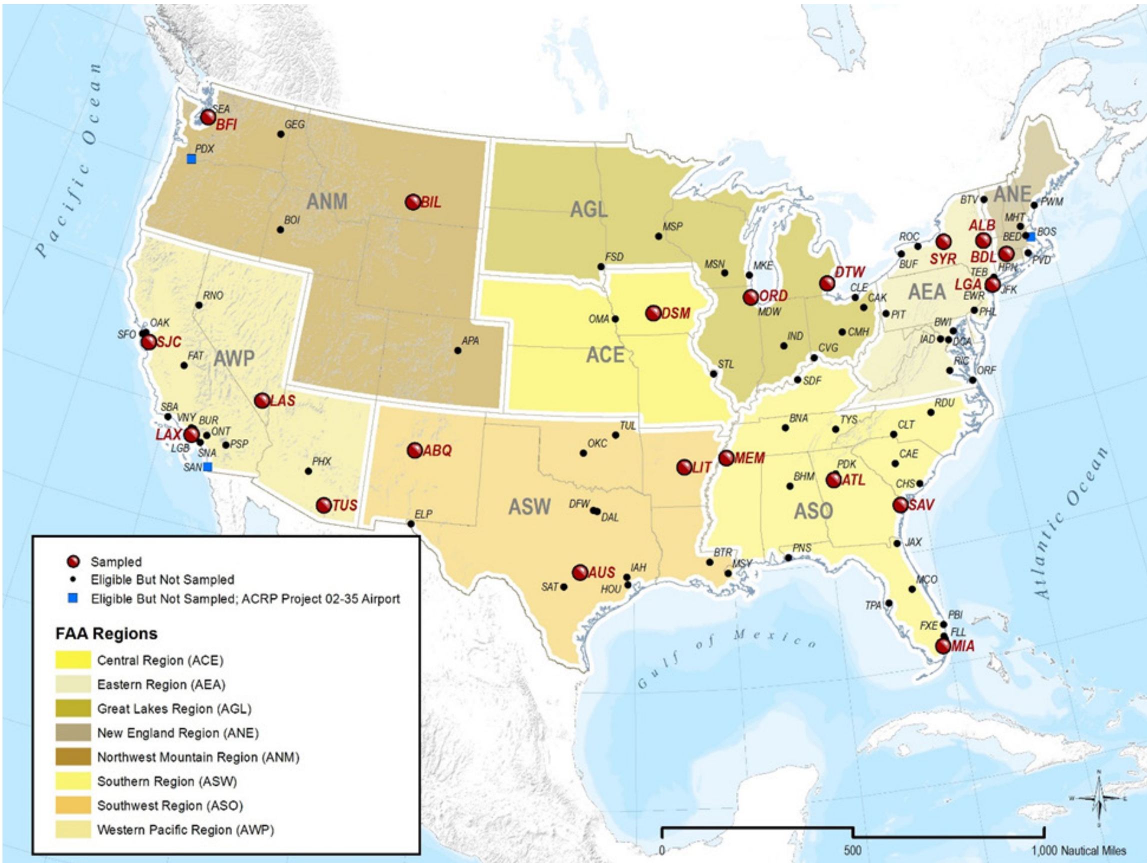

Figure 3-1. Map of Airports Eligible for the Survey and Sampled Airports

3.2 Balanced Sampling of 20 Airports

Balanced sampling was used to select the 20 airports for the NES, with the goal of obtaining a representative sample of airports. An "ideal" sample of airports would be a small-scale version of the population that mirrors the population for every characteristic of interest; however, because most characteristics are unknown before sampling, no sample selection procedure can provide an absolute guarantee that every characteristic in the sample has the same distribution as in the population. Balanced sampling ensures that the sample matches the population on a predetermined subset of characteristics called the balancing factors. The values of the balancing factors are known for the population units before sampling, and the balanced sample is selected so that the sample mean of each balancing factor approximately equals the population mean for that factor.[11] The method of balanced sampling dates back to Yates (1946), was advocated as an alternative to probability sampling by Royall (1976), and is described and explored in detail in Valliant et al. (2000) and Tillé (2011).

The airport sample for the NES has approximately the same proportion of airports as the population with respect to each of the balancing factors shown in Table 3-2. The set of 20 airports, taken as a whole, represents the population of 95 airports with respect to these balancing factors. The FAA, in collaboration with the research team, selected these factors for the reasons outlined below.

[11] A balanced sample is also a goal of random sample selection (Brewer, 2002, p. 82). A large randomly selected sample is expected to be approximately balanced on different factors because of the law of large numbers. But in a sample of size 20, a particular randomly chosen sample can be badly unbalanced on some factors. The balanced sample selection guarantees that the sample is representative on the balancing factors. Variables that are highly correlated with the balancing factors are expected to be approximately balanced as well.

Table 3-2. Balancing Factors for Selection of Airports

Balancing Factor	Description of Selection Variables
FAA Region	Proportion of airports in each of eight FAA regions in the contiguous US(1)
Average Daily Temperature	Proportion of airports with average daily temperature above 70 degrees F
	Proportion of airports with average daily temperature below 55 degrees F
Percent of DNL Nighttime Flight Operations	Proportion of airports with 20 percent DNL nighttime operations(2)
Average Daily Flight Operations	Proportion of airports with more than 300 average daily flight operations(3)
Aircraft Fleet Mix Ratio	Proportion of airports with a fleet mix ratio of commuter to large jet aircraft flight operations exceeding 1(4)
Population within 5 Miles	Proportion of airports with at least 230,000 people living within 5 miles of the airport(5)

Notes:

(1) The FAA has nine regions but only eight in the contiguous US.

(2) DNL nighttime is 10:00 p.m. to 6:59 a.m.; 20 percent was the originally calculated median percentages of nighttime operations, discovered later to have been in error, see text below and Appendix C for further detail .

(3) Three hundred flight operations was a rounding of the median number of daily flight operations across the 95 airports, 270.

(4) Large jet aircraft defined as jet-engine aircraft weighing more than 41,000 pounds, such as the B737, A320, B757, B747; Commuter aircraft are all non-jet aircraft, such as the ATR-42, SF-340 and general aviation aircraft, along with regional and business jet aircraft, such as the Canadair Regional Jet and Learjet.

(5) The mean population within 5 miles of the airport, 230,000, was selected as the dividing point (instead of the median) because it ensured that the airports with the largest population affected were represented in the sample proportionately to their representation in the population of 95 airports.

The region factor ensured that the proportion of sampled airports within each region would be approximately equal to the proportion of the 95 airports within that region. This forced the sample to be spread out among the eight regions; without this balancing, it would have been theoretically possible for all of the airports except for ATL, ORD, LAX, and the New York City-area airport to have been located in one area of the country with no sampled airports in the rest of the country.

The temperature factor was chosen to ensure that the sample contained airports with a range of temperatures. Previous research has indicated that temperatures affect annoyance, with higher annoyance being observed at higher temperatures (Miedema, Fields and Vos 2005). Together, the two temperature factor divisions guarantee that the sample percentage of airports in each of the three average daily temperature ranges—below 55 degrees F, between 55 and 70 degrees F, and above 70 degrees F—matches the population percentage in that category.

For DNL nighttime operations, the sample was selected to match the population percentage of airports with more than 20 percent nighttime operations, according to initial calculations of those percentages. After the survey data were collected, an error was discovered in the calculations of the percentage of nighttime operations. This error does not affect the representativeness of the sample, however — balanced sampling guarantees that the sample is representative on any factors used in the design — and, in fact, the sample closely matches the population distribution for the corrected values of percentage nighttime operations. The population distribution of corrected percentage nighttime operations has 25th, 50th, and 75th percentiles of 9.8 percent, 12.8 percent, and 15.8 percent, respectively; the corresponding percentiles for the sample are 9.9 percent, 12.6 percent, and 17.0 percent.

The operations and fleet mix factors ensured that the sampled airports have variations in the number of daily operations and fleet mix. The population factor was included so that airports with varied population settings, (i.e., airports in rural, suburban and urban settings), would be included.

The target sample size for each category of each factor was set equal to the integer closest to the product of 20 and the proportion of the 95 airports in the sampling frame in that category. A sample met the balancing constraints if it achieved the target sample size for each of the factors in Table 3-2. In this way, the proportion of airports in the sample with average daily temperature above 70 degrees Fahrenheit (F) approximately[12] equalled the proportion of airports in the sampling frame with average daily temperature above 70 degrees F; the proportion of airports in the sample with more than 20 percent nighttime operations approximately equalled the proportion of airports in the sampling frame with more than 20 percent nighttime operations; and so on, for each of the balancing factors.

Restricted random sampling (Valliant, Dorfman, and Royall 2000) with a modification to include the airports ATL, ORD, and LAX, was used to select a sample that provides balance on the factors given in Table 3-2. In restricted random sampling, a large number[13] of random samples is generated from the population of airports. Each of those samples is checked to see whether it meets the balancing constraints; any samples that do not meet the constraints are rejected. Finally, one sample is selected at random from the non-rejected samples (all of which meet the balancing constraints). This procedure results in a sample that is randomly selected from the set of possible samples that are balanced with respect to the factors in Table 3-2. The procedure for generating candidate balanced samples, and the random selection at the last stage, ensure that the sample used for the NES, after accounting for the inclusion of LAX, ATL, and ORD, was selected using objective procedures and not subjective judgments. The details of the procedure used to select the sample of 20 airports are given in Appendix C along with a description of the development of each of the balancing factors. Appendix C also presents the distribution of the balancing factors for the sample of 20 airports, relative to the distribution for the 95 airports listed in Table 3-1.

Table 3-3 and Figure 3-1 show the 20 airports in the sample. As described in Chapter 7, noise modeling also included SEA due to the influence of its aircraft operations on BFI.

Table 3-3. The 20 Airports in the Sample

Identifier	Airport Name	Identifier	Airport Name
ABQ	Albuquerque International Sunport	LAX	Los Angeles International
ALB	Albany International	LGA	LaGuardia
ATL	Hartsfield-Jackson Atlanta International	LIT	Bill and Hillary Clinton National Airport / Adams Field
AUS	Austin-Bergstrom International	MEM	Memphis International
BDL	Bradley International	MIA	Miami International
BFI	Boeing Field / King County International	ORD	Chicago O'Hare International
BIL	Billings Logan International	SAV	Savannah / Hilton Head International
DSM	Des Moines International	SJC	Norman Y. Mineta San Jose International
DTW	Detroit Metropolitan Wayne County	SYR	Syracuse Hancock International
LAS	McCarran International	TUS	Tucson International

[12] The equality was approximate because the number of airports in the sample meeting each criterion had to be an integer.

[13] The balanced sampling procedure guarantees that the sample as a whole is representative with respect to the balancing factors; the additional step of random selection from the set of possible samples that meet the balancing constraints provides an additional layer of protection for the sample being representative on other characteristics.

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4 Address Selection and Data Collection Protocols

This section describes the process whereby individual addresses were selected, based on DNL strata, near each of the 20 airports; and the protocols that were used for the mail and telephone surveys. Section 4.1 describes how the sample size for each aircraft was determined for each of the noise strata. Section 4.2 describes the procedures used to select the sampled addresses from each noise stratum, and to divide the sample into release groups so that addresses from each noise stratum and airport would be sampled throughout the yearlong period of data collection. Sections 4.3 and 4.4 describe the data collection protocols for the mail and telephone surveys, respectively.

4.1 Sample Size Selection of Addresses

With the objective of this research effort to determine a regression-based curve describing the national relationship between annoyance (in terms of percent HA) and DNL, the sample design for addresses to be selected from each airport community was tailored for estimating a regression relationship (Lohr 2014). The target population for each airport was defined to be addresses with aircraft DNL of 50 dB or greater. FAA primarily considered the following factors in choosing DNL 50 dB as the NES's lower bound for a contour interval:

- In addition to the primary DNL threshold of 65 dB, the FAA also considers changes in DNL at noise exposures as low as DNL 45 dB, for purposes of identifying reportable changes for air traffic actions under the National Environmental Policy Act (NEPA).
- The US Environmental Protection Agency (EPA) has identified DNL 55 dB as adequate to protect public health and welfare with an adequate margin of safety (EPA 1974).
- While the FAA's Integrated Noise Model (INM) can accurately compute aircraft noise exposure over the full extent of conditions required by regulation, the accuracy of the calculation depends on a number of assumptions about thrust, altitude, and airspeed. As aircraft distance from the airport increases, the importance of these parameters to the noise on the ground also increases. As a result, greater care must be taken in the preparation of modeling inputs for lower DNL values and increased modeling uncertainty is possible.
- The 1992 FICON curve had relatively few (annoyance) data points below DNL 55 dB compared to greater DNL values.
- The cost of the NES would increase with decreasing DNL because greater numbers of population/respondents would need to be included.

The number of airports and sample size for each airport were selected to allow accurate estimation of the national dose-response curve and dose-response curves for each airport. There are two components to the variance of the estimated national curve: the first is the variability among respondents within an airport community, and the second is the differences from one airport to another. Increasing the number of respondents for one particular airport community only addresses the first source of variability; increasing the number of airports reduces both sources of variability. Having 20 airports allows the relationship to be estimated precisely using a smaller sample size within each airport community. The research team used results of previous studies (FICON 1992; Fidell and Silvati 2004; Fidell et al. 2011) to calculate estimated precisions for varied numbers of respondents. This effort demonstrated that the numbers of respondents in Table 4-1 should achieve the aforementioned goal. Increasing the number of addresses per airport beyond 500 was not expected to increase precision appreciably.

Table 4-1. Target Number of Respondents for each Airport, and for the NES as a Whole

Survey	Each Airport or All Airports	Noise Exposure Range, dB DNL					Total
		50-55	55-60	60-65	65-70	70+	
Mail	Each airport	100	100	100	100	100	500
Mail	Total, all airports	2,000	2,000	2,000	2,000	2,000	10,000
Telephone	Each airport	19.5	19.5	19.5	19.5	19.5	97
Telephone	Total, all airports	389	389	389	389	389	1,945

Each mail respondent was invited to participate in an additional telephone interview, and the anticipated number of telephone respondents was calculated assuming that 19.5 percent of mail respondents could be reached by telephone and would agree to participate in the telephone interview. Tables 4-2 and 4-3 show the assumptions made about response rates and vacancies used when planning the survey. Based on the ACRP 02-35 study and on the rates of other recent studies, the research team anticipated an overall mail response rate of 40.0 percent and a telephone response rate of 7.8 percent, as shown in Table 4-3. These response rates include assumptions about postal non-deliverables, resident locations with no matching phone number or with invalid phone numbers.

Table 4-2. Anticipated Sample Sizes and Completes

Item	Number
A. Mail Survey	
A1. Initial sample	26,700
A2. 6.3% PND (Postal nondeliverables) (see Note 1)	1,682
A3. Eligible sample (A1 minus A2)	25,018
A4. 40% of A3 complete mail questionnaires	10,007
B. Telephone Survey (see Note 2)	
B1. 40% of A4 match to telephone number	4,003
B2. 85.1% of B1 are valid matches	3,407
B3. 30% of B2 complete phone interview	1,022
B4. 60% of A4 do not match to telephone number	6,004
B5. 14.9% of B1 are invalid matches	596
B6. Total phone number requests (B4 + B5)	6,600
B7. 35% of B6 provide phone number	2,310
B8. 40% of B7 complete phone interview	924
B9. Total telephone completes (B3 + B8)	1,946

Notes:
(1) Postal nondeliverables are mailed questionnaires returned as nondeliverable by the US Postal Service.
(2) The numbers here vary from the table in the OMB submission due to a corrected error.

Table 4-3. Anticipated Response Rates

Response Rate	Percent
Anticipated mail survey response rate (A4/A3)	40%
Anticipated telephone survey response rate (B9/A3)	7.8%

In order to achieve high precision for the estimated dose-response relationships, a stratified random sampling design was used to select addresses across a range of noise exposures. The sample allocation in Table 4-1 also makes the sample design robust to planning assumptions about the shape of the curve (Abdelbasit and Plackett 1983, Chaloner and Larntz 1989) and allows for evaluating possible deviations from the assumed logistic model.

Stratified random sampling provided a sample that was relatively evenly distributed across noise levels by allowing the sample to have greater sampling fractions for addresses at greater noise exposures than would have been possible with simple random sampling within airports. A simple random sample of 500 households, taken from the set of an airport's households with DNL greater than or equal to 50 dB, would give low precision for estimating the logistic regression function. Most of the addresses in a simple random sample would have low DNL, and few, if any, households in the simple random sample would have high DNL. Such a sample would result in fitting a logistic regression curve to a data set with almost all of the DNL values at the low end of the range, and thus would have little information for fitting a curve to the upper end of the DNL range (approximately DNL 70 dB in this case).

Five DNL strata were defined by contour lines of DNL 50, 55, 60, 65 and 70 dB. The strata were defined as 50-55 dB, 55-60 dB, 60-65 dB, 65-70 dB and "70+" dB, where addresses exactly on the boundaries were assigned to the higher noise stratum. Addresses were randomly selected within each of the noise strata at each airport, with an initial target sample size of 100 respondents per stratum. To achieve 100 respondents in each stratum, approximately 250 addresses would be needed under the assumed response rate (40 percent) to receive 100 completed questionnaires.

As stated in Section 5, any Federally-funded project that solicits information from US citizens requires review and approval by the US OMB.[14] After the sampling plan, which included the associated survey instruments, was approved by the OMB, the DNL contours were used to ascertain the number of addresses in each DNL stratum at each of the 20 airports in the sample. When addresses were counted in September 2015,[15] it was found that only three of the airports had at least 250 addresses in the highest DNL stratum of 70 dB or more, and only seven airports had at least 250 addresses with DNL greater than or equal to 65 dB. Table 4-4 gives the number of airports, out of the sample of 20 airports, with sufficient addresses (250 at expected 40 percent response rate) to obtain at least 100 completed questionnaires in each of the five noise strata and number of airports with any addresses at each noise strata.

Table 4-4. Airports Having Sufficient Addresses to Complete 100 Questionnaires within Each Noise Exposure Range

Number of Airports Statistic	Numbers of Airports Having Addresses in DNL Range				
	50-55 dB	55-60 dB	60-65 dB	65-70 dB	70 dB or Greater
Having adequate sample sizes to meet goal of 100 subjects per noise exposure range	20	20	11	7	3
Having any subjects per noise exposure range	20	20	20	17	7

The sample size of 500 for each airport (100 per noise stratum) was re-allocated to the noise strata at airports with insufficient numbers of addresses in high noise strata. The re-allocation was done starting at the highest noise stratum. If there were insufficient addresses to yield 100 respondents in the DNL 70+ dB noise stratum, then all addresses in that stratum were to be sampled. The difference was calculated between the target sample size in that stratum (100) minus the expected number of respondents from that stratum. That difference was then allocated equally to the remaining noise strata at the airport. If there were insufficient addresses in the DNL 65-70 dB stratum, the process was repeated with that stratum, and the difference between the target sample size and the expected number of responses in that stratum was allocated equally to the lower noise strata. For example, for an airport with no addresses having DNL greater than 70 dB, but with sufficient addresses in the other noise strata, the sample was re-allocated so as to yield an expected 125 respondents in each of the four noise strata of DNL 50-55 dB, 55-60 dB, 60-65 dB, and 65-70 dB. Table 4-5

[14] Paperwork Reduction Act, Pub. L. No. 96-511, 94 Stat. 2812, codified at 44 U.S.C. §§ 3501–3521 https://www.gpo.gov/fdsys/pkg/PLAW-104publ13/html/PLAW-104publ13.htm

[15] The FAA furnished to the contractor team the 95 airports from whom survey respondents at 20 airports (selected as previously described) were to be sampled. At the time of this initial selection (circa 2011) each of these 95 airports were believed to contain at least 100 people (not necessarily addresses) exposed to between DNL 60 dB and DNL 65 dB and 100 people exposed to DNL greater than 65 dB based on prior FAA analysis.

shows the updated estimates of completes by strata after this re-allocation. The individual airport sample sizes for each stratum varied and, therefore, are not shown in Table 4-5.

Table 4-5. Revised Planned Number of Respondents for each Airport, and for the NES as a Whole

Survey	Each Airport or All Airports	Number of Planned Respondents in DNL Range					Total
		50-55 dB	55-60 dB	60-65 dB	65-70 dB	70 dB or Greater	
Mail	Each airport	*	*	*	*	*	500
Mail	Total, all airports	3,449	3,441	1,856	913	341	10,000
Telephone	Each airport	*	*	*	*	*	97
Telephone	Total, all airports	671	669	361	178	66	1,945

* Counts for each airport by noise strata are not displayed since the numbers were variable depending on number of addresses available.

4.2 Procedures for Selecting Addresses

The target sample sizes allocated in Section 4.1 were inflated to allow for a reserve sample in the event that response rates were less than expected, or that the rates for vacant and seasonal housing or undeliverable addresses were greater than expected. The initial sample sizes were calculated based on the predicted 40 percent response rate and 6.3 percent postal nondeliverable (PND) rate. Extra reserve sample was included should the response rate be less than 40 percent or the PND rate exceed 6.3 percent at some airports. The size of the reserve sample varied across airports because airports with a greater number of addresses classified as vacant, seasonal, and drop points[16] were allocated additional reserve sample. As mentioned in Section 4.1, all addresses were selected for the sample in noise strata that had insufficient addresses to yield 100 respondents under these assumptions.

The US Postal Service (USPS) Computerized Delivery Sequence File (CDSF)[17] was used as the household sampling frame. For each airport in the sample, contours for DNL 50, 55, 60, 65, and 70 dB were determined using the FAA's INM, as described above. These contours defined the sampling strata for each airport. The contours were provided as GIS shape files to the sampling vendor who identified all households within each stratum using the USPS CDSF.

Addresses identified as businesses, group quarters[18], and post office (PO) boxes (unless this was the only way the household received mail) were excluded from sampling. However, to ensure maximum coverage, addresses identified as vacant and seasonal were included due to the length of the field period and the chance the occupancy status would change by the time of sample release. Additionally, drop points were included since some airports had a very high proportion of such addresses. Addresses that met these criteria were sampled with equal probability within noise strata at each airport, resulting in a total initial sample size of 53,916. The sample was randomly assigned to six waves within each airport and noise stratum, with a wave released every 2 months. The first wave's size was set based upon estimates of sample performance from the ACRP 02-35 study and was released in its entirety at the beginning of data collection. To ensure that the first wave was a representative subsample of the initial sample, it was formed by sorting the initial sample within each airport noise stratum by county, census tract, block group, and block; then selecting an equal probability systematic sample within each airport noise stratum. The Wave 1 sample size within each

[16] Response rates are often less for addresses in these classifications. A drop point is a mail delivery point that serves multiple households (US Postal Service 2016, p. 22).

[17] A product of the United States Postal Service (USPS) available through third-party vendors, the Computerized Delivery Sequence (CDS) program provides a frequently updated list of all addresses in the US.

[18] We followed the US Census Bureau, which classifies all people not living in housing units (house, apartment, mobile home, rented rooms) as living in group quarters. There are two types of group quarters: institutional (e.g., correctional facilities, nursing homes, or mental hospitals) and non-institutional (e.g., college dormitories, military barracks, group homes, or missions).

noise stratum was calculated based on the target number of approximately 10,000 completes for the noise stratum (500 for each airport) divided by the number of waves (six), and a response rate of 40 percent and PND rate of 6.3 percent, i.e., target/(.4 × .937 × 6). Wave 1 consisted of 4,476 addresses. The performance of this and future waves provided actual information on the response and PND rates at each sampled airport's noise strata to inform future sample release sizes within each airport and noise strata to meet the targets.

Waves 2 through 6 were formed by randomly assigning the remaining addresses (53,916 minus 4,476) to five approximately equal-sized waves of about 9,890 each. Waves 2 through 6 were further randomly assigned to release groups of 20 addresses each within each airport and noise stratum where there were sufficient addresses to obtain the overall goal of 100 completed questionnaires. The number of release groups ($n_{relgrps}$) that could be formed in each noise stratum was calculated by dividing the remaining number of addresses in the noise stratum by 20. To ensure that each wave matched as closely as possible the geographical distribution of the initial sample, the waves and release groups were assigned by first sorting the remaining addresses within each airport noise stratum by county, census tract, block group, and block, then numbering the addresses from 1 to $n_{relgrps}$ repeatedly. This was followed by a sort by airport noise stratum, and release group number, then numbering the release groups from 2 to 6 repeatedly to create Waves 2 to 6.

In the higher noise strata where there were insufficient addresses to achieve 100 completed questionnaires at a particular airport, single, equal release groups were assigned to each wave because all sampled cases in these strata were scheduled to be released. In these higher noise strata, Waves 2 to 6 were assigned by sorting the remaining cases (after excluding Wave 1) by county, census tract, block group, and block, then numbering the addresses from two to 6.

Because each wave was a representative subsample of the initial sample, and the same mailout procedures were followed for each wave/release group, this allowed any number of release groups to be sent out each wave without bias. Releasing the sample in this manner allowed the target sample sizes to be obtained because more or fewer release groups could be released in particular airports and noise strata where needed.

4.3 Procedures for Mail Survey

The mailing protocol used for the main data collection followed published procedures (Dillman, Smyth and Christian 2008). All sampled addresses were contacted between two to four times, depending on when the questionnaire was returned. The contacts included:

- An initial survey package,
- A thank-you/reminder postcard approximately 1 week after the initial survey mailing,
- A second survey package mailing 2 weeks after the thank-you/reminder postcard (3 weeks after initial survey mailing), and
- A third survey package mailing 3 weeks after the second survey package mailing.

The contents of each survey package included a cover letter that provided the survey purpose and sponsorship, Frequently Asked Questions (FAQs) and answers, and a paper questionnaire that the respondent was requested to complete and return via an included postage-paid envelope. All materials mailed to the respondent referenced the "Neighborhood Environment Survey." All survey materials were provided in English and Spanish. This followed established procedures for eliciting response from Spanish-speaking households (Brick et al. 2012). A quasi-random selection procedure was used to select an adult to answer the mail questionnaire. The instructions on the inside page asked that the adult with the next birthday complete the questionnaire.

A $2 cash prepaid monetary incentive was included with the initial mail package sent via USPS first-class mail. Pre-paid incentives of this size have been shown to significantly increase response to mail surveys (Church

1993; Dillman, Smyth and Christian 2008; Edwards et al. 2005). For example, in a recent meta-analysis of incentive experiments (Mercer et al. 2015), it was found that incentives of this size increase response rates by approximately 10 percentage points for a mail survey. The initial survey package and the thank-you reminder postcard were mailed to all sampled addresses. Only nonrespondents to the prior mail packages received subsequent survey package mailings. Mailings returned as PND by the USPS were excluded from subsequent mailings.

The second survey package was sent using express delivery. This increased the visibility of the package and maximized response at this stage (Dillman, Smyth and Christian 2008). Mailings undeliverable by express delivery were not excluded from the last mailing since USPS can often deliver to these addresses. The last mailing was sent USPS first class.

4.4 Procedures for Telephone Survey

Households that completed the mail questionnaire were eligible for the telephone interview. First, an attempt was made to obtain a telephone number for each household through a directory. Those that had a successful telephone match were mailed a letter requesting participation in the telephone survey. If no telephone match was available or if the matched phone number was determined to be invalid, the household was mailed a request to provide a telephone number. This survey package included a cover letter explaining the follow-up contact procedure and sponsorship. A short form for providing the household's telephone number was also included. The request for telephone number followed the mail contact procedures outlined by Dillman, Smyth, and Christian (2008), except there were three contacts. All households received a reminder postcard, and nonresponding households received a nonresponse follow-up request. All mailings were done using USPS first-class postage.

For the telephone interview, an adult was selected using the Rizzo method (Rizzo, Brick and Park 2004). If there is just one adult household member, that person was selected, whereas if exactly two, the CATI program randomly selected one of them. If more than two, the CATI program randomly determined if the screener respondent was selected or one of the other adults. If the screener respondent is not selected the adult with the next birthday was selected. If the screener respondent did not know which adult had the next birthday, a roster of adults in the household was collected and one adult was selected at random. This is a probability method of selection and gives each adult in the household an equal chance of being selected. Respondents were able to complete the telephone interview in English or Spanish. Respondents who completed the telephone interview received $10 as a thank-you and were told about the $10 at the beginning of the call and in the advance letters. An incentive was used because additional participation was requested from the household. Promised incentives on telephone surveys have been found to be effective in improving response (Singer et al. 1999). The meta-analysis by Mercer et al. (2015), for example, predicts this amount would increase response rates by approximately 5 percentage points.

Appendix D contains the analysis of the telephone survey results.

5 Reviews of Survey Method

The NES utilized multiple independent reviews of the employed methods as well as a pilot study, ACRP 02-35. The statistical analysis methodologies were approved by the Bureau of Transportation Statistics (BTS) and data collection was approved the OMB. An Institutional Review Board at Westat also reviewed all of the methodologies used in conducting the national survey. Technical bodies also reviewed the work. This included the Federal Interagency Committee on Aviation Noise (FICAN) as well as external review groups that examined the methods underlying the data collection and analysis process and the resulting data. These reviews took place at three separate points during the ACRP study and during the conduct of the NES. Sections 5.1 and 5.2 describe the regulatory and other technical reviews for the NES, respectively.

5.1 Regulatory Reviews

Regulatory reviews consist of those conducted by the OMB and Westat's Institutional Review Board (IRB).

5.1.1 OMB approval

Federally-sponsored data collections involving the public are required to receive an OMB approval under the Paperwork Reduction Act (PRA). Such clearance is required for data collections involving 10 or more respondents within a 12-month period. The approval process entails four main steps:

1. Preparation of an Information Collection Request (ICR) package,
2. A Federal Register notice informing the public of the intent to request clearance for the proposed data collection with a 60-day comment period,
3. A Federal Register notice informing the public that the ICR package is being submitted to OMB with a 30-day comment period, and
4. Submission of the ICR package to OMB with a 60-day review period.

Under Task 2 of the contract, FAA, HMMH, and Westat coordinated to prepare the NES's OMB submission from early 2013 through early 2015.[19] A 60-day Federal Register notice (2014-13686[20]) was posted on June 12, 2014 to solicit public comment on the proposed survey. Seven comments were received from the public and the team prepared responses in August 2014. A 30-day Federal Register notice (2014-21795[21]) was posted on September 12, 2014. No comments were received. FAA submitted the ICR materials to OMB on December 12, 2014. Two teleconferences were held with OMB to discuss the submission in April 2015. OMB approved the submission on April 27, 2015 and the survey was assigned OMB control number 2120-0762 (expiration date: 04/30/2018).

5.1.2 IRB approval

An IRB is a type of committee used in research that is formally designated to review, approve, and monitor behavioral and biomedical research involving humans. Westat's IRB includes a diverse group of nine individuals: researchers across a broad range of substantive areas, a physician, and two unaffiliated community members. The Board meets once a month to review protocols that include sensitive topics or vulnerable populations at the discretion of the IRB Chair. The IRB operates under procedures set forth in the regulations of the US Department of Health and Human Services and in the Federalwide Assurance (FWA)

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[19] https://www.reginfo.gov/public/do/PRAViewDocument?ref_nbr=201409-2120-002

[20] https://www.federalregister.gov/documents/2014/06/12/2014-13686/agency-information-collection-activities-requests-for-comments-clearance-of-renewed-approval-of

[21] https://www.federalregister.gov/documents/2014/09/12/2014-21795/agency-information-collection-activities-requests-for-comments-clearance-of-new-approval-of

granted to Westat by the Office for Human Research Protections (OHRP). IRB approval is required before research may begin, continue, or be changed by the research team.

Westat's IRB requires each study to submit an initial application consisting of background material on the study, including research goals, methods, informed consent process, and materials (e.g., letters, scripts, questionnaires). The IRB then reviews the material to ensure compliance with human subjects' protection research rules and regulations.

Westat submitted the NES initial application to the IRB on August 26, 2015 and received expedited approval on September 1, 2015. Westat's IRB conducted annual continuing reviews for the duration of the contract.

5.2 Other Technical Reviews

As described below, the NES also underwent reviews by other agencies, two reviews by panels of experts and the NES's statistical methods were presented at three professional conferences on statistics and survey methodology.

In 2014, the BTS reviewed the statistical analyses methodologies as part of the DOT review of the OMB PRA package. BTS approved the methodologies within the PRA.

The FICAN consists of representatives from the US Departments of Defense, Interior, Transportation, and Housing and Urban Development, in addition to the US EPA, and the National Aeronautics and Space Administration (NASA); a representative from the National Institute of Health also participates in FICAN meetings, though it is not an official member. In 2013, FICAN reviewed the methods used to select the 20 airports that were surveyed and stated, "the balanced sampling methodology that was employed is the correct choice given the purpose of the research effort and the number and range of airports available for selection" (FICAN 2013).

In 2016 and 2017, the FAA convened a professionally facilitated Expert Review from international professionals in the field of noise dose-response research, to provide an objective third party review of the project's survey design, noise modeling, regression analysis techniques, supplemental analysis, and development of the national dose-response curve. The 2016 Expert Review consisted of five members and the 2017 Expert Review consisted of six members. Members were affiliated with private industry, a scientific/research resource of the US Department of Transportation, and two European scientific organizations. Many of the members had over 30 years of relevant experience. The Expert Panels provided suggestions for additional analyses and insight to the project team that were incorporated into this report. In addition to these reviews, in 2013 an expert review was conducted in association with the ACRP 02-35 project on the questions used in the mail questionnaire and phone interview.

The statistical methods employed in the NES have been presented at three professional conferences on statistics and survey methodology (Jodts and Lohr 2017a; Jodts and Lohr 2017b; Lohr, Broene and Jodts 2017).

6 Survey Administration and Response Rates

This section describes how the survey was administered and data was collected as well as the actual response rates for the mail and phone instruments. Section 6.1 documents how the data collectors were trained. Section 6.2 addresses the flow of data collection for both survey instruments. Section 6.3 describes the management and review of data. Section 6.4 provides the response rate calculation methodology. Section 6.5 details the survey response rates by various metrics.

6.1 Data Collector Training

In November 2015, five data collectors were trained and started work on the project. Due to attrition, in June 2016, three additional data collectors were trained and started production.

Training consisted of three phases: self-paced, WebEx, and role-play. The following sections detail the structure and content of each training session. Trainees had to successfully complete each session to move to the next stage.

6.1.1 Self-Paced

In the self-paced portion of training, data collectors were expected to review specific materials to introduce themselves to the study subject and survey instrument. The materials were placed in Westat's Learning Management System (LMS) and the data collectors could complete them on their own. If they did not complete their self-study within the specified timeframe, they were unable to proceed to the next section of training. Under the self-paced portion, data collectors reviewed sample letters and postcards and practiced going through the instrument. Trainees were required to take and pass a quiz addressing materials in the self-paced tutorial.

6.1.2 WebEx

The WebEx session was led by project staff (trainer) and facilitated by a Westat Telephone Research Center (TRC) team leader. During this time, the trainer provided an opportunity for the data collectors to ask any questions they may have had on the self-paced training materials. For the majority of this training, the trainer and trainees went through the instrument demonstrating different scenarios. In this segment, the trainer would have the interviewing platform open, which was viewable by all trainees on their computer screens via web conference. The trainees took turns reading the questions as if they were the interviewer, and the trainer would answer based on the scenario they were practicing. The trainee would then indicate which answer to select.

6.1.3 Role-Plays

In the final stage of training, the data collectors were paired with each other, and took turns acting as interviewer and respondent. They were expected to complete two role-plays, acting as both the interviewer and as the respondent. These role-plays covered different scenarios the interviewer might encounter during live production. The role-play sessions were monitored by supervisory staff who verified that trainees had mastered the content before proceeding to live interviewing.

6.1.4 Training for Spanish Language Interviewing

All Spanish bilingual data collectors completed the English self-paced, WebEx, and role-play sessions. They also participated in a separate Spanish role-play session where they completed the interview in Spanish with another Spanish-speaking data collector. All requirements for completion were the same as the English role-plays.

6.2 Data Collection Flow

6.2.1 Mail Survey

As noted in Section 2, the sample was released in waves, and the wave sizes varied to adjust for yield rates (number of competed questionnaires/sample released) within each airport's noise strata as data collection progressed in order to meet targets. The sample releases in each wave took into account the average yield for the performance to date but were somewhat conservative (meaning erring on the side of inviting too many households) to account for variation in yield at each wave and to ensure the completed questionnaires hit the overall targets in the end. Wave 2, in particular, was much larger than other waves since the sample was drawn before returns from the final Wave 1 mailing came in. This meant the team had limited data available and, therefore, made conservative assumptions about eligibility and response rates. Later waves were also drawn at a similar time in the preceding wave, but benefited from the cumulative yields to date allowing for more precise sample releases. Variations in response rate and yield at each wave accounted for differences in later waves. Table 6-1 shows the date and quantities mailed for each stage by wave. As discussed in Sections 4.3 and 4.4, the NES provided English and Spanish versions of the questionnaire to all respondents, in order to address lower Hispanic response rates observed in the ACRP study. Seven hundred fifty nine of the 10,328 completed mail questionnaires (7.3 percent) were done in Spanish, and 154 of the 2,328 telephone interviews (6.6 percent) were conducted in Spanish.

6.2.2 Telephone Survey

Telephone interviewing began November 12, 2015, and finished on November 13, 2016. Of the households that completed the mail questionnaire, 6,736 had a matched phone number or provided a phone number in response to a phone request and were called in an attempt to complete the telephone interview.

The telephone survey mail activities occurred on an ongoing basis driven by mail questionnaire receipts, but the sample waves were not a driving factor in the operations. The following indicates the date of initial and final mailing for each type and the schedule throughout operations. Minor adjustments to the weekly mailings were made periodically throughout the year to account for postal holidays.

- On November 4, 2015, the first telephone request mailing was sent to addresses that had completed the mail questionnaire but for whom there was no matching phone number. These requests continued each Wednesday for additional addresses as they completed the mail questionnaire and for those whom were identified as having an incorrect matched number. The last mailing was sent October 26, 2016.
- The first advance letter mailing for addresses that had completed the mail questionnaire and had a matching phone number was sent on November 5, 2015. These letters continued each Thursday for additional addresses as they completed the mail questionnaire. The last mailing was sent November 3, 2016.
- Thank you/reminder postcards were sent to the first batch of addresses receiving the telephone request mailing on November 12, 2015, and continued each Thursday for subsequent mail batches. The last mailing was sent October 27, 2016.
- The first nonresponse follow-up mailing for those who had not returned their phone number were was sent on November 25, 2015, and continued each Thursday. The last mailing was sent October 27, 2016.
- The first thank-you letter mailing, with $10 incentive, for those completing the telephone interview was sent November 19, 2015, and continued each Thursday for additional completes. The last mailing was sent November 17, 2016.

Table 6-1. Mail Quantities by Wave and Stage

Wave	Mailing	Date	Quantity
1	Initial survey invitation	10/13/2015	4,476
1	Thank you/reminder postcard	10/20/2015	4,476
1	2nd survey invitation (Express)	11/3/2015	3,677
1	3rd survey invitation	11/24/2015	2,759
2	Initial survey invitation	12/15/2015	5,509
2	Thank you/reminder postcard	12/22/2015	5,509
2	2nd survey invitation (Express)	1/5/2016	4,665
2	3rd survey invitation	1/26/2016	3,424
3	Initial survey invitation	2/16/2016	4,856
3	Thank you/reminder postcard	2/23/2016	4,856
3	2nd survey invitation (Express)	3/8/2016	3,661
3	3rd survey invitation	3/29/2016	3,749(1)
4	Initial survey invitation	4/12/2016	4,485
4	Thank you/reminder postcard	4/19/2016	4,485
4	2nd survey invitation (Express)	5/3/2016	3,600
4	3rd survey invitation	5/24/2016	2,857
5	Initial survey invitation	6/14/2016	3,907
5	Thank you/reminder postcard	6/21/2016	3,907
5	2nd survey invitation (Express)	7/7/2016	3,091
5	3rd survey invitation	7/28/2016	2,581
6	Initial survey invitation	8/16/2016(2)	4,935
6	Thank you/reminder postcard	8/23/2016	4,935
6	2nd survey invitation (Express)	9/7/2016	3,822
6	3rd survey invitation	9/27/2016	3,086

Notes:
(1) For Wave 3, the third survey invitation mailing was larger than the second invitation mailing because of an error in the parameters used to extract the addresses that led to an inadvertent inclusion of some addresses in the final nonresponse mailing.
(2) During the Wave 6 initial mail out, the postage meter broke down while the survey packages were being metered. Shipped pieces metered on the 8/16/2016 amounted to 3,724, and after the meter was repaired, the remaining 1,661 pieces were shipped on the 8/17/2016.

6.3 Data Management and Review

Returned NES mail questionnaires and Telephone Request Forms with at least one completed question were scanned using TeleForm, a questionnaire design and scanning software that provides automated data capture. Scanning staff reviewed the resulting scanned images for quality, and then passed them into the software’s verification and data capture module. Alchemy, an image database and retrieval system, was used to store the questionnaire form images. The hard-copy forms were retained in a secured location until data files were complete.

The data capture module presented for verification any data items that the software could not read with the required level of confidence. The level of confidence is a feature of the TeleForm software that reflects the likelihood that a scanned image is what the software perceives it to be, (e.g., a specific number or letter).

The scanning verification staff compared images against the data recorded by the software and typed corrections into the recorded data as necessary. Once recorded data for a form were accurate, the data were saved to the database. If the scanning staff could not determine the content of the image with certainty, (e.g., if the marks were particularly light), the staff would review the original hard copy questionnaire.

Scanning quality control (QC) staff also reviewed frequencies of the captured data. Verification staff and QC staff also reviewed open-ended items to ensure that all text was captured correctly.

Data Management (DM) staff also reviewed frequencies of the captured data after the scanning verification and QC staff completed their review and resulting data updates. DM staff made additional data updates when necessary, such as reviewing and reconciling multiple responses to a single item on the mail questionnaire or outlier values, (e.g., very large household sizes).

During these receipt, scanning, data capture, and data review processes, the scanned data resided in a series of tables in a Structured Query Language (SQL) server database to preserve the data at each snapshot in time. Additional products, such as SAS®, readily communicate with SQL server to allow for efficient transmission of data from one stage to the next.

6.4 Response Rate Calculation Methodology

Response rates for mail and telephone surveys were calculated per American Association for Public Opinion Research (AAPOR) guidelines (AAPOR 2016). Response Rate 1 (RR1) and Response Rate 2 (RR2) were for the mail and phone surveys, respectively. Equation (6.1) is the formula for RR1. RR1, or the minimum response rate, is the number of complete interviews (mail questionnaires in this research effort) divided by the number of interviews (complete plus partial) plus the number of non-interviews (refusal and break-off plus non-contacts plus others) plus all cases of unknown eligibility (unknown if housing unit, plus unknown, other).

$$RR1 = \frac{I}{[(I+P)+(R+NC+O)+(UH+UO)]} \tag{6.1}$$

where:

- RR = Response rate;
- I = Complete interview;
- P = Partial interview;
- R = Refusal and break-off;
- NC = Non-contact;
- O = Other;
- UH = Unknown if household/occupied HU;
- UO = Unknown, other.

Equation (6.2) shows the formula for RR2. RR2 counts partial interviews as respondents.

$$RR2 = \frac{I+P}{[(I+P)+(R+NC+O)+(UH+UO)]} \tag{6.2}$$

In short, the numerator includes the cases with questionnaire data in the final data file while the denominator includes all samples cases minus the ineligible cases (PNDs).

6.5 Response Rates and Additional Survey Metrics

Tables 6-2 and 6-3 report the observed sample size and pertinent response rates, which overall compare favorably to the anticipated rates reported in Table 6-4 through Table 6-9. The resulting response rate for each was slightly greater than the anticipated rate – 40.3 percent observed vs. 40.0 percent anticipated for the mail survey and 9.1 percent observed vs. 8.6 percent anticipated for the telephone survey.

Table 6-2. Sample Sizes and Completes

Item	Number
A. Mail Survey	
A1. Initial sample	28,168
A2. 9.1% PND (Postal nondeliverables)	2,561
A3. Eligible sample (A1 minus A2)	25,607
A4. Completed mail questionnaires	10,328
B. Telephone Survey (see Note 1)	
B1. 49% of A4 match to telephone number	5,066
B2. 77.8% of B1 are valid matches	3,942
B3. 30% of B2 completed phone interview	*1,179*
B4. 51% of A4 did not match to telephone number	5,262
B5. 22.2% of B1 were invalid matches	1,124
B6. Total phone number requests sent (B4 + B5) (see Note 2)	6,289
B7. 31% of B6 provide phone number	1,967
B8. 58% of B7 completed phone interview	*1,149*
B9. Total telephone completes (B3 + B8)	2,328

Notes: American Association for Public Opinion Research (AAPOR); response rate (RR)
(1) Telephone complete numbers reflect full (n=2,244) and partial (n=84) interviews.
(2) This number is slightly below the sum of the two previous numbers (difference of 97) because 48 of the 5,262 completed the mail questionnaire too close to the end of data collection to receive a phone number request. Additionally, 47 of the 1,124 were identified as invalid numbers too late in the data collection to receive a phone request, and another two mail respondents requested future contacts be stopped before the phone request was sent.

Table 6-3. Response Rates

Response Rates	Percent
Final mail survey response rate (A4/A3) (AAPOR RR1) (see Note 1)	40.3%
Final telephone survey response rate (B9/A3) (AAPOR RR2)	9.1%

(1) AAPOR 2016.

One notable exception is the PND rate, which was greater than anticipated (9.1 percent observed vs. 6.3 percent anticipated). For this research effort, including all vacant addresses ensured complete coverage of the sample area, whereas for the ACRP 02-35 study, only two of three airports included vacant addresses. Other factors that may have led to a higher PND rate are:

- Vacancy rates vary significantly from airport to airport and some of the sampled airports in the NES had high vacancy rates;
- The NES was in the field longer than the ACRP study, therefore, providing more time for the PNDs to be returned; and
- The NES had a third survey mailing 3 weeks later than the second and final mailing in the ACRP study allowing additional PNDs to be identified. However, while the sample was drawn all at once prior to the start of data collection (up to 1 year in advance of Wave 6 release), this should not have affected the observed rates because it is presumed that the vacancy rates remain stable over time, with the exception of households that are demolished (i.e., removed from the sample universe). With the exception of the

first wave, which was closest to the sample draw, evidence that this rate did not increase over time is provided in Table 6-6, which covers the PND rate across waves.

The telephone match rates (see Section 4.4) and accuracy of matched numbers also differed from the anticipated rates. The match rate is largely a reflection of the population with listed landline telephone numbers. This means communities with a greater than average proportion of unlisted phone numbers or cell phone only households will have lower match rates. The three airports in the ACRP 02-35 study averaged a 40 percent match rate. The NES, by contrast, averaged 49 percent and this resulted in more matched phone numbers than anticipated. However, the accuracy of the matched phones was a bit less than in the ACRP study, meaning a lower percentage of matches reached the correct household. This could have been due to the lag between sample selection and release for some cases or other unknown factors.

Lastly, there was a large improvement in the response rate among those who had provided a phone number (58 percent observed vs. 40 percent anticipated). While the design included a thank-you/reminder postcard and a follow-up request to the nonresponders of the phone request for the NES, the rate of provided phone numbers was slightly less than the anticipated rates based upon ACRP 02-35 results (31 percent observed vs. 35 percent anticipated). It is unknown why a higher response rate was experienced among those who provided their number.

Tables 6-4 through 6-9 provide data collection metrics and response rates (AAPOR RR1 for mail surveys and AAPOR RR2 for telephone surveys) for the survey by stratum, wave, and airport, respectively. Tables 6-8 and 6-9 indicate that the airports had varied response rates for both mail and telephone, with mail response rates ranging from 31.8 percent to 54.1 percent, and telephone response rates ranging from 5.5 percent to 10.5 percent. The correlation between the mail response rate and the telephone response rate across airports is 0.90. In Table 6-5, the response rate decreases for successive noise exposure strata. However, this decrease may be related to the variability in airport response rates, since the airports with larger ranges of noise exposure tend to have lower overall response rates. The response propensity analysis in Appendix E (Section E-1) found that for most airports, the value of DNL was not statistically significantly associated with response rate after accounting for the other variables in the model.

Table 6-4. Mail Survey (AAPOR RR1) Sample Sizes, Completes, and Response Rates by Strata

DNL Stratum	Sample size (1)	Completes	Yield (2)	PND	PND rate	Response rate (RR1)
50-55	9,134	3,592	39.3%	817	8.9%	43.2%
55-60	9,261	3,481	37.6%	804	8.7%	41.2%
60-65	5,470	2,016	36.9%	419	7.7%	39.9%
65-70	3,041	914	30.0%	330	10.9%	33.7%
70+	1,262	325	25.8%	191	15.1%	30.3%
Overall	**28,168**	**10,328**	**36.7%**	**2,561**	**9.1%**	**40.3%**

Notes:
(1) Sample size represents the number of addresses to which the mail questionnaire was sent.
(2) Yield is defined as completes divided by sample size.

Table 6-5. Telephone Survey (AAPOR RR2) Sample Sizes, Completes, and Response Rates by Strata

DNL Stratum	Sample size (1)	Completes	Response rate (RR2)
50-55	9,134	831	10.0%
55-60	9,261	801	9.5%
60-65	5,470	453	9.0%
65-70	3,041	186	6.9%
70+	1,262	57	5.3%
Overall	**28,168**	**2,328**	**9.1%**

Notes:
(1) Sample size represents the number of addresses to which the mail questionnaire was sent.

Table 6-6. Mail Survey (AAPOR RR1) Sample Sizes, Completes, and Response Rates by Wave

Wave	Sample size (1)	Completes	Yield (2)	PND	PND rate	Response rate (RR1)
1	4,476	1,704	38.1%	324	7.2%	41.0%
2	5,509	2,009	36.5%	525	9.5%	40.3%
3	4,856	1,861	38.3%	507	10.4%	42.8%
4	4,485	1,601	35.7%	401	8.9%	39.2%
5	3,907	1,402	35.9%	370	9.5%	39.6%
6	4,935	1,751	35.5%	434	8.8%	38.9%
Overall	**28,168**	**10,328**	**36.7%**	**2,561**	**9.1%**	**40.3%**

Notes:
(1) Sample size represents the number of addresses to which the mail questionnaire was sent.
(2) Yield is defined as completes divided by sample size.

Table 6-7. Telephone Survey (AAPOR RR2) Sample Sizes, Completes, and Response Rates by Wave

Wave	Sample size (1)	Completes	Response rate (RR2)
1	4,476	418	10.1%
2	5,509	503	10.1%
3	4,856	452	10.4%
4	4,485	369	9.0%
5	3,907	299	8.5%
6	4,935	287	6.4%
Overall	**28,168**	**2,328**	**9.1%**

Notes:
(1) Sample size represents the number of addresses to which the mail questionnaire was sent.

Table 6-8. Mail Survey (AAPOR RR1) Sample Sizes, Completes, and Response Rates by Airport

Airport Identifier	Sample size (1)	Completes	Yield (2)	PND	PND rate	Response rate (RR1)
ABQ	1,484	513	34.6%	174	11.7%	39.2%
ALB	1,034	504	48.7%	52	5.0%	51.3%
ATL	1,744	503	28.8%	266	15.3%	34.0%
AUS	1,574	510	32.4%	118	7.5%	35.0%
BDL	1,066	519	48.7%	50	4.7%	51.1%
BFI	1,302	516	39.6%	76	5.8%	42.1%
BIL	1,169	508	43.5%	111	9.5%	48.0%
DSM	1,085	527	48.6%	62	5.7%	51.5%
DTW	1,287	508	39.5%	106	8.2%	43.0%
LAS	1,724	527	30.6%	214	12.4%	34.9%
LAX	1,504	521	34.6%	63	4.2%	36.2%
LGA	1,489	528	35.5%	54	3.6%	36.8%
LIT	1,612	535	33.2%	340	21.1%	42.1%
MEM	1,880	511	27.2%	310	16.5%	32.5%
MIA	1,810	534	29.5%	133	7.3%	31.8%
ORD	1,126	500	44.4%	47	4.2%	46.3%
SAV	1,390	528	38.0%	100	7.2%	40.9%
SJC	1,222	501	41.0%	43	3.5%	42.5%
SYR	1,024	515	50.3%	72	7.0%	54.1%
TUS	1,642	520	31.7%	170	10.4%	35.3%
Overall	**28,168**	**10,328**	**36.7%**	**2,561**	**9.1%**	**40.3%**

Notes:
(1) Sample size represents the number of addresses to which the mail questionnaire was sent.
(2) Yield is defined as completes divided by sample size.

Table 6-9. Telephone Survey (AAPOR RR2) Sample Sizes, Completes, and Response Rates by Airport

Airport Identifier	Sample size (1)	Completes	Response rate (RR2)
ABQ	1,484	112	8.5%
ALB	1,034	139	14.2%
ATL	1,744	129	8.7%
AUS	1,574	110	7.6%
BDL	1,066	138	13.6%
BFI	1,302	92	7.5%
BIL	1,169	138	13.0%
DSM	1,085	139	13.6%
DTW	1,287	133	11.3%
LAS	1,724	90	6.0%
LAX	1,504	108	7.5%
LGA	1,489	79	5.5%
LIT	1,612	141	11.1%
MEM	1,880	121	7.7%
MIA	1,810	100	6.0%
ORD	1,126	103	9.5%
SAV	1,390	108	8.4%
SJC	1,222	93	7.9%
SYR	1,024	148	15.5%
TUS	1,642	107	7.3%
Overall	**28,168**	**2,328**	**9.1%**

Notes:
(1) Sample size represents the number of addresses to which the mail questionnaire was sent.

Table 6-10 shows the distribution a plot of completed mail questionnaires and telephone interviews by month. The goal of a yearlong data collection was to capture an average dose response across all seasons.[22] Since each wave's mailings crossed over 2 months and returns continued to come in during the months following, it is not possible to calculate a monthly response rate.

Table 6-10. Completes by Month

Month	Mail	Telephone
January	1,058	253
February	934	232
March	906	210
April	999	174
May	730	235
June	521	195
July	777	171
August	1,024	154
September	855	165
October	833	155
November	877	185
December	814	199
Total	**10,328**	**2,328**

Notes:
(1) October and November include 2015 and 2016.

[22] The yearlong data collection was also consistent with computing a yearly DNL.

7 Computation of DNL for Average Daily Flight Operations

Cumulative aircraft noise exposure is typically presented in terms of DNL that is based on annual average daily operations. Examining a year's worth of data accounts for seasonal or other variability in aircraft operations. For this project, a method was devised to compute noise exposure for every day of a year and the overall annual average day DNL in a consistent, repeatable manner for each airport considered.

It is important to note that for modeling of any kind, a degree of uncertainty in the results should be expected. Modeling accuracy is dependent on a range of factors. The two primary factors are 1) how well the fundamental quantity to be modeled is understood and calculated, and 2) how accurately the inputs needed by the model are provided. The aircraft noise modeling for this research effort used the FAA-approved INM, which provides both detailed noise calculations and a framework to manage the large amount of input data needed to accurately represent actual conditions. In this way, any aircraft noise modeling uncertainty was minimized resulting in accurate results suitable for the analysis described in this report.

Although the focus of the research effort is the national dose-response based on the 20 airports listed in Section 3.2, noise modeling included Seattle-Tacoma International Airport (SEA). Because of its proximity to BFI and the layout of SEA-based flight tracks, SEA's flight operations significantly influence the DNL of BFI's set of potential respondents. Of the 20 selected airports, only BFI had another airport (SEA) in proximity capable of influencing the DNL of the selected airport.

This section documents in detail how DNL for each of the 20 airports was computed. Section 7.1 provides an overview of the method. Section 7.2 address the basic setup parameters used in the INM. Section 7.3 discusses the radar flight track data and its processing. Section 7.4 addresses final data processing and Section 7.5 concludes with consideration of numbers of operations and final DNL calculations.

Appendix F summarizes the basic data used for modeling each of the airports. The intent of Appendix F is to assist in understanding the general nature of the airspace use and the predominant aircraft types that use each airport. It is not intended to provide sufficient information to repeat the noise metric calculations done for this research effort.

7.1 Overview of Method and Introduction

DNL for every potential respondent location at each airport was computed with the FAA's INM version 7.0d (FAA 2013), based on annual average daily flight operations. Although INM was superseded in 2015 by the FAA's Aviation Environmental Design Tool (AEDT)[23], initial phases of this project had started years prior and had used INM for selection of respondents. The use of INM, instead of AEDT, was maintained for consistency throughout the project.

Most of the input data for the INM relied on a year's worth of radar flight tracking data from the FAA for each of the 20 airports. Section 7.3.2 gives specific dates. FAA radar flight tracking data sources consisted of the Performance Data Analysis and Reporting System (PDARS)[24] and National Offload Program (NOP).[25] Operations counts derived from the radar flight tracking data were scaled and balanced to match official

[23] https://aedt.faa.gov/

[24] PDARS gathers information from systems at Air Route Traffic Control Centers (ARTCCs), Terminal Radar and Approach Control (TRACON) facilities and most recently from Air Traffic Control Tower (ATCT) facilities. ARTCCs track and provide service to an aircraft for the duration of its journey. TRACONs track and provide service to aircraft approaching and departing between 5 and 50 miles of an airport. ATCTs track and provide service to aircraft on the airport surface and immediate vicinity. Definition from http://www.atac.com/pdars.html

[25] NOP is operated by the FAA, and collects National Airspace System (NAS) operational data daily. One of the data items collected is flight tracks. Flight tracks contain identifying flight number and flight status (arrival, departure, or overflight) and position reports including (latitude, longitude, altitude, and time-of-report).

National Airspace System air traffic operations data available for public release, (i.e., the FAA's Air Traffic Activity Data System (ATADS) counts), for 2015 for each airport. Using specialized data management software and utilities[26], the radar flight tracking data for each airport was consistently checked and pre-processed into INM-compatible input for each available day. INM was used to generate daily DNL results, which were then energy-averaged to determine the average annual day DNL results.

DNL for each airport was computed twice – once for the generation of DNL contours and the selection of respondents (Section 4) using data from 2012 and 2013/2014 and a second time when the survey was completed with a final set of respondents using updated aircraft operations counts for 2015. See Section 7.3.2 for further detail about the data sources for each run.

No ground run-up modeling was performed.

7.2 Basic Setup Parameters

This section describes the basic physical parameters unique to each airport that are required by the INM – runway lengths and locations (7.2.1), helipads (7.2.2), if any, and local weather conditions (7.2.3) and terrain (7.2.4).

7.2.1 Runway Geometry

The INM includes an internal airport layout database, including runway locations, orientation, start-of-takeoff roll points, runway end elevations, landing thresholds, approach angles, etc. The primary information INM uses concerning runways is:

- Departure thresholds (i.e. where aircraft begin their take-off roll),
- Arrival threshold (a location marked on the runway),
- Arrival threshold crossing height (TCH) (the height that arriving aircraft cross the arrival threshold),
- Displaced threshold (distance from the runway end where an aircraft first touches down),
- Runway gradient (i.e. is the runway slightly uphill or downhill),
- Runway location, and
- Runway direction.

The INM data for each of the selected airports were updated with data downloaded from the "Airport Data & Contact Information" section of FAA's website.[27] These data originate from the FAA Airport Master Record (5010-1) forms.

7.2.2 Helipad Location

The locations of helipads (if present) were determined using a combination of FAA 5010 data, location of the beginning/end of helicopter flight tracks, and visual investigation of satellite imagery. INM requires that helicopter operations originate and end at a helipad. Therefore, a helipad must be identified if helicopter operations are to be modeled at a particular airport. If helicopters operate from runways, then a virtual helipad must be identified at the location on the runway used by helicopters.

[26] HMMH's proprietary programs, InFLIGHT™ and RealContours™ and several HMMH-developed processing utilities, were used to process and check the radar data into an INM-compatible form. These programs and utilities manage the large amount of data involved in running the INM using operations for a year of operations at an airport. These HMMH programs do no noise related computation; they assist in preparing the input needed by the INM.

[27] FAA 5010 data downloaded July 10, 2013 from http://www.faa.gov/airports/airport_safety/airportdata_5010/

7.2.3 Weather

The INM has several settings that account for the effects that meteorological conditions have on aircraft performance profiles and sound propagation. INM's meteorological settings include average temperature, barometric pressure, relative humidity, and wind direction and speed.

For purposes of establishing the sampling frame and consistency with the radar flight tracking data (see Section 7.3 for the latter), weather data was downloaded from the National Climatic Data Center (NCDC) website[28] for the date range June 2012 to May 2013 for all airports.[29] The data range of the weather data was the same as the radar flight tracking data's date range, for all airports except ORD.[30] Annual average daily weather conditions were based on analysis of the hourly NCDC data. Table 7-1 displays the resultant annual average weather conditions for each airport. The computation of each day's DNL for the 2015 case year used the data from Table 7-1[31], including ORD.

Table 7-1. Modeled Average Weather Conditions

Airport Identifier	WBAN Station ID	Temperature (degrees Fahrenheit)	Barometric Pressure (inches of Mercury)	Relative Humidity (Percent RH)
ABQ	23050	59.0	29.96	32.5
ALB	14735	50.0	30.02	67.9
ATL	13874	62.8	30.06	63.9
AUS	13904	68.5	30.00	65.5
BDL	14740	51.8	30.00	65.5
BFI	24234	53.4	30.06	71.3
BIL	24033	49.8	29.98	50.7
DSM	14933	52.2	30.01	62.8
DTW	94847	51.7	30.02	65.0
LAS	23169	71.1	29.88	25.5
LAX	23174	63.2	29.98	69.4
LGA	14732	56.2	30.01	61.8
LIT	13963	62.9	30.05	66.1
MEM	13893	62.9	30.04	63.8
MIA	12839	76.7	30.04	70.8
ORD	94846	51.6	30.00	66.6
SAV	3822	66.1	30.06	71.2
SJC	23293	59.1	30.03	67.9
SYR	14771	50.7	30.00	67.6
TUS	23160	70.9	29.90	33.3
SEA	24233	52.7	30.09	72.0

7.2.4 Terrain

Terrain data describe the elevations of the ground surface surrounding the airport and on airport property. The INM uses terrain data to adjust the ground level under the flight paths at which noise metrics are computed. The terrain data do not affect the aircraft's performance or emitted noise levels, but do affect the

[28] Weather data available at: ftp://ftp3.ncdc.noaa.gov/pub/data/noaa/isd-lite/

[29] Weather data were not adjusted for missing or bad radar dates described in Section 7.3. The entire range was used for weather averaging.

[30] As described in Section 7.3.2, ORD's radar data ranged from November 2013 to October 2014.

[31] Each day's weather conditions could not be used because of the limitations of the data processing software.

distance between the aircraft and a "receiver" on the ground. This in turn affects the noise levels propagated to the receiver. The terrain data were obtained from the United States Geological Survey (USGS). [32]

7.3 Radar Flight Tracking Data Processing

Subsections 7.3.1 through 7.3.6 describe the sources of radar flight tracking data and its processing.

7.3.1 Radar Flight Tracking Data Sources

The FAA provided data from two repositories of historical National Airspace System (NAS) Data: PDARS and NOP. Both repositories collect and store similar Instrument Flight Rule (IFR) flight track data from FAA air surveillance systems. Availability of Visual Flight Rule (VFR) flight track data is often limited, as FAA does not always retain this data. In accordance with FAA policy in providing radar flight tracking data, the FAA omitted sensitive military operations and aircraft with an approved Block Aircraft Registration Request.

Table 7-2 lists the radar flight tracking data sources used for the 20 selected airports. Approximately half of the selected airports were served by PDARS and the remaining airports were served by NOP. PDARS and NOP are further described in the following two subsections, respectively.

Table 7-2. Radar Flight Tracking Data Sources

PDARS / ARTCC	NOP
ATL	ABQ
BFI	ALB
DTW	AUS
LAS	BDL
LAX	BIL
LGA	DSM
MEM	LIT
MIA	SAV
ORD	SYR
SJC	TUS
SEA	

Note: SEA was modeled and its results combined with BFI due to SEA's proximity to BFI.

7.3.1.1 PDARS

PDARS gathers information from systems at Air Route Traffic Control Centers (ARTCCs), Terminal Radar and Approach Control (TRACON) facilities and most recently from Air Traffic Control Tower (ATCT) facilities. ARTCCs track and provide service to an aircraft for the duration of its journey. TRACONs track and provide service to aircraft approaching and departing between 5 and 50 miles of an airport. ATCTs track and provide service to aircraft on the airport surface and immediate vicinity.

Ten (10) of the selected airports (plus SEA) were close to TRACONs and thus PDARS radar flight tracking data were available. As the provided PDARS radar flight tracking data did not include city pairs[33], it was supplemented with data from the ARTCC. The ARTCC data includes arrival and departure airports for every flight operation, and these data were used to associate the proper city pair with the PDARS data for as many

[32] Terrain data downloaded from http://viewer.nationalmap.gov/viewer.

[33] City pairs are the two airports between which an aircraft flies. The city pairs are used to determine the distance of the flight. INM represents trip distance with a "stage length" as a surrogate for aircraft takeoff weight (related to amount of fuel required to cover the trip distance). Thus, a city pair is needed to select the best INM departure flight profile (altitudes, power settings and speeds) for each specific aircraft type.

flights as possible. Hence, the constructed database contains city pairs for most flights, which was used to select the proper INM departure stage lengths (see Section 7.4.2).

7.3.1.2 NOP

NOP is operated by the FAA, and collects NAS operational data daily. One of the data items collected is flight tracks. Flight tracks contain identifying flight number and flight status (arrival, departure, or overflight) and position reports including (latitude, longitude, altitude, and time-of-report).

For the remaining ten (10) airports, radar flight tracking data were acquired from the NOP. The NOP radar flight tracking data did not include runway assignments, so spatial analyses were performed to make the runway assignments (see Section 7.3.4).

7.3.2 Dates Included in Radar Flight Tracking Data

The date range of data selected for all airports except ORD is June 1, 2012 to May 31, 2013. For ORD, data from November 1, 2013 to October 31, 2014 was used because of the initiation of the ORD modernization program begun in October 2013. Additionally, due to NOP data issues on December 1, 2012 and December 2, 2012, data for these two days were also removed for all NOP-sourced airports. There were several other unused days for some of the airports because the days were either missing completely, duplicating other days, or contained inaccurate information. Table 7-3 shows the dates excluded from radar flight tracking data for each selected airport.

Table 7-3. Radar Flight Tracking Data Date Summary

Airport Identifier	Total Days Included	Days Not Included
ABQ	354	12/1/2012, 12/2/2012, 1/25/2013 to 2/3/2013
ALB	363	12/1/2012, 12/2/2012
ATL	365	
AUS	363	12/1/2012, 12/2/2012
BDL	363	12/1/2012, 12/2/2012
BFI	365	
BIL	359	12/1/2012 to 12/6/2012
DSM	363	12/1/2012, 12/2/2012
DTW	365	
LAS	365	
LAX	365	
LGA	362	3 days excluded due to Hurricane Sandy
LIT	363	12/1/2012, 12/2/2012
MEM	365	
MIA	365	
ORD	361	12/1/2013, 2/23/2014, 3/8/2014, 3/9/2014
SAV	365	12/1/2012, 12/2/2012
SJC	365	
SYR	363	12/1/2012, 12/2/2012
TUS	360	6/23/2012, 8/31/2012, 12/1/2012, 12/2/2012, 12/15/2012
SEA	365	

7.3.3 Initial Data Filtering and Time Zone Adjustment

Through coordination with FAA, HMMH received radar flight tracking data files for each airport. Both types of radar flight tracking data (NOP and PDARS) consist of text files, but the format of the text files is different between them. HMMH used proprietary in-house software to parse the data files and import the data into several tables within a SQL database (one database for each airport).

During the import process, several filtering options were used to exclude and/or modify radar flight tracking data that was deemed unusable or unsatisfactory. These import options included the following options, each of which is discussed in their respective subsections:

- Time Gap Limits,
- Speed Outlier Detection,
- Maximum Range Filtering,
- Maximum Altitude Filtering, and
- Time Zone Adjustment.

7.3.3.1 Time Gap Limits

The Time Gap Limit analysis computed the time difference between consecutive points of a flight track. Radar systems interrogate and supply a data point every 4 to 5 seconds, but in the case of corrupted data received, points from two different flights can be mistakenly joined together as one flight track or unexpected gaps in time greater than the normal can mean the track is unreliable. When two consecutive points of a track had a time difference greater than a specified threshold, the flight track was split into two separate flight tracks at that gap. A large time gap between consecutive points often indicates a problem with the flight track, and the flight track geometry was considered unreliable for the purpose of the research effort.

The time gap threshold used for this project was 270 seconds (4.5 minutes).

7.3.3.2 Speed Outlier Detection

Speed is reported in the raw data. The Speed Outlier Detection analysis identified flight track points whose speed exceeded a specified threshold, i.e., a flight segment of such speed would not make sense in the context of “near-airport” aircraft operations. If the speed specified in the radar flight tracking data was greater than a specified threshold, the flight track point was considered an outlier or corrupt and not uploaded to the SQL database. The resultant flight track would be derived from the remaining points for that flight.

The speed threshold used for this project was 320 meters per second (622 knots; 716 miles per hour).

7.3.3.3 Maximum Range Filtering

Maximum Range Filtering excluded flight track points whose distance from the airport of interest exceeded a specified threshold distance. The flight tracks were “clipped” at the threshold distance to exclude data not in the area of interest and would not influence the resultant cumulative noise exposure. This also excluded flight track points that may have been reported incorrectly.

The maximum range threshold used for this project was 200 nautical miles.

7.3.3.4 Maximum Altitude Filtering

The Maximum Altitude Filtering excluded flight track points whose altitude exceeded a specified threshold altitude. The flight tracks were “clipped” at the threshold altitude to exclude data not in the area of interest and would not influence the resultant cumulative noise exposure. This also excludes flight track points that may have been reported incorrectly.

The maximum altitude threshold used for this project was 100,000 feet above Mean Sea Level.

7.3.3.5 Time Zone Adjustment

The PDARS radar flight tracking data timestamp information is reported in local time, appropriate for each airport. However, the NOP radar flight tracking data timestamp information is reported in Coordinated Universal Time (UTC). For the purposes of noise modeling, it is important to convert these timestamps into a local time zone to determine DNL period (day or night). Each airport with NOP data was converted to the appropriate local time zone for that airport. Table 7-4 lists the time zone adjustments applied to each airport.

Table 7-4. Time Zone Adjustments for Airports with NOP Data

Airport Identifier	Local Time Zone (US)	UTC Standard Offset	UTC Daylight Savings Time Offset
ABQ	Mountain	UTC-7	UTC-6
ALB	Eastern	UTC-5	UTC-4
AUS	Central	UTC-6	UTC-5
BDL	Eastern	UTC-5	UTC-4
BIL	Mountain	UTC-7	UTC-6
DSM	Central	UTC-6	UTC-5
LIT	Central	UTC-6	UTC-5
SAV	Eastern	UTC-5	UTC-4
SYR	Eastern	UTC-5	UTC-4
TUS	Mountain	UTC-7	UTC-6

Note: Daylight Savings Time runs from the second Sunday in March at 02:00 a.m. until the first Sunday in November at 02:00 a.m., in all zones, except TUS.

7.3.4 Runway Assignment, Data Reduction and Final Filtering

7.3.4.1 Runway Assignment

Spatial analyses were performed on each airport's data to make and/or verify the runway assignments reported in the radar flight tracking data. These spatial analyses include the calculations of [1] angle between "closest" flight track segment and assigned runway and [2] distance between "closest" flight track segment and assigned runway.

These spatial calculations helped determine runway assignment for each flight track. As the NOP radar flight tracking data did not include runway assignments, spatial analysis was used to make the runway assignments. As the PDARS radar flight tracking data included runway assignments, spatial analysis was used to verify the runway assignments.

7.3.4.2 Extraneous Points

Once the geometric analyses had been performed, the Ramer-Douglas-Peucker algorithm (Ramer 1972, Douglas and Peucker 1973) was applied to the flight track points. The purpose of the algorithm is, given a curve composed of line segments, to find a similar curve with fewer points. The algorithm defines 'dissimilar' based on the maximum distance between the original curve and the simplified curve, i.e., the Hausdorff distance between the curves (Hausdorff 1914). The simplified curve consists of a subset of the points that defined the original curve.

Reducing the number of flight track points while maintaining the flight track shape reduces analysis time, reduces noise modeling run time, and reduces data storage requirements.

7.3.4.3 Final Filtering

Within the SQL databases for each airport, some flight operations were tagged as "Bad Data," indicating that they were not usable for noise modeling. There are several reasons that an operation may have been deemed unusable for noise modeling purposes, including erroneous flight track geometry, a lack of information to assign to an aircraft type, duplicate operations, or the operation was an overflight, i.e., not an operation associated with the airport of interest. Averaging all airports, discarded (filtered out) data comprised five percent of the non-overflight airport-specific operations, due to the reasons summarized above.

7.3.5 Data Checking

Flight tracks from the radar data were visually inspected to ensure:

- Assignment to the correct runway,
- Alignment with the assigned runway, and
- Arrivals and departures were correctly identified.

Flight track inspection also determined the altitudes of the downwind legs of "circuit" (touch and go or other types of closed pattern) flights.

Figure 7-1 shows a typical example of the arrival and departure data for one of the 20 selected airports, while Figure 7-2 is a closer view in which it is possible to see that the alignments are reasonable (red are arrivals, green are departures). Ultimately, as the radar tracks were converted to INM tracks, the tracks were extended or trimmed to connect with the proper runway ends.

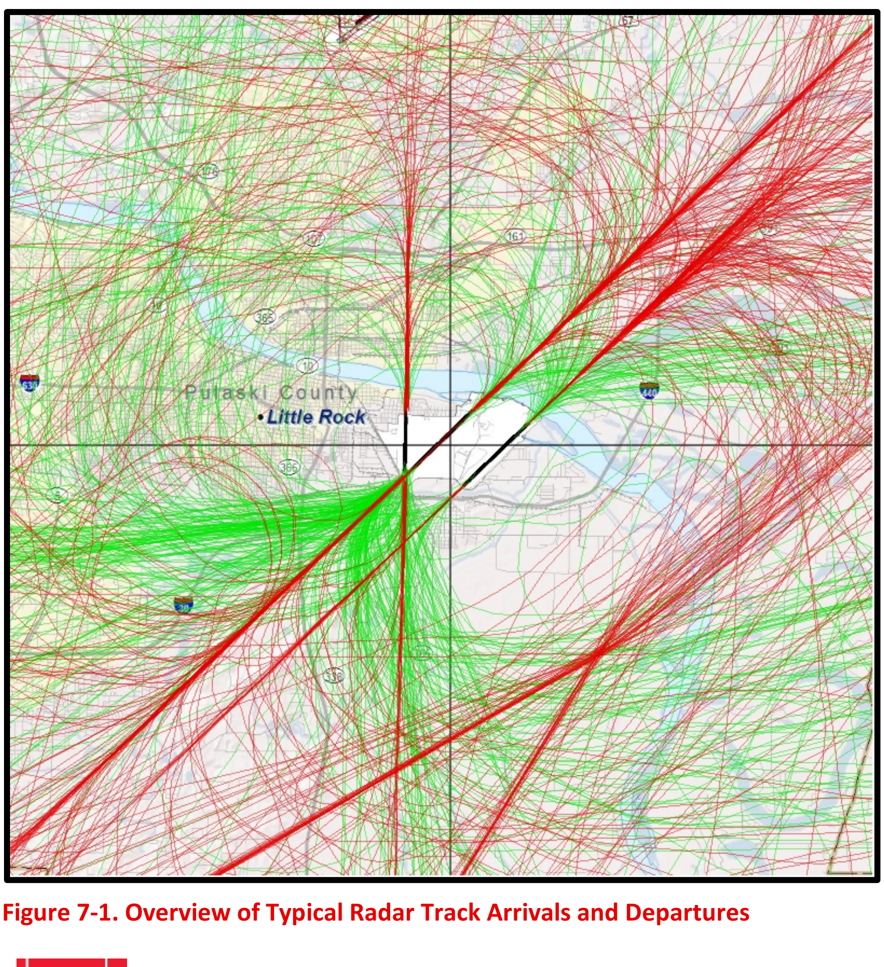

Figure 7-1. Overview of Typical Radar Track Arrivals and Departures

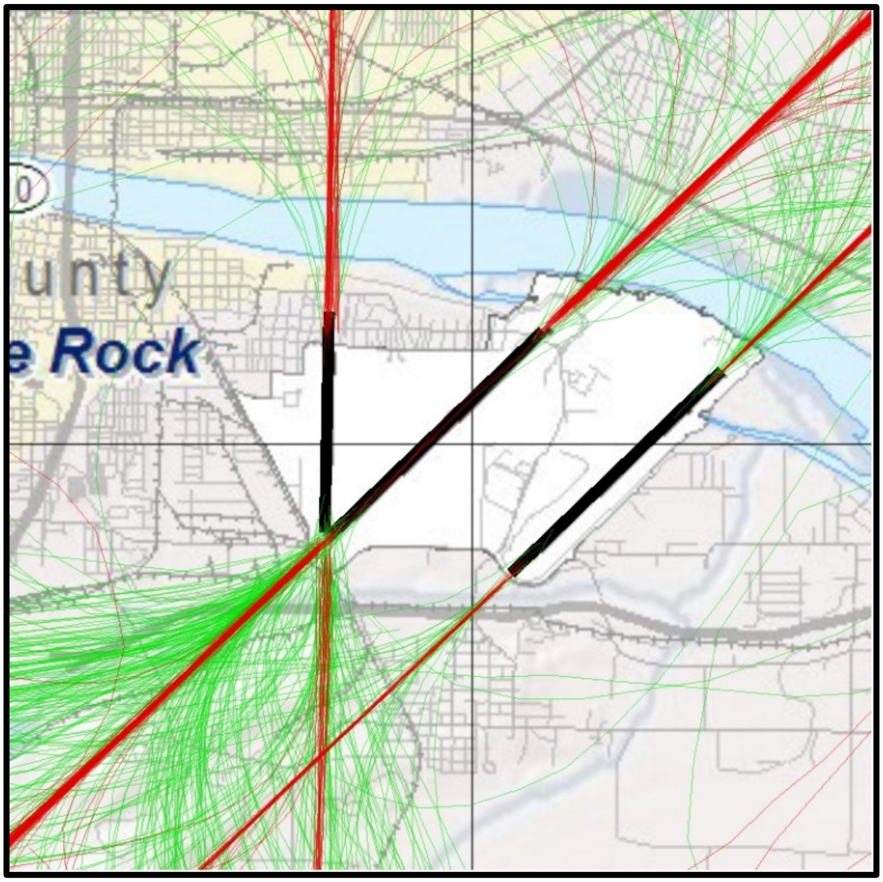

Figure 7-2. Close-up View to Check Alignment with Runways

Closed pattern flight tracks, or "Circuits", were also examined. Modeling circuit tracks with the INM requires special consideration. Generally, these tracks depart and arrive on a single runway and in the INM must be treated as the combination of separate takeoff and landing segments. In general, circuits consist of a departure segment, a level "downwind" segment and an arrival segment. For the downwind segment, INM requires an altitude or pattern height. Pattern altitudes were determined from published sources but if they were not published, the pattern altitudes were determined from examination of the most common long level segment. Each circuit is counted as two operations in the ATADS counts to which the modeled operations were scaled.

Figure 7-3 shows an example of a flight track identified as a circuit. The track shown in the figure is for a C-130 Hercules conducting two separate patterns – the large pattern was flown first, followed by the smaller pattern.

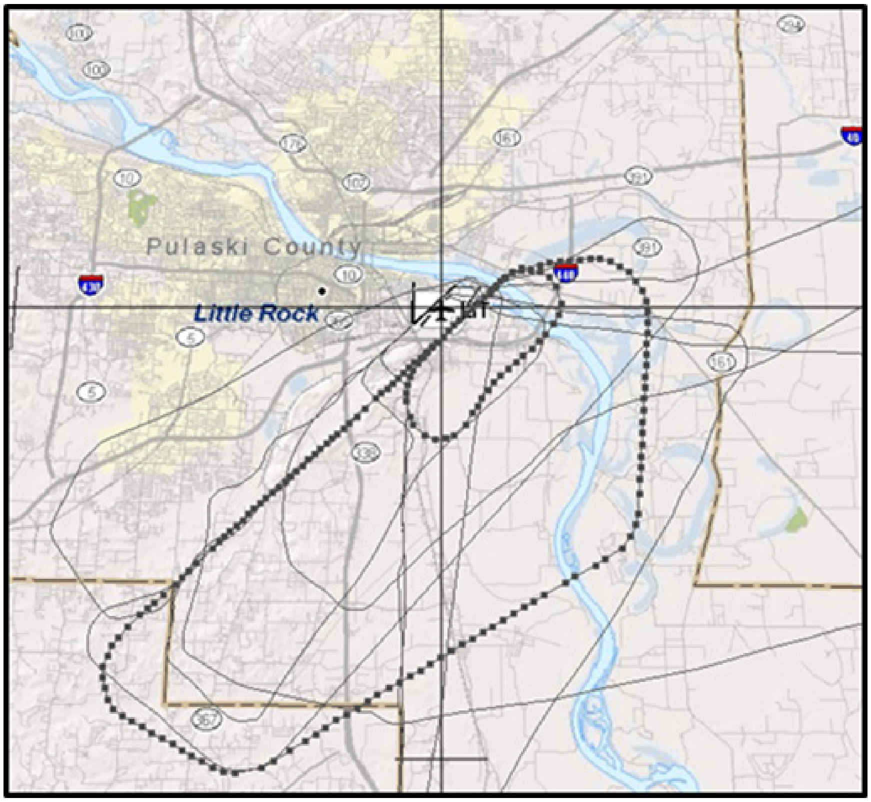

Figure 7-3. Circuit Tracks in the Flight Tracking Data with C-130 Circuit Identified

The particular track of Figure 7-3 is noteworthy because it demonstrates how two different altitudes may be flown and both must be identified and modeled. Figure 7-4 shows a graph of altitude versus elapsed time for the identified flight of Figure 7-3. Figure 7-4 shows the large pattern's downwind leg is at 2000 feet Above Field Elevation (AFE), while the small pattern's downwind leg is at approximately 1,200 feet AFE. For some airports, it was necessary to develop two circuit profiles for other purposes such as differentiating altitudes between non-jet and jet or military aircraft.

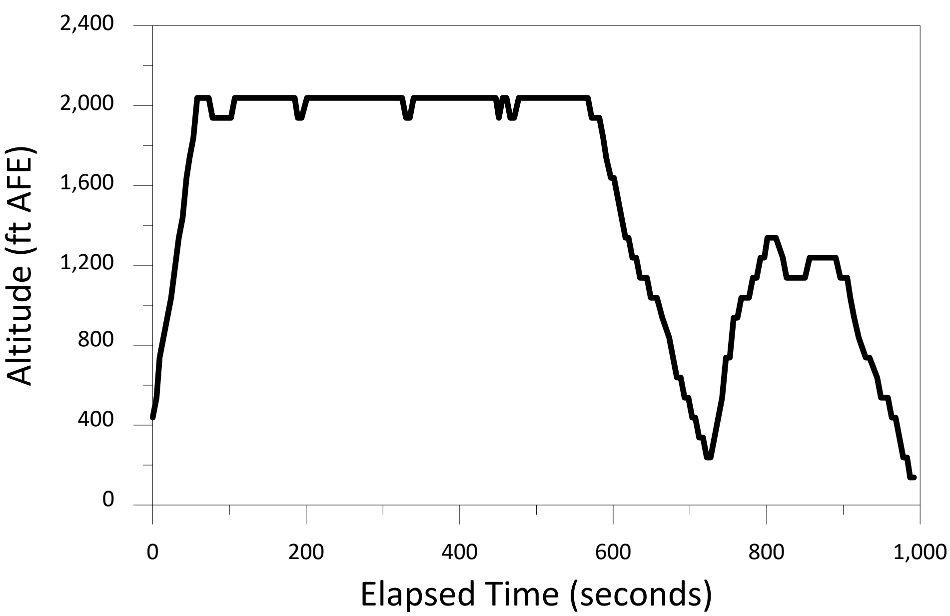

Figure 7-4. Representative Altitude Profile for the Aforementioned C-130 Circuits

7.3.6 Extended Flight Profiles

To ensure that DNL as low as 50 dB could be modeled accurately, the maximum cumulative flight track distances for each INM standard flight profile were compared against the expected flight track distances from the flight tracking data. The latter distances were found to exceed those in the standard INM flight profile database. Therefore, all arrivals were extended at constant approach thrust and angle from 6,000 feet AFE to 10,000 feet AFE, and all departures were extended at constant climb thrust and angle from 10,000 feet AFE to 18,000 feet AFE. Best modeling practices previously approved for INM were used to modify the standard profiles.

7.4 Final Data Processing

Subsections 7.4.1 through 7.4.5 describe five facets of the final data processing.

7.4.1 Generating INM Input

Using the database of flights conditioned as described in the above subsections, each available aircraft flight track was prepared for input into INM, conducting the following pre-modeling checks for compatibility with the INM:

- Examined each track for sufficient length (adequate number of radar returns to model the full profile),
- Checked that a runway assignment exists for all tracks,
- Cut the arrival track where the aircraft descended through 500 feet AFE and then connected the track to the appropriate runway end[34], and
- Checked aircraft type and whether or not the type is acceptable for the runway assigned. Occasionally, through improper coding or typographical error, departing aircraft are assigned to a runway from which they are incapable of taking off. In other words, their distance required to rotate or takeoff exceeds the length of the runway. The software equivalent of look-up tables of acceptable aircraft types for each runway was prepared and used to avoid this error.

Having eliminated tracks with insufficient or incorrect data[35], the INM input was generated. The process itself does not modify INM “standard” noise, performance or aircraft substitution data, but rather selects the best standard data or FAA approved non-standard data, available to INM for each individual flight track.

To create the INM input, the following functions were performed:

- Directly converted the radar flight track from PDARS or NOP for every identified aircraft operation to an INM-formatted track;
- Modeled each ground track as it was flown, including deviations (due to weather, safety or other reasons) from the typical flight patterns;
- Modeled each operation:
    - On the specific runway that was actually used and
    - In the period (i.e. day = 7 a.m. to 9:59 p.m. and night = 10 p.m. to 6:59 a.m.) in which that operation occurred.

[34] INM requires arrival tracks to end (or begin in reverse) precisely at the runway endpoint whereas radar data rarely ends exactly at the runway endpoint.

[35] Across the 20 airports, eliminated (insufficient or incorrect) radar tracks ranged from less than 1 percent (LAX) to 10 percent (ABQ). The 20-airport average was 4 percent.

- Selected the specific airframe and engine combination to model, on an operation-by-operation basis, by using the aircraft type designator associated with the flight plan and, if available, the registration number and the published composition of the individual operator's aircraft inventory (see Section 7.4.4); and
- Used the city-pair distances (the Great Circle distance around the globe connecting a departing and arriving airport) to select a standard INM departure stage length. Stage length is an index associated with a range of trip distance. Where no city-pair was available, stage length was selected by comparing the radar flight track altitude profile to the standard INM aircraft departure profiles (see Section 7.4.2).

7.4.2 Flight Profiles

The stage length for individual departure flights having city pairs was calculated based on the destination airport (city-pair) on the flight plan. Each flight's city-pair great-circle distance was compared to the stage lengths available in the default INM database and an appropriate selection was made. INM does not have all stage lengths available for all aircraft. In cases where the stage length determined by city-pair was not available in the INM or would result in aircraft over-running the runway on departure, the maximum stage length available not causing the aircraft to overrun the runway was selected. If a particular INM aircraft had multiple available default profiles in INM for a given stage length or an operation did not have a city pair, the flight track's altitude profile was compared to the available default INM profiles, and a default INM profile was assigned based on the closest match.

7.4.3 Day / Night Assignment

The flight tracking data included timestamp data for each operation. For arrivals and circuits, the flight's end time (last radar ping) was used to determine if the flight belonged to the DNL nighttime period (10:00 p.m. through 6:59 a.m.). For departures, the flight's start time (first radar ping) was used.[36] The INM applies the DNL-defined 10 dB "penalty" to all operations occurring at night.

7.4.4 Aircraft Types

The INM aircraft database contains noise and performance data for over 100 different aircraft types. The aircraft types given in the radar flight tracking data were converted to the most appropriate INM aircraft type contained within the INM database. The conversion to INM type consisted of several look-up tables, including (in order of priority) FAA registration data lookups, published airline and nationwide fleet mix data (J.P. Airline Fleet International 2013/2014), and HMMH experience.

Table 7-5 shows the modeled annual flight "events"[37] by aircraft category to convey a sense of how predominant aircraft categories varied across the airports. Commercial Jet events dominated other categories at all airports for both data years except: a) BFI and BIL, where Civilian Props dominated for both data years; and b) TUS, where Civilian Props dominated for 2015. TUS had the highest Military Fighter Jet percentage of all airports at 14-16 percent; Military Fighter Jet aircraft were likely a large contributor to the DNL at TUS.

Table 7-5 also shows the events data for both data years for which DNL was computed (initially for sampling purposes using 2012-2013 data and the second time for final DNL at each respondent using 2015 data). Total events decreased from the 2012-2013 data year to 2015 by an average of 2.4 percent across the set of airports. Figure 7-5 presents the total flight events for both data years graphically. MEM experienced the

[36] Note that these nighttime percentages were computed from 2012-2013/2014 radar data and thus reflect the best available operations numbers for each airport information and most accurate nighttime percent, Section 7.4.3; the error discussed in Section 3.5.2, Percentage of Nighttime Operations, had no effect on DNL computations.

[37] The term 'event' is intentionally used instead of the term 'operation'. An event is an arrival, departure or pattern (or circuit) where a pattern is counted as one event. An operation is an arrival, departure or pattern where a pattern is counted as two operations.

greatest decrease in total events (15.6 percent). SJC experienced the greatest increase in total events (9.6 percent). If SEA is included, the average decrease in total events is 1.4 percent and SEA would be the airport with the greatest increase in total events at 19 percent.

Table 7-5. Annual Flight Events by Aircraft Family

Airport Identifier	Commercial Jet	Civilian Jet, Other	Civilian Prop	Civilian Rotorcraft	Military Jet, Fighter	Military Jet, Other	Military Prop	Military Rotorcraft	Total
2012-2013									
ABQ	64,949	4,800	40,923	3,318	1,386	637	8,817	8,387	133,217
ALB	32,895	3,281	26,755	2,791	-	93	1,464	2,512	69,791
ATL	904,914	4,934	10,929	-	7	190	102	-	921,076
AUS	107,847	17,213	38,823	2,698	680	398	2,841	2,260	172,760
BDL	69,727	9,361	10,776	2,470	7	1,385	571	1,331	95,628
BFI	19,253	31,724	111,615	-	458	100	110	-	163,260
BIL	12,360	3,518	52,638	1,542	8	104	337	62	70,569
DSM	41,003	10,101	19,178	440	27	189	185	64	71,187
DTW	414,973	4,393	4,539	-	17	111	60	-	424,093
LAS	356,971	36,821	20,255	107,488	369	268	611	-	522,783
LAX	532,903	16,008	51,090	-	-	-	-	-	600,001
LGA	360,467	5,782	5,502	363	-	-	-	-	372,114
LIT	40,504	12,341	30,774	3,122	165	2,575	8,830	618	98,929
MEM	224,272	11,432	16,395	-	307	496	562	-	253,464
MIA	354,369	14,161	23,413	-	3	472	477	-	392,895
ORD*	858,143	5,475	5,483	-	-	175	18	-	869,294
SAV	32,120	12,905	26,946	1,574	2,796	1,028	2,757	658	80,784
SJC	95,412	16,236	20,542	-	-	42	232	-	132,464
SYR	32,740	3,001	24,643	1,479	26	285	489	395	63,058
TUS	44,129	10,361	42,063	6,826	16,663	1,237	1,314	407	123,000
SEA	215,792	2,307	90,819	-	-	-	-	-	308,918
2015									
ABQ	56,819	4,958	38,751	3,047	1,501	494	6,985	9,112	121,667
ALB	30,575	3,469	25,171	2,716	-	78	1,195	2,090	65,294
ATL	870,252	4,640	6,948	-	16	417	224	-	882,497
AUS	122,269	16,927	38,718	2,593	922	539	3,856	3,060	188,884
BDL	70,792	8,812	8,702	2,325	5	1,112	461	1,063	93,272
BFI	19,276	28,265	96,709	-	724	158	175	-	145,307
BIL	12,516	3,671	53,939	1,565	7	113	278	50	72,139
DSM	38,741	9,685	16,920	397	86	490	534	203	67,056
DTW	371,878	4,359	3,037	-	9	60	32	-	379,375
LAS	365,623	36,173	19,504	101,983	472	343	781	-	524,879
LAX	598,879	17,257	38,357	-	-	-	-	-	654,493

Table 7-5. Annual Flight Events by Aircraft Family (continued)

Airport Identifier	Commercial Jet	Civilian Jet, Other	Civilian Prop	Civilian Rotorcraft	Military Jet, Fighter	Military Jet, Other	Military Prop	Military Rotorcraft	Total
2015									
LGA	358,443	5,327	4,258	334	-	-	-	-	368,362
LIT	32,647	11,807	30,558	2,405	152	2,356	8,059	566	88,550
MEM	191,334	12,662	12,798	-	534	864	979	-	219,171
MIA	379,172	13,862	18,658	-	3	606	613	-	412,914
ORD	864,798	5,394	4,810	-	-	130	5	-	875,137
SAV	35,724	12,314	26,082	1,370	3,154	1,195	3,192	772	83,803
SJC	106,195	17,837	22,169	-	-	42	226	-	146,469
SYR	31,973	3,013	21,679	1,416	27	220	579	405	59,312
TUS	41,215	10,134	43,562	6,749	20,002	1,354	1,568	508	125,092
SEA	271,392	2,658	107,233	-	-	-	-	-	381,283

* For ORD, "2012-2013" is actually 2013-2014.

7.4.5 Define Study Area for Each Airport

INM requires a contour grid area to be defined for each airport. It is standard practice to base the extent of this area on the lowest value of DNL to be contoured or computed. For this project, the lowest DNL to be contoured is 50 dB. Although this project is basing its results on annual average daily operations, best practice is to base the extents of the study area on the 'busiest' day, i.e., the day with the most operations, because the DNL 50 dB contour of the busiest day will always be larger than the DNL 50 dB contour of the average day. Hence, once the pre-modeling runs were done and all days were ready for INM processing, the busiest day was selected and run to determine the size and shape of the DNL 50 dB contour with the following steps:

- Dominant operational flow days, i.e., days with most operations in each flow condition, were identified,
- DNL contours for dominant operational flow days were computed,
- Maximum extent of DNL 50 dB contour was determined from the DNL contours for the dominant operational flow days,
- Grid size was set to cover the maximum extent of the DNL 50 dB contour and
- Terrain grid was cropped to one nautical mile larger than the noise grid extent.

Additionally, all daily DNL 50 dB contours were examined to insure that none extended beyond the planned study area.

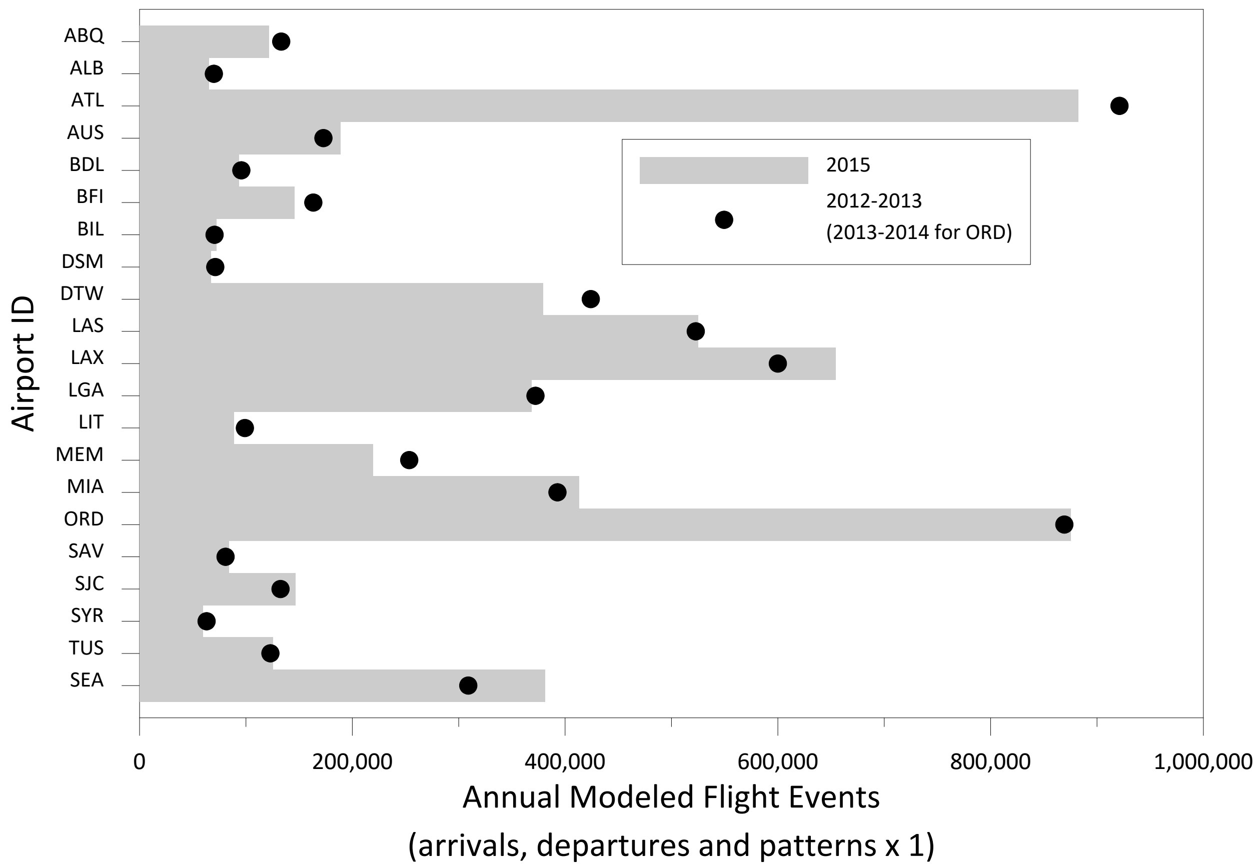

Figure 7-5. Total Flight Events for Both Data Years

7.5 Numbers of Operations and Final DNL Computations

Having created all the necessary model input data, as described in the preceding sections, only adjustments to operations numbers and error checking remained before producing the final output runs. Sections 7.5.1 through 7.5.2 detail the adjustments made and the output processing, respectively.

7.5.1 Scale and Balance Operations

The data source and standard for numbers of annual flight operations for each airport was traffic counts from the FAA's ATADS for 2015. Because the operations numbers derived from flight tracking data may not have been equal to the ATADS counts, the former needed to be reconciled – scaled and balanced – to the 2015 ATADS counts. Scaling means adjusting the modeled operations to equal the FAA's annual counts by aircraft category. Balancing means making the modeled arrival operations equal the modeled departure operations by aircraft type and FAA aircraft category. Aircraft categories were (FAA 2014):

- Air Carrier: Operations by aircraft capable of holding 60 seats or more and are flying using a three-letter company designator.
- Air Taxi: Operations by aircraft less than 60 seats and are flying using a three letter company designator or the prefix "Tango".
- Military: all classes of military operations.
- General Aviation: Civil (non-military) aircraft operations not otherwise classified under air carrier or air taxi.

Operations were assigned to the FAA aircraft categories given the airline code from the radar flight tracking data and INM's aircraft database (Weight and Owner Categories of the INM 'aircraft.dbf' file) and by manual inspection. Appendix F shows the ATADS data and its evolution through the scaling process. Except for the overall numbers of flight operations, the final noise modeling did not account for operational changes occurring at some of the study airports during the period between 2012 and 2015, nor any changes occurring during the survey period in 2015/2016.

Table 7-6 shows the total number of radar tracks used and the total number of operations modeled on those tracks because of the scaling and balancing process that assigned the total number of operations to the total number of usable radar tracks. For the 2015 data year, the ratios ranged from 1.02 (MEM)) to 1.95 (BFI), averaging 1.16. BFI, BIL and TUS had the highest ratios of the set of airports, i.e., between 1.46 and 1.95.

Table 7-6. Total Number of Tracks and Operations Modeled

Airport Identifier	Number of Flight Tracks	2012-2013* Annual Flight Operations Modeled (ATADS counts scaled to Number of Data Days)	2012-2013* Ratio of Operations to Flight Tracks	2015 Annual Flight Operations Modeled	2015 Ratio of Operations to Flight Tracks
ABQ	115,036	138,797	1.21	124,184	1.08
ALB	60,829	74,322	1.22	69,865	1.15
ATL	912,968	921,077	1.01	882,497	0.97
AUS	157,269	174,105	1.11	191,193	1.22
BDL	89,513	95,902	1.07	93,507	1.04
BFI	84,772	187,016	2.21	165,571	1.95
BIL	52,953	79,783	1.51	81,040	1.53
DSM	62,377	73,777	1.18	69,387	1.11
DTW	420,749	424,093	1.01	379,376	0.90
LAS	497,494	522,784	1.05	524,878	1.06
LAX	593,065	600,001	1.01	654,493	1.10
LGA	358,160	372,113	1.04	368,362	1.03
LIT	87,439	105,077	1.20	99,039	1.13
MEM	248,129	253,464	1.02	219,171	0.88
MIA	386,554	392,894	1.02	412,915	1.07
ORD	839,073	869,294	1.04	875,136	1.04
SAV	68,102	88,567	1.30	88,932	1.31
SJC	130,949	134,953	1.03	148,669	1.14
SYR	55,756	65,985	1.18	61,227	1.10
TUS	98,321	139,008	1.41	143,435	1.46
SEA	303,793	308,918	1.02	381,283	1.26

Note: Daylight Savings Time runs from the second Sunday in March at 02:00 a.m. until the first Sunday in November at 02:00 a.m. in all zones.

7.5.2 Final DNL Computations

After flight track counts were corrected, scaled and balanced, the data was packaged into an INM "Study" to produce a validation or "test" run. Once each test run of INM for each airport was verified to be error-free, a final run of all data days produced daily DNL values at each subject location.[38] Finally, the annual average DNL for each subject location was computed by energy averaging all results at every computation point[39] for each airport.

[38] The final modeling missed between 1 and 9 annual flight events at eight of the modeled airports and 275 flight events at BIL. The missing events did not significantly affect the resultant dose-response curves. See Appendix F for more detail.

[39] INM's detailed grid method was used to compute the specific values at each subject location.

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8 Dose-Response Curves

The main purpose of the NES was to produce updated dose-response curves relating the predicted annual average daily noise exposure of residents near airports with their self-reported levels of annoyance. This section provides individual dose-response curves for each of the 20 airports (Section 8.1) and the dose-response curve for all 20 airports together, referred to as the national curve (Section 8.2). These curves were developed using a statistical model based upon all mail questionnaire responses, which allowed for variation among the airports while combining them to produce a national curve.

The logistic regression model from FICON (1992) was used as the basis of the functional form of the individual airport and national curves. In addition to the historical consistency of this choice, alternative models were examined with the result that the model fit for logistic regression was found to require the fewest assumptions, offer the greatest flexibility, and yet provide a good fit to the observed data (see Appendix G). OMB also approved the method. The model in Equation (8.1) gives the predicted percent HA:

$$\text{Percent HA} = \frac{100\ \exp(\beta_0 + \ \beta_1 DNL)}{1 + \exp(\beta_0 + \ \beta_1 DNL)}. \tag{8.1}$$

Details of the mathematical formulations of the individual airport and national models and of the computational methods used to fit the models are given in Appendix H. All data analyses in Chapters 8 and 9, and in Appendices E, G, H, I and J, were generated using SAS/STAT® software, Version 9.4.[40]

The outcome variable HA was defined using the responses to Question 5e of the mail questionnaire. Question 5 asked: “Thinking about the last 12 months or so, when you are here at home, how much does each of the following bother, disturb or annoy you?” and part e of the question asked about “Noise from aircraft.” HA was set equal to one if the respondent reported being “very” or “extremely” annoyed by aircraft noise, and was set equal to zero if the respondent reported being “not at all,” “slightly,” or “moderately” annoyed by aircraft noise.[41]

8.1 Dose-Response Curves for Individual Airports

Table 8-1 gives the model coefficients, standard errors, and 95 percent confidence intervals for the fitted curves from each of the 20 sampled airports. Figure 8-1 displays the 20 individual airport curves.[42] Separate graphs for each airport, showing the curve, 95 percent confidence bands, and data points summarizing percent HA for groups of respondents, are presented in Appendix I.

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[41] Sixty-seven of the respondents checked more than one response to Question 5e. For example, 13 respondents checked both 4 (very) and 5 (extremely) annoyed. For respondents who checked more than one response, we calculated the average of the checked values and defined HIGH_ANNOY to be one if the average was 4 or greater and zero otherwise. For 40 of the 67 cases, the checked categories were entirely within the set {1, 2, 3} or the set {4, 5}.

[42] To protect the confidentiality of the respondents, each curve is drawn from DNL 50 dB to a maximum value of DNL that is rounded to a multiple of 5 near the highest DNL value. The range of DNL displayed for each airport was determined as follows. The respondents were categorized into five DNL groups: 55 dB or less, 55-60 dB, 60-65 dB, 65-70 dB, 70 dB or greater. The number of respondents in each group was calculated, and the graph was extended to the boundary of the largest DNL group that has at least 20 respondents, where the boundary of the highest DNL group is set to 75 dB. For example, if an airport has 250 respondents with DNL less than 55 dB, 250 respondents in the range 55-60 dB, and 3 respondents above 60 dB, the curve is displayed from DNL 50 dB to DNL 60 dB. Alternatively, if an airport has 240 respondents with noise exposure less than 55 dB, 240 respondents in 55-60 dB, and 23 respondents in 60-65 dB, the curve is displayed from DNL 50 dB to DNL 65 dB.

Table 8-1. Model Coefficients for Individual Airport Curves

Airport Identifier	Intercept	Standard Error of Intercept	Lower 95% Confidence Limit of Intercept	Upper 95% Confidence Limit of Intercept	Slope	Standard Error of Slope	Lower 95% Confidence Limit of Slope	Upper 95% Confidence Limit of Slope
ABQ	-6.1563	2.1591	-10.4250	-1.9521	0.1093	0.0406	0.0302	0.1894
ALB	-8.2847	1.5698	-11.4155	-5.2521	0.1355	0.0279	0.0815	0.1911
ATL	-8.3554	1.0956	-10.5485	-6.2480	0.1379	0.0182	0.1027	0.1743
AUS	-11.4847	1.6807	-14.8551	-8.2546	0.1903	0.0298	0.1330	0.2499
BDL	-6.9470	1.3290	-9.5961	-4.3781	0.1124	0.0233	0.0674	0.1587
BFI	-6.5752	1.1655	-8.8959	-4.3210	0.1031	0.0195	0.0652	0.1419
BIL	-13.8302	2.2344	-18.3277	-9.5522	0.2395	0.0407	0.1614	0.3213
DSM	-8.6299	1.4657	-11.5504	-5.7968	0.1387	0.0254	0.0895	0.1892
DTW	-5.9880	1.3581	-8.6806	-3.3507	0.1059	0.0237	0.0598	0.1530
LAS	-6.6325	1.0178	-8.6646	-4.6697	0.1025	0.0169	0.0699	0.1361
LAX	-5.7330	0.8695	-7.4677	-4.0548	0.0930	0.0137	0.0665	0.1204
LGA	-13.1473	1.2944	-15.7651	-10.6832	0.2125	0.0214	0.1718	0.2556
LIT	-8.0593	1.4986	-11.0430	-5.1606	0.1395	0.0271	0.0871	0.1934
MEM	-8.9629	1.0223	-11.0252	-7.0113	0.1388	0.0163	0.1077	0.1715
MIA	-12.6290	1.2452	-15.1485	-10.2599	0.2005	0.0201	0.1622	0.2412
ORD	-10.5999	1.1034	-12.8285	-8.4963	0.1840	0.0185	0.1488	0.2214
SAV	-9.1981	1.9600	-13.0964	-5.4026	0.1566	0.0355	0.0878	0.2270
SJC	-10.7487	1.4209	-13.6010	-8.0228	0.1782	0.0245	0.1312	0.2273
SYR	-3.4425	1.3248	-6.0567	-0.8563	0.0489	0.0234	0.00307	0.0951
TUS	-7.3388	1.3725	-10.0761	-4.6882	0.1399	0.0242	0.0933	0.1882

This graph displays the estimated dose-response curve for each airport. The y-axis is the estimated percent highly annoyed and the x-axis is the noise exposure, measured by the DNL in decibels. At noise exposure of DNL 50 dB, at the left side of the graph, the predicted percent highly annoyed ranged from about 7 percent to 40 percent. At noise exposure of DNL 75 dB, the four airports with this level of noise exposure have percent highly annoyed ranging from about to 75 percent for LAX to about 95 percent for ORD. The individual airport curves do not independently provide a complete picture of the national response to aircraft noise.

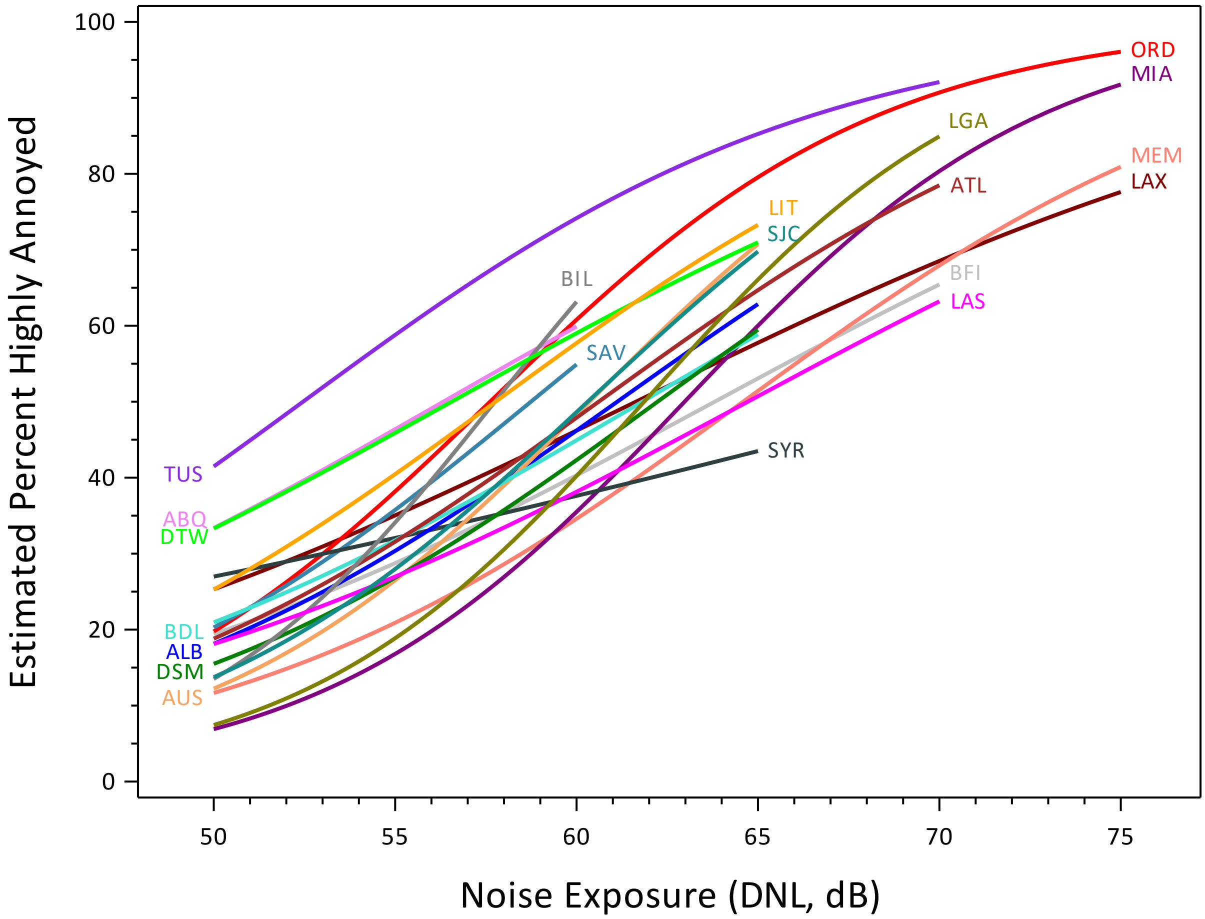

Figure 8-1. Individual Dose-Response Curves for all 20 Airports

8.2 National Dose-Response Curve

The national curve is a current national estimate of the relationship between noise and perceived annoyance based on a representative sample of airports and of residents living near them. It was created by combining the data from all of the individual airports into a single dataset. That combined dataset was used to estimate the parameters in a model that included the airports as random effects, (i.e., treating them as a random sample that is drawn from a larger population of all airports), thereby incorporating an estimate of the variation present had we drawn a different sample of airports. The approach uses all available data to create a national curve, while at the same time provides an estimated dose-response curve for each individual airport. In this way, the national curve can be considered a weighted average of all the sampled airports, taking into account how precisely the model fits each airport. The dose response is similar for most of the airports. Consequently, this approach gives more precise estimates of the model parameters by combining all airport data in a single model than if separate estimates for each airport, based on their own smaller sample, were simply averaged. In this analysis, airports with a more precise fit are given somewhat greater weight in producing the national average.

An alternative approach would have been to create separate curves for each airport independently, and then average equally the resulting slopes and intercepts to obtain a national curve. For comparison purposes, this method was evaluated and was shown to produce results within a few percentage points of the selected method. Appendix H (Section H.2) gives the mathematical formulation of this model. The alternative approach, while potentially more straightforward, would not have produced individual airport curves, a national curve, and tests for all the parameter estimates in a single analysis informed by all the data. However, the method employed herein is able to do all of this.

Equation (8.2) displays the equation for the national curve.

$$\text{Percent HA} = \frac{100\ \exp(-8.4304 + \ 0.1397\ DNL)}{1 + \exp(-8.4304 + \ 0.1397\ DNL)}. \tag{8.2}$$

Table 8-2 repeats the model's coefficients, and provides their standard errors and 95 percent confidence intervals.

Table 8-2. Model Coefficients for the National Dose-Response Curve

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-8.4304	0.5789	-9.6420	-7.2187
Slope, β_1	0.1397	0.0098	0.1192	0.1602

Figure 8-2 graphically displays the dose-response curve and can be used to estimate a 95 percent confidence interval on an estimated percent HA for a given DNL. The dashed lines result from incorporating all responses from all sample airports into a single model estimating both the predicted annoyance and the confidence interval for that estimate. The national curve results in approximately 20 percent HA at DNL 50 dB, 66 percent HA at DNL 65 dB and 79 percent HA at DNL 70 dB. See Appendix H for definition of the 95 percent confidence interval.

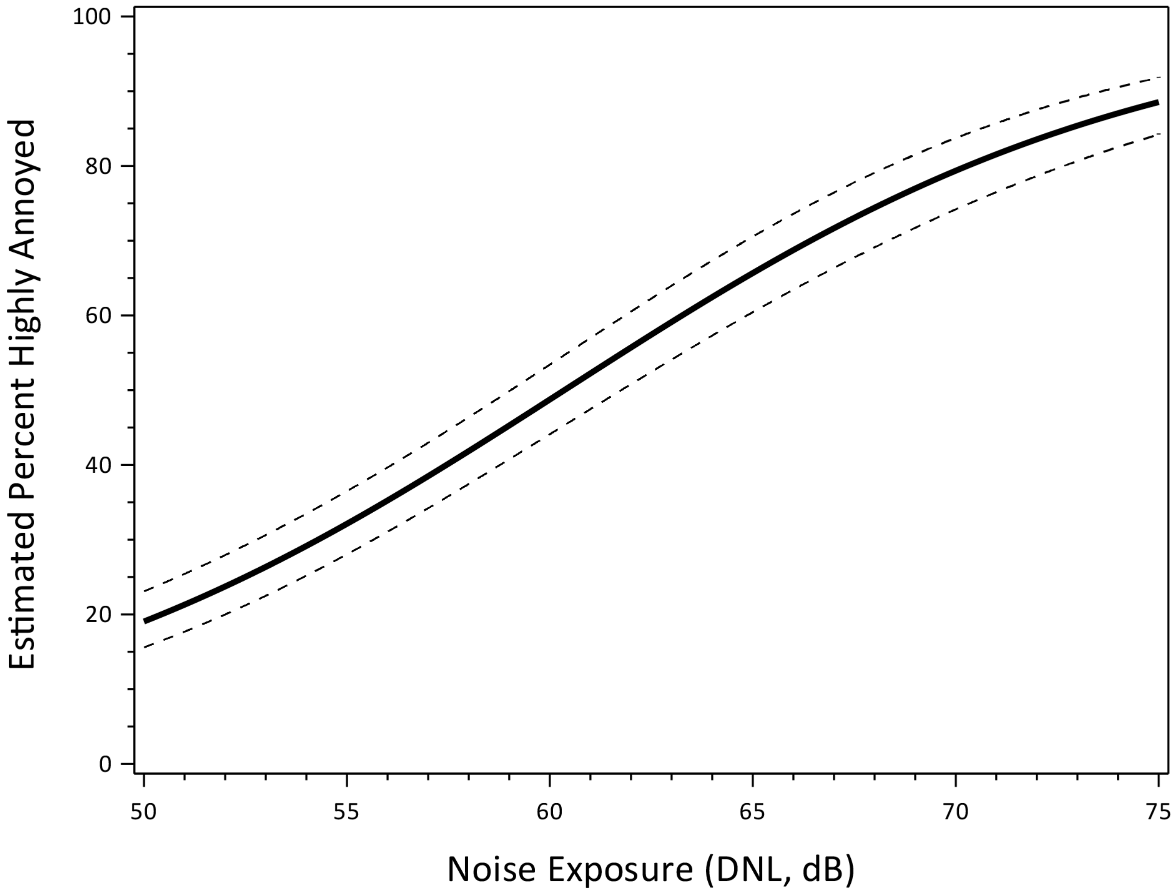

Figure 8-2. National Dose-Response Curve (solid line), with 95 Percent Confidence Intervals on Annoyance for a Given DNL (dashed lines)

Figure 8-3 displays the national curve along with a shaded region showing the range of the curves for each of the 20 airports from Figure 8-1. The national curve is approximately in the middle of the range of the individual airport curves. See Section 9.4 for discussion of airport-to-airport differences.

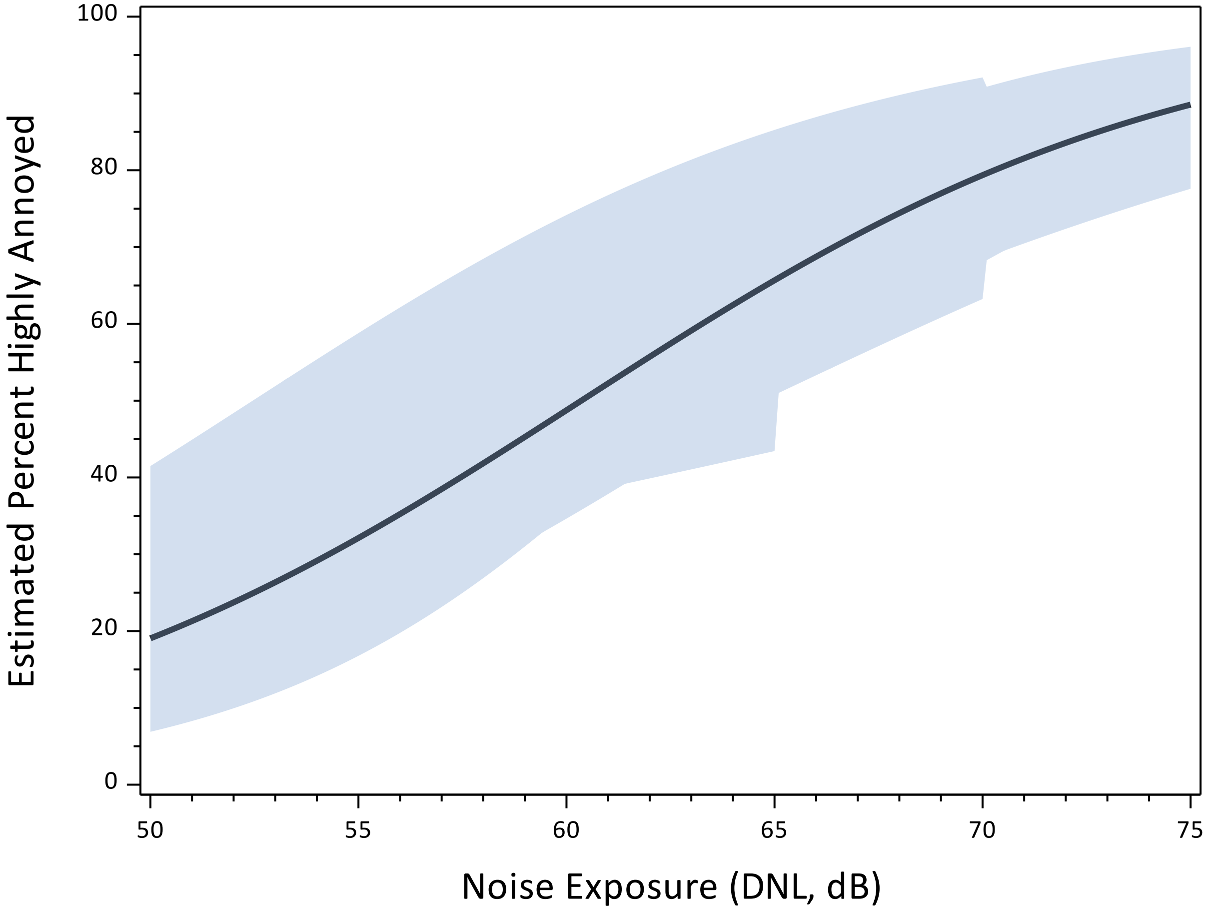

Figure 8-3. National Dose-Response Curve (solid line), Compared to Range (shaded area) of the 20 Individual Airport Dose-Response Curves

Figure 8-4 compares the national curve to four other curves from frequently cited research:

- the FICON (1992) curve,
- two community tolerance level analyses from Equation (G.1) of the International Organization for Standardization (ISO) (2016), and
- the Netherlands Organisation for Applied Scientific Research (TNO) curve at the bottom of page 4 of Janssen and Vos (2011), also given as Equation (H.3) in ISO (2016).

The dashed lines indicate the 95 percent confidence interval for a predicted percent HA for a given DNL.

The FICON, ISO and TNO equations are shown below as Equations (8.3) through (8.5), respectively. In Equation (8.4), the value of the constant depends on the adjustment used for aircraft noise. Figure 8-4 shows the ISO curve for values of the constant equal to 65 and 68, to represent the range of recommended adjustments for aircraft noise.

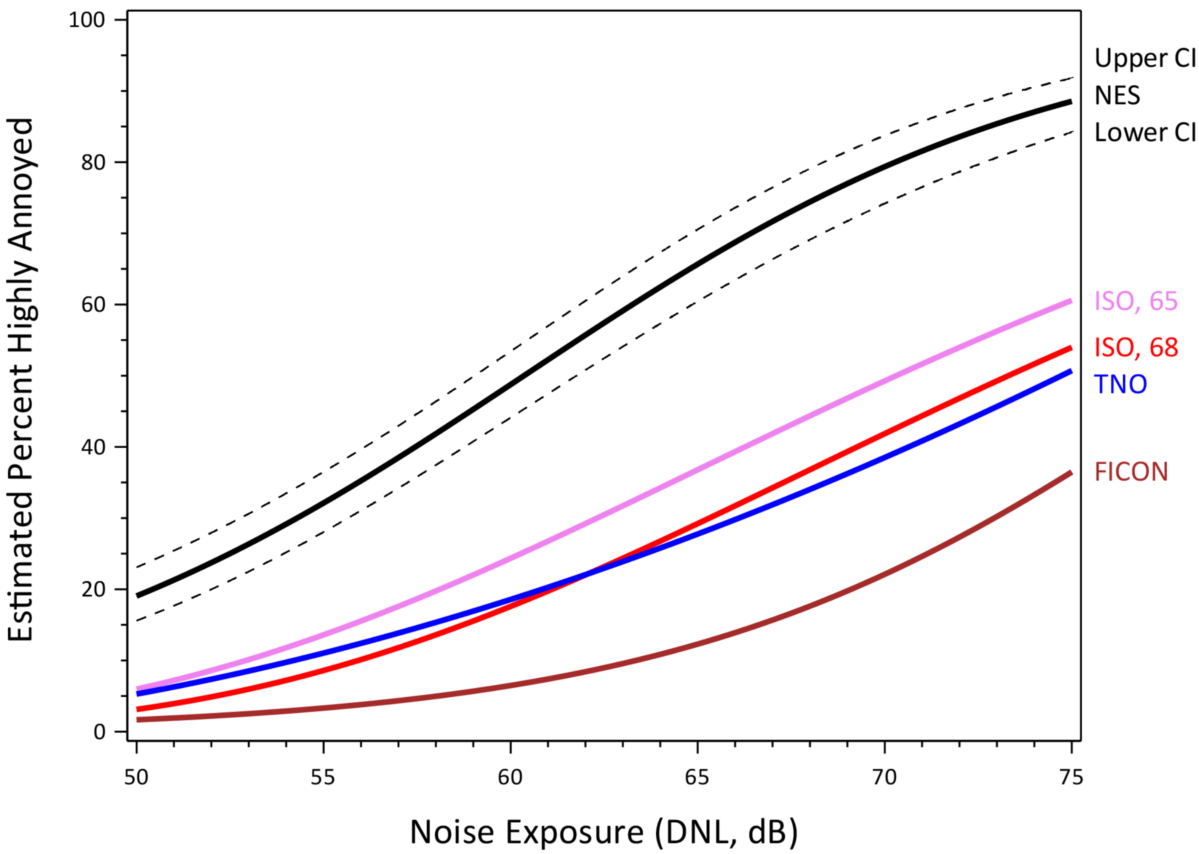

Figure 8-4. National Dose-Response Curve (NES), with 95 Percent Confidence Intervals (CI) on Annoyance for a given DNL. TNO, FICON and ISO Curves with Constants 65 and 68 are Shown Below the National Curve

$$\text{Percent HA}_{\text{FICON 1992}} = \frac{100\ \exp(-11.13 + 0.141\ DNL)}{1 + \exp(-11.13 + 0.141\ DNL)} \tag{8.3}$$

$$\text{Percent HA}_{\text{CTL ISO 2016}} = 100\exp\left\{-\left[\frac{1}{10^{0.1[DNL-\text{constant}]}}\right]^{0.3}\right\} \tag{8.4}$$

$$\text{Percent HA}_{\text{TNO}} = \text{-1.395E-04}\times(DNL\text{-}42)^3 + \text{4.081E-02}\times(DNL\text{-}42)^2 + 0.342\times(DNL\text{-}42) \tag{8.5}$$

Figure 8-5 shows the curve along with estimates of percent HA for groups of observations from the individual airports.[43] Note that the dashed lines in Figure 8-5 and their actual values given in Table 8-3 describe the precision of estimated HA for a given DNL from the national model. They are not a reflection of the much more variable distribution of the points, which represent the variation in individual annoyance responses. In a similar way, the sample mean is much less variable than the individual observations used to compute it.

In Figure 8-5, the national curve is near the middle of the points from DNL 50 dB up to about DNL 68 dB. Above DNL 68 dB, there is some divergence between the curve and the data points from the airports that have high noise exposure. This divergence occurs in part because the national curve can be thought of as "averaging" the individual dose-response curves (Appendix H, Section H.2), and the results greater than DNL 70 dB are extrapolated for the thirteen airports (see Table 4-4) that have no data greater than DNL 70 dB.

Figure 8-5 has been simplified with DNL aggregated into eight bins to address Personally Identifiable Information (PII) considerations (i.e., to protect respondent anonymity). However, the actual curve fitting was conducted with the original non-binned data.

Sensitivity analyses, presented in Appendix G, confirmed that the curve fits the data well under alternative models for DNL less than 70 dB: The curves from the alternative models were inside the confidence limits shown in Figure 8-2 for all values of DNL between 50 and 70 dB. However, some of the alternative models predicted less annoyance than the curve shown in Figure 8-2 for values of DNL greater than 70 dB. Caution should be used when employing the logistic regression curve to predict a national value of percent HA for values of DNL greater than 70 dB. There were relatively few observations in the data set greater than 70 dB, so the data provide less information for the form of the curve in that region than in the region with DNL less than 70 dB.

[43] The data points were calculated as follows. For each airport, the respondents were classified into DNL groups of width 3 dB: less than 52.5, 52.5 to 55.5, 55.5 to 58.5, 58.5 to 61.5, 61.5 to 64.5, 64.5 to 67.5, 67.5 to 70.5, and 70.5+. Any group with fewer than 20 respondents was merged with the group to its left to protect respondent confidentiality. The percent HA was calculated for each group and airport was plotted against the midpoint of the DNL range (the midpoints are 51, 54, 57, 60, 63, 66, 69, and 72). All 20 airports had points plotted at DNL 51 dB; only the four airports with at least 20 respondents above DNL 70.5 dB had points plotted at DNL 72 dB.

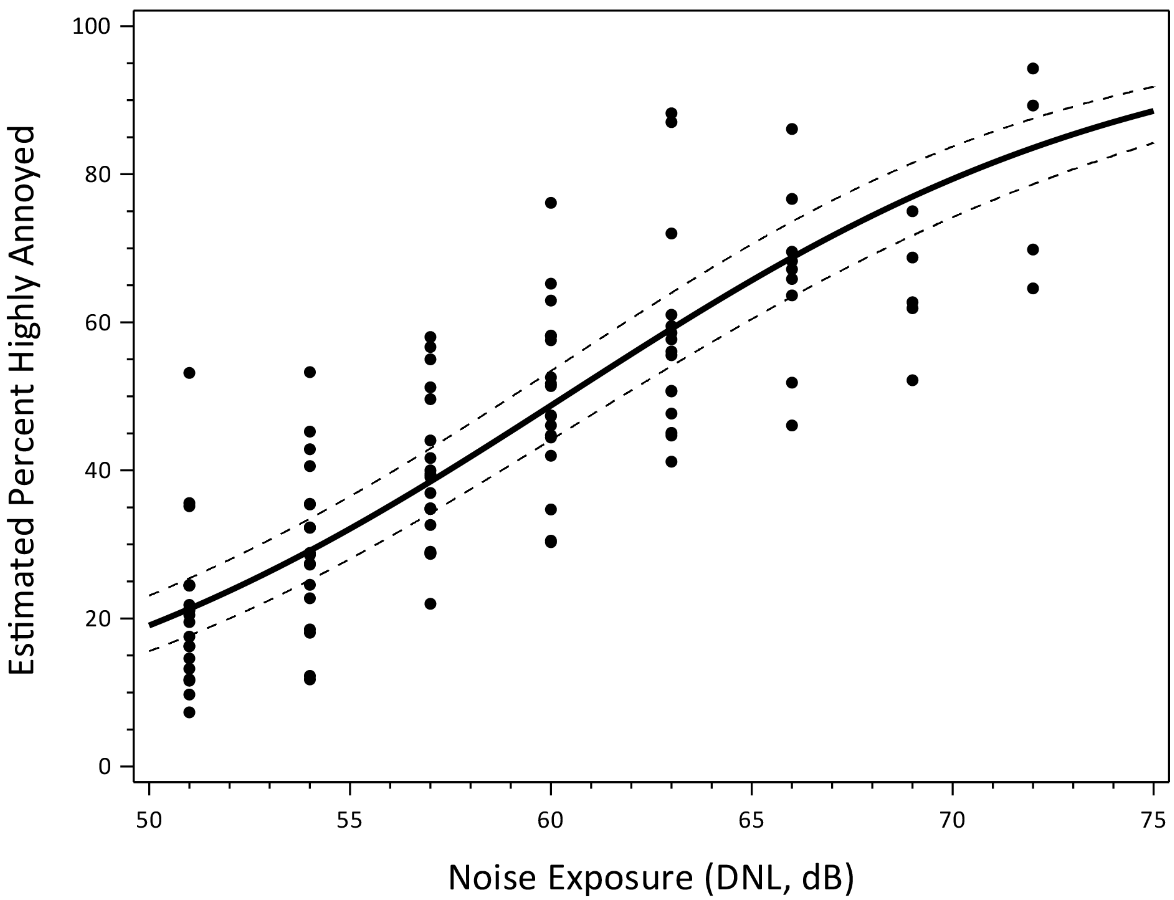

Figure 8-5. National Dose-response Curve, With 95 Percent Confidence Intervals on Annoyance for a given DNL, Displayed with 5-dB binned (see previous footnote) Point Estimates of Percent HA from Individual Airports

Table 8-3 shows the predicted percent HA from the model in Equation 8.2, for DNL between 50 and 70 dB.

Table 8-3. Predicted Percent HA at Selected Noise Exposures, from National Dose-response Curve

DNL Value (dB)	Predicted Percent HA	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
50	19.1	1.9	15.4	23.4
51	21.3	2.0	17.5	25.7
52	23.7	2.0	19.8	28.2
53	26.4	2.1	22.2	30.9
54	29.2	2.1	24.9	33.8
55	32.1	2.2	27.8	36.8
56	35.2	2.2	30.8	40.0
57	38.5	2.2	33.9	43.3
58	41.8	2.3	37.2	46.7
59	45.3	2.3	40.5	50.2
60	48.8	2.4	43.8	53.7
61	52.2	2.4	47.1	57.3
62	55.7	2.5	50.5	60.8
63	59.1	2.5	53.7	64.3
64	62.5	2.6	57.0	67.7
65	65.7	2.6	60.1	70.9
66	68.7	2.6	63.1	73.9
67	71.7	2.6	66.0	76.7
68	74.4	2.6	68.7	79.4
69	77.0	2.5	71.3	81.8
70	79.4	2.4	73.8	84.0

8.3 Considerations for Interpreting the Curves

The interpretation of a regression model for summarizing the relationship between a response variable y (here, the indicator variable percent HA defined at the beginning of this section) and an explanatory variable x (here, DNL) in a population depends on several factors:

1. Representativeness of the sample with respect to the population,
2. Functional form of the regression model and how well it fits the data,
3. Method for measuring y and the accuracy of the y values, and
4. Method for measuring x and the accuracy of the x values.

In the NES, residents in each of the 20 airport communities were surveyed with the same survey design and protocol, using the same questionnaire, and over the same period. Previous studies used different survey methods and measurements of annoyance. Janssen et al. (2011) reviewed literature finding that some of the differences among previous studies could be explained by the study design and sample selection methods. Some of the studies that served as the foundation of the ISO, TNO, and FICON curves used telephone or face-to-face survey administration, or used different mailing and nonresponse follow-up protocols for a mail survey; measured highly annoyed using a different instrument or different scale; had different response rates; surveyed the population for only part of a year rather than the whole year; and used different methods for computing DNL for respondents. The data for the studies were collected from different countries and in different languages. Importantly, many of the prior studies included noise from a variety of transportation sources.

The ISO and TNO curves from Equations (8.4) and (8.5) were fit using statistical models of different form than the two-parameter logistic regression model in Equation (8.1). The ISO curve used a log-log link function instead of the logit link function used in Equation (8.1), and it fixed the slope of the equation at a predetermined value instead of estimating it from the data see Appendix G, Section G.4 for a discussion of the model used for the ISO curve. The TNO model (Janssen and Vos, 2011) is a polynomial approximation to the results from a grouped regression model (Groothuis-Oudshoorn and Miedema, 2006) in which the individual airport study intercepts are random effects; as discussed in Appendix H, Section H.2, the model used for the national curve in Equation (8.2) uses random effects for both the slopes and the intercepts.

The NES national curve may differ from dose-response curves from other studies because the relationship between noise exposure and annoyance has changed since the earlier studies, but the differences may alternatively be due to differences in study design, implementation, measurement, cultural differences for studies occurring in other countries, or a combination of these factors. In addition, advances in technology and statistical theory have resulted in changes in methodology that were not available for some of the previous studies. Many of these aspects are discussed in the following subsection, along with implications for comparing the estimated dose-response curves from the NES with other dose-response curves in the literature.

8.3.1 Sample Representativeness

As described in Chapter 3, the sample of airports in the NES was selected using balanced probability sampling so that it is representative of the population of 95 airports with respect to the factors listed in Table 3-2. Within each airport, a stratified random sample of addresses, stratified by noise exposure, was taken at each airport, ensuring that the sample of addresses selected from each noise stratum is representative of the population of addresses in that noise stratum.

Although the address-based sampling method used in the NES has been demonstrated to have greater response rates than alternative methods of data collection such as telephone surveys (National Research Council, 2013, Chapter 4) and the ACRP study showed the response rate from the mail administration to be much greater than that of a telephone survey (Miller et al. 2014a), there was still nonresponse to the survey. If the nonrespondents differ from the respondents, and if those differences cannot be controlled for through statistical modeling or weighting, then the sample may not be fully representative of the population (Brick 2013).

The dose-response curves in Sections 8.1 and 8.2 are constructed using data from the respondents to the survey. The survey has no information on the annoyance level of the nonrespondents. Westat conducted analyses to investigate whether respondents and nonrespondents differed on characteristics that are known for every sampled address, whether respondent or not. Appendix E reports the nonresponse bias analyses performed for the survey. To conduct a further exploration of potential nonresponse bias, the model was refit to data using nonresponse-adjusted weights. The curve from this model, reported in Appendix G (Section G.3), was visually indistinguishable from the curve fitted without weights from Figure 8-2. This indicates that the dose-response relationship is unaffected by nonresponse bias adjustments that can be done using information from the sampling frame, and provides evidence that nonresponse bias is not detected from the information known from the sampling frame. However, the information known about both respondents and nonrespondents is limited, and it is possible that respondents and nonrespondents differ on characteristics not known in the sampling frame, including their annoyance to aircraft noise.

8.3.2 Regression Model Form

The analysis reported in this section used the two-parameter logistic regression model from Equation (8.1) to summarize the dose-response relationship, as requested by FAA. The logistic regression model is widely used to model dose-response relationships because it can fit many different possible sigmoidal shapes (Cox and Snell 1989). As with any parametric model, the two-parameter logistic regression model assumes a specific form for the relationship between percent HA and noise exposure. In particular, the logistic model is symmetric about the point where 50 percent are highly annoyed. [44] The model also assumes that the percent HA always increases as DNL increases.

Appendix G evaluates the fit of the model for the individual-airport and national dose-response curves. Overall, for DNL below 70 dB, the predicted percent HA from the two-parameter national logistic model is similar to the predicted percent HA for alternative models that were fit to the data. As shown in Appendix G (Figure G-1), for DNL greater than 70 dB, some of the alternative models predicted less percent HA than the logistic model. An alternative one-parameter model from Fidell et al. (2011) exhibited significant lack of fit for the NES data, as presented in Appendix G (Section G.4).

8.3.3 Methodology and Accuracy of Measurement of Highly Annoyed

Chapter 2 described the development of the NES methodology and the question used to classify a respondent as being highly annoyed. Annoyance was measured following procedures developed by ICBEN (Fields et al. 2001), recommended by ISO (2016), including the use of a five-point verbal scale, which is widely used in current surveys. Respondents answering "Very" or "Extremely" annoyed are counted as HA as opposed to those answering "Not at all", "Slightly" or "Moderately" annoyed. Some laboratory research has shown that people rate "Very" and "High" as expressing equivalent degrees of annoyance (Fields et al. 2001). Many earlier surveys, including many of those in the FICON analysis (1992), derived their annoyance indicator from survey questions that differed in such features as: the use of numeric rather than verbal scales, the language of administration, the reaction (not always "annoyance"), the number of scale points, the verbal labels for the scale points ("highly" has not been offered as a choice in surveys), and whether the scale is presented in as single question or is broken into two parts with a screening question. The NES mail questionnaire only asked about aircraft noise annoyance as part of a rating of thirteen neighborhood conditions. As a result, respondents in the NES mail survey, as for most recent surveys, did not know that aircraft noise was the focus of the inquiry when answering the question. Noise annoyance surveys differ considerably from one another in many ways that sometimes affect survey responses (Groves et al. 2011) and might affect annoyance responses. Examples include the season of administration, the mode of questioning (mail, telephone, face-to-face, etc.), the method for identifying households, whether the respondent within a household is self-selected or selected by the survey, and the context set by any introductory materials including the identification of the survey purpose and sponsor.

8.3.4 Methodology and Accuracy of DNL Modeling

Chapter 7 described the methodology used by the NES to calculate the value of DNL for each sampled address in the research effort, and the steps taken by HMMH to ensure the accuracy of those calculations. Westat performed internal consistency checks to verify that the values of DNL used in the model were consistent with the noise contours that had been used when selecting the sample.

8.3.5 Comparison with Other Curves

A comparison of the NES curves to other curves in the literature should consider the populations from the studies and how well the samples represent those populations, and how well the statistical models that are employed summarize the information from those studies. It also needs to account for differences in the methodology for measuring HA and possible differences in the calculation of DNL. The survey methodology used in the NES follows current best practices in public opinion / social science research. These methods

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[44] Dobson and Barnett (2008, Section 7.3) review alternative models that can be used for dose-response relationships, including probit and complementary log-log link models. The different models give similar results for predicted percentages between 30 and 70 percent but may differ slightly for predicted percentages close to 0 and 100 percent. In particular, log-log and complementary log-log link models do not have the symmetry property of the logistic and probit models. The log-log link model has a shallower slope than the logistic model when the predicted percentage is close to 100 percent and a steeper slope when the predicted percentage is close to 0 percent.

were tested and refined following a pilot test (ACRP 02-35) and have been commonly used for recent major surveys by other Federal agencies such as the Federal Highway Administration, National Cancer Institute and the Department of Education.[45]

Figure 8-4 shows that the TNO, ISO, and FICON curves fall outside of 95 percent confidence limits for the national curve fit to the NES data. This indicates that the NES curve is statistically significantly different from the mathematical functions used to summarize those curves. However, each of the TNO, ISO, and FICON curves is an estimate based on airport surveys that had been conducted in the past and on samples of respondents in those surveyed airports. These surveys also had sampling and nonsampling errors, and a proper significance test would need to account for the errors in the studies used to construct the TNO, ISO and FICON estimates.

The model for the NES in Equation (8.1) used the same functional form as the FICON (1992) curve. Table 8-4 compares the coefficients from the two curves. The estimated slope from the FICON (1992) curve is close to that of the NES curve. The intercept for the NES curve, however, is greater than the FICON value of -11.13. The estimated coefficients indicate that the rate of increase in percent HA with increasing DNL is consistent with the earlier FICON results. However, it appears that the percent HA for a given DNL has increased over that previously observed in FICON.

Table 8-4. Comparison of NES and FICON (1992) Coefficients

Coefficient	Estimate from NES Curve	Lower 95% Confidence Limit for NES Curve	Upper 95% Confidence Limit for NES Curve	Estimate from FICON (1992)
Intercept, β_0	-8.4304	-9.6420	-7.2187	-11.13
Slope, β_1	0.1397	0.1192	0.1602	0.141

The increase in annoyance at all levels of DNL exposure should be placed in context with the timeframe of this research effort. The FICON curve utilized data from the 1960s through 1980s and is now several decades old. Over that timeframe, the public may have become increasingly sensitive to aircraft noise at a given DNL, perhaps due to differences in the nature of sound exposure (e.g., changes in operations, frequency of flights), differences in study design, country surveyed, implementation and measurement, changes in attitudes, or a combination of these factors. Meta-analysis of more recent studies has also found higher levels of aircraft noise annoyance compared to historical curves (Guski et al. 2017). Further research is underway by the project team to examine historical trends in aircraft noise annoyance data, including comparisons to other recent research.

[45] These recurrent major Federally-funded national surveys have all transitioned from telephone to mail data collection over the past decade: National Household Travel Survey, Federal Highway Administration, Department of Transportation - https://www.nationalhouseholdtravelsurvey.com/
Health Information National Trends Survey (HINTS), National Cancer Institute - https://hints.cancer.gov/
National Household Education Surveys, National Center for Education Statistics, Department of Education - https://nces.ed.gov/nhes/

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9 Additional Factors Analyzed

Additional analyses were performed to investigate whether the airport-to-airport differences in the dose-response curves could be partially explained by other factors. It is important to note that the final list of factors was determined before the end of data collection and before data analysis on the dose-response curves commenced. Thus, they are considered pre-planned hypotheses. The scientific community has established that posing hypotheses after exploring patterns in the data, known as data fishing or p-hacking, leads to more false positive findings (Head et al. 2015). The American Statistical Association Statement on Statistical Significance and P-Values (Wasserstein and Lazar 2016) provides guidance for interpreting the results of statistical tests. Note that although multiple hypotheses are considered in this section, the results presented were not adjusted for multiple testing. The results given below consider the comparison-wise error rate, not the familywise error rate (see Oehlert (2000), Chapter 5, for a discussion of the two error rates).

The FAA identified the following six factors to be examined:

1. Climate
2. “Visible” Flight Events
3. “Noticeable” Flight Events
4. “Relatively Important” Flight Events
5. Race/Ethnicity
6. Income

The factors associated with each analysis area are described briefly in Table 9-1 and in detail in Appendix J along with their rationale. Income was not asked on the NES mail questionnaire and was studied using census block group statistics from the American Community Survey. For race/ethnicity, the variable MINORITY was defined using respondents’ self-reported information. Climate was characterized by the sum of Cooling Degree Days and Heating Degree Days. A flight event was defined as ‘visible’ if it was at least 45° above the horizon and within a slant distance of 12,000 feet of the respondent. A flight event was ‘noticeable’ if it had a Maximum (A-weighted) Sound Level (L_{max}) of at least 50 dB at the respondent’s location.[46] A flight event was ‘relatively important’ if it was one of the events contributing up to 1 dB of the total DNL at the respondent’s location.

The analyses in this section investigate whether, after controlling for DNL, these factors are related to the overall level of aircraft noise annoyance or moderate the relationship between annoyance and noise exposure as measured by DNL. Section 9.1 addresses the climate analysis. Section 9.2 addresses the analyses for the three flight event metrics and Section 9.3 addresses the race/ethnicity and income analyses.

[46] The concept of “noticeability” here means that some aspect of aircraft flights, possibly in addition to their sound level, may raise awareness of the planes and hence increase the annoyance.

Table 9-1. Additional Factors Studied

Factor	Definition
DEGREEDAYS (Climate)	Sum of the number of annual cooling degree days and heating degree days for the airport. A degree day is the difference between the day's mean temperature and 65 degrees Fahrenheit. It is termed a 'cooling degree day' if the day's mean temperature is greater than 65 degrees Fahrenheit and a 'heating degree day' if the day's mean temperature is less than 65 degrees Fahrenheit.
VISIBLE	Number of flights for which the point of closest approach has an elevation angle greater than or equal to 45 degrees above the horizon, and with a slant distance less than 12,000 feet.
NUMBERABOVE50 ('Noticeable')	Number of modeled aircraft events at or above a maximum sound level (L_{max}) of 50 dBA at the sampled address during the calculation period.
IMPORTANT	Number of aircraft operations that produce a DNL value within 1 dB of the total DNL value for all aircraft operations at the sampled address during the calculation period.
MINORITY (Race/Ethnicity)	1 if the respondent reported being Hispanic or selected one or more of the following race categories: Black or African American, American Indian or Alaska Native, Asian, or Native Hawaiian or Other Pacific Islander; 0 if the respondent reported being non-Hispanic and selected only the White category for race.
PCTBELOWPOVERTY (Income)	Percentage of population below the poverty level in the census block group containing the sampled address, calculated from the 2010-2014 American Community Survey five-year estimates.

9.1 Degree Heating and Cooling Days

The variable DEGREEDAYS is an airport-level characteristic, i.e., the variable has the same value for all addresses at an airport. The other variables in Table 9-1 vary among respondents from the same airport community. While the variable DEGREEDAYS could potentially be associated with differences in the overall level of annoyance between airports, it cannot be used to explain differences among households residing near the same airport.

The variable DEGREEDAYS was analyzed by including an extra term in the model in Equation (8.1), as described in Section G.3. The model fit is Equation (9.1).

$$\text{Percent HA} = \frac{100\ \exp(\beta_0 +\ \beta_1 DNL +\ \beta_2\ DEGREEDAYS)}{1 + \exp(\beta_0 +\ \beta_1 DNL +\ \beta_2\ DEGREEDAYS)}. \tag{9.1}$$

The estimated model coefficients, along with standard errors and 95 percent confidence intervals, are given in Table 9-2.

Table 9-2. Model Coefficients for Model with DEGREEDAYS

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-8.4154	0.6862	-9.8516	-6.9792
DNL, β_1	0.1397	0.0100	0.1187	0.1607
DEGREEDAYS, β_2	-0.000003	0.00005	-0.0001	0.0001

The estimated coefficient for DEGREEDAYS (β_2) is not significantly different from zero (T = 0.003, p-value = 0.96). There is no evidence that households near airports with higher total degree heating and cooling days have higher, or lower, levels of annoyance to aircraft noise.

The results from the model reported in Table 9-2 indicate that a linear term for DEGREEDAYS does not help explain airport-to-airport differences in annoyance. Because DEGREEDAYS is an airport-level characteristic, an additional graphical analysis could be performed to display the lack of relationship between DEGREEDAYS and percent HA. Figure 9-1 displays the predicted percent HA at DNL 55 dB for each of the 20 sampled airports, related the value of DEGREEDAYS for that airport. The predicted values of percent HA were calculated by substituting the airport-specific regression coefficients from Table 8-1 into the model in Equation (8.1).[47] If DEGREEDAYS helped explain airport-to-airport differences in annoyance at DNL 55 dB, one would expect to see a trend in the graph. However, there is no apparent trend in Figure 9-1: airports with high values of percent HA at DNL 55 dB, and airports with low values of percent HA at DNL 55 dB, appear at high, low, and middle values of DEGREEDAYS. Figures 9-2 and 9-3 show a similar lack of relationship between DEGREEDAYS and predicted percent HA at DNL 60 dB and predicted percent HA at DNL 65 dB, respectively.

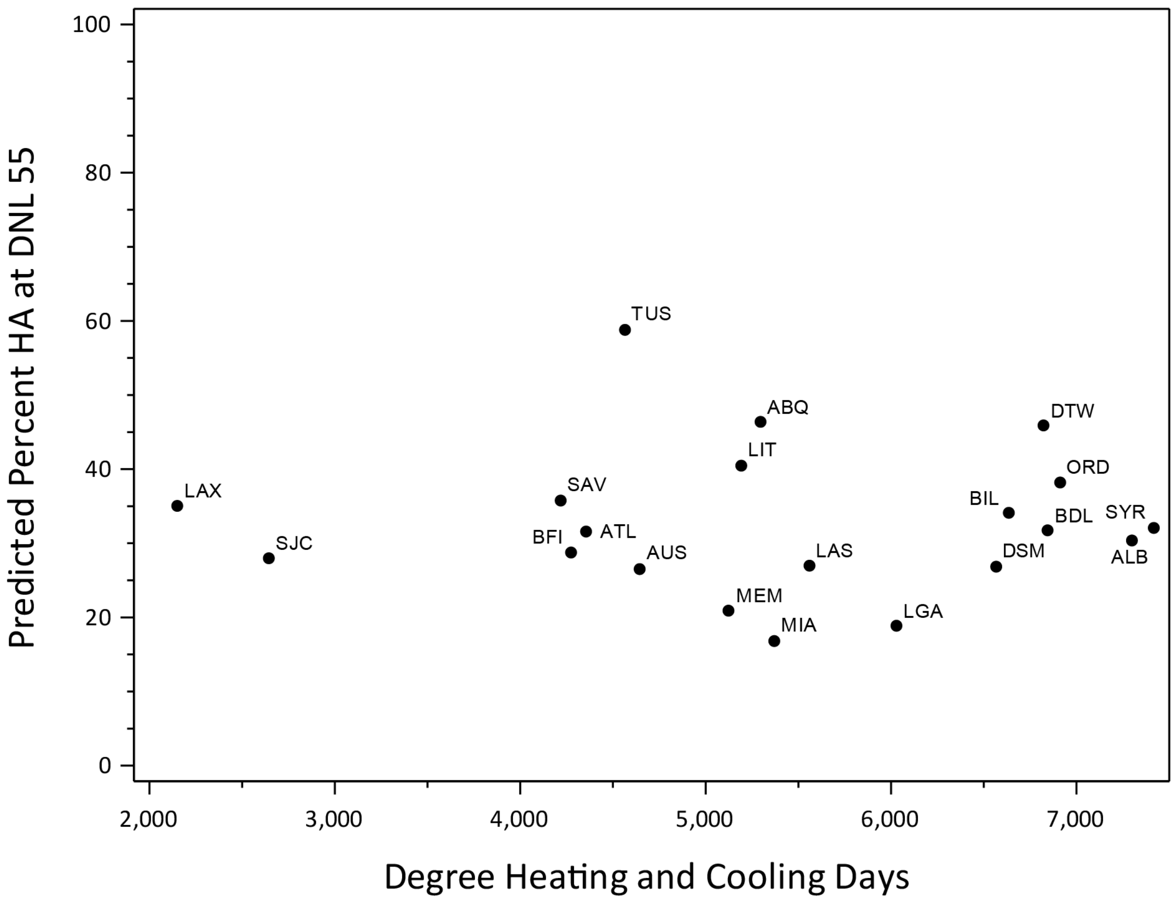

Figure 9-1. Estimated Percent HA at DNL 55 dB by Airport Total Degree Days

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[47] For example, the predicted percent HA for ABQ at DNL 55 dB was calculated as 100 exp(-6.1563 + 0.1093 x 55) /[1 + exp (-6.1563 + 0.1093 x 55)] = 46.38 percent. The predicted percentage from the model was used so that all airports would be compared on the same footing. Because different airports have different distributions of DNL values, a comparison of average percent HA across airports would result in some airports having higher percent HA merely because they had more sampled households with high DNL value.

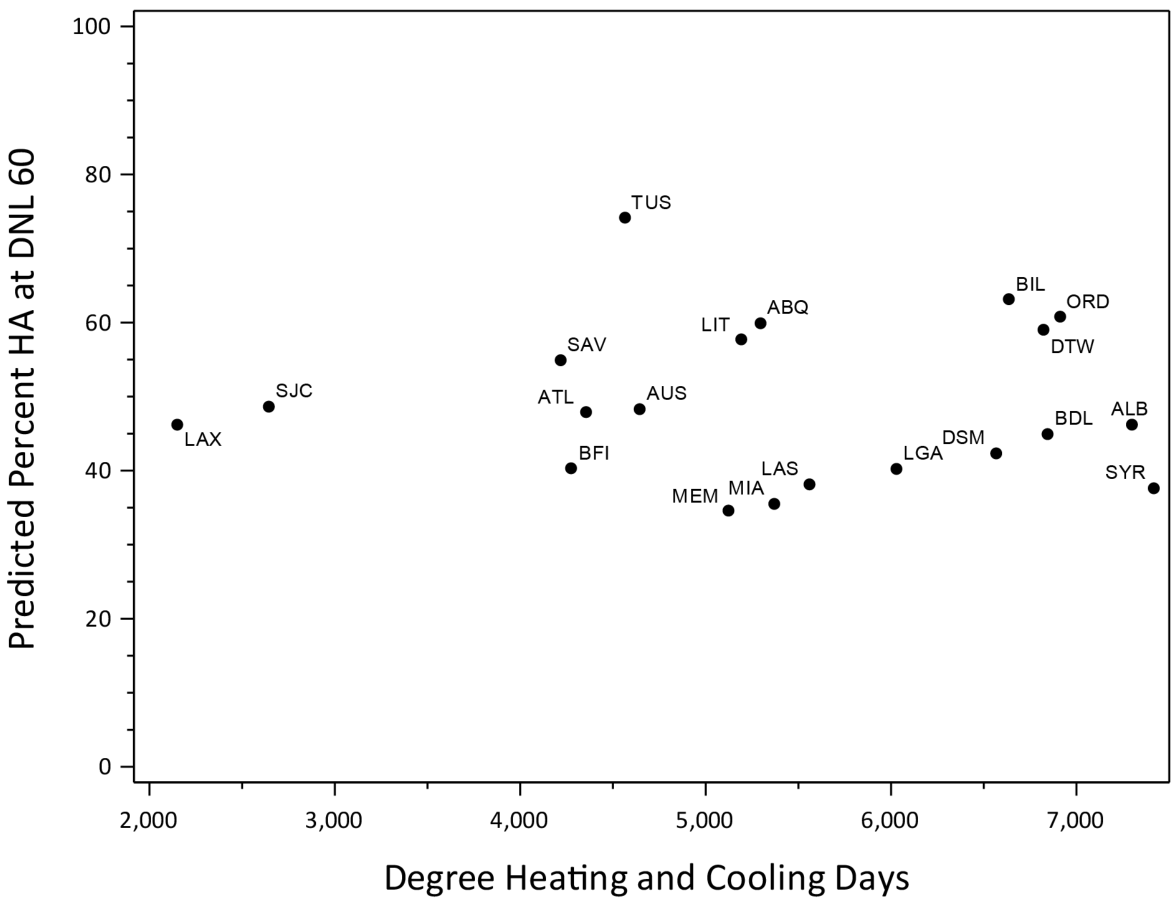

Figure 9-2. Estimated Percent HA at DNL 60 dB by Airport Total Degree Days

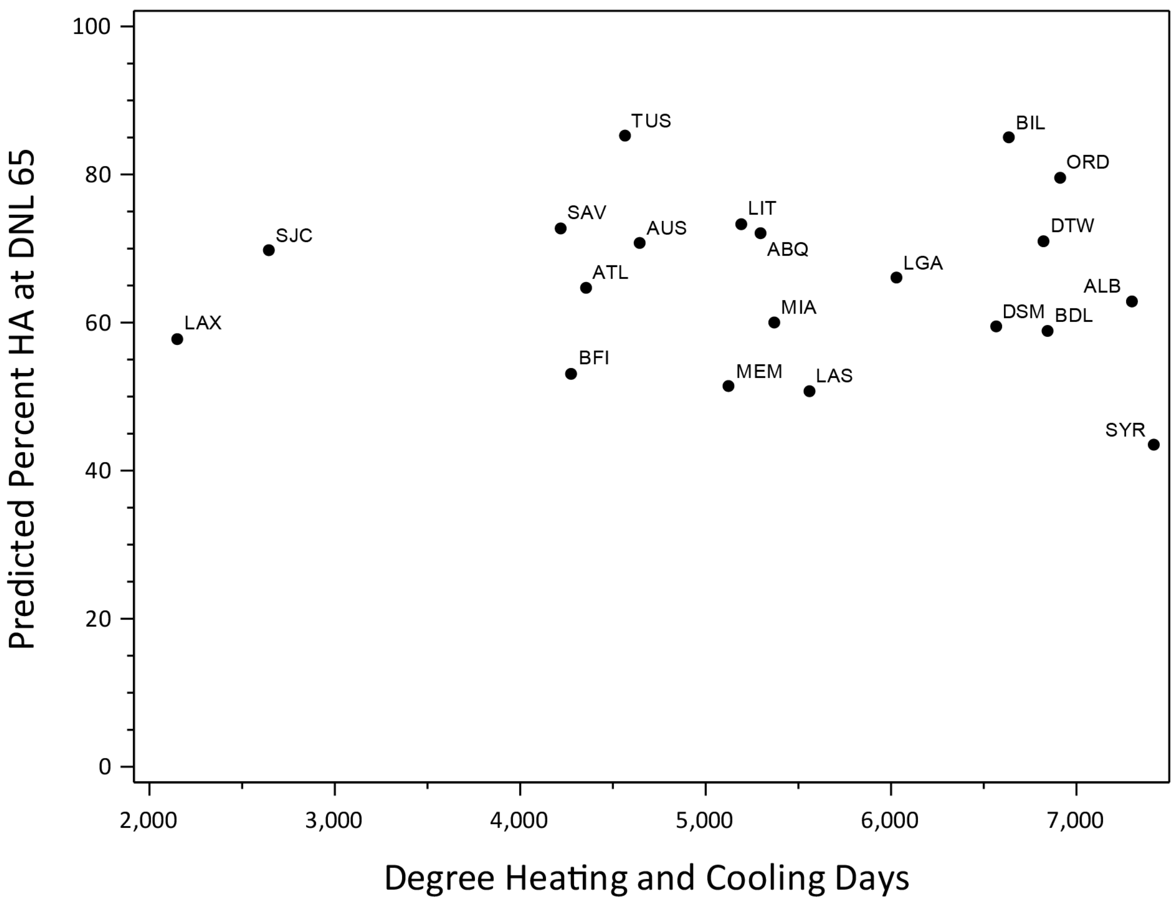

Figure 9-3. Estimated Percent HA at DNL 65 dB by Airport Total Degree Days

9.2 Additional Metrics

The values of the metrics IMPORTANT, NUMBERABOVE50, and VISIBLE differ among respondents in an airport community. Therefore, the model used to investigate the relationship of each FACTOR to annoyance includes terms for the modification the overall level of annoyance (β_2) and for the modification of the slope (β_3):

$$\text{Percent HA} = \frac{100\ \exp(\beta_0 + \beta_1 DNL + \beta_2\ FACTOR + \beta_3 FACTOR \times DNL)}{1 + \exp(\beta_0 + \beta_1 DNL + \beta_2\ FACTOR + \beta_3 FACTOR \times DNL)}. \tag{9.2}$$

The statistical models and tests used to evaluate the association between these factors and annoyance to aircraft noise are described in Appendix G (Section G.3). Tables 9-3 through 9-5 present the model coefficients, standard errors, and 95 percent confidence intervals for the variables VISIBLE, NUMBERABOVE50, and IMPORTANT, respectively.

Table 9-3. Model Coefficients for Model with VISIBLE

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-7.9988	0.5440	-9.1374	-6.8603
DNL, β_1	0.1317	0.0095	0.1119	0.1516
VISIBLE, β_2	-0.0034	0.0032	-0.0101	0.0034
VISIBLE x DNL, β_3	0.000062	0.00005	-0.00004	0.00017

Table 9-4. Model Coefficients for Model with NUMBERABOVE50

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-9.9748	1.0179	-12.1054	-7.8443
DNL, β_1	0.1673	0.0181	0.1295	0.2051
NUMBERABOVE50, β_2	0.0043	0.0018	0.0006	0.0080
NUMBERABOVE50x DNL, β_3	-0.00008	0.00003	-0.00014	-0.00001

Table 9-5. Model Coefficients for Model with IMPORTANT

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-8.6774	0.8855	-10.5307	-6.8240
DNL, β_1	0.1446	0.0161	0.1110	0.1782
IMPORTANT, β_2	0.0022	0.0056	-0.0096	0.0139
IMPORTANT x DNL, β_3	-0.00004	0.0001	-0.0003	0.0002

For the factor NUMBERABOVE50, the coefficients for the intercept and DNL appear quite different from those in the model in Table 8-2 containing only those variables. This occurs because of multicollinearity in the data: the variable NUMBERABOVE50 is highly correlated with DNL, and that correlation causes the estimated regression coefficients to be unstable as reflected in the increased standard errors for those coefficients. For predicting percent HA, each model needs to be considered in its entirety. Belsley et al. (1980) discuss multicollinearity and its implications for interpreting regression coefficients. [48]

The model in Equation (9.2) has two more terms than the model in Equation (8.1). A Wald test statistic, described in Equation (G.6) of Section G.3, was used to test the null hypothesis that both β_2 and β_3 are 0. This test considers whether either FACTOR, FACTOR x DNL, or both together, explain any of the variability in the response HA after controlling for DNL. For VISIBLE, the test statistic is 4.0 with p-value > 0.10. For NUMBERABOVE50, the test statistic is 6.0 with p-value = 0.05. For IMPORTANT, the test statistic is 0.46 with p-value > 0.10. Thus, VISIBLE and IMPORTANT are not statistically significantly related to HA after controlling for the effect of DNL; NUMBERABOVE50 is marginally significant, but the effect is not large and the result needs further investigation because of the high correlation between NUMBERABOVE50 and DNL. The analysis indicates that after accounting for the effect of DNL, VISIBLE and IMPORTANT do not provide additional information that can explain annoyance.

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[48] If there were no multicollinearity, the model in Equation (9.2) could be used to describe how the dose-response curve relating percent HA and DNL differs when the extra variable in the model takes different values. For example, from Table 9-4, the predicted relationship between percent HA and DNL when NUMBERABOVE50 = 500 is

$$\text{Percent HA when (NUMBERABOVE50} = 500) = \frac{100\ \exp(-7.82 + \ 0.127\ DNL)}{1 + \exp(-7.82 + \ 0.127\ DNL)},$$

where the intercept is calculated as -7.82 = -9.9748 + 0.0043 (500) and the slope is calculated as 0.1673 – 0.00008 (500) = 0.127. Similarly, the predicted relationship between percent HA and DNL when NUMBERABOVE50 = 1,000 is

$$\text{Percent HA when (NUMBERABOVE50} = 1000) = \frac{100\ \exp(-5.67 + \ 0.087\ DNL)}{1 + \exp(-5.67 + \ 0.087\ DNL)}.$$

However, because NUMBERABOVE50 and DNL are highly correlated, the relationships in each of the two equations above are likely valid only for a small range of DNL values. For example, there are almost no addresses in the sample where NUMBERABOVE50 is less than or equal to 500 and DNL is greater than 60 dB, or where NUMBERABOVE50 is greater than or equal to 1,000 and DNL is less than 55 dB. Thus, an attempt to apply the model to predict percent HA when NUMBERABOVE50 = 500 and DNL = 65 is an extrapolation outside the range of the data. Note that the multicollinearity affects the estimated coefficients of the model. The predicted values of percent HA, however, are consistent with those from the model in Equation (8.2) as long as the prediction is made for values of DNL and NUMBERABOVE50 that are jointly in the range of the data.

9.3 Race/Ethnicity and Poverty Status

Tables 9-6 and 9-7 present the results of the analysis of the variables MINORITY and PERCENTBELOWPOVERTY. The Wald test statistic for MINORITY is Q = 1.2 with p-value = 0.55; the test statistic for PERCENTBELOWPOVERTY is Q = 0.4 with p-value > 0.80. Neither variable is statistically significantly associated with HA, after controlling for the effect of DNL. The analysis indicates that the dose-response curve is essentially unaffected by consideration of minority status or the percent below poverty in the census block group.

Table 9-6. Model Coefficients for Model with MINORITY

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-8.8753	0.8210	-10.5936	-7.1570
DNL, β_1	0.1478	0.0144	0.1177	0.1779
MINORITY, β_2	0.5412	0.7271	-0.9805	2.0629
MINORITY x DNL, β_3	-0.0106	0.0125	-0.0367	0.0156

Table 9-7. Model Coefficients for Model with PERCENTBELOWPOVERTY

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-8.8369	1.0783	-11.0938	-6.5800
DNL, β_1	0.1470	0.0189	0.1074	0.1866
PERCENTBELOWPOVERTY, β_2	0.0199	0.0323	-0.0476	0.0874
PERCENTBELOWPOVERTY x DNL, β_3	-0.0004	0.0006	-0.0016	0.0009

The difference in percent HA between minority and non-minority respondents exposed to the same DNL values was not statistically significant. In addition, airports with greater percentages of minority residents did not exhibit different values of percent HA at specific DNL values than airports with lower percentages of minority residents.

As stated in Table 9-1, PERCENTBELOWPOVERTY is the percentage below poverty in the census block group containing the respondent's address. It is a neighborhood characteristic, and does not describe the poverty status of the respondent's household. The analysis presented in Table 9-7 indicates that respondents in high-poverty block groups have similar relationships between annoyance and DNL exposure as do respondents in low-poverty block groups.

9.4 Summary

This section presented the results of the analyses of factors that had been hypothesized, prior to the data collection, as potential causes of differences among the individual dose-response curves for different airports. Of the six factors studied – climate, "visible" flight events, "noticeable" flight events, "relatively important" flight events, race/ethnicity, and income – only the factor "noticeable" exhibited any ability to explain differences in the dose-response relationships among individuals or airports, and for that factor the relationship was only marginally statistically significant.

Although different airports do have different relationships between percent HA and noise exposure as measured by DNL, none of the factors studied in this section provided a compelling explanation for why those relationships may differ.

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10 Data Files Available for Further Analyses

The FAA is making sets of data available for further analyses by others. Section 10.1 provides a synopsis of the noise modeling data set. Other sets of questionnaire output data are in two use classifications – public and restricted. Sections 10.2 and 10.3 describe the Public Use File (PUF) and Restricted Use File (RUF), respectively.

10.1 Noise Modeling Data

Approximately 1.2 terabytes of noise modeling data is available in the following four data categories, each having its own subsection:

1. Radar Flight Tracking Data,
2. Daily INM Studies,
3. DNL Contours, and
4. Daily INM Detailed Grid Results.

10.2 Public Use File

The PUF contains the NES's primary results in a way that protects PII. The following two subsections describe the PUF. Subsection 10.1.3 presents example output from the PUF. The PUF will be made publicly available in comma-separated values (CSV) and SAS® formats.

10.2.1 Key variables

The NES Mail questionnaire instrument consisted of the following 10 questions:

- Question 1 asked if there was more than one person age 18 or older living in the household.
- Question 2 requested the total number of persons age 18 or older if Question 1 was "Yes."
- Question 4 requested the first name of the person completing the questionnaire.
- Question 5, parts A-M asked the level of annoyance with various environmental factors.
- Question 6 requested the respondent to rate their neighborhood on a scale of 0-10.
- Question 7 asked the respondent's year of birth.
- Question 8 requested the respondent's gender.
- Question 9 asked the respondents Hispanic origin.
- Question 10 requested the respondent's race.
- Question 11 asked the sex, age, and month born of all adults in the household.

Question 3 was an instruction for the adult with the next birthday to complete the questionnaire and did not request data.

10.2.2 Excluded Information

PII was removed from the PUF. This means that the data set does not include, at a minimum, any of the following: name, address, telephone, or latitude and longitude (geolocation) of respondents' residence.

Detailed indirect identifiers would greatly increase the chance of successfully identifying a respondent if released to the public and are not included in the file. Additional such variables include airport identifier, continuous DNL value, birth year, race/ethnicity with more detailed categories, and variables from the telephone instrument that are more sensitive and increase the risk of data disclosure.

10.2.3 Example Output

Derived from the PUF, Table 10-1 presents the percentages for each annoyance category (numerically 1 through 5) for most of the variables listed in Section 10.1.1. Table 10-1 also summarizes the percentage *HA* for each variable listed in the mail questionnaire, e.g., 9 percent are highly annoyed by undesirable business, institution or industrial property in their neighborhood. In general, between 9 and 22 percent of those surveyed were highly annoyed by items not related to aircraft noise, whereas 42 percent were highly annoyed by aircraft noise.

Table 10-1. Example Output Data from PUF – Survey Questions

Survey Question	Percent HA (score of 4 & 5)	Percent of Responses Within Each Category				
		Not at All Annoyed	Slightly Annoyed	Moderately Annoyed	Very Annoyed	Extremely Annoyed
		1	2	3	4	5
Noise from cars, truck or other road traffic	17	29	31	23	10	7
Smells or dirt from road traffic	11	53	23	13	6	5
Smoke, gas or bad smells from anything else	13	49	24	14	7	6
Litter or poorly kept up housing	22	35	26	17	12	10
Noise from aircraft	42	14	20	24	18	24
Your neighbors' noise or other activities	13	40	30	17	8	5
Any other noises you hear when are here at home	16	52	19	13	8	8
Undesirable business, institutional or industrial property	9	68	15	8	5	4
A lack of parks or green spaces	17	52	17	14	9	8
Inadequate public transportation	15	55	17	13	8	7
The amount of neighborhood crime	20	31	29	20	11	9
Poor city or county services	18	42	24	16	9	9

Note: Percentages for intermediate responses (e.g., 1.5, 2.5, etc.) were combined with next highest integer response. For example, percentages associated with "1.5" were added to percentages associated with "2"; 1 thru 5 sum horizontally to 100 percent.

Table 10-2 summarizes the data with regard to the aircraft DNL groupings. Twenty-five percent of respondents exposed to DNL less than or equal to 55 dB were highly annoyed whereas 74 percent of respondents exposed to DNL greater than 70 dB were highly annoyed. The overall data trends are also true in the individual categories with over one-fifth of the respondents being extremely annoyed in the range of DNL 55 to 60 dB and one-third of the respondents being extremely annoyed in the range of DNL 60 to 65 dB.

Table 10-2. Example Output Data from PUF – Aircraft DNL

Aircraft DNL	Percent HA (score of 4 & 5)	Percent of Responses Within Each Category (1)				
		Not at All Annoyed	Slightly Annoyed	Moderately Annoyed	Very Annoyed	Extremely Annoyed
		1	2	3	4	5
Less than or equal to 55 dB	25	22	26	27	14	11
55-60 dB (2)	40	13	20	27	19	21
60-65 dB (2)	55	7	16	22	21	34
65-70 dB (2)	66	6	9	19	21	45
Greater than 70 dB (2)	74	3	9	14	17	57

Notes:

1) Percentages for intermediate responses (e.g., 1.5, 2.5, etc.) were combined with next highest integer response. For example, percentages associated with "1.5" were added to percentages associated with "2"; 1 thru 5 sum horizontally to 100 percent.
2) Exclusive of lower bound.

10.3 Restricted Use File

The RUF contains more detailed data than the PUF, including PII. Due to the data's sensitivity and non-disclosure requirements, the RUF can be provided by the FAA but only on a case-by-case basis.

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11 References

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Analysis of the Neighborhood Environmental Survey

Volume 2 of 4: Appendices A through E

Contracts DTFACT-15-D-00008 and DTFACT-15-D-00007

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William J. Hughes Technical Center
4th Floor, M26
Atlantic City International Airport
Atlantic City, NJ 08405

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Appendix A Mail Survey Instrument and Materials

A.1 Mail Survey Instrument

A.1.1 English Version

OMB #2120-0762
Exp. 04/30/2018

START HERE:

This survey should be filled out by an adult household member living at this address.

Please use a blue or black pen if available.

These first questions ask about your household.

1. Is there more than one person age 18 or older living in this household?

☐ Yes
☐ No → **GO TO number 5 on the next page**

2. Including yourself, how many people age 18 or older live in this household?

☐☐

3. The adult with the next birthday should complete this questionnaire. This way, across all households, this survey will include responses from adults of all ages.

4. Please write the first name, nickname or initials of the adult with the next birthday. This is the person who should complete the questionnaire.

☐

5. Thinking about the last 12 months or so, when you are here at home, how much does each of the following bother, disturb or annoy you?

		Not at all	Slightly	Moderately	Very	Extremely
a.	Noise from cars, trucks or other road traffic	☐	☐	☐	☐	☐
b.	Smells or dirt from road traffic	☐	☐	☐	☐	☐
c.	Smoke, gas or bad smells from anything else	☐	☐	☐	☐	☐
d.	Litter or poorly kept up housing	☐	☐	☐	☐	☐
e.	Noise from aircraft	☐	☐	☐	☐	☐
f.	Your neighbors' noise or other activities	☐	☐	☐	☐	☐
g.	Any other noises you hear when you are here at home If this bothers or annoys you, what is the noise? ________________	☐	☐	☐	☐	☐
h.	Undesirable business, institutional or industrial property	☐	☐	☐	☐	☐
i.	A lack of parks or green spaces	☐	☐	☐	☐	☐
j.	Inadequate public transportation	☐	☐	☐	☐	☐
k.	The amount of neighborhood crime	☐	☐	☐	☐	☐
l.	Poor city or county services	☐	☐	☐	☐	☐
m.	Any other problems that you notice when you are here at home If this bothers or annoys you, what is the problem? ________________	☐	☐	☐	☐	☐

6. Now considering how you feel about everything in your neighborhood, how would you rate your neighborhood as a place to live on a scale from 0 to 10 where 0 is worst and 10 is best?

Worst 0	1	2	3	4	5	6	7	8	9	Best 10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

These last questions are about you and your household.

7. In what year were you born?

☐	☐	☐	☐
Y	Y	Y	Y

8. Are you male or female?

☐ Male
☐ Female

9. Are you Spanish, Hispanic, or Latino?

☐ Yes
☐ No

10. What is your race? One or more categories may be selected.

Mark ☒ one or more.

☐ White
☐ Black or African American
☐ American Indian or Alaska Native
☐ Asian
☐ Native Hawaiian or Other Pacific Islander

11. <u>Starting with yourself,</u> please mark the sex, and write in the age and month of birth for each adult 18 years of age or older living at this address.

	Sex	Age	Month Born (01-12)
SELF	☐ Male ☐ Female	☐☐☐	☐☐
Adult 2	☐ Male ☐ Female	☐☐☐	☐☐
Adult 3	☐ Male ☐ Female	☐☐☐	☐☐
Adult 4	☐ Male ☐ Female	☐☐☐	☐☐
Adult 5	☐ Male ☐ Female	☐☐☐	☐☐

Thank you. Please return this form in the postage paid envelope provided or mail it to:

Neighborhood Environment Survey
Westat
1600 Research Blvd., Room RC B16
Rockville, MD 20850

Toll-free number for questions: 1-855-210-4396

A.1.2 Spanish Version

OMB #2120-0762
Fecha de vencimiento: 04/30/2018

COMIENCE AQUÍ:

Esta encuesta la debe responder un adulto que viva en esta dirección.
Use un bolígrafo de tinta negra o azul.

Las primeras preguntas son sobre su hogar.

1. ¿Hay más de una persona mayor de 18 años que viva en esta casa?

☐ Si
☐ No → **VAYA a la pregunta 5 en la siguiente página**

2. Incluyéndose a usted, ¿cuántas personas mayores de 18 años viven en esta casa?

☐☐

3. Debe contestar este cuestionario el adulto próximo a cumplir años. De esta manera, en todos los hogares, esta encuesta incluirá respuestas de adultos de todas las edades.

4. Por favor escriba el nombre, apodo o iniciales del adulto próximo a cumplir años. Esta es la persona que debe contestar el cuestionario.

☐

5. Piense en los últimos 12 meses más o menos. Cuando usted está aquí en casa, ¿qué tanto le molesta, perturba o fastidia lo siguiente?

	Nada ▼	Muy poco ▼	Moderadamente ▼	Bastante ▼	Extremadamente ▼
a. Ruido de automóviles, camiones u otro tráfico vial	☐	☐	☐	☐	☐
b. Olores o basura del tráfico vial	☐	☐	☐	☐	☐
c. Humo, gas o malos olores de otra cosa	☐	☐	☐	☐	☐
d. Basuras o viviendas en mal estado	☐	☐	☐	☐	☐
e. Ruido de aviones	☐	☐	☐	☐	☐
f. El ruido u otras actividades que hacen sus vecinos	☐	☐	☐	☐	☐
g. Otros ruidos que oye cuando está aquí en casa **¿Qué otro ruido le molesta o fastidia?** ______	☐	☐	☐	☐	☐
h. Negocios o propiedades institucionales o industriales indeseables	☐	☐	☐	☐	☐
i. Falta de parques o zonas verdes	☐	☐	☐	☐	☐
j. Transporte público inadecuado	☐	☐	☐	☐	☐
k. La cantidad de delitos en el vecindario	☐	☐	☐	☐	☐
l. Malos servicios de la ciudad o del condado	☐	☐	☐	☐	☐
m. Otros problemas que nota cuando está aquí en casa **¿Qué otro problema le molesta o fastidia?** ______	☐	☐	☐	☐	☐

6. Teniendo en cuenta lo que usted piensa acerca de su vecindario, ¿cómo calificaría su vecindario como lugar para vivir en una escala de 0 a 10 donde 0 es lo peor y 10 es lo mejor?

Lo peor 0	1	2	3	4	5	6	7	8	9	Lo mejor 10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Estas últimas preguntas son acerca de usted y de su hogar.

7 ¿En qué año nació usted?

A	A	A	A

8. ¿Es usted de sexo masculino o femenino?

☐ Masculino
☐ Femenino

9. ¿Es usted hispano o latino?

☐ Si
☐ No

10. ¿Cuál es su raza? Puede marcar más de una respuesta.

Marque con una ☒ una o más opciones.

☐ Blanca
☐ Negra o africana americana
☐ India americana o nativa de Alaska
☐ Asiática
☐ Nativa de Hawái o de otras islas del Pacífico

11. <u>Comenzando con usted,</u> por favor marque el sexo y escriba la edad y mes de nacimiento de cada adulto mayor de 18 años que vive en esta dirección.

	Sexo	**Edad**	**Mes de nacimiento (01-12)**
USTED	☐ Masculino ☐ Femenino	☐☐☐	☐☐
Adulto 2	☐ Masculino ☐ Femenino	☐☐☐	☐☐
Adulto 3	☐ Masculino ☐ Femenino	☐☐☐	☐☐
Adulto 4	☐ Masculino ☐ Femenino	☐☐☐	☐☐
Adulto 5	☐ Masculino ☐ Femenino	☐☐☐	☐☐

Muchas gracias. Por favor envíe este formulario en el sobre adjunto cuyos gastos de envío ya han sido pagados o envíelo por correo a:

Neighborhood Environment Survey
Westat
1600 Research Blvd., Room RC B16
Rockville, MD 20850

Línea directa y gratuita para preguntas: 1-855-210-4396

A.2 Mail Survey Materials

A.2.1 Cover Letter for Mail

A.2.1.1 English Version

Neighborhood Environment Survey

Sponsored by U.S. Department of Transportation

«City» Resident
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Dear «City» Resident:

Your household has been selected to take part in an important study for the United States Department of Transportation, a branch of the Federal Government. Since 1967, the United States Department of Transportation has been responsible for ensuring a fast, safe, efficient, accessible and convenient transportation system. We consider neighborhood environmental quality when planning, developing and revising transportation-related policies. The Neighborhood Environment Survey results will be used to update policies that affect the environment in American neighborhoods.

Your household is part of a scientific sample that represents the people who live in neighborhoods like yours. We have asked Westat, a statistical social science firm to obtain your views.

In order to make sure we get responses from a wide variety of people, please have the adult in your household with the next birthday complete and return this questionnaire in the next two weeks. If you are the only adult in the household, we ask that you complete this survey. We have enclosed $2 as a token of our appreciation for your participation.

Your participation is voluntary. However, your household's participation will help inform us about your neighborhood and the views of people who live in neighborhoods like yours. The information you provide will be maintained confidential to the extent allowed by law. If you have any questions about this study please call Westat toll-free at 1-855-210-4396.

Thank you in advance for your cooperation.

Sincerely,

Barbara McCann

Barbara McCann
Director, Office of Safety, Energy, and Environment

A.2.1.2 Spanish Version

Encuesta del medio ambiente de los vecindarios

Patrocinada por el Departamento de Transporte de Estados Unidos

Habitante de «City»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Estimado(a) habitante de «City»:

Su hogar ha sido seleccionado para participar en un importante estudio para el Departamento de Transporte de Estados Unidos, una rama del gobierno federal. Desde 1967, el Departamento de Transporte de Estados Unidos ha sido el responsable de asegurarse de que el sistema de transporte sea rápido, seguro, eficiente, accesible y conveniente. Nosotros tenemos en cuenta la calidad medioambiental del vecindario cuando planificamos, desarrollamos y revisamos políticas relacionadas con el transporte. Los resultados de la Encuesta del medio ambiente de los vecindarios se usarán para actualizar políticas que afectan al medio ambiente en los vecindarios de Estados Unidos.

Su hogar forma parte de una muestra científica que representa a las personas que viven en vecindarios como el suyo. Le hemos pedido a Westat, una compañía de estudios de ciencias sociales, que obtenga sus comentarios.

Con el fin de asegurarnos de recibir respuestas de una gran variedad de personas, quisiéramos que el adulto próximo a cumplir años conteste y nos devuelva este cuestionario dentro de las próximas dos semanas. Si usted es el único adulto del hogar, le pedimos que conteste esta encuesta. Hemos adjuntado 2 dólares como muestra de nuestro agradecimiento por su participación.

Su participación es voluntaria. Sin embargo, la participación de su hogar nos ayudará a informarnos acerca de su vecindario y de las opiniones de las personas que viven en vecindarios como el suyo. La información que usted nos dé se mantendrá de manera confidencial hasta donde lo permite la ley. Si usted tiene alguna pregunta acerca de este estudio llame a la línea directa y gratuita de Westat al 1-855-210-4396.

Le agradecemos de antemano por su colaboración.

Atentamente,

Barbara McCann

Barbara McCann
Directora, oficina de seguridad, energía y medio ambiente

A.2.2 Mail Postcard

A.2.2.1 English Version

A few weeks ago you received an invitation to take part in the Neighborhood Environment Survey, a survey sponsored by the United States Department of Transportation. If you have already completed and returned this survey, we are very grateful and thank you. If you have not, we encourage you to do so.

In order to make sure we get responses from a wide variety of people, we ask that the adult in your household with the next birthday complete the mail survey. If you are the only adult in the household, we ask that you complete the survey.

This is an important survey that will help provide information that will be used to develop and revise transportation-related policies that affect neighborhoods like yours. We are very grateful for your participation.

{RETURN ADDRESS/LOGO}

{CITY} RESIDENT
{ADDRESS LINE 1}
{ADDRESS LINE 2}
{CITY}, {STATE} {ZIP}

A.2.2.2 Spanish Version

Hace unas semanas usted recibió una invitación para participar en la Encuesta del medio ambiente de los vecindarios, una encuesta patrocinada por el Departamento de Transporte de Estados Unidos. Si usted ya ha contestado y enviado esta encuesta, se lo agradecemos mucho. Si usted todavía no lo ha hecho, lo animamos a que lo haga.

Con el fin de asegurarnos de recibir respuestas de una gran variedad de personas, quisiéramos que el adulto próximo a cumplir años conteste la encuesta por correo. Si usted es el único adulto del hogar, le pedimos que conteste esta encuesta.

Se trata de una importante encuesta que puede ayudar a brindar información que se usará para desarrollar y revisar políticas relacionadas con el transporte que afectan a vecindarios como el suyo. Le agradecemos mucho su participación.

{RETURN ADDRESS/LOGO}

HABITANTE DE {CITY}
{ADDRESS LINE 1}
{ADDRESS LINE 2}
{CITY}, {STATE} {ZIP}

A.2.3 Mail NR Follow-up Letter

A.2.3.1 English Version

Neighborhood Environment Survey

Sponsored by U.S. Department of Transportation

«City» Resident
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Dear «City» Resident:

Recently you received a letter inviting you to take part in an important environmental study for the United States Department of Transportation. Unfortunately we have not yet received a reply from your household. If you have already sent in the survey, thank-you very much for your help. If you haven't yet had time to respond, we encourage you to do so. Your participation in this study is important because your views will help the Department of Transportation update transportation-related policies that affect people in neighborhoods like yours.

For your convenience we've enclosed a replacement to the original survey that was sent to your household.

In order to make sure we get responses from a wide variety of people, please have the adult in your household with the next birthday complete and return this questionnaire in the next two weeks to Westat, the statistical social science firm that is conducting the study. If you are the only adult in the household, we ask that you complete this survey.

Your participation is voluntary. However, your participation is essential to inform us about your neighborhood and the views of people who live in neighborhoods like yours. The information you provide will be maintained confidential to the extent allowed by law. If you have any questions about this study please call Westat toll-free at 1-855-210-4396.

Thank you in advance for your cooperation.

Sincerely,

Barbara McCann
Director, Office of Safety, Energy, and Environment

A.2.3.2 Spanish Version

Encuesta del medio ambiente de los vecindarios

Patrocinada por el Departamento de Transporte de Estados Unidos

Habitante de «City»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Estimado(a) habitante de «City»:

Hace poco usted recibió una carta informándole que iba a recibir una llamada para participar en un importante estudio medioambiental para el Departamento de Transporte de Estados Unidos. Lamentablemente todavía no hemos recibido la respuesta de su hogar. Si usted ya ha enviado la encuesta, le agradecemos mucho su colaboración. Si usted todavía no ha tenido tiempo para contestarla, lo animamos a que lo haga. Su participación en este estudio es importante, ya que sus opiniones ayudarán al Departamento de Transporte a actualizar políticas relacionadas con el transporte que afectan a personas en vecindarios como el suyo.

Para su comodidad, hemos incluido un reemplazo del cuestionario original que enviaron a su hogar.

Con el fin de asegurarnos de recibir respuestas de una gran variedad de personas, quisiéramos que el adulto próximo a cumplir años conteste y nos devuelva este cuestionario dentro de las próximas dos semanas a Westat, la compañía de estudios de ciencias sociales que lleva a cabo el estudio. Si usted es el único adulto del hogar, le pedimos que conteste esta encuesta.

Su participación es voluntaria. Sin embargo, la participación de su hogar nos ayudará a informarnos acerca de su vecindario y de las opiniones de las personas que viven en vecindarios como el suyo. La información que usted nos dé se mantendrá de manera confidencial hasta donde lo permite la ley. Si usted tiene alguna pregunta acerca de este estudio llame a la línea directa y gratuita de Westat al 1-855-210-4396.

Le agradecemos de antemano por su colaboración.

Atentamente,

Barbara McCann
Directora, oficina de seguridad, energía y medio ambiente

Appendix B Telephone Survey Instrument and Materials

B.1 Telephone Survey Instrument

B.1.1 English Version

Neighborhood Environment Survey

Hello. My name is ___ and I'm calling about a neighborhood environment survey being conducted for the United States Department of Transportation. We recently sent you a letter about this survey and will provide you with ten dollars as a token of our appreciation upon completion of the interview. {DISPLAY D4}

Are you {DISPLAY D5} at least 18 years old? (If 'NO" ask for an adult household member.)

D4	*IF THIS IS A CELL PHONE (BASE.LANDCELL = 2)*	"If you are currently driving a car or doing any activity that requires your full attention, I need to call you back at a later time."
i	*IF CELL OR LANDLINE STATUS IS UNKNOWN (BASE.LANDCELL = 3)*	"If I have reached you on a cell phone and you are currently driving a car or doing any activity that requires your full attention I need to call you back at a later time."
	ELSE	BLANK
D5	*IF THIS IS A LANDLINE (BASE.LANDCELL = 1)*	"a member of this household and"
	ELSE	BLANK

PROGRAMMING NOTE: If probable business, continue to verify address (A3) to verify accuracy of phone match.

INTRO: This information is being collected as part of a neighborhood environment survey for the United States Department of Transportation which is being conducted by Westat, a social science research firm. The information will be used to measure residents' attitudes about their environment.

A3. Before I get started, I'd like to determine the eligibility of your household to participate in the survey. Is your home address {DISPLAY ADDRESS}

[VERIFY SPELLING. RECORD CHANGES OR PRESS ENTER IF NO CHANGE.]

PROGRAMMING NOTE: If address does not match, case is finalized; there is no need to ask A3_1.

A3_1. Is this address…
a business only,
a residence only, or
both?

PROGRAMMING NOTE: If business only, case becomes ineligible. This is after address has been verified and indicates that a business was sampled. This is for both the phone match and phone numbers collected by mail groups.

A4. Including yourself, how many adults age 18 and older, currently live in your household? [IF NEEDED: Include adults who think of this household as their primary place of residence. Include adults who usually stay in the household but are temporarily away on business, vacation, or in a hospital.]

[Implement Rizzo respondent selection algorithm].

OBS. IS THE ORIGINAL RESPONDENT SELECTED TO DO THE SURVEY?

YES...1 (GO TO Short Intro)
NO...2 (Continue)

A5.1 [NUMBER OF ADULTS = 2] Please tell me just the first name of the other adult in this household.

Is this person male or female?

MALE	1
FEMALE	2
REFUSED	-7
DON'T KNOW	-8

A5.2 [NUMBER OF ADULTS > 2] Please tell me just the first name of the adult in this household, **other than yourself**, who will have the next birthday.

Is this person male or female?

MALE	1
FEMALE	2
REFUSED	-7
DON'T KNOW	-8

A6. May I please speak to [NAME/GENDER].

<u>Full Introduction</u> *[If interview is with person who did not answer above questions.]*

My name is ___ and I'm calling about the Neighborhood Environment Survey. We recently sent you a letter about this survey which is sponsored by the United States Department of Transportation. As noted in the letter we will provide you with ten dollars as a token of our appreciation upon completion of the interview.

Westat, a social science research firm, is contacting households around America to help the U.S. Department of Transportation learn more about the environmental conditions of neighborhoods like yours. This information will be used to update transportation-related policies.

Your household is one of a small number that has been selected from the [CITY] area. Your participation will represent the views of many others in neighborhoods like yours. Participation in this survey is completely voluntary. You may skip any questions that you don't want to answer and you can stop at any time. The survey should take about 20 minutes.

May I continue with the survey?

CONTINUE 1
GO TO RESULT ....GT

Short Introduction

OK, it looks like you are eligible for the survey. As a reminder, we are contacting households in neighborhoods like yours around America to help the U.S. Department of Transportation learn more about the environmental conditions of neighborhoods like yours. Your household is one of a small number that has been selected from the [CITY] area. Your participation will represent the views of many others in communities like yours.

Participation in this survey is completely voluntary. You may skip any questions that you don't want to answer and you can stop at any time. The survey should take about 20 minutes.

May I continue with the survey?

CONTINUE 1
GO TO RESULT ....GT

[IF SCREENER RESPONDENT IS SELECTED RESPONDENT]

A7.1 The following questions will ask you about things you may notice when you are "here at home". By here at home we mean the address that we confirmed with you.

[IF SCREENER RESPONDENT IS NOT THE SELECTED RESPONDENT]

A7.2 The following questions will ask you about things you may notice when you are "here at home". By here at home we mean the following address:

[DISPLAY ADDRESS CONFIRMED IN A3, CONTINUE TO QUESTION 1]

1. Thinking about <u>the last 12 months or so</u>, when you are here at home, how much does [INSERT TEXT FROM A-M] bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?

	Not at all	Slightly	Moderately	Very	Extremely	Refused	Don't know
a. Noise from cars, trucks or other road traffic	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
b. Smells or dirt from road traffic	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
c. Smoke, gas or bad smells from anything else	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
d. Litter or poorly kept up housing	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
e. Noise from aircraft	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
f. Your neighbors' noise or other activities	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
g. Are there any other noises you hear when you are here at home? 1 = YES 2 = NO [IF YES] What is that noise? [DESCRIBE IN BOX BELOW.] Thinking about <u>the last 12 months or so</u>, when you are here at home, how much does (DESCRIBED NOISE) bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
Describe: ______________________________							
h. Undesirable business, institutional or industrial property	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
i. A lack of parks or green spaces	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
j. Inadequate public transportation	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
k. The amount of neighborhood crime	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
l. Poor city or county services	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8

	Not at all	Slightly	Moderately	Very	Extremely	Refused	Don't know
m. Are there any other problems that you notice when you are here at home? 1 = YES 2 = NO [IF YES]: What is that problem? [DESCRIBE IN BOX BELOW.] Thinking about <u>the last 12 months or so</u>, when you are here at home, how much does (DESCRIBED PROBLEM) bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ -7	☐ -8
Describe: ______________________________							

2. Now considering how you feel about everything in your neighborhood, how would you rate your neighborhood as a place to live on a scale from 0 to 10 where 0 is worst and 10 is best?

|__|__|

REFUSED.. -7
DON'T KNOW................................. -8

3. Now please rate noise on a 0 to 10 opinion scale for how much the noise bothers, disturbs or annoys you when you are here at home. If you are not at all annoyed choose 0; if you are extremely annoyed choose 10; if you are somewhere in between, choose a number between 0 and 10.

First about noise in general.

Thinking about <u>the last 12 months</u> or so, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the noise in general when you are here at home?

|__|__|

REFUSED.. -7
DON'T KNOW................................. -8

4. Thinking about the last 12 months or so, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the noise from cars or trucks or other road traffic?

|__|__|

REFUSED.. -7
DON'T KNOW................................ -8

5. Thinking about the last 12 months or so, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the noise from aircraft?

|__|__|

REFUSED.. -7
DON'T KNOW................................ -8

BOX 1

[IF RESPONDENT ANSWERS "NOT AT ALL ANNOYED" BY AIRCRAFT IN BOTH THE PREVIOUS 5-POINT VERBAL-SCALE AND 0-10 SCALE AIRCRAFT NOISE QUESTIONS → GO TO Q6.

OTHERWISE GO TO Q7.

6. [ASK ONLY IF "NOT AT ALL ANNOYED" BY AIRCRAFT IN BOTH THE PREVIOUS 5-POINT VERBAL-SCALE AND 0-10 SCALE AIRCRAFT NOISE QUESTIONS]

Have you ever heard the sound from an aircraft when you were here at home?

YES.. 1 (GO TO 7)
NO.. 2 (BOX 2)

BOX 2

Even if the aircraft noise has not annoyed you during the last year, we still need your views on particular aspects of aircraft. If you don't notice them, please say so. If you do notice them, that's fine, too. Just tell us about your views and we can move right along.

7. Has an aircraft ever [waked you or kept you awake at night] when you are at home?

	Yes	No	Don't notice aircraft	Refused	Don't know
a. waked you up or kept you awake at night?............	☐1	☐2	☐-6	☐-7	☐-8
b. Startled or surprised you?	☐1	☐2	☐-6	☐-7	☐-8
c. Frightened you?	☐1	☐2	☐-6	☐-7	☐-8

[INTRO8] The next questions ask whether or not aircraft actually bothered, disturbed, or annoyed you in different ways during the last 12 months when you have been here at home.

[ASK ONLY SPECIFIC TYPES OF DISTURBANCES WHICH WERE IDENTIFIED IN QUESTION 7]

8. Thinking about the last 12 months or so, when you are at home, have the aircraft bothered, disturbed or annoyed you by [READ FIRST ITEM THAT WAS NOTICED]

Would you say: extremely, very, moderately, slightly, or not at all?

	Extremely	Very	Moderately	Slightly	Not at all	Refused	Don't know
a. Waking you up or keeping you awake at night...............	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
b. Startling or surprising you	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
c. Frightening you....................	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8

To understand why aircraft noise may or may not affect you, we ask you to consider your situation here at home, your observations about aircraft flights here and the actions authorities have been taking.

Your next answers provide background for understanding your living situation in this area.

9. Which of the following best describes the building where you live?

A mobile home?.. 1 (Go to 10)
A one-family house detached from any other house?............ 2 (Go to 10)
A one-family house attached to one or more houses? .... 3 (Go to 10)
A building with two or more apartments? 4
Some other type of place?
What type of building is that? (DESCRIBE) ________ 5 (Go to 10)
REFUSED.. -7 (Go to 10)
DON'T KNOW... -8 (Go to 10)

9a. Approximately, how many apartments are there in your building??

2 APARTMENTS	1
3 or 4 APARTMENTS	2
5 TO 9 APARTMENTS	3
10 TO 19 APARTMENTS	4
20 TO 49 APARTMENTS	5
50 OR MORE APARTMENTS	6

10. Do you own your home or are you renting?

OWN (INCLUDE OWING A MORTGAGE)	1
RENTING	2
REFUSED	-7
DON'T KNOW	-8

11. How many of the five weekdays from Monday through Friday are you usually out away from home most of the day, that is 8 hours or more? Are you usually away, on all five weekdays, or fewer weekdays, or are you usually not away on any weekday?

[PROBE IF NUMBER OF WEEKDAYS NOT VOLUNTEERED]

How many weekdays are you usually away?

0 NOT AWAY ON ANY WEEKDAY	0
1 DAY	1
2 DAYS	2
3 DAYS	3
4 DAYS	4
5 AWAY ALL 5 WEEKDAYS	5
REFUSED	-7
DON'T KNOW	-8

12. Think about those weeks in the year when you spend the most time out-of-doors in your yard or on your porch, deck or balcony. At that time of year, how many hours a week would you say you are out-of-doors at home?

|__|__|
HOURS

REFUSED	-7
DON'T KNOW	-8

13. In what year and month did you move to your home here?

|__|__|__|__| |__|__|
YEAR MONTH

REFUSED	-7
DON'T KNOW	-8

14. Since you moved here, has the total amount of aircraft noise increased, decreased or stayed about the same?

INCREASED	1
STAYED ABOUT THE SAME	2
DECREASED	3
NEVER HEARD ANY AIRCRAFT (VOLUNTEERED)	-6
REFUSED	-7
DON'T KNOW	-8

15. What do you think aircraft noise will be like here in the next few years: Do you think the total amount of aircraft noise will increase, decrease or stay about the same here?

INCREASE	1
STAY ABOUT THE SAME	2
DECREASE	3
WILL CONTINUE TO NEVER HEAR ANY AIRCRAFT (VOLUNTEERED)	-6
REFUSED	-7
DON'T KNOW	-8

16. When you are at home, have you ever heard aircraft sitting on the ground or moving around on the ground on the airport property?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

17. [ASK IF "HEARD" IN PREVIOUS QUESTION] Thinking about the last 12 months or so, when you are at home, how much have the aircraft sitting on the ground or moving around on the ground on the airport property bothered, disturbed or annoyed you: extremely, very, moderately, slightly, or not at all?

EXTREMELY	1
VERY	2
MODERATELY	3
SLIGHTLY	4
NOT AT ALL	5
REFUSED	-7
DON'T KNOW	-8

Next we ask you to provide some background about this area and the airport.

18. How knowledgeable are you about noise and other community environmental issues in the [CITY NAME] area: Are you extremely knowledgeable, very knowledgeable, moderately knowledgeable, slightly knowledgeable, or not at all knowledgeable?

EXTREMELY KNOWLEDGEABLE	1
VERY KNOWLEDGEABLE	2
MODERATELY KNOWLEDGEABLE	3
SLIGHTLY KNOWLEDGEABLE	4
NOT AT ALL KNOWLEDGEABLE	5
REFUSED	-7
DON'T KNOW	-8

19. About how many trips a year do you and other members of your household make from the [LOCAL AIRPORT]?

One trip is considered as round-trip travel and includes all family members traveling together. If any family members travel separately, please count those as separate trips as long as they use [LOCAL AIRPORT].

|__|__|
NUMBER OF TIMES

REFUSED	-7
DON'T KNOW	-8

20. Do you or anyone else in your household work at [LOCAL AIRPORT] or work for a company or organization that does business with [LOCAL AIRPORT])?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

21. How much have you learned about your community's aircraft noise issues from media reports in the newspaper or on radio or TV: a great deal, somewhat, a little or nothing at all?

A GREAT DEAL	1
SOMEWHAT,	2
A LITTLE	3
NOTHING AT ALL	4
REFUSED	-7
DON'T KNOW	-8

22. How about a more local information source? How much have you learned about your community's aircraft noise issues from a community newspaper or other more local organization, newsletter or local internet source: a great deal, somewhat, a little or nothing at all?

A GREAT DEAL	1
SOMEWHAT,	2
A LITTLE	3
NOTHING AT ALL	4
REFUSED	-7
DON'T KNOW	-8

23. How about your closest neighbors making their views known about aircraft noise: Have they clearly made their views known, have they revealed only a little about their views, or have they kept their views to themselves?

MADE THEIR VIEWS CLEARLY KNOWN	1
REVEALED A LITTLE,	2
KEPT VIEWS TO THEMSELVES	3
REFUSED	-7
DON'T KNOW	-8

24. As far as you know, have there ever been disputes between airport authorities and community residents about aircraft noise around (…LOCAL AIRPORT…)?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

25. Are any community groups or other organizations trying to reduce aircraft noise or don't you know?

GROUP IS	1
GROUP IS NOT	2
REFUSED	-7
DON'T KNOW	-8

26. Have you or anyone in your household ever tried to get something done about aircraft noise such as telephoning the airport, sending a message, writing a letter, contacting an official, going to a meeting, joining a group or doing something else?

YES	1	(GO TO 26a)
NO	2	(-6, -7, -8 GO TO 27)
DON'T NOTICE ANY AIRCRAFT (VOLUNTEERED)	-6	
REFUSED	-7	
DON'T KNOW	-8	

26a. Was the airport contacted directly?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

27. If someone wants to make a complaint about aircraft noise these days, do you know if there is a convenient way to contact (…LOCAL AIRPORT…)?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

28. How much do you think that residents' actions and views can influence (…LOCAL AIRPORT…) noise policy? Do you think that residents' views can very greatly influence policy, greatly influence policy, moderately influence, slightly influence, or not at all influence policy?

VERY GREATLY INFLUENCE	5
GREATLY INFLUENCE	4
MODERATELY INFLUENCE	3
SLIGHTLY INFLUENCE	2
NOT AT ALL INFLUENCE	1
REFUSED	-7
DON'T KNOW	-8

29. Has your home been sound insulated?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

Next we ask for your views about the local officials and managers at the airport who oversee aircraft operations in this area.

30. To what extent do you think [LOCAL AIRPORT] officials recognize the community residents' feelings about aircraft noise? Do you think the officials recognize the residents' feelings extremely well, very well, moderately well, slightly, or not at all?

EXTREMELY WELL	5
VERY WELL	4
MODERATELY WELL	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

31. How fully do you feel the [LOCAL AIRPORT] officials keep community residents informed about the planning for airport changes? Do you think the officials keep communities extremely well informed, very well informed, moderately well informed, slightly informed, or not at all informed?

EXTREMELY WELL	5
VERY WELL	4
MODERATELY WELL	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

32. How completely do you feel you can trust the [LOCAL AIRPORT] officials to work fairly with the community by following official, agreed-upon procedures and providing accurate information? Do you feel you can rely upon the [LOCAL AIRPORT] officials completely, considerably, moderately, slightly or not at all?

COMPLETELY	1
CONSIDERABLY	2
MODERATELY	3
SLIGHTLY	4
NOT AT ALL	5
REFUSED	-7
DON'T KNOW	-8

33. How much do you think [INSERT TEXT FROM A-C] could reduce the aircraft noise around here: Could [INSERT TEXT FROM A-C] reduce the noise very greatly, greatly, moderately, slightly or not at all?

	Very greatly	Greatly	Moderately	Slightly	Not at all	Refused	Don't know
a. The officials who run [LOCAL AIRPORT]	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
b. Other government officials	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
c. The pilots flying the planes	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8

34. As far as you know, have the authorities at [LOCAL AIRPORT] ever taken steps to try to reduce or control the amount of aircraft noise here?

YES	1	(GO TO 40a)
NO	2	(GO TO 41)
REFUSED	-7	(GO TO 41)
DON'T KNOW	-8	(GO TO 41)

34a. What did they do?

____

____

35. How important do you think that [LOCAL AIRPORT] is for the [CITY NAME] area: Is [LOCAL AIRPORT] extremely important, very important, moderately important, slightly important or not at all important?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

We just have a couple more opinion questions and then a little background information before we are finished.

36. How sensitive are you generally to noise of all kinds: extremely sensitive, very sensitive, moderately sensitive, slightly sensitive, or not at all sensitive?

EXTREMELY SENSITIVE	5
VERY SENSITIVE	4
MODERATELY SENSITIVE	3
SLIGHTLY SENSITIVE	2
NOT AT ALL SENSITIVE	1
REFUSED	-7
DON'T KNOW	-8

37. To summarize your opinion about aircraft noise in this neighborhood, please consider all we have discussed and use a zero to four opinion thermometer where zero is not at all annoyed, four is extremely annoyed and one to three are in between.

    What number from zero to four shows how much you are bothered or annoyed by aircraft noise in this neighborhood?

    |__|

REFUSED	-7
DON'T KNOW	-8

Next we need to learn where the aircraft are flying in this area.

38. Are most of the aircraft that you notice from your home coming down for a landing at the airport, taking off from the airport, are about half landing and about half taking off, are they doing something else, or don't you know?

LANDING	1
ABOUT HALF AND HALF	2
TAKING OFF	3
DOING SOMETHING ELSE (PROBE: **What are they doing**?) ________________	4
DON'T NOTICE ANY AIRCRAFT (VOLUNTEERED)	-6
REFUSED	-7
DON'T KNOW	-8

39. Thinking about all the aircraft you notice when you are at home, about what percent fly directly over your property?

|__|__|__|%

DON'T NOTICE ANY AIRCRAFT (VOLUNTEERED)	-6
REFUSED	-7
DON'T KNOW	-8

40. When you are at home or around the neighbourhood, how fearful or concerned are you that an aircraft might crash nearby: Are you extremely, very, moderately, slightly, or not at all concerned that an aircraft might crash?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

41. When you are at home, how concerned are you that an aircraft crash might actually hurt you or your own property: Are you extremely, very, moderately, slightly, or not at all concerned that an aircraft might hurt you or your property?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

Now consider your feelings about possible car or truck road traffic accidents or possible passenger or freight train railway derailments or crashes in this area.

42. When you are at home or around the neighborhood, how fearful or concerned are you that there might be car or truck road traffic accidents nearby: Are you extremely, moderately, slightly, or not at all concerned that there might be a road traffic crash?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

43. When you are at home or around the neighborhood, how fearful or concerned are you that there might be a passenger train or freight train derailment or crash nearby? Are you extremely, moderately, slightly, or not at all concerned that there might be a train crash?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

44. Which type of traffic, if any, do you feel is the most dangerous for you or your property when you are here at home: road traffic, railway trains or aircraft?

ROAD TRAFFIC	1
RAILWAY TRAINS	2
AIRCRAFT	3
NONE ARE DANGEROUS	5
REFUSED	-7
DON'T KNOW (INCLUDES NOT ABLE TO CHOOSE THE MOST DANGEROUS)	-8

45. In what month and year were you born

|__|__| / |__|__|__|__

MONTH YEAR

REFUSED	-7
DON'T KNOW	-8

46. What is the highest level of school you have completed or the highest degree you have received?

LESS THAN 1ST GRADE 01
1ST, 2ND, 3RD OR 4TH GRADE 02
5TH OR 6TH GRADE 03
7TH OR 8TH GRADE 04
9TH GRADE 05
10TH GRADE 06
11TH GRADE 07
12TH GRADE, NO DIPLOMA 08
HIGH SCHOOL GRADUATE – HIGH SCHOOL DIPLOMA OR EQUIVALENT (FOR EXAMPLE: GED) 09
SOME COLLEGE BUT NO DEGREE................................ 10
DIPLOMA OR CERTIFICATE FROM A VOCATIONAL, TECHNICAL, TRADE OR BUSINESS SCHOOL BEYOND THE HIGH SCHOOL LEVEL 11
ASSOCIATE DEGREE IN COLLEGE – OCCUPATIONAL/VOCATIONAL PROGRAM 12
ASSOCIATE DEGREE IN COLLEGE – ACADEMIC PROGRAM... 13
BACHELORS DEGREE (FOR EXAMPLE: BA, AB, BS) 14
MASTER'S DEGREE (FOR EXAMPLE: MA, MS, MENG, MED, MSW, MBA) 15
PROFESSIONAL SCHOOL DEGREE (FOR EXAMPLE: MD, DDS, DVM, LLB, JD) 16
DOCTORATE DEGREE (FOR EXAMPLE: PHD, EDD) .. 17
REFUSED.. -7
DON'T KNOW... -8

47. [IF GENDER COLLECTED IN A5.1 OR A5.2 FROM THE SELECTED RESPONDENT (SELECTED RESPONDENT WAS SCREENER RESPONDENT) THEN SKIP 45 AND CONTINUE WITH 46, OTHERWISE ASK IF NOT SURE. OTHERWISE CODE AND CONTINUE WITH 46.]

Are you male or female?

MALE 1
FEMALE.. 2
REFUSED .... -7
DON'T KNOW................................... -8

48. Are you Spanish, Hispanic, or Latino?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

49. What race or races do you consider yourself to be? [SELECT ALL THAT APPLY]

WHITE	1
BLACK OR AFRICAN AMERICAN	2
AMERICAN INDIAN OR ALASKA NATIVE	3
ASIAN	4
NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	5
REFUSED	-7
DON'T KNOW	-8

50. What is the approximate total income from everyone in this household including such things as wages, salary, interest, pensions, or government payments? Would you say [READ RESPONSES]:

[IF THEY REFUSE TO ANSWER, PROBE:]

Is it less than 25 thousand dollars a year?
from 25 to 50 thousand?
50 thousand and one to 100 thousand?
100 thousand and one to 200 thousand?
or 200 thousand or more a year?

LESS THAN 25,000	1
25,000 – 50,000	2
50,001 – 100,000	3
100,001 – 200,000	4
200,001 or more	5
REFUSED	-7
DON'T KNOW	-8

51. Is there anything more you would like to tell me or are there any questions I can answer for you?

____

____

____

[INT87] Those are all the questions I have. Thank you again for participating in this very important study. [PRESS NEXT TO CONTINUE]

B.1.2 Spanish Version

Neighborhood Environment Survey

Buenos días/Buenas tardes. Mi nombre es ___ y estoy llamando acerca de una encuesta sobre el medio ambiente de los vecindarios que estamos realizando para el Departamento de Transporte de Estados Unidos. Recientemente le enviamos una carta acerca de esta encuesta y le daremos 10 dólares como muestra de agradecimiento después de que completemos la entrevista. {DISPLAY D4}

¿Es usted {DISPLAY D5} mayor de edad, es decir tiene un mínimo de 18 años de edad? (If 'NO" ask for an adult household member.)

D4	*IF THIS IS A CELL PHONE (BASE.LANDCELL = 2)*	"Avíseme si en este momento está manejando o haciendo otra actividad que requiera de su total atención, para poder llamar en otro momento."
i	*IF CELL OR LANDLINE STATUS IS UNKNOWN (BASE.LANDCELL = 3)*	"Si lo he llamado a un teléfono celular y en este momento está manejando o haciendo otra actividad que requiera de su total atención, lo volveré a llamar en otro momento.
	ELSE	BLANK
D5	*IF THIS IS A LANDLINE (BASE.LANDCELL = 1)*	"un miembro de este hogar y "
	ELSE	BLANK

PROGRAMMING NOTE: If probable business, continue to verify address (A3) to verify accuracy of phone match.

<u>INTRO</u>: Estamos reuniendo esta información como parte de una encuesta sobre el medio ambiente de los vecindarios que realiza Westat, una compañía de estudios en ciencias sociales, para el Departamento de Transporte de Estados Unidos. La información se usará para medir las opiniones de los habitantes de los vecindarios acerca de su medio ambiente.

A3. Antes de comenzar, quisiera determinar si su hogar reúne los requisitos para participar en el estudio. ¿Es la dirección de su hogar {DISPLAY ADDRESS}?

[VERIFY SPELLING. RECORD CHANGES OR PRESS ENTER IF NO CHANGE.]

PROGRAMMING NOTE: If address does not match, case is finalized, there is no need to ask A3_1.

A3_1. ¿Es esta dirección...
únicamente un negocio,
únicamente una vivienda o
ambas cosas?

PROGRAMMING NOTE: If business only, case becomes ineligible. This is after address has been verified and indicates that a business was sampled. This is for both the phone match and phone numbers collected by mail groups.

A4. ¿Cuántos adultos mayores de 18 años viven en su hogar?

[Implement Rizzo respondent selection algorithm].

OBS. IS THE ORIGINAL RESPONDENT SELECTED TO DO THE SURVEY?

YES..1 (GO TO Short Intro)
NO...2 (Continue)

A5.1 [NUMBER OF ADULTS = 2] Por favor dígame únicamente el nombre del otro adulto de este hogar.

¿Es esta persona de sexo masculino o femenino?

MALE	1
FEMALE	2
REFUSED	-7
DON'T KNOW	-8

A5.2 [NUMBER OF ADULTS > 2] Por favor dígame únicamente el nombre del adulto de este hogar, **aparte de usted**, que tendrá el próximo cumpleaños.

¿Es esta persona de sexo masculino o femenino?

MALE	1
FEMALE	2
REFUSED	-7
DON'T KNOW	-8

A6. ¿Puedo hablar con [NAME/GENDER]?

<u>Full Introduction</u> *[If interview is with person who did not answer above questions.]*

Mi nombre es ___ y estoy llamando acerca de la Encuesta del medio ambiente de los vecindarios. Recientemente le enviamos una carta acerca de esta encuesta que patrocina el Departamento de Transporte de Estados Unidos. Como se menciona en la carta, le daremos diez dólares como muestra de nuestro agradecimiento después de que complete la entrevista.

Westat, una compañía de estudios de ciencias sociales, está contactando a hogares en todo Estados Unidos para ayudarle al Departamento de Transporte de Estados Unidos a saber más acerca de las condiciones medioambientales de vecindarios como el suyo. Esta información se usará para actualizar las políticas relacionadas con el transporte.

Su hogar es uno de un pequeño número que ha sido seleccionado en la zona de [CITY]. Su participación representará las opiniones de muchas otras personas en vecindarios como el suyo. La participación en esta encuesta es completamente voluntaria. Puede dejar de contestar preguntas que prefiera no contestar y puede detener la entrevista en cualquier momento. La encuesta tomará unos 20 minutos.

¿Puedo continuar con la encuesta?

CONTINUE 1
GO TO RESULT ....GT

Short Introduction

Muy bien. Parece que usted reúne los requisitos para participar en la encuesta. Queremos recordarle que estamos contactando a hogares en todo Estados Unidos para ayudarle al Departamento de Transporte de Estados Unidos a saber más acerca de las condiciones medioambientales de vecindarios como el suyo. Su hogar es uno de un pequeño número que ha sido seleccionado en la zona de [CITY]. Su participación representará las opiniones de muchas otras comunidades como la suya.

La participación en esta encuesta es completamente voluntaria. Puede dejar de contestar preguntas que prefiera no contestar y puede detener la entrevista en cualquier momento. La encuesta tomará unos 20 minutos.
¿Puedo continuar con la encuesta?

CONTINUE 1
GO TO RESULT ....GT

[IF SCREENER RESPONDENT IS SELECTED RESPONDENT]

A7.1 Las siguientes preguntas son acerca de cosas que posiblemente note cuando está "aquí en casa". Al decir aquí en casa nos referimos a la dirección que hemos confirmado con usted.

[IF SCREENER RESPONDENT IS NOT THE SELECTED RESPONDENT]

A7.2 Las siguientes preguntas son acerca de cosas que posiblemente note cuando está "aquí en casa". Al decir aquí en casa nos referimos a la siguiente dirección:

[DISPLAY ADDRESS CONFIRMED IN A3, CONTINUE TO QUESTION 1]

1. Piense en los <u>últimos 12 meses más o menos.</u> Cuando usted está aquí en casa, ¿qué tanto le molesta, perturba o fastidia [INSERT TEXT FROM A-M]? ¿Diría que nada, muy poco, moderadamente, bastante o extremadamente?

	Nada	Muy poco	Moderadamente	Bastante	Extremadamente	Refused	Don't know
a. El ruido de automóviles, camiones u otro tráfico vial	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
b. Los olores o basura del tráfico vial	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
c. El humo, gas o malos olores de otra cosa	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
d. Las basuras o viviendas en mal estado	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
e. El ruido de aeronaves	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
f. El ruido u otras actividades que hacen sus vecinos	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
g. ¿Hay otros ruidos que escucha cuando está aquí en casa? 1 = YES 2 = NO [IF YES] ¿Qué ruidos? [DESCRIBE IN BOX BELOW.] Piense en los <u>últimos 12 meses más o menos</u>. Cuando usted está aquí en casa, ¿qué tanto le molesta, perturba o fastidia (DESCRIBED NOISE)? ¿Diría que nada, muy poco, moderadamente, bastante o extremadamente?	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
Describa: ______________________________							
h. Negocios o propiedades institucionales o industriales indeseables	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
i. La falta de parques o zonas verdes	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
j. El transporte público inadecuado	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
k. La cantidad de delitos en el vecindario	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8

	Nada	Muy poco	Moderadamente	Bastante	Extremadamente	Refused	Don't know
l. Los malos servicios de la ciudad o del condado	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
m. ¿Hay algún otro problema que ha notado cuando está aquí en casa? 1= YES 2 = NO [IF YES]: ¿Qué problema? Piense en los últimos 12 meses más o menos. Cuando usted está aquí en casa, ¿qué tanto le molesta, perturba o fastidia (DESCRIBED NOISE)? ¿Diría que nada, muy poco, moderadamente, bastante o extremadamente?	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
Describa: ______________________________							

2. Teniendo en cuenta lo que usted piensa acerca de su vecindario, ¿cómo calificaría su vecindario como lugar para vivir en una escala de 0 a 10 donde 0 es lo peor y 10 es lo mejor?

|__|__|

REFUSED.. -7
DON'T KNOW................................ -8

3. Ahora por favor califique al ruido en una escala de 0 a 10 respecto a qué tanto el ruido le molesta, perturba o fastidia cuando está aquí en casa. Si no le fastidia nada, elija 0; si le fastidia en extremo, elija 10. Si se siente en un punto intermedio, elija un número entre 0 y 10.

Primero acerca del ruido en general.

Piense en los <u>últimos 12 meses más o menos.</u> ¿Qué número de 0 a 10 describe mejor cuánto le molesta, perturba o fastidia el ruido en general cuando está aquí en casa?

|__|__|

REFUSED.. -7
DON'T KNOW................................ -8

4. Piense en los <u>últimos 12 meses más o menos.</u> ¿Qué número de 0 a 10 describe mejor cuánto le molesta, perturba o fastidia el ruido de automóviles, camiones u otro tráfico vial?

|__|__|

REFUSED.. -7
DON'T KNOW................................ -8

5. Piense en los <u>últimos 12 meses más o menos.</u> ¿Qué número de 0 a 10 describe mejor cuánto le molesta, perturba o fastidia el ruido de aeronaves?

|__|__|

REFUSED.. -7
DON'T KNOW................................ -8

BOX 1

[IF RESPONDENT ANSWERS "NOT AT ALL ANNOYED" BY AIRCRAFT IN BOTH THE PREVIOUS 5-POINT VERBAL-SCALE AND 0-10 SCALE AIRCRAFT NOISE QUESTIONS → GO TO Q6.

OTHERWISE GO TO Q7.

6. [ASK ONLY IF "NOT AT ALL ANNOYED" BY AIRCRAFT IN BOTH THE PREVIOUS 5-POINT VERBAL-SCALE AND 0-10 SCALE AIRCRAFT NOISE QUESTIONS]

¿Alguna vez ha oído el ruido de una aeronave cuando está aquí en casa?

YES.. 1 (GO TO 7)
NO.. 2 (BOX 2)

BOX 2

Incluso si el ruido de aeronaves no lo ha fastidiado durante los últimos 12 meses, quisiéramos conocer su opinión acerca de aspectos particulares de las aeronaves. Si no las nota, por favor díganoslo. Si las nota, está bien. Simplemente cuéntenos su opinión y continuaremos con la encuesta.

7. ¿Alguna vez una aeronave [lo ha despertado o no lo ha dejado dormir en la noche] cuando usted está en casa?

	Yes	No	Don't notice aircraft	Refused	Don't know
a. ¿Lo ha despertado o no lo ha dejado dormir en la noche?..	☐1	☐2	☐-6	☐-7	☐-8
b. ¿Lo ha sobresaltado o sorprendido?	☐1	☐2	☐-6	☐-7	☐-8
c. ¿Lo ha asustado?...	☐1	☐2	☐-6	☐-7	☐-8

Las siguientes preguntas son acerca de si las aeronaves lo han molestado, perturbado o fastidiado de distintas maneras en los últimos 12 meses cuando ha estado aquí en casa.

[ASK ONLY SPECIFIC TYPES OF DISTURBANCES WHICH WERE IDENTIFIED IN QUESTION 7]

8. Piense en los <u>últimos 12 meses más o menos,</u> cuando está aquí en casa. ¿Lo han molestado, perturbado o fastidiado las aeronaves al...? [READ FIRST ITEM THAT WAS NOTICED]

¿Diría que: extremadamente, bastante, moderadamente, muy poco o nada?

	Extremadamente	Bastante	Moderadamente	Muy poco	Nada	Refused	Don't know
a. Despertarlo o no dejarlo dormir en la noche........................	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
b. Sobresaltarlo o sorprenderlo.............	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
c. Asustarlo..................	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8

Para entender por qué el ruido de aeronaves podría o no podría afectarlo, queremos pedirle que considere su situación aquí en casa, sus observaciones acerca de vuelos de aeronaves aquí y las acciones que las autoridades han tomado.

Sus respuestas nos dan información general para entender su condición de vivienda en esta zona.

9. ¿Cuál de las siguientes opciones describe mejor el lugar donde usted vive?

¿Una casa móvil?	1	(Go to 10)
¿Una casa para una familia que no está adosada a otra casa?	2	(Go to 10)
¿Una casa para una familia que está adosada a una o más casas?	3	(Go to 10)
¿Un edificio de dos o más apartamentos?	4	
¿Otro tipo de lugar?		
¿Qué tipo de lugar? (Descríbalo) ________________	5	(Go to 10)
REFUSED	-7	(Go to 10)
DON'T KNOW	-8	(Go to 10)

9a. Aproximadamente, ¿cuántos apartamentos hay en su edificio?

2 APARTMENTS	1
3 or 4 APARTMENTS	2
5 TO 9 APARTMENTS	3
10 TO 19 APARTMENTS	4
20 TO 49 APARTMENTS	5
50 OR MORE APARTMENTS	6

10. ¿Es usted el dueño de su vivienda o paga alquiler?

OWN (INCLUDE OWING A MORTGAGE)	1
RENTING	2
REFUSED	-7
DON'T KNOW	-8

11. ¿Cuántos días entresemana, de lunes a viernes, está usted fuera de casa la mayor parte del día, es decir 8 horas o más? ¿Normalmente está fuera los cinco días entresemana o menos días o normalmente no está fuera ningún día entresemana?

[PROBE IF NUMBER OF WEEKDAYS NOT VOLUNTEERED]

¿Cuántos días entresemana normalmente está fuera?]

0 NOT AWAY ON ANY WEEKDAY	0
1 DAY	1
2 DAYS	2
3 DAYS	3
4 DAYS	4
5 AWAY ALL 5 WEEKDAYS	5
REFUSED	-7
DON'T KNOW	-8

12. Piense en esas semanas del año cuando usted pasa la mayor parte del día afuera en su jardín, terraza o balcón. En esa época del año, ¿cuántas horas al día diría que usted pasa afuera en su casa?

|__|__|
HOURS

REFUSED.. -7
DON'T KNOW................................ -8

13. ¿En qué año y mes se mudó a su casa aquí?

|__|__|__|__| |__|__|
YEAR MONTH

REFUSED.. -7
DON'T KNOW................................ -8

14. Desde que usted se mudó aquí, ¿el total de ruido de aeronaves ha aumentado, disminuido o permanecido igual?

INCREASED 1
STAYED ABOUT THE SAME 2
DECREASED.. 3
NEVER HEARD ANY AIRCRAFT (VOLUNTEERED).... -6
REFUSED... -7
DON'T KNOW... -8

15. ¿Cómo cree que será el ruido de aeronaves aquí en los próximos años? ¿Cree que el total de ruido de aeronaves aumentará, disminuirá o permanecerá igual aquí?

INCREASE.. 1
STAY ABOUT THE SAME 2
DECREASE.. 3
WILL CONTINUE TO NEVER HEAR ANY AIRCRAFT
(VOLUNTEERED).. -6
REFUSED... -7
DON'T KNOW... -8

16. Cuando está en casa, ¿ha escuchado alguna vez las aeronaves cuando están en tierra o cuando se mueven en tierra en el aeropuerto?

YES 1
NO 2
REFUSED .... -7
DON'T KNOW................................ -8

17. [ASK IF "HEARD" IN PREVIOUS QUESTION] Piense en los últimos 12 meses más o menos, cuando está aquí en casa. ¿Qué tanto lo molestan, perturban o fastidian las aeronaves cuando están en tierra o se mueven en tierra en el aeropuerto? ¿Extremadamente, bastante, moderadamente, muy poco o nada?

EXTREMELY	1
VERY	2
MODERATELY	3
SLIGHTLY	4
NOT AT ALL	5
REFUSED	6
DON'T KNOW	7

Ahora queremos preguntarle información general acerca de esta área y del aeropuerto.

18. ¿Qué tanto conocimiento tiene usted acerca del ruido y otros problemas ambientales de la comunidad en la zona de [CITY NAME]? ¿Es usted extremadamente conocedor, bastante conocedor, moderadamente conocedor, poco conocedor o nada conocedor?

EXTREMELY KNOWLEDGEABLE	1
VERY KNOWLEDGEABLE	2
MODERATELY KNOWLEDGEABLE	3
SLIGHTLY KNOWLEDGEABLE	4
NOT AT ALL KNOWLEDGEABLE	5
REFUSED	-7
DON'T KNOW	-8

19. Aproximadamente, ¿cuántos viajes al año hace usted u otros miembros de su hogar desde el aeropuerto [LOCAL AIRPORT]?

Un viaje es un viaje de ida y vuelta e incluye a todos los miembros de la familia que viajan juntos. Si algún miembro de la familia viaja por separado, cuente esos viajes por separado siempre y cuando viajen desde el aeropuerto [LOCAL AIRPORT].

|__|__|
NUMBER OF TIMES

REFUSED	-7
DON'T KNOW	-8

20. ¿Alguien en su hogar trabaja en el aeropuerto [LOCAL AIRPORT] o trabaja para una compañía u organización que hace negocios con el aeropuerto [LOCAL AIRPORT])?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

21. ¿Qué tanto ha aprendido acerca de los problemas por ruido de aeronaves en su comunidad de informes en periódicos, la radio o la televisión? ¿Bastante, algo, muy poco o nada?

A GREAT DEAL	1
SOMEWHAT,	2
A LITTLE	3
NOTHING AT ALL	4
REFUSED	-7
DON'T KNOW	-8

22. ¿Y de alguna fuente más local de información? ¿Qué tanto ha aprendido acerca de los problemas por ruido de aeronaves en su comunidad de un periódico comunitario u otra organización más local, boletín o fuente local en Internet? ¿Bastante, algo, muy poco o nada?

A GREAT DEAL	1
SOMEWHAT,	2
A LITTLE	3
NOTHING AT ALL	4
REFUSED	-7
DON'T KNOW	-8

23. ¿Y sus vecinos más cercanos han dado su opinión acerca del ruido de aeronaves? ¿Han dado a conocer su opinión abiertamente, han dado a conocer muy poco sobre su opinión o han guardado su opinión?

MADE THEIR VIEWS CLEARLY KNOWN	1
REVEALED A LITTLE,	2
KEPT VIEWS TO THEMSELVES	3
REFUSED	-7
DON'T KNOW	-8

24. ¿Hasta dónde usted sabe alguna vez ha habido disputas entre la autoridad aeroportuaria y los residentes de la comunidad acerca del ruido de aeronaves alrededor del aeropuerto (…LOCAL AIRPORT…)?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

25. ¿Hay algún grupo comunitario u otras organizaciones tratando de reducir el ruido de aeronaves?

GROUP IS	1
GROUP IS NOT	2
REFUSED	-7
DON'T KNOW	-8

26. ¿Alguna vez ha tratado usted o alguien de su hogar de hacer algo respecto al ruido de aeronaves como por ejemplo, llamar al aeropuerto, enviar un mensaje, escribir una carta, comunicarse con un funcionario, asistir a una reunión, unirse a un grupo o hacer alguna otra cosa?

YES	1	(GO TO 31a)
NO	2	(GO TO 32)
DON'T NOTICE ANY AIRCRAFT (VOLUNTEERED)	-6	
REFUSED	-7	
DON'T KNOW	-8	

26a. ¿Se contactó al aeropuerto directamente?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

27. Si hoy día alguien desea presentar una queja acerca del ruido de aeronaves, ¿sabe si hay una manera conveniente de contactar a (…LOCAL AIRPORT…)?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

28. ¿Qué tanto cree que las acciones y opiniones de los residentes pueden influir en las políticas del ruido del aeropuerto (…LOCAL AIRPORT…)? ¿Cree usted que las opiniones de los residentes pueden tener una muy gran influencia en las políticas, pueden tener gran influencia, pueden tener una influencia moderada, pueden tener poca influencia o no tienen ninguna influencia?

VERY GREATLY INFLUENCE	5
GREATLY INFLUENCE	4
MODERATELY INFLUENCE	3
SLIGHTLY INFLUENCE	2
NOT AT ALL INFLUENCE	1
REFUSED	-7
DON'T KNOW	-8

29. ¿Tiene su casa insolación contra el ruido?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

Ahora queremos preguntarle acerca de su opinión sobre los funcionarios locales y directivos del aeropuerto quienes supervisan las operaciones de aeronaves en esta zona.

30. ¿En qué medida cree usted que los funcionarios del aeropuerto [LOCAL AIRPORT] reconocen lo que piensan los residentes de la comunidad respecto al ruido de aeronaves? ¿Cree que los funcionarios reconocen lo que piensan los residentes extremadamente bien, muy bien, moderadamente bien, muy poco o para nada?

EXTREMELY WELL	5
VERY WELL	4
MODERATELY WELL	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

31. ¿Qué tan bien cree usted que los funcionarios del aeropuerto [LOCAL AIRPORT] mantienen informados a los residentes de la comunidad respecto a la planeación de cambios en el aeropuerto? ¿Cree que los funcionarios mantienen a las comunidades excelentemente informadas, muy bien informadas, moderadamente informadas, poco informadas o nada informadas?

EXTREMELY WELL	5
VERY WELL	4
MODERATELY WELL	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

32. ¿Qué tan bien cree usted que puede confiar en que los funcionarios del aeropuerto [LOCAL AIRPORT] trabajan de manera justa con la comunidad al seguir procedimientos oficiales acordados y dar información veraz? ¿Cree que puede confiar en los funcionarios del aeropuerto [LOCAL AIRPORT] completamente, considerablemente, moderadamente, poco o nada?

COMPLETELY	1
CONSIDERABLY	2
MODERATELY	3
SLIGHTLY	4
NOT AT ALL	5
REFUSED	-7
DON'T KNOW	-8

33. ¿Cuánto cree usted que [INSERT TEXT FROM A-C] podrían reducir el ruido de aeronaves en esta zona. ¿Podrían [INSERT TEXT FROM A-C] reducir el ruido en extremo, bastante, moderadamente, muy poco o nada?

	En extremo	Bastante	Moderadamente	Muy poco	Nada	Refused	Don't know
a. Los funcionarios a cargo del aeropuerto [LOCAL AIRPORT]	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
b. Otros funcionarios del gobierno	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8
c. Los pilotos de los aviones	☐5	☐4	☐3	☐2	☐1	☐-7	☐-8

34. Hasta donde usted sabe ¿alguna vez han tomado medidas las autoridades en el aeropuerto [LOCAL AIRPORT] para tratar de reducir o controlar la cantidad de ruido de aeronaves aquí?

YES	1	(GO TO 40a)
NO	2	(GO TO 41)
REFUSED	-7	(GO TO 41)
DON'T KNOW	-8	(GO TO 41)

34a. ¿Qué hicieron?

____

____

35. ¿Qué tan importante cree usted que es el aeropuerto [LOCAL AIRPORT] para la zona de [CITY NAME]? ¿Es el aeropuerto [LOCAL AIRPORT] extremadamente importante, muy importante, moderadamente importante, poco importante o nada importante?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

Tenemos un par de preguntas más acerca de su opinión y después algunas preguntas generales antes de terminar.

36. ¿Qué tan sensible es usted al ruido en general? ¿Es extremadamente sensible, muy sensible, moderadamente sensible, poco sensible o nada sensible?

EXTREMELY SENSITIVE	5
VERY SENSITIVE	4
MODERATELY SENSITIVE	3
SLIGHTLY SENSITIVE	2
NOT AT ALL SENSITIVE	1
REFUSED	-7
DON'T KNOW	-8

37. Para resumir su opinión acerca del ruido de aeronaves en este vecindario por favor tenga en cuenta todo sobre lo que hemos hablado y use una escala de cero a cuatro, en la que cero significa que el ruido no le fastidia en absoluto, cuatro significa que le fastidia en extremo y uno y tres son puntos intermedios.

¿Qué número entre cero y cuatro muestra cuánto le molesta o fastidia el ruido de aeronaves en este vecindario?

|__|

REFUSED	-7
DON'T KNOW	-8

Ahora queremos saber dónde vuelan las aeronaves en esta zona.

38. ¿La mayoría de aeronaves que escucha desde su casa van a aterrizar en el aeropuerto, están despegando del aeropuerto, un 50 por ciento está despegando y otro 50 por ciento está aterrizando, están haciendo algo más o no sabe?

LANDING	1
ABOUT HALF AND HALF	2
TAKING OFF	3
DOING SOMETHING ELSE (PROBE: **¿Qué están haciendo**?) ________________	4
DON'T NOTICE ANY AIRCRAFT (VOLUNTEERED)	-6
REFUSED	-7
DON'T KNOW	-8

39. Piense en las aeronaves que escucha cuando está en casa. ¿Aproximadamente qué porcentaje vuela directamente sobre su propiedad?

|__|__|__|%

DON'T NOTICE ANY AIRCRAFT (VOLUNTEERED)	-6
REFUSED	-7
DON'T KNOW	-8

40. Cuando está en casa o en el vecindario, ¿qué tanto le preocupa o asusta que una aeronave se estrelle cerca de donde usted está? ¿Le preocupa en extremo, bastante, moderadamente, muy poco o nada que una aeronave se pueda estrellar?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

41. Cuando está en casa, ¿qué tanto le preocupa que un accidente de una aeronave lo haga daño a usted o a su propiedad? ¿Le preocupa en extremo, bastante, moderadamente, muy poco o nada que una aeronave le haga daño a usted o a su propiedad?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

Ahora tenga en cuenta lo que usted piensa acerca de posibles accidentes de tránsito o un posible accidente de un tren de pasajeros o carga en esta zona.

42. Cuando está en casa o en el vecindario, ¿qué tanto le preocupa o asusta que haya un accidente de tránsito cerca de donde usted está? ¿Le preocupa en extremo, bastante, moderadamente, muy poco o nada que haya un accidente de tránsito?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

43. Cuando está en casa o en el vecindario, ¿qué tanto le preocupa o asusta que haya un accidente de un tren de pasajeros o carga cerca de donde usted está? ¿Le preocupa en extremo, bastante, moderadamente, muy poco o nada que haya un accidente de un tren?

EXTREMELY	5
VERY	4
MODERATELY	3
SLIGHTLY	2
NOT AT ALL	1
REFUSED	-7
DON'T KNOW	-8

44. ¿Qué tipo de tráfico cree usted es el más peligroso para usted o para su propiedad cuando usted está aquí en casa: tráfico vial, trenes o aeronaves?

ROAD TRAFFIC	1
RAILWAY TRAINS	2
AIRCRAFT	3
NONE ARE DANGEROUS	5
REFUSED	-7
DON'T KNOW (INCLUDES NOT ABLE TO CHOOSE THE MOST DANGEROUS)	-8

45. ¿En qué mes y año nació usted?

|__|__| / |__|__|__|__
MONTH YEAR

REFUSED	-7
DON'T KNOW	-8

46. ¿Cuál es el grado más alto de escuela que ha completado o el título más alto que ha recibido?

LESS THAN 1ST GRADE 01
1ST, 2ND, 3RD OR 4TH GRADE 02
5TH OR 6TH GRADE 03
7TH OR 8TH GRADE 04
9TH GRADE 05
10TH GRADE 06
11TH GRADE 07
12TH GRADE, NO DIPLOMA 08
HIGH SCHOOL GRADUATE – HIGH SCHOOL DIPLOMA OR EQUIVALENT (FOR EXAMPLE: GED) 09
SOME COLLEGE BUT NO DEGREE................................ 10
DIPLOMA OR CERTIFICATE FROM A VOCATIONAL, TECHNICAL, TRADE OR BUSINESS SCHOOL BEYOND THE HIGH SCHOOL LEVEL 11
ASSOCIATE DEGREE IN COLLEGE – OCCUPATIONAL/VOCATIONAL PROGRAM 12
ASSOCIATE DEGREE IN COLLEGE – ACADEMIC PROGRAM.. 13
BACHELORS DEGREE (FOR EXAMPLE: BA, AB, BS) 14
MASTER'S DEGREE (FOR EXAMPLE: MA, MS, MENG, MED, MSW, MBA) 15
PROFESSIONAL SCHOOL DEGREE (FOR EXAMPLE: MD, DDS, DVM, LLB, JD) 16
DOCTORATE DEGREE (FOR EXAMPLE: PHD, EDD) .. 17
REFUSED...-97
DON'T KNOW...-98

47. [IF GENDER COLLECTED IN A5.1 OR A5.2 FROM THE SELECTED RESPONDENT (SELECTED RESPONDENT WAS SCREENER RESPONDENT) THEN SKIP 45 AND CONTINUE WITH 46, OTHERWISE ASK IF NOT SURE. OTHERWISE CODE AND CONTINUE WITH 46.]

¿Es usted de sexo masculino o femenino?

MALE 1
FEMALE... 2
REFUSED .... -7
DON'T KNOW................................. -8

48. ¿Es usted hispano o latino?

YES	1
NO	2
REFUSED	-7
DON'T KNOW	-8

49. ¿De qué raza o razas se considera usted? [SELECT ALL]

WHITE	1
BLACK OR AFRICAN AMERICAN	2
AMERICAN INDIAN OR ALASKA NATIVE	3
ASIAN	4
NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	5
REFUSED	-7
DON'T KNOW	-8

50. ¿Cuál es el ingreso total aproximado de todos en este hogar, incluyendo cosas como pagas, salarios, intereses, pensiones o pagos del gobierno? ¿Diría que [READ RESPONSES]:

[GO THROUGH LIST UNTIL RESPONDENT GIVES ANSWER]

es menos de 25,000 dólares al año, de 25,000 a 50,000 dólares al año, de 50,000 a 100,000 dólares al año, de 100,000 a 200,000 dólares al año o más de 200,000 dólares al año? [IF GIVE A BORDERLINE. PROBE]: "¿Diría que probablemente fue un poco más o un poco menos que [BORDERLINE VALUE]?]

LESS THAN 25,000	1
25,000 – 50,000	2
50,000 – 100,000	3
100,000 – 200,000	4
Over 200,000	5
REFUSED	-7
DON'T KNOW	-8

51. ¿Tiene algún otro comentario u opinión o tiene alguna pregunta para mí?

____

____

____

Esas son todas las preguntas que tengo. Muchas gracias por su participación en este importante estudio.

B.2 Telephone Survey Materials

B.2.1 Match Phone Advance Letter

B.2.1.1 English Version

Neighborhood Environment Survey

Sponsored by U.S. Department of Transportation

«City» Resident
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Dear «City» Resident:

Someone in your household recently completed the Neighborhood Environment Survey. Thank-you for participating in this important study. We would like to ask some follow-up questions in a telephone interview. As a reminder, this study is sponsored by the United States Department of Transportation, a branch of the Federal Government. Since 1967, the United States Department of Transportation has been responsible for ensuring a fast, safe, efficient, accessible and convenient transportation system. We consider neighborhood environmental quality when planning, developing and revising transportation-related policies. The Neighborhood Environment Survey results will be used to update policies that affect the environment in American neighborhoods.

We have asked Westat, a statistical social science firm to obtain your views. Westat will call in the next few days to conduct a brief interview with an adult in your household. Upon completion of the telephone interview we will provide that person with $10 as a token of our appreciation.

Participation in this study is voluntary. However, your household's participation will help inform us about your neighborhood and the views of people who live in neighborhoods like yours. The information you provide will be maintained confidential to the extent allowed by law. If you have any questions about this study please call Westat toll-free at 1-855-210-4396.

Thank you in advance for your cooperation.

Sincerely,

Barbara McCann
Director, Office of Safety, Energy, and Environment

B.2.1.2 Spanish Version

Encuesta del medio ambiente de los vecindarios

Patrocinada por el Departamento de Transporte de Estados Unidos

Habitante de «City»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Estimado(a) habitante de «City»:

Una persona de su hogar contestó hace poco la Encuesta del medio ambiente de los vecindarios. Muchas gracias por su participación en este importante estudio. Quisiéramos hacerle unas preguntas de seguimiento en una entrevista telefónica. Queremos recordarle que el estudio lo patrocina el Departamento de Transporte de Estados Unidos, una rama del gobierno federal. Desde 1967, el Departamento de Transporte de Estados Unidos ha sido el responsable de asegurarse de que el sistema de transporte sea rápido, seguro, eficiente, accesible y conveniente. Nosotros tenemos en cuenta la calidad medioambiental del vecindario cuando planificamos, desarrollamos y revisamos políticas relacionadas con el transporte. Los resultados de la Encuesta del medio ambiente de los vecindarios se usarán para actualizar políticas que afectan al medio ambiente en los vecindarios de Estados Unidos.

Le hemos pedido a Westat, una compañía de estudios de ciencias sociales, que obtenga sus comentarios. Westat llamará en los siguientes días para realizar una breve entrevista con un adulto de su hogar. Después de completar la entrevista le daremos a esta persona 10 dólares como una muestra de nuestro agradecimiento.

La participación en este estudio es voluntaria. Sin embargo, la participación de su hogar nos ayudará a informarnos acerca de su vecindario y de las opiniones de las personas que viven en vecindarios como el suyo. La información que usted nos dé se mantendrá de manera confidencial hasta donde lo permite la ley. Si usted tiene alguna pregunta acerca de este estudio llame a la línea directa y gratuita de Westat al 1-855-210-4396.

Le agradecemos de antemano por su colaboración.

Atentamente,

Barbara McCann

Barbara McCann
Directora, oficina de seguridad, energía y medio ambiente

B.2.2 Invalid Phone Match Letter

B.2.2.1 English Version

Neighborhood Environment Survey

Sponsored by U.S. Department of Transportation

«City» Resident
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Dear «City» Resident:

Recently you received a letter informing you that you would be receiving a call to take part in an important environmental study for the United States Department of Transportation. Unfortunately we did not have a correct phone number to reach you. Your participation in this study is important, because your views will help the Department of Transportation update transportation-related policies that affect people in neighborhoods like yours.

We ask that you return the enclosed brief questionnaire to correct the phone number we have for your household. After you return this questionnaire, an interviewer will call to conduct an interview with an adult in your household. Upon completion of the interview we will provide that person with $10 as a token of our appreciation.

Participation in this study is voluntary. However, your household's participation will help inform us about your neighborhood and the views of people in neighborhoods like yours. We have asked Westat, a statistical social science firm to obtain your views. The information you provide will be maintained confidential to the extent allowed by law. If you have any questions about this study please call Westat toll-free at 1-855-210-4396.

Thank you in advance for your cooperation.

Sincerely,

Barbara McCann
Director, Office of Safety, Energy, and Environment

B.2.2.2 Spanish Version

Encuesta del medio ambiente de los vecindarios

Patrocinada por el Departamento de Transporte de Estados Unidos

Habitante de «City»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Estimado(a) habitante de «City»:

Hace poco usted recibió una carta informándole que iba a recibir una llamada para participar en un importante estudio medioambiental para el Departamento de Transporte de Estados Unidos. Lamentablemente no tenemos un número de teléfono correcto para comunicarnos con usted. Su participación en este estudio es importante, ya que sus opiniones ayudarán al Departamento de Transporte a actualizar políticas relacionadas con el transporte que afectan a personas en vecindarios como el suyo.

Le pedimos que nos devuelva el breve cuestionario adjunto para corregir el número de teléfono que tenemos de su hogar. Luego de devolver este cuestionario, un entrevistador lo llamará para llevar a cabo una entrevista con un adulto de su hogar. Después de completar la entrevista le daremos a esta persona 10 dólares como una muestra de nuestro agradecimiento.

La participación en este estudio es voluntaria. Sin embargo, la participación de su hogar nos ayudará a informarnos acerca de su vecindario y de las opiniones de las personas en vecindarios como el suyo. Le hemos pedido a Westat, una compañía de estudios de ciencias sociales, que obtenga sus comentarios. La información que usted nos dé se mantendrá de manera confidencial hasta donde lo permite la ley. Si usted tiene alguna pregunta acerca de este estudio llame a la línea directa y gratuita de Westat al 1-855-210-4396.

Le agradecemos de antemano por su colaboración.

Atentamente,

Barbara McCann
Directora, oficina de seguridad, energía y medio ambiente

B.2.3 Phone Request

B.2.3.1 English Version

This survey will be conducted by telephone. In order to get in touch with you, we need to collect some information on your household.

Please have this filled out by an adult household member living at this address.

Please use a blue or black pen if available.

1. **Including yourself, how many people age 18 or older live in this household? (Please include any persons who are temporarily away at this time, for example, anyone temporarily hospitalized or on a vacation or business trip.)**

   ☐☐

2. **What is the best phone number to use to contact you? (This phone number will only be used for the purpose of this research study.)**

   (☐☐☐) ☐☐☐ - ☐☐☐☐

Thank you. Please return this form in the postage paid envelope provided or mail it to:

Neighborhood Environment Survey
Westat
1600 Research Blvd., Room RC B16
Rockville, MD 20850

Toll-free number for questions: 1-855-210-4396

B.2.3.2 Spanish Version

Esta encuesta se hará por teléfono. Para poder comunicarnos con usted debemos reunir una información acerca de su hogar.

Un adulto que viva en el hogar debe contestar esta información.

Por favor use un bolígrafo de tinta negra o azul.

1. **Incluyéndose a usted, ¿cuántas personas mayores de 18 años viven en esta casa? (Incluya a las personas que están temporalmente fuera de casa, por ejemplo alguien que está hospitalizado temporalmente, de vacaciones o en un viaje de negocios.)**

   ☐☐

2. **¿Cuál es el mejor número de teléfono para comunicarse con usted? (Este número solo se usará para fines de este estudio de investigación.)**

   (☐☐☐) ☐☐☐ - ☐☐☐☐

Muchas gracias. Por favor envíe este formulario en el sobre adjunto cuyos gastos de envío ya han sido pagados o envíelo por correo a:

Neighborhood Environment Survey
Westat
1600 Research Blvd., Room RC B16
Rockville, MD 20850

Línea directa y gratuita para preguntas: 1-855-210-4396

B.2.4 Phone Request Cover Letter

B.2.4.1 English Version

Neighborhood Environment Survey

Sponsored by U.S. Department of Transportation

«City» Resident
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Dear «City» Resident:

Someone in your household recently completed the Neighborhood Environment Survey. Thank-you for participating in this important study. We would like to ask some follow-up questions in a telephone interview. As a reminder, this study is sponsored by the United States Department of Transportation, a branch of the Federal Government. Since 1967, the United States Department of Transportation has been responsible for ensuring a fast, safe, efficient, accessible and convenient transportation system. We consider neighborhood environmental quality when planning, developing and revising transportation-related policies. The Neighborhood Environment Survey results will be used to update policies that affect the environment in American neighborhoods.

We have asked Westat, a statistical social science firm to obtain your views. We ask that you return this brief questionnaire in the next two weeks. After you return the enclosed questionnaire, Westat will call to conduct a brief interview with an adult in your household. Upon completion of the telephone interview we will provide that person with $10 as a token of our appreciation.

Participation in this study is voluntary. However, your household's participation will help inform us about your neighborhood and the views of people who live in neighborhoods like yours. The information you provide will be maintained confidential to the extent allowed by law. If you have any questions about this study please call Westat toll-free at 1-855-210-4396.

Thank you in advance for your cooperation.

Sincerely,

Barbara McCann
Director, Office of Safety, Energy, and Environment

B.2.4.2 Spanish Version

Encuesta del medio ambiente de los vecindarios

Patrocinada por el Departamento de Transporte de Estados Unidos

Habitante de «City»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Estimado(a) habitante de «City»:

Una persona de su hogar contestó hace poco la Encuesta del medio ambiente de los vecindarios. Gracias por participar en este importante estudio. Quisiéramos hacerle unas preguntas de seguimiento mediante una entrevista telefónica. Queremos recordarle que el estudio lo patrocina el Departamento de Transporte de Estados Unidos, una rama del gobierno federal. Desde 1967, el Departamento de Transporte de Estados Unidos ha sido el responsable de asegurarse de que el sistema de transporte sea rápido, seguro, eficiente, accesible y conveniente. Nosotros tenemos en cuenta la calidad medioambiental del vecindario cuando planificamos, desarrollamos y revisamos políticas relacionadas con el transporte. Los resultados de la Encuesta del medio ambiente de los vecindarios se usarán para actualizar políticas que afectan al medio ambiente en los vecindarios de Estados Unidos.

Le hemos pedido a Westat, una compañía de estudios de ciencias sociales, que obtenga sus comentarios. Le pedimos que nos devuelva este breve cuestionario en las siguientes dos semanas. Luego de devolver este cuestionario, un entrevistador lo llamará para llevar a cabo una entrevista con un adulto de su hogar. Después de completar la entrevista le daremos a esta persona 10 dólares como una muestra de nuestro agradecimiento.

La participación en este estudio es voluntaria. Sin embargo, la participación de su hogar nos ayudará a informarnos acerca de su vecindario y de las opiniones de las personas que viven en vecindarios como el suyo. La información que usted nos dé se mantendrá de manera confidencial hasta donde lo permite la ley. Si usted tiene alguna pregunta acerca de este estudio llame a la línea directa y gratuita de Westat al 1-855-210-4396.

Le agradecemos de antemano por su colaboración.

Atentamente,

Barbara McCann
Directora, oficina de seguridad, energía y medio ambiente

B.2.5 Phone Request Postcard

B.2.5.1 English Version

A few weeks ago you received a request asking you to provide a phone number we can use to reach this household. The phone number you provide will **only** be used for the Neighborhood Environment Survey, a survey sponsored by the United States Department of Transportation. If you have already completed and returned the request for your phone number, we are very grateful and thank you. If you have not, we encourage you to do so.

The phone number you provide will not be used for any other purpose and will not be shared with anyone. Once we receive your phone number a member of our interviewing staff will contact your household to complete this brief survey.

This is an important survey that can help provide information that will be used to develop and revise transportation-related policies that affect neighborhoods like yours. We are very grateful for your participation.

{RETURN ADDRESS/LOGO}

{CITY} RESIDENT
{ADDRESS LINE 1}
{ADDRESS LINE 2}
{CITY}, {STATE} {ZIP}

B.2.5.2 Spanish Version

Hace unas semana usted recibió una solicitud pidiéndole que de un número de teléfono para poder comunicarnos con este hogar. El número de teléfono que dé únicamente su usará para la Encuesta del medio ambiente de los vecindarios, una encuesta patrocinada por el Departamento de Transporte de Estados Unidos. Si usted ya ha contestado y enviado la solicitud de su número de teléfono, se lo agradecemos mucho. Si usted todavía no lo ha hecho, lo animamos a que lo haga.

El número de teléfono que nos dé no se usará para otros fines y no se compartirá con ninguna persona. Una vez que recibamos su número de teléfono, un miembro de nuestro equipo de entrevistadores se comunicará con su hogar para completar una breve encuesta.

Se trata de una importante encuesta que puede ayudar a brindar información que se usará para desarrollar y revisar políticas relacionadas con el transporte que afectan a vecindarios como el suyo. Le agradecemos mucho su participación.

{RETURN ADDRESS/LOGO}

HABITANTE DE {CITY}
{ADDRESS LINE 1}
{ADDRESS LINE 2}
{CITY}, {STATE} {ZIP}

B.2.6 Phone Request NR Follow-up Letter

B.2.6.1 English Version

Neighborhood Environment Survey

Sponsored by U.S. Department of Transportation

«City» Resident
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Dear «City» Resident:

Recently you received a letter inviting you to take part in an important environmental study for the United States Department of Transportation. Unfortunately we have not yet received a reply from your household. If you have already sent in the survey, thank-you very much for your help. If you haven't yet had time to respond, we encourage you to do so. Your participation in this study is important because your views will help the Department of Transportation update transportation-related policies that affect people in neighborhoods like yours.

For your convenience we've enclosed a replacement to the original questionnaire that was sent to your household requesting your phone number. That number will only be used to conduct a brief interview with an adult in your household. We have asked Westat, a statistical social science firm to conduct these interviews. Upon completion of the telephone interview we will provide that person with $10 as a token of our appreciation.

Participation in the study is voluntary. However, your household's participation will help inform us about your neighborhood and the views of people who live in neighborhoods like yours. The information you provide will be maintained confidential to the extent allowed by law. If you have any questions about this study please call Westat toll-free at 1-855-210-4396.

Thank you in advance for your cooperation.

Sincerely,

Barbara McCann
Director, Office of Safety, Energy, and Environment

B.2.6.2 Spanish Version

Encuesta del medio ambiente de los vecindarios

Patrocinada por el Departamento de Transporte de Estados Unidos

Habitante de «City»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Estimado(a) habitante de «City»:

Hace poco usted recibió una carta informándole que iba a recibir una llamada para participar en un importante estudio medioambiental para el Departamento de Transporte de Estados Unidos. Lamentablemente todavía no hemos recibido la respuesta de su hogar. Si usted ya ha enviado la encuesta, le agradecemos mucho su colaboración. Si usted todavía no ha tenido tiempo para contestarla, lo animamos a que lo haga. Su participación en este estudio es importante, ya que sus opiniones ayudarán al Departamento de Transporte a actualizar políticas relacionadas con el transporte que afectan a personas en vecindarios como el suyo.

Para su comodidad, hemos incluido un reemplazo del cuestionario original que enviaron a su hogar solicitando su número de teléfono. Ese número se usará únicamente para llevar a cabo una breve entrevista con un adulto de su hogar. Le hemos pedido a Westat, una compañía de estudios de ciencias sociales, que realice estas entrevistas. Después de completar la entrevista le daremos a esta persona 10 dólares como una muestra de nuestro agradecimiento.

La participación en el estudio es voluntaria. Sin embargo, la participación de su hogar nos ayudará a informarnos acerca de su vecindario y de las opiniones de las personas que viven en vecindarios como el suyo. La información que usted nos dé se mantendrá de manera confidencial hasta donde lo permite la ley. Si usted tiene alguna pregunta acerca de este estudio llame a la línea directa y gratuita de Westat al 1-855-210-4396.

Le agradecemos de antemano por su colaboración.

Atentamente,

Barbara McCann

Barbara McCann
Directora, oficina de seguridad, energía y medio ambiente

B.2.7 Phone Thank You Letter

B.2.7.1 English Version

Neighborhood Environment Survey

Sponsored by U.S. Department of Transportation

«Name»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Dear «Name»:

Thank you for completing the Neighborhood Environment Study phone survey. We have enclosed $10 as a sign of our appreciation for your participation. The Neighborhood Environment Survey results will be used to update policies that affect the environment in American neighborhoods.

If you have any questions about this study please call Westat toll-free at 1-855-210-4396.

Thank you for your cooperation.

Sincerely,

Barbara McCann
Director, Office of Safety, Energy, and Environment

B.2.7.2 Spanish Version

Encuesta del medio ambiente de los vecindarios

Patrocinada por el Departamento de Transporte de Estados Unidos

«Name»
«Address1»
«Address2»
«City», «State» «Zip»-«Zip4»

Estimado(a) «Name»:

Gracias por completar la encuesta telefónica del Estudio del medio ambiente de los vecindarios. Hemos adjuntado 10 dólares como muestra de nuestro agradecimiento por su participación. Los resultados de la Encuesta del medio ambiente de los vecindarios se usarán para actualizar políticas que afectan al medio ambiente en los vecindarios de Estados Unidos.

Si usted tiene alguna pregunta acerca de este estudio llame a la línea directa y gratuita de Westat al 1-855-210-4396.

Le agradecemos su colaboración.

Atentamente,

Barbara McCann
Directora, Oficina de seguridad, energía y medio ambiente

B.3 Variable Names Assigned to Survey Questions

Q#	Variable	Label	Question Text
1a	PALNseTraffic	Phone AL: Noise from Traffic	Thinking about the last 12 months or so, when you are here at home, how much does noise from cars, trucks or other road traffic bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1b	PALSmellTraffic	Phone AL: Smells Dirt from Traffic	Thinking about the last 12 months or so, when you are here at home, how much does smells or dirt from road traffic bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1c	PALSmellOther	Phone AL: Smoke Gas Bad Smells Else	Thinking about the last 12 months or so, when you are here at home, how much does smoke, gas or bad smells from anything else bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1d	PALLitter	Phone AL: Litter Poorly Kept Housing	Thinking about the last 12 months or so, when you are here at home, how much does litter or poorly kept up housing bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1e	PALAC	Phone AL: Noise Aircraft	Thinking about the last 12 months or so, when you are here at home, how much does noise from aircraft bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1f	PALNeighbor	Phone AL: Neighbors Noise	Thinking about the last 12 months or so, when you are here at home, how much does your neighbors' noise or other activities bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1g	POtherNse	Phone Other Annoying Noise	Are there any other noises you hear when you are here at home?
1gOS	PALOtherNse	Phone AL: Other Noise	Thinking about the last 12 months or so, when you are here at home, how much does <OTHER NOISE> bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1h	PALBusiness	Phone AL: Undesirable Business Property	Thinking about the last 12 months or so, when you are here at home, how much does undesirable business, institutional or industrial property bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1i	PALNoParks	Phone AL: Lack of Parks	Thinking about the last 12 months or so, when you are here at home, how much does a lack of parks or green spaces bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1j	PALPubTransit	Phone AL: Inadequate Public Transportation	Thinking about the last 12 months or so, when you are here at home, how much does inadequate public transportation bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?

Q#	Variable	Label	Question Text
1k	PALCrime	Phone AL: Crime	Thinking about the last 12 months or so, when you are here at home, how much does the amount of neighborhood crime bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1l	PALCitySvces	Phone AL: Poor City County Services	Thinking about the last 12 months or so, when you are here at home, how much does poor city or county services bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
1m	POthProb	Phone Other Annoying Problems	Are there any other problems that you notice when you are here at home?
1mOS	PALOthProb	Phone AL: Other Problems	Thinking about the last 12 months or so, when you are here at home, how much does <OTHER PROBLEM> bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
2	PRateNeighborhood	Phone Neighborhood Rating	Now considering how you feel about everything in your neighborhood, how would you rate your neighborhood as a place to live on a scale from 0 to 10 where 0 is worst and 10 is best?
3	PGenNseRt	Phone General Noise Rating	Now please rate noise on a 0 to 10 opinion scale for how much the noise bothers, disturbs or annoys you when you are here at home. If you are not at all annoyed choose 0; if you are extremely annoyed choose 10; if you are somewhere in between, choose a number between 0 and 10. First about noise in general. Thinking about the last 12 months or so, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the noise in general when you are here at home?
4	PGenNseRtTraffic	Phone General Noise from Traffic Rating	Thinking about the last 12 months or so, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the noise from cars or trucks or other road traffic?
5	PGenNseRtAC	Phone General Noise from Aircraft Rating	Thinking about the last 12 months or so, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the noise from aircraft?
6	PHearAC	Phone Ever Heard The Sound from Aircraft At Home	Have you ever heard the sound from an aircraft when you were here at home?
7a	PACWake	Phone Ever Waked up from Aircraft	Has an aircraft ever waked you up or kept you awake at night when you are at home?
7b	PACStartle	Phone Ever Startled Surprised from Aircraft	Has an aircraft ever startled or surprised you when you are at home?
7c	PACFrighten	Phone Ever Frightened from Aircraft	Has an aircraft ever frightened you when you are at home?
8a	PALACWake	Phone AL: Waking You up at Night	Thinking about the last 12 months or so, when you are at home, have the aircraft bothered, disturbed or annoyed you by waking you up or keeping you awake at night? Would you say extremely, very, moderately slightly, or not at all?

Q#	Variable	Label	Question Text
8b	PALACStartle	Phone AL: Startling Surprising You	Thinking about the last 12 months or so, when you are at home, have the aircraft bothered, disturbed or annoyed you by startling or surprising you? Would you say extremely, very, moderately slightly, or not at all?
8c	PALACFrighten	Phone AL: Frightening You	Thinking about the last 12 months or so, when you are at home, have the aircraft bothered, disturbed or annoyed you by frightening you? Would you say extremely, very, moderately slightly, or not at all?
9	PBldgTp	Phone Describe Building Where Live	To understand why aircraft noise may or may not affect you, we ask you to consider your situation here at home, your observations about aircraft flights here and the actions authorities have been taking. Your next answers provide background for understanding your living situation in this area. Which of the following best describes the building where you live?
9a	PNumApts	Phone Apartments in Building	Approximately, how many apartments are there in your building?
10	POwnRent	Phone Own or Rent Home	Do you own your home or are you renting?
11	PWkDayNotHome	Phone Weekdays Away from Home	How many of the five weekdays from Monday through Friday are you usually out away from home most of the day, that is 8 hours or more? Are you usually away, on all five weekdays, or fewer weekdays, or are you usually not away on any weekday? [PROBE IF NUMBER OF WEEKDAYS NOT VOLUNTEERED: How many weekdays are you usually away?]
12	PHrOutside	Phone Hours Week Out-of-Doors	Think about those weeks in the year when you spend the most time out-of-doors in your yard or on your porch, deck or balcony. At that time of year, how many hours a week would you say you are out-of-doors at home?
13MTH	PMonthMovedToHome	Phone Month Moved to Home	In what year and month did you move to your home here?
13YR	PYearMovedToHome	Phone Year Moved to Home	In what year and month did you move to your home here?
14	PACNseChg	Phone Aircraft Noise Increase Decrease Same	Since you moved here, has the total amount of aircraft noise increased, decreased or stayed about the same?
15	PACNseFuture	Phone Aircraft Noise in Next Few Years	What do you think aircraft noise will be like here in the next few years: Do you think the total amount of aircraft noise will increase, decrease or stay about the same here?
16	PHrdACGrd	Phone Heard Aircraft on the Ground	When you are at home, have you ever heard aircraft sitting on the ground or moving around on the ground on the airport property?
17	PALACGrd	Phone AL: Aircraft on the Ground	Thinking about the last 12 months or so, when you are at home, how much have the aircraft sitting on the ground or moving around on the ground on the airport property bothered, disturbed or annoyed you: extremely, very, moderately, slightly, or not at all?

Q#	Variable	Label	Question Text
18	PKnowCommIssues	Phone Knowledgeable About Community Issues	Next we ask you to provide some background about this area and the airport. How knowledgeable are you about noise and other community environmental issues in the <BASECITY> area: Are you extremely knowledgeable, very knowledgeable, moderately knowledgeable, slightly knowledgeable, or not at all knowledgeable?
19	PAPTripsYr	Phone How Many Trips from Airport	About how many trips a year do you and other members of your household make from the <AIRPORT>? One trip is considered as round-trip travel and includes all family members traveling together. If any family members travel separately, please count those as separate trips as long as they use <AIRPORT>.
20	PWrkAtAP	Phone Work at Airport	Do you or anyone else in your household work at <AIRPORT> or work for a company or organization that does business with <AIRPORT>?
21	PLrnMedia	Phone Learn Aircraft Noise Issues: Media	How much have you learned about your community's aircraft noise issues from media reports in the newspaper or on radio or TV: a great deal, somewhat, a little or nothing at all?
22	PLrnLocalInfo	Phone Learn Aircraft Noise Issues: Local Info	How about a more local information source? How much have you learned about your community's aircraft noise issues from a community newspaper or other more local organization, newsletter or local internet source: a great deal, somewhat, a little or nothing at all?
23	PNbrsViewACNse	Phone Neighbors Views Known On Aircraft Noise	How about your closest neighbors making their views known about aircraft noise: Have they clearly made their views known, have they revealed only a little about their views, or have they kept their views to themselves?
24	PAuthDisputes	Phone Disputes between Airport and Residents	As far as you know, have there ever been disputes between airport authorities and community residents about aircraft noise around <AIRPORT>?
25	PCommGroup	Phone Community Groups Reduce Aircraft Noise	Are any community groups or other organizations trying to reduce aircraft noise or don't you know?
26	PHHActOnACNse	Phone HH Done Anything about Aircraft Noise	Have you or anyone in your household ever tried to get something done about aircraft noise such as telephoning the airport, sending a message, writing a letter, contacting an official, going to a meeting, joining a group or doing something else?
26a	PContactAP	Phone HH Contact Airport Directly	Was the airport contacted directly?
27	PWayToComplain	Phone Convenient Way to Make Complaint	If someone wants to make a complaint about aircraft noise these days, do you know if there is a convenient way to contact <AIRPORT>?
28	PResInfluenAP	Phone Can Residents Action Influence Airport	How much do you think that residents' actions and views can influence <AIRPORT> noise policy? Do you think that residents' views can very greatly influence policy, greatly influence policy, moderately influence, slightly influence, or not at all influence policy?
29	PHomeInsulate	Phone Has Home Been Sound Insulated	Has your home been sound insulated?

Q#	Variable	Label	Question Text
30	PAPRcgnzRes	Phone Airport Recognize Residents Feelings	Next we ask for your views about the local officials and managers at the airport who oversee aircraft operations in this area. To what extent do you think <AIRPORT> officials recognize the community residents' feelings about aircraft noise? Do you think the officials recognize the residents' feelings extremely well, very well, moderately well, slightly, or not at all?
31	PAPInformRes	Phone Airport Keeps Residents Informed	How fully do you feel the <AIRPORT> officials keep community residents informed about the planning for airport changes? Do you think the officials keep communities extremely well informed, very well informed, moderately well informed, slightly informed, or not at all informed?
32	PAPTrusted	Phone Can Trust Airport to Work Fairly	How completely do you feel you can trust the <AIRPORT> officials to work fairly with the community by following official, agreed-upon procedures and providing accurate information? Do you feel you can rely upon the <AIRPORT> officials completely, considerably, moderately, slightly or not at all?
33a	PRedACNseAPOff	Phone Could Officials of Airport Reduce Noise	How much do you think the officials who run <AIRPORT> could reduce the aircraft noise around here: Could the officials who run <AIRPORT> reduce the noise very greatly, greatly, moderately, slightly or not at all?
33b	PRedACNseAPOthGov	Phone Could Other Gov Officials Reduce Noise	How much do you think other government officials could reduce the aircraft noise around here: Could other government officials reduce the noise very greatly, greatly, moderately, slightly or not at all?
33c	PRedACNseAPilots	Phone Could Pilots Reduce Noise	How much do you think the pilots flying the planes could reduce the aircraft noise around here: Could the pilots flying the planes reduce the noise very greatly, greatly, moderately, slightly or not at all?
34	PAPRedACNse	Phone Authorities Taken Steps Reduce Noise	As far as you know, have the authorities at <AIRPORT> ever taken steps to try to reduce or control the amount of aircraft noise here?
35	PAPImportant	Phone Importance of Airport for City	How important do you think that <AIRPORT> is for the <BASECITY> area: Is <AIRPORT> extremely important, very important, moderately important, slightly important or not at all important?
36	PRespSenstve	Phone Sensitive to Noise	We just have a couple more opinion questions and then a little background information before we are finished. How sensitive are you generally to noise of all kinds: extremely sensitive, very sensitive, moderately sensitive, slightly sensitive, or not at all sensitive?
37	PRespBothrdACNse	Phone Bothered by Aircraft Noise	To summarize your opinion about aircraft noise in this neighborhood, please consider all we have discussed and use a zero to four opinion thermometer where zero is not at all annoyed, four is extremely annoyed and one to three are in between. What number from zero to four shows how much you are bothered or annoyed by aircraft noise in this neighborhood?

Q#	Variable	Label	Question Text
38	PACTakeOffLand	Phone Aircraft Landing Taking off Both	Next we need to learn where the aircraft are flying in this area. Are most of the aircraft that you notice from your home coming down for a landing at the airport, taking off from the airport, are about half landing and about half taking off, are they doing something else, or don't you know?
39	PACPctFlyOverH	Phone Percent Aircraft Fly Directly Over	Thinking about all the aircraft you notice when you are at home, about what percent fly directly over your property?
40	PCNACCrash	Phone Concern: Aircraft Crash Nearby	When you are at home or around the neighborhood, how fearful or concerned are you that an aircraft might crash nearby: Are you extremely, very, moderately, slightly, or not at all concerned that an aircraft might crash?
41	PCNACHurtYou	Phone Concern: Aircraft Hurt You or Property	When you are at home, how concerned are you that an aircraft crash might actually hurt you or your own property: Are you extremely, very, moderately, slightly, or not at all concerned that an aircraft might hurt you or your property?
42	PCNTrfAccdnt	Phone Concern: Traffic Accidents Nearby	Now consider your feelings about possible car or truck road traffic accidents or possible passenger or freight train railway derailments or crashes in this area. When you are at home or around the neighborhood, how fearful or concerned are you that there might be car or truck road traffic accidents nearby: Are you extremely, moderately, slightly, or not at all concerned that there might be a road traffic crash?
43	PCNTrnCrash	Phone Concern: Train Crash Nearby	When you are at home or around the neighborhood, how fearful or concerned are you that there might be a passenger train or freight train derailment or crash nearby? Are you extremely, moderately, slightly, or not at all concerned that there might be a train crash?
44	PDangerTrf	Phone Most Danger: Traffic Trains Aircraft	Which type of traffic, if any, do you feel is the most dangerous for you or your property when you are here at home: road traffic, railway trains or aircraft?
45MTH	PMonthBorn	Phone Month Born	In what month and year were you born?
45YR	PYearBorn	Phone Year Born	In what month and year were you born?
46	PHighestEd	Phone Highest Level of School	What is the highest level of school you have completed or the highest degree you have received?
47	PGender	Phone Gender	[ASKED IF NOT SURE.] Are you male or female?
48	PHispanic	Phone Spanish Hispanic Latino	Are you Spanish, Hispanic, or Latino?
49	PRaceEthnicity	Phone Respondent Race/Ethnicity	What race or races do you consider yourself to be? [SELECT ALL THAT APPLY.]
50	PHHIncome	Phone Total Income Household	What is the approximate total income from everyone in this household including such things as wages, salary, interest, pensions, or government payments? Would you say [READ RESPONSES]: [IF THEY REFUSE TO ANSWER, PROBE:] Is it less than 25 thousand dollars a year? From 25 to 50 thousand? 50 to 100 thousand? 100 to 200 thousand? Or over 200 thousand a year?

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Appendix C Description of Balanced Sampling

C.1 Balanced Sampling Procedure

A balanced sampling procedure was used for the NES, ensuring that the sample has approximately the same proportion of airports as the population with respect to each of the balancing factors chosen by the FAA listed in Table 3-2.

Balanced sampling is a more general form of stratification and is sometimes used when the number of desired stratification factors for a stratified random sample is larger than the sample size will support (Tillé 2011). Stratified random sampling relies on the randomization to approximately balance factors not used in the stratification. With a large sample size, these are expected to be approximately balanced, but with a smaller sample size the sample that is chosen may be unrepresentative on one or more factors not used in the stratification. Balanced sampling allows selection of a sample that is representative on a larger number of factors than can be handled with stratification, and thus guarantees that the 20 airports chosen for the NES will be similar to the 95 airports in the population on all balancing factors listed in Table 3-2.

The procedure used to select the balanced sample was designed to:

1. Include ATL, LAX, and ORD in the sample.
2. Include exactly one of the three major New York City-area airports (JFK, LGA or EWR) in the sample.
3. Choose the 16 remaining airports for the sample so that the full sample of 20 airports meets the balancing constraints for the factors in Table 3-2.

Table C-1 gives the population proportions and desired sample sizes for each of the balancing variables. The sample size given in the table is the closest value for matching the proportion of airports in that class. For FAA region, both ANE (New England) and ANM (Northwest Mountain) gave an unrounded sample size of 1.5: this was resolved by allotting two airports to ANM and one to ANE.

Table C-1. Population Proportion and Desired Sample Size for Each Balancing Factor

Factor	Number of airports in sampling frame	Proportion of airports in sampling frame	Sample size (unrounded)	Sample size required to meet balancing criterion
FAA Region (contiguous US)				
Central (ACE)	3	3.2%	0.6	1
Eastern (AEA)	16	16.8%	3.4	3
Great Lakes (AGL)	11	11.6%	2.3	2
New England (ANE)	7	7.4%	1.5	1
Northwest Mountain (ANM)	7	7.4%	1.5	2
Southern (ASO)	21	22.1%	4.4	4
Southwest (ASW)	13	13.7%	2.7	3
Western Pacific (AWP)	17	17.9%	3.6	4
Temperature (degrees F)				
Greater than or Equal to 70	9	9.5%	1.9	2
Between 55.1 and 69.9 (inclusive)	49	51.6%	10.3	10
Less than or equal to 55	37	38.9%	7.8	8
Percent DNL Nighttime Operations (see Note 1)				
Greater than or Equal to 20%	36	37.9%	7.6	8
Less than 20%	59	62.1%	12.4	12
Average Daily Flight Operations				
Greater than or Equal to 300	48	50.5%	10.1	10
Less than 300	47	49.5%	9.9	10
Fleet Mix Ratio				
Greater than or equal to 1	57	60.0%	12	12
Less than 1	38	40.0%	8	8
Population within 5 Miles				
Greater than or Equal to 230,000	35	36.8%	7.4	7
Fewer than 230,000	60	63.2%	12.6	13

Notes:
1) DNL nighttime is 10:00 pm to 6:59 am. See Table 3-2 regarding division value.

Restricted random sampling (Valliant, Dorfman and Royall 2000) with a modification to include the directed airports of ATL, ORD and LAX, was used to select a sample that had the sample sizes for each category given in Table C-1. Restricted random sampling consists of the following three steps:

1. Generate a large number of random samples of size 20 from the population.
2. Reject the samples that do not meet the balancing constraints.
3. Select one sample at random from the remaining samples (all of which meet the balancing constraints).

To modify this procedure to include the certainty airports, Westat first generated 250,000 stratified random samples using the strata given in Table C-2. Generating stratified samples as the first step ensured that all of these 250,000 candidate samples had the correct number of airports from each of the eight FAA regions, and always included ATL, LAX, ORD, and one of the New York City-area airports chosen at random. This occurred because each of ATL, LAX, and ORD was selected with certainty from its stratum, and exactly one airport was selected from the stratum consisting of EWR, JFK, and LGA. Region was chosen as the basis of the stratification factor because it has the most categories.[1]

Table C-2. Strata Used in Initial Step of Generating Candidate Samples

Stratum	Number of airports in population	Number of airports in sample
ACE	3	1
AEA (minus EWR, JFK, LGA)	13	2
AGL (minus ORD)	10	1
ANE	7	1
ANM	7	2
ASO (minus ATL)	20	3
ASW	13	3
AWP (minus LAX)	16	3
ATL	1	1
LAX	1	1
ORD	1	1
EWR, JFK, LGA	3	1
Total	95	20

Of the 250,000 stratified samples that were generated, 55 also met the balancing criteria on the other factors. The sample for this study was selected randomly from this set of 55. Although the three airports ATL, LAX and ORD were directed to be in the sample, the remainder of the sample was drawn using random selection methods. This ensures that while the sample as a whole is balanced, all airports except for the three certainty airports were chosen randomly and not purposively.

C.2 Description of Balancing Factor Divisions and Airport Factor Values

The following five subsections address the balancing factors of temperature, nighttime operations, average daily operations, fleet mix ratio and population. The data for each of these factors for each of the 95 airports are in Table C-3. This data are presented in alphabetical order of the airport ID, whereas plots of the data introduced in each of the subsections is shown in descending order of value of the balancing factor. The selected airports are shown in bold.

[1] This was done purely for computational efficiency and does not imply FAA region is more important than other factors. By using the first factor, FAA Region, in Table 2-1 for generating the candidate samples, the computational effort was substantially reduced. This is because every generated sample was balanced for each of the eight FAA regions and only needed to be checked for whether it was also balanced on the other six factors. The same procedure would work (and would produce similar samples) if, say, the initial samples had been stratified on temperature, but in that case each sample would have needed to be checked for balance on 11 other criteria, so a much higher fraction of the generated samples would be rejected.

Table C-3. Balancing Factor Data for All Airports in Sampling Frame

Selected Airports Shown in Bold

Airport Identifier	Airport Name	Annual Average Daily Temperature (degrees F)	Original Percent of Operations During DNL Nighttime (%)	Revised/corrected Percent of Operations During DNL Nighttime (%)	2011 ETMS Average Daily Flight Operations	Ratio of Commuter/Small Flight Operations to Large Aircraft Flight Operations	Population Within 5 Miles of Airport
ABQ	**Albuquerque Intl Sunport**	**58.04**	**17.0**	**11.8**	**274.7**	0.6	**144,952**
ALB	**Albany Intl**	**48.65**	**27.2**	**21.7**	**163.0**	1.4	**114,935**
APA	Centennial	50.02	15.2	12.5	158.6	17805.0	175,093
ATL	**Hartsfield-Jackson Atlanta Intl**	**62.34**	**7.2**	**8.6**	**2518.1**	0.4	**212,823**
AUS	**Austin-Bergstrom Intl**	**71.01**	**18.6**	**13.2**	**385.1**	0.7	**88,849**
BDL	**Bradley Intl**	**50.63**	**26.2**	**17.6**	**266.4**	1.1	**43,567**
BED	Laurence G Hanscom Field	50.05	10.9	6.7	116.9	73.8	83,189
BFI	**Boeing Field/King County Intl**	**53.70**	**17.8**	**12.7**	**184.4**	2.5	**291,268**
BHM	Birmingham Intl	63.01	18.3	13.2	240.6	1.8	122,517
BIL	**Billings Logan Intl**	**47.86**	**21.3**	**15.2**	**106.7**	2.1	**93,175**
BNA	Nashville Intl	59.88	14.1	10.7	448.3	1.1	156,815
BOI	Boise Air Terminal/Gowen Field	52.95	20.2	12.9	173.4	1.2	133,467
BOS	General Edward Lawrence Logan Intl	51.47	18.3	13.1	952.4	0.6	491,152
BTR	Baton Rouge Metropolitan, Ryan Field	67.18	17.1	12.0	106.7	147.2	103,711
BTV	Burlington Intl	46.48	19.9	14.1	105.2	14.3	74,691
BUF	Buffalo Niagara Intl	48.51	25.7	16.6	239.7	1.4	225,144
BUR	Bob Hope	63.98	11.7	4.7	319.4	0.6	539,666
BWI	Baltimore/Washington Intl Thurgood Marshall	55.77	13.7	10.7	731.5	0.2	175,445
CAE	Columbia Metropolitan	63.63	23.3	19.1	118.2	5.1	67,415
CAK	Akron-Canton Regional	49.92	22.8	15.9	103.6	1.6	82,632
CHS	Charleston Air Force Base/Intl	65.48	18.0	13.0	190.9	2.0	116,289
CLE	Cleveland-Hopkins Intl	51.07	21.8	9.3	513.3	2.5	211,482

Airport Identifier	Airport Name	Annual Average Daily Temperature (degrees F)	Original Percent of Operations During DNL Nighttime (%)	Revised/corrected Percent of Operations During DNL Nighttime (%)	2011 ETMS Average Daily Flight Operations	Ratio of Commuter/Small Flight Operations to Large Aircraft Flight Operations	Population Within 5 Miles of Airport
CLT	Charlotte/Douglas Intl	60.76	9.7	10.7	1455.4	1.3	94,245
CMH	Port Columbus Intl	53.27	21.5	14.4	352.5	2.5	241,443
CVG	Cincinnati/Northern Kentucky Intl	54.05	24.4	18.3	435.0	2.3	110,969
DAL	Dallas Love Field	67.31	11.8	8.4	446.3	0.7	299,718
DCA	Ronald Reagan Washington National	57.89	12.5	9.8	772.8	1.5	650,983
DFW	Dallas/Fort Worth Intl	66.25	9.4	7.7	1767.5	0.6	143,253
DSM	**Des Moines Intl**	**50.55**	**24.4**	**14.9**	**165.2**	3.8	**118,690**
DTW	**Detroit Metropolitan Wayne County**	**50.37**	**23.6**	**7.1**	**1216.2**	1.8	**88,989**
ELP	El Paso Intl	65.82	18.2	13.8	176.8	0.7	198,467
EWR	Newark Liberty Intl	55.24	20.0	15.0	1111.4	0.6	705,858
FAT	Fresno Yosemite Intl	64.29	27.6	20.3	102.0	4.5	343,067
FLL	Fort Lauderdale/Hollywood Intl	77.18	18.0	13.8	672.6	0.2	268,341
FSD	Joe Foss Field	46.35	25.4	17.0	133.0	3.6	99,444
FXE	Fort Lauderdale Executive	76.05	14.3	8.6	115.2	2315.0	431,855
GEG	Spokane Intl	48.08	26.4	20.6	145.1	0.3	23,782
HOU	William P. Hobby	69.92	12.3	8.4	474.6	0.6	306,751
HPN	Westchester County	51.84	14.6	9.5	321.2	25.2	144,067
IAD	Washington Dulles Intl	55.15	14.9	14.2	965.8	1.6	151,207
IAH	George Bush Intercontinental/Houston	69.12	21.2	15.9	1444.6	1.2	117,326
IND	Indianapolis Intl	53.31	33.7	22.9	425.6	1.1	103,671
JAX	Jacksonville Intl	67.67	16.5	11.5	239.4	1.0	32,293
JFK	John F. Kennedy Intl	54.08	19.9	16.6	1122.1	0.4	725,214
LAS	**McCarran Intl**	**69.42**	**15.2**	**10.5**	**1107.1**	0.2	**379,622**
LAX	**Los Angeles Intl**	**62.38**	**19.5**	**17.7**	**1636.7**	0.3	**513,937**
LGA	**LaGuardia**	**55.55**	**16.4**	**8.6**	**1007.2**	1.2	**235,506**
LGB	Long Beach/Daugherty Field	63.85	8.0	2.0	130.7	0.7	686,242

Airport Identifier	Airport Name	Annual Average Daily Temperature (degrees F)	Original Percent of Operations During DNL Nighttime (%)	Revised/corrected Percent of Operations During DNL Nighttime (%)	2011 ETMS Average Daily Flight Operations	Ratio of Commuter/Small Flight Operations to Large Aircraft Flight Operations	Population Within 5 Miles of Airport
LIT	**Bill and Hillary Clinton National**	**62.51**	**15.7**	**11.2**	**196.1**	2.6	**62,879**
MCO	Orlando Intl	71.66	13.0	9.6	859.4	0.1	83,097
MDW	Chicago Midway Intl	51.88	11.2	9.8	651.9	0.3	687,736
MEM	**Memphis Intl**	**62.86**	**32.2**	**30.3**	**833.3**	0.7	**182,538**
MHT	Manchester	49.75	28.8	22.0	146.1	1.1	114,100
MIA	**Miami Intl**	**76.65**	**14.4**	**11.6**	**1001.1**	0.2	**531,630**
MKE	General Mitchell Intl	48.45	16.2	11.5	456.0	1.0	229,049
MSN	Dane County Regional	47.45	15.7	11.2	122.2	6.9	94,834
MSP	Minneapolis-St. Paul Intl	46.63	10.3	8.4	1178.3	1.3	274,649
MSY	Louis Armstrong New Orleans Intl	69.37	18.7	12.2	298.5	0.4	159,362
OAK	Metropolitan Oakland Intl	57.65	22.9	17.0	402.6	0.2	324,655
OKC	Will Rogers World	60.23	22.2	15.7	206.8	1.6	119,005
OMA	Eppley Airfield	51.32	20.9	15.1	250.4	2.0	132,853
ONT	Ontario Intl	64.28	29.0	26.2	211.6	0.2	316,731
ORD	**Chicago O'Hare Intl**	**50.47**	**11.2**	**8.4**	**2394.9**	1.5	**257,655**
ORF	Norfolk Intl	60.65	28.5	14.3	205.7	2.2	240,746
PBI	Palm Beach Intl	75.29	13.9	10.3	312.4	1.1	262,326
PDK	Dekalb-Peachtree	62.53	8.9	5.9	172.5	6868.0	293,275
PDX	Portland Intl	54.27	21.3	16.8	558.2	0.3	316,661
PHL	Philadelphia Intl	56.06	14.4	13.5	1215.4	1.2	253,078
PHX	Phoenix Sky Harbor Intl	74.92	14.3	8.9	1229.8	0.3	333,915
PIT	Pittsburgh Intl	54.65	21.0	14.4	388.6	1.4	52,658
PNS	Pensacola Gulf Coast Regional	68.01	20.6	15.3	108.1	2.3	107,206
PSP	Palm Springs Intl	76.06	16.8	12.2	105.2	2.4	97,126
PVD	Theodore Francis Green State	51.49	24.2	15.6	174.1	1.0	184,465
PWM	Portland Intl Jetport	46.75	22.0	17.4	113.9	4.9	112,143
RDU	Raleigh-Durham Intl	59.83	17.2	13.1	463.6	1.7	92,617
RIC	Richmond Intl	58.26	22.9	18.6	224.2	2.9	64,993

Airport Identifier	Airport Name	Annual Average Daily Temperature (degrees F)	Original Percent of Operations During DNL Nighttime (%)	Revised/corrected Percent of Operations During DNL Nighttime (%)	2011 ETMS Average Daily Flight Operations	Ratio of Commuter/Small Flight Operations to Large Aircraft Flight Operations	Population Within 5 Miles of Airport
RNO	Reno/Tahoe Intl	53.57	15.0	9.8	171.8	0.5	201,855
ROC	Greater Rochester Intl	48.45	27.7	19.4	164.0	2.7	197,791
SAN	San Diego Intl	62.99	16.6	12.2	495.9	0.2	389,036
SAT	San Antonio Intl	69.03	20.1	14.0	399.9	0.8	268,037
SAV	**Savannah / Hilton Head Intl**	**65.90**	**15.0**	**11.5**	**156.5**	4.8	**29,087**
SBA	Santa Barbara Municipal	58.95	13.1	8.7	117.6	78.8	77,453
SDF	Louisville Intl-Standiford Field	57.81	48.7	39.3	403.3	0.6	235,856
SEA	Seattle-Tacoma Intl	52.12	19.2	15.9	854.9	0.1	189,518
SFO	San Francisco Intl	57.02	23.2	13.9	1090.4	0.3	191,527
SJC	**Norman Y. Mineta San Jose Intl**	**60.75**	**13.2**	**10.3**	**336.1**	0.5	**562,139**
SNA	John Wayne Airport-Orange County	63.96	10.2	3.4	337.1	0.4	540,237
STL	Lambert-St. Louis Intl	57.14	15.9	10.6	490.9	0.6	195,758
SYR	**Syracuse Hancock Intl**	**48.65**	**24.1**	**20.3**	**149.9**	3.5	**147,814**
TEB	Teterboro	53.99	11.7	9.4	397.7	2229.0	625,053
TPA	Tampa Intl	72.71	15.3	11.0	496.7	0.1	225,867
TUL	Tulsa Intl	60.89	21.0	13.2	196.6	1.8	103,273
TUS	**Tucson Intl**	**69.85**	**20.7**	**12.4**	**200.1**	1.6	**121,790**
TYS	McGhee Tyson	58.81	21.2	6.6	189.7	5.9	52,198
VNY	Van Nuys	65.68	14.8	10.1	125.7	87.8	712,651

C.2.1 Average Daily Temperature

One of the few airport variables that have been found to affect annoyance is climate, with warmer climates resulting in higher annoyance (Miller et al. 2014a). The divisions of 55 °F and 70 °F were selected to ensure all climate zones of the contiguous US would be sampled. These divisions guarantee the sample percentage of airports in each of the three average daily temperature ranges—below 55 °F, between 55 and 70 °F, and above 70 °F — matches the population percentage in that category.[2]

The average daily temperature data were provided by the FAA, and were based on 10-year annual averages.[3] Table C-3 gives the average daily temperatures for all 95 airports with the selected airports in bold. The description of the weather data used to determine the sampling frame is given in Table C-4. Figure C-1 graphs the average daily temperatures for each of the 95 airports, shows the factor division, and highlights the selected airports in black.

Table C-4. Weather Data Description

Item	Description	Field Type	Field Size	Units	Source	Comments
Mean Temperature	Mean annual temperature	real	7.2	Degrees Fahrenheit	NOAA (GSSD or 30-year normal)	In US; 30-year normal used for this value
Sea Level Pressure	Mean annual sea level pressure	real	8.2	Millibars	NOAA (GSSD)	
Station Pressure	Mean annual station pressure	real	8.2	Millibars	NOAA (GSSD)	
Dew Point	Mean annual dew point	real	7.2	Degrees Fahrenheit	NOAA (GSSD)	
Relative Humidity	Mean annual relative humidity	float	6.2	Percentage	NOAA (GSSD)	Calculated from dew point and temperature
Wind Speed	Mean annual wind speed	real	6.2	Knots	NOAA (GSSD)	
Average Temperature	Average annual temperature	real	7.2	Degrees Fahrenheit	NOAA (GSSD or 30-year normal)	In US; 10 year average used for this value

[2] Only two balancing factors are needed for this since when the percentages below 55 °F and the percentages above 70 °F match for the sample and population, the percentage between 55 and 70 °F must match as well.
[3] The weather data period was June 2012 through May 2013.

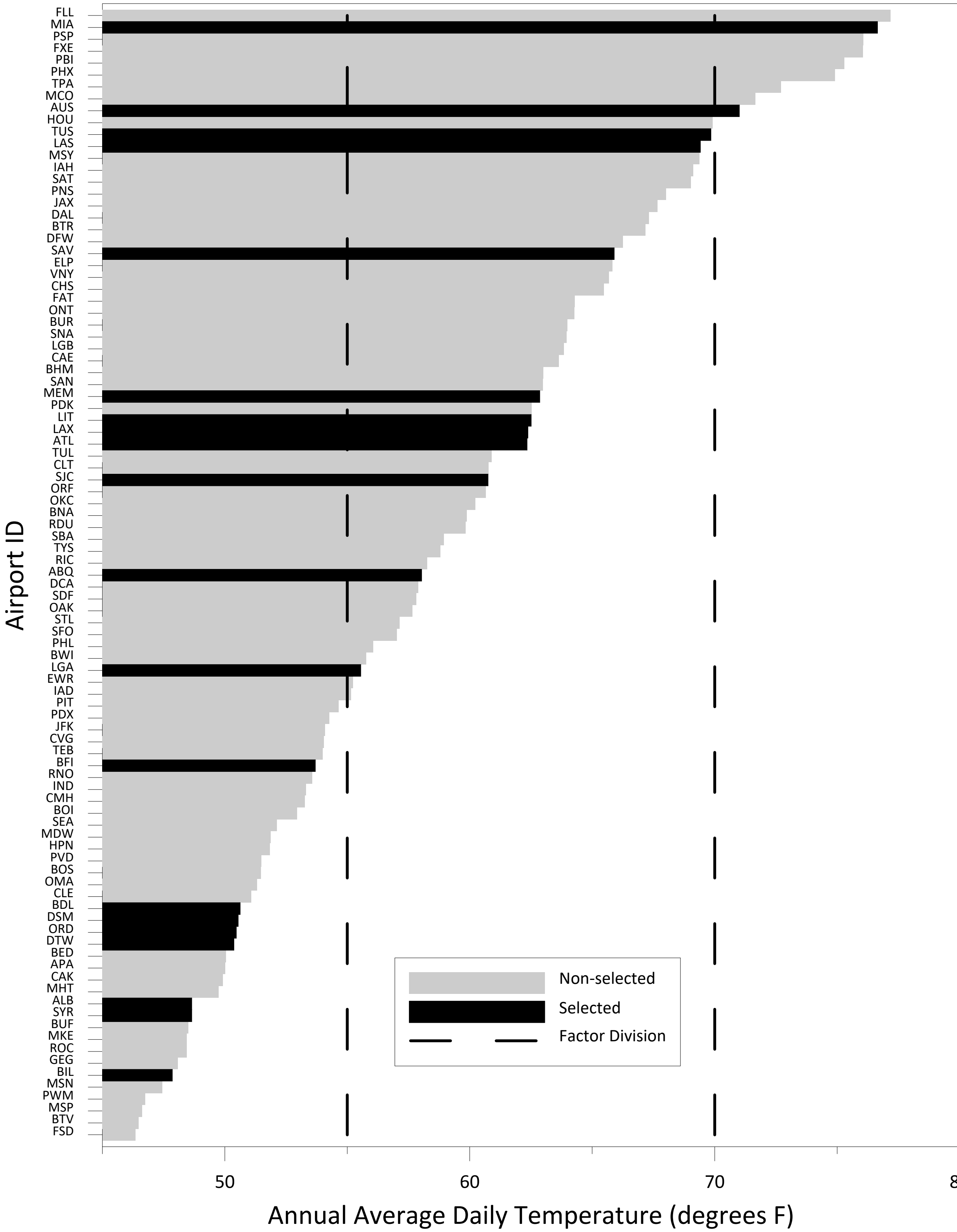

Figure C-1. Average Temperatures: All Airports with Selected Airports Identified

Factor Divisions are shown

C.2.2 Percentage of Nighttime Operations

It was hypothesized that a larger percent of operations during the DNL nighttime period (10 p.m. – 7 a.m.) might be associated with higher annoyance responses. For all airports in the sampling frame, annual operations were downloaded from FAA's Traffic Flow Management System Counts (TFMSC)[4] data for the period November 1, 2011 to October 31, 2012. This database provides operations counts by weight class, aircraft type, and arrival or departure time (by hour) and permits determination of nighttime operations. The original division used for this balancing factor was 20 percent of operations at night.

However, post-survey review showed that percentages were unrealistically high. The original analyses had misidentified aircraft flights with no arrival or departure hours given, marked as "N/A", were included in the nighttime operations counts. The revised analyses ignored all "N/A" flights and recomputed the nighttime percentages. Both values are given in Table C-3. Figure C-2 graphs the original values, shows the factor division, and identifies the selected airports in black. Figure C-3 graphs the revised values, the median used as the division, and the twenty selected airports. The desired goal for number of airports greater than the balancing factor of 20 percent (median value rounded up) was 8 airports. As shown in Figure C-2 (original analysis) and Figure C-3 (revised analysis), both distributions of the 20 selected airports meet this goal.

This error in the original calculations does not affect the representativeness of the sample – balanced sampling guarantees that the sample is representative on any factors used in the design – and in fact, the sample closely matches the population distribution for the corrected values of percentage nighttime operations. The population distribution of percentage nighttime operations has 25th, 50th, and 75th percentiles of 9.8 percent, 12.8 percent, and 15.8 percent, respectively; the corresponding percentiles for the sample are 9.93 percent, 12.6 percent, and 17.0 percent.

[4] TFMSC is the system / website that may be accessed for the counts. The Traffic Flow Management System (TFMS) is a data exchange system for supporting the management and monitoring of national air traffic flow. TFMS processes all available data sources such as flight plan messages, flight plan amendment messages, and departure and arrival messages. The FAA's airspace lab assembles TFMS flight messages into one record per flight. TFMS is restricted to the subset of flights that fly under Instrument Flight Rules (IFR) and are captured by the FAA's enroute computers. Most Visual Flight Rules (VFR) and some non-enroute IFR traffic is excluded.

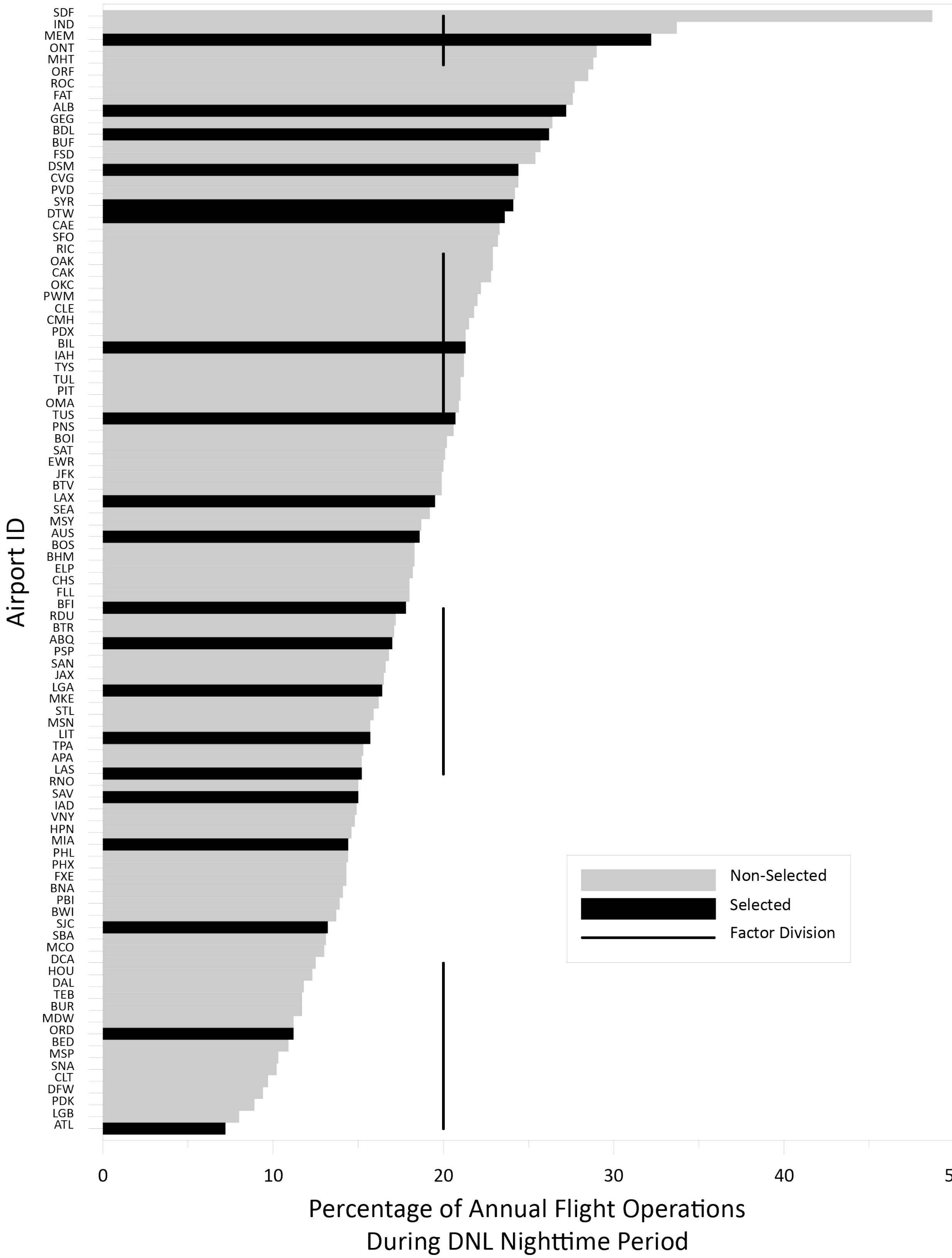

Figure C-2. Average Nighttime Operations Original Percent: All Airports with Selected Airports Identified
Factor Division Shown

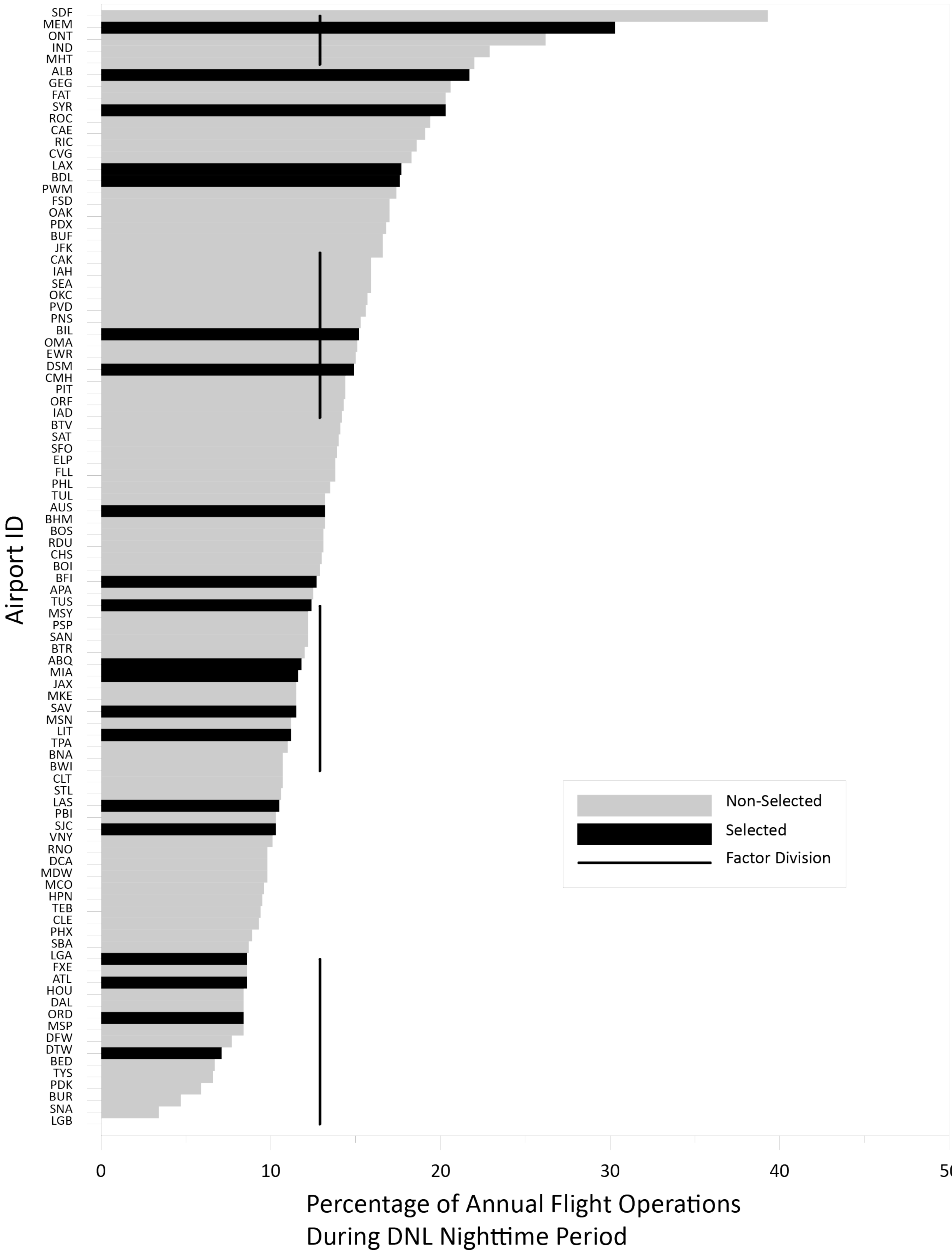

Figure C-3. Average Nighttime Operations Revised Percent: All Airports with Selected Airports Identified

Factor Division Shown (median)

C.2.3 Average Daily Flight Operations

Because the primary objective of the survey is to develop a nationally applicable relationship between annoyance and noise exposure, the sample should represent the smaller, less busy airports as well as the larger, busier ones. Thus, one of the balancing factors was number of average daily flight operations, which help ensure the sample can be used to study differences that might be due to having a large number of operations. The approximate median for all 95 airports (300 average daily flight operations) was chosen as the determinant of the sample division between “large” and “small” airports.

Annual operations for all sampling frame airports were derived from the 2011 Enhanced Traffic Management System (ETMS) data provided by the FAA’s Office of Environment and Energy (AEE). Table C-3 lists operations for all ninety-five airports with the twenty sample airports highlighted in bold. Figure C-4 graphs the operations for each of the 95 airports and shows the factor division. The 20 selected airports are shown in black.

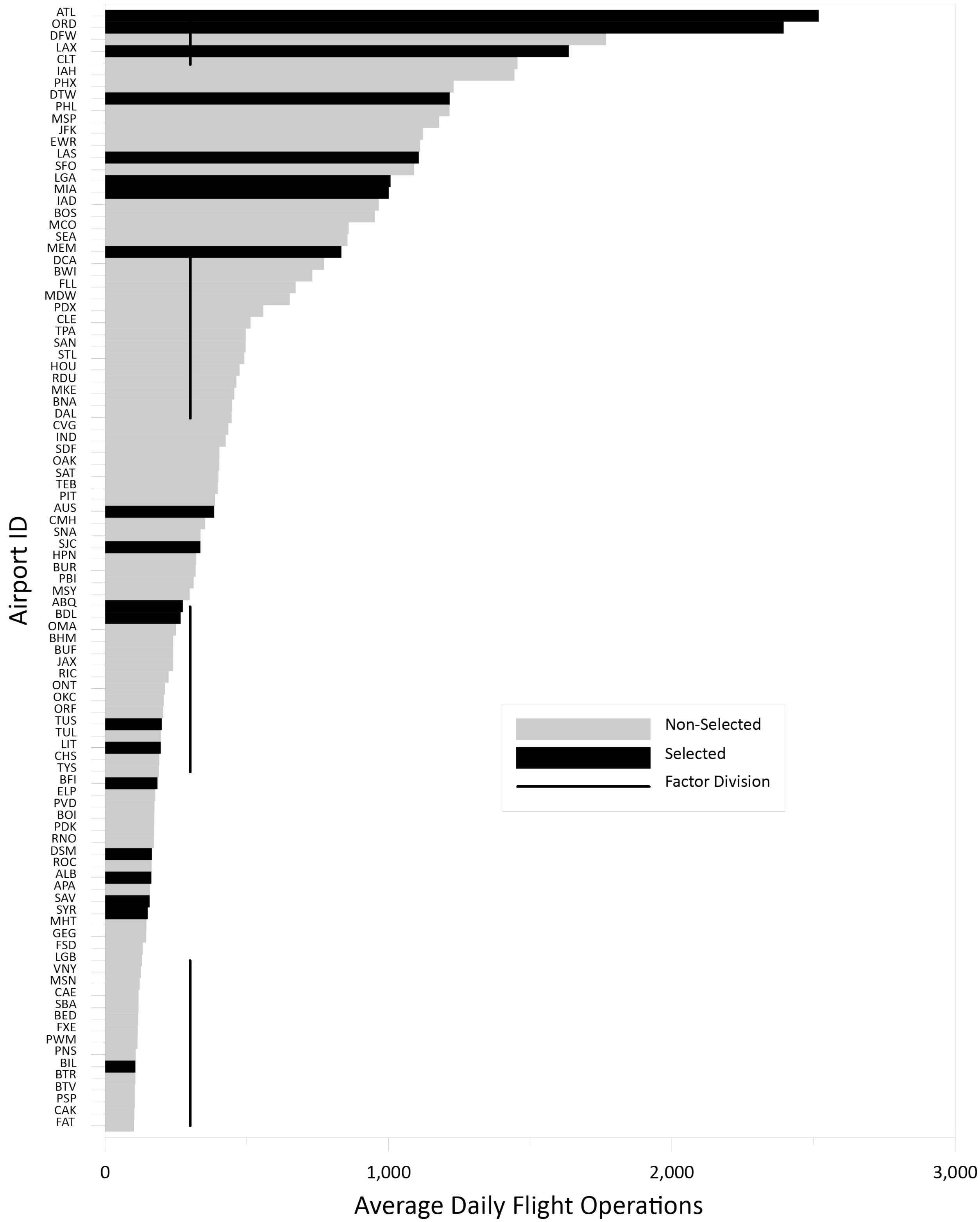

Figure C-4. Average Daily Operations: All Airports with Selected Airports Identified

Factor Division Shown

C.2.4 Fleet Mix Ratio

It is possible that for a given noise exposure, annoyance reactions may be different depending on fleet mix. Smaller, lighter aircraft generally tend to be somewhat quieter than larger heavier aircraft. Consequently, greater numbers of overflights of the smaller aircraft would be required to produce a cumulative noise exposure equivalent to that produced by a lesser number of large aircraft. The balancing factor of fleet mix ratio ensures the sample can be used to study differences that might be due to having different fleet mix ratios.

TFMSC data in the "city pair" view and "weight class" grouping identify the weight class for every flight, the arrival and departure times, as well as other data. The classes are:

- **A** Heavy: Any aircraft weighing more than 255,000 pounds, such as the Boeing 747 or Airbus A340;
- **B** B757: Boeing 757 all series;
- **C** Large Jet: Large jet aircraft weighing more than 41,000 pounds and up to 255,000 pounds, such as the Boeing 737 or Airbus A320;
- **D** Large Commuter: Large non-jet aircraft (such as the Aerospatiale/Alenia ATR-42 and the Saab SF 340), and small regional jets (such as the Bombardier Canadair Regional Jet), weighing more than 41,000 pounds and up to 255,000 pounds;
- **E** Medium: Small commuter aircraft including business jets weighing more than 12,500 pounds and up to 41,000 pounds, such as the Embraer 120 or the Learjet 35; and
- **F** Small: Small, single, or twin engine aircraft weighing 12,500 pounds or less, such as the Beech 90 or the Cessna Caravan.

An additional class, "Unknown", refers to unspecified equipment.

TFMSC data were analyzed using Sound Exposure Level (SEL) values from the FAA's Integrated Noise Model (INM) aircraft noise database to estimate the best grouping into "large" and "commuter / small" aircraft on the basis of sound level produced on the ground. The resulting large aircraft group included the above mentioned classes (A) through (C), and the commuter/light aircraft group included classes (D) through (F) and the "unknown" category. In terms of energy average SEL for the fleets of the 95 airports, the difference between large and commuter/small in total sound produced was about 7 dB. An equal sound energy division of 5 times as many light as heavy aircraft operations for this factor was initially considered. However, such a division would over-represent the airports with many light aircraft. A ratio of commuter/light (classes D through F) to large (classes A through C) of 1 was selected by FAA as the dividing value.

Table C-3 gives the flight mix ratios for all 95 airports with the sample twenty airports in bold. Figure C-5 graphs the fleet mix ratios for each of the 95 airports, shows the factor division, and highlights the selected airports in black.

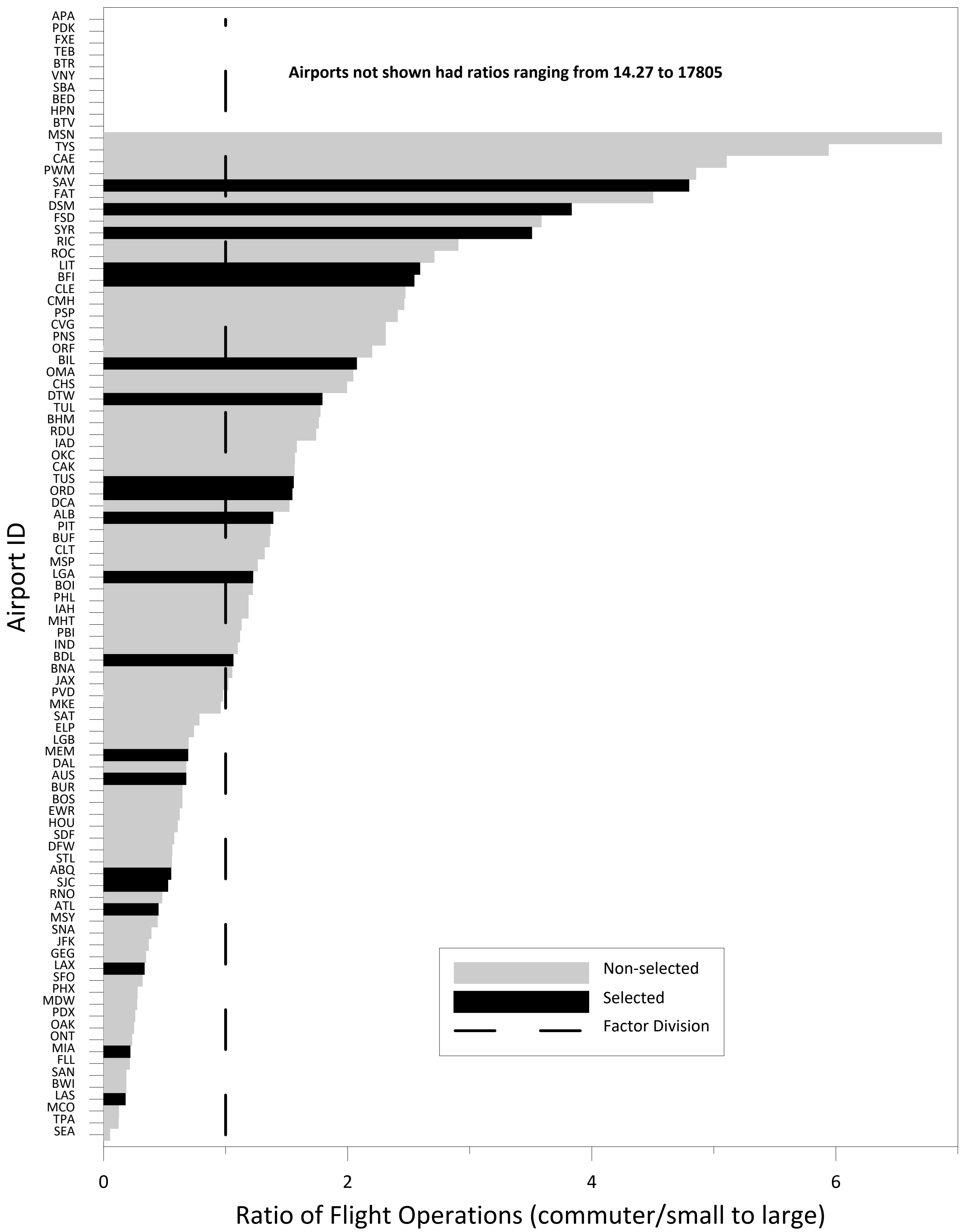

Figure C-5. Fleet Mix Ratios: All Airports with the Selected Airports Identified

Factor Division is Shown

C.2.5 Population within Five Miles of Airport

It was also hypothesized that the population density around an airport could bear some relationship to aircraft noise annoyance. Population density has been a surrogate for local ambient (non-aircraft, non-major nearby highway) noise levels (Schomer et al. 2011). The local noise could distract from or increase awareness of aircraft noise, though clear evidence is lacking (Miller et al. 2014a). Fidell (1978) suggested that population density may be associated with lifestyles, and that apartment dwellers in high density areas may have different opinions than suburban residents. At least one study suggests the more important population effect is whether people do or do not perceive the area to be overpopulated (Verbrugge and Taylor 1980).

Population within the area defined by a five (5) mile radius of each airport's reference point was determined, used as an indicator of population density, and a mean of approximately 230,000 residents per 78.5 sq. mi.[5] was used to divide the sample.[6] US census tract data from 2010 and airport location were used to compute populations within 5 miles of the airport. Table C-3 gives the populations for all 95 airports with the selected sample in bold. Figure C-6 graphs the population values for each of the 95 airports, shows the factor division, and highlights the selected airports in black.

[5] The area, in square miles, contained within a five-mile radius.
[6] The true average is 231,707, but 230,000 was selected for simplicity and does not alter the dividing point insofar as the 95 airports are concerned.

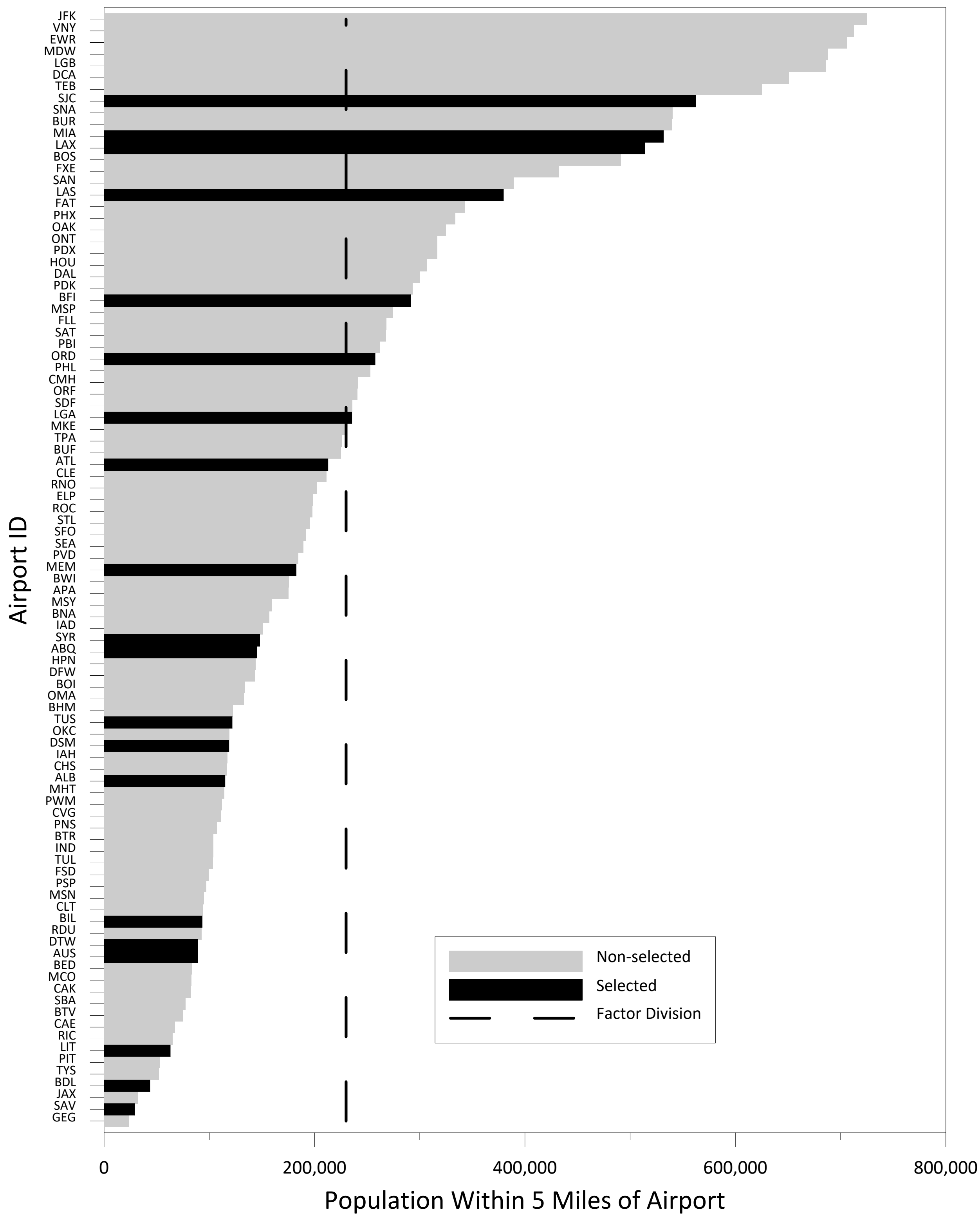

Figure C-6. Populations within 5 Miles: All Airports with Selected Airports Identified Factor Division Shown

C.2.6 Overview of the Balancing Factors and the Selected Airports

Figure C-7 gives scatterplots of the sampled airports with respect to the nongeographic factors used in balancing. Each plot in the figure is a scatterplot of the x and y variables given by the column name and row name, respectively.

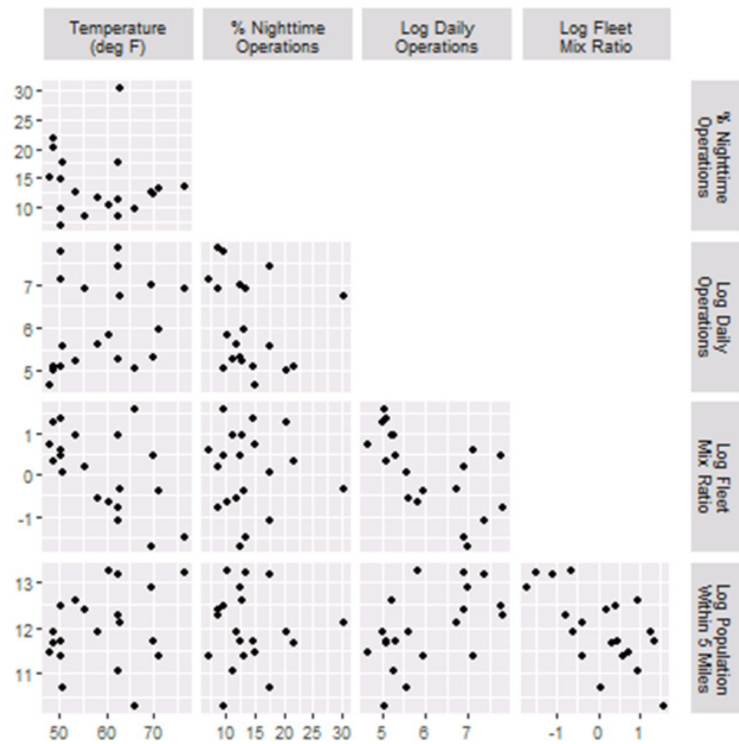

Figure C-7. Scatterplot Matrix of Balancing Factors, for the Selected Sample

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Appendix D Analysis of Telephone Survey Data

This appendix contains seven subsections. Section D.1 serves as an Introduction and high-level summary of the appendix. Sections D.2 through D.4 contain the details of the three initial exploratory analyses of the telephone survey data. Sections D.5 and D.6 present technical details supporting the aforementioned analysis sections. Section D.7 lists some general caveats and cautions about the telephone survey and conclusions drawn from it.

D.1 Introduction and Summary

As described in Section 2, two survey instruments were administered to adult residents within the NES: a mail questionnaire and, for those who responded to that, a follow-up telephone interview. The mail survey forms the basis of the dose-response relationship of aircraft noise and annoyance. The broader telephone survey was designed to obtain further information about attitudes towards airports and airport policies, to explore the potential cause of the annoyance to aircraft noise and examine why some people are highly annoyed by aircraft noise at a particular noise exposure while others at the same noise exposure are not. The telephone interview (see Appendix B for the survey instrument) asked detailed questions on a number of areas including respondents' opinions on noise, exposure to aircraft noise, relationship to the airport, concerns about aircraft operations, views on airport community relations, among others. The phone survey data was not used to calculate the dose-response curve as all responding households were already represented in the mail survey.

In this appendix, we present the results of *initial* analyses conducted on the telephone survey data. From the wide range of topics covered in the telephone questionnaire, the scope of the analysis was designed to provide a thorough, but not necessarily exhaustive, review of the information. Future research on this data may provide additional insights. The following three exploratory analyses were conducted:

1) Comparison with mail survey results in Section D.2,

2) Exploratory factor analysis (EFA) in Section D.3, and

3) Characteristics of highly and not-highly annoyed respondents in Section D.4.

The results are summarized below.

Comparison of telephone dose-response curve to the mail survey results. The dose-response curve generated from the telephone survey indicates less highly annoyed responses versus the mail survey. Three hypotheses were suggested to explain the difference in reported percent highly annoyed across survey modes. The best explanation was that of social desirability bias of the telephone survey, i.e., people responded differently when the survey was interviewer-administered (telephone) versus self-administered (mail).

Exploratory factor analysis (EFA). EFA is a statistical technique to find one or more groups of variables, called "factors", which summarize complex inter-relationships of observed variables. For the telephone survey, an EFA was conducted to better understand the relationship of the answers given by the respondents to their annoyance from aircraft noise, as captured by the survey's focus question: "Thinking about the last 12 months or so, when you are here at home, how much does [noise from aircraft] bother, disturb or annoy you?" The EFA identified seven factors (see Table D-8). Interpreting the top-ranked factor, Factor 7, as an example, people's degree of being highly annoyed by aircraft noise correlated to their degree of being startled, frightened and/or awakened by aircraft noise.

Twenty-two questions had weak connections with other questions in the survey and could not be grouped into factors, but when comparing their overall strengths of association with the survey's focus question to the Factors' strengths, five of the 7 factors, i.e., Factors 7, 3, 4, 2 and 1, ranked higher than these 22 questions. As shown in Table D-9, Factors 5 and 6 were outranked by three of the ungrouped questions in terms of their importance to aircraft noise annoyance.

The strength of association with the survey's focus question was also examined across four DNL stratum, for each of the factors and remaining questions. Factors 3 and 7 were consistently ranked first or second across all of the DNL strata. That is, the correlation of aircraft noise annoyance with being startled/frightened/awakened and their general traffic noise/smells rating were stronger than all other factors/questions, regardless of DNL.

Characteristics of highly and not-highly annoyed respondents. Another type of statistical analysis, called a Classification and Regression Tree (CART) analysis, was undertaken to identify characteristics of highly and not-highly annoyed respondents in the four DNL strata listed above. In all DNL strata, the most important characteristic for predicting highly annoyed respondents is being startled, frightened, or awakened by aircraft noise. The next most important characteristic for predicting highly annoyed respondents is the belief that the airport is not working collaboratively with them, however, this was limited to the 50-55 dB DNL and 60-65 dB DNL strata.

D.2 Comparison of Dose-Response Curves

Section D.2.1 compares characteristics of the mail and telephone respondents. Although the primary result of the mail survey was the national dose-response curve, a dose-response curve from the telephone survey was generated to examine potential survey mode differences in reported annoyance, and is discussed and shown in Section D.2.2. Section D.2.3 offers hypotheses for the differences in annoyance between the two survey modes.

D.2.1 Respondents

NES mail survey respondents were invited to participate in a follow-up telephone survey. As such, the telephone surveys represent a subset of households responding to the mail survey. Of the 10,328 households responding to the mail survey, 2,328 (23 percent) also responded to the telephone survey.

The telephone interview typically occurred from a couple weeks up to a few months after the mail survey was received. The average number of days between the two was 40 (median = 36) with a range from 11 to 229 days. The "next birthday" method (see Sections 4.3 and 4.4) of respondent selection was utilized for both the mail and telephone surveys. The telephone and mail respondents may not have been the same person for a number of reasons, such as:

- In households with more than one adult, a birthday may have occurred between surveys,
- Respondents may not have followed selection instructions of either survey,
- Respondents may have provided a different birth month and year across surveys, or
- The occupancy of a household/address may have changed between surveys.

Answers to month and year of birth variables from the mail and phone surveys were compared. Based on this comparison, approximately half the households with responses to the mail and phone surveys were answered by a different person within the household.

Month and year of birth were missing for either the telephone or mail survey for 136 of the 2,328 (6 percent) telephone respondents. Of those that provided a response for both the mail and telephone surveys, 1,050 (50 percent) provided the same month and year of birth for both surveys. Given the time between surveys we would expect some difference in respondents across surveys, but without further analysis the exact percentages are unknown.

To consider any differences in the distribution of mail and phone survey respondents across the range of aircraft noise exposures, Table D-1 presents a comparison stratified by DNL intervals of 5 dB. The percentages are nearly identical except for one percent differences in the lowest and highest strata. A chi-square test[7] was performed and verified that no statistically significant difference between the two distributions occurred.

[7] The chi-square test yielded a p-value of 0.1096

Table D-1. Percentages of Mail and Telephone Respondents by DNL Stratum

DNL Stratum (dB)	Percent of Mail Respondents	Percent of Telephone Respondents
50-55	35%	36%
55-60	33%	33%
60-65	20%	20%
65-70	9%	9%
70+	3%	2%
Total	**100%**	**100%**

D.2.2 Dose-Response Curves

For comparative purposes, a dose-response curve from the telephone survey was generated in a manner identical to the national dose-response curve from the mail survey[8], as described in Chapter 8. Unlike the national dose-response curve, the telephone survey-derived curve could not be generated for each individual airport due to the telephone survey's small sample size.

The respondent's answers to the telephone survey's question 1e[9] were fit to the same logistic regression model shown in Equation 8.1. Question 1e was given the variable name of PALAC. Table D-2 provides the model's coefficients, their standard errors and 95 percent confidence intervals for the telephone survey dose-response curve. These are analogous the curve parameters shown in Table 8-2 for the national curve.

Table D-2. Model Coefficients for the Dose-response Curve Derived from the Telephone Survey

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-7.5620	0.7649	-9.1630	-5.9610
Slope, β_1	0.1172	0.0132	0.0897	0.1448

Comparable to the results of the national dose-response curve shown in Table 8-3, Table D-3 presents the predicted percent HA from the model for DNL between 50 and 70 dB from the phone survey question 1e.

[8] The national dose-response curve is based on data from the mail survey only.

[9] The question was "Thinking about the last 12 months or so, when you are here at home, how much does *noise from aircraft* bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?"

Table D-3. Predicted Percent HA at Selected Noise Exposures, from Telephone Survey Dose-response Curve

DNL Value (dB)	Predicted Percent HA	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
50	15.4	1.9	11.9	19.7
51	17.0	1.9	13.5	21.3
52	18.8	1.9	15.1	23.1
53	20.6	1.9	16.9	24.9
54	22.6	2.0	18.8	26.9
55	24.7	2.0	20.8	29.1
56	27.0	2.0	22.9	31.4
57	29.3	2.1	25.1	33.9
58	31.8	2.2	27.4	36.6
59	34.4	2.3	29.7	39.4
60	37.1	2.5	32.1	42.4
61	39.9	2.7	34.5	45.5
62	42.7	2.9	36.9	48.8
63	45.6	3.1	39.3	52.1
64	48.5	3.3	41.7	55.4
65	51.5	3.5	44.1	58.7
66	54.4	3.7	46.5	62.0
67	57.3	3.9	48.9	65.2
68	60.1	4.1	51.3	68.3
69	62.9	4.2	53.7	71.2
70	65.6	4.3	56.0	74.0

Figure D-1 compares the national dose-response curve of Figure 8-2 (shown in black lines), which was based on 10,328 (mail) respondents, to the curve generated by the parameters in Table D-2 (shown in red lines), which was based on 2,328 (telephone) respondents. Each curve models the percent indicating a highly annoyed response as a function of DNL. Identical to the mail survey's Question 5e, the telephone respondent was given choices of "not at all," "slightly," "moderately," "very," or "extremely" to the telephone survey's Question 1e. A respondent was identified to be 'highly annoyed' if they answered either of the latter two choices (very or extremely). The dashed lines represent the confidence interval surrounding the curves.

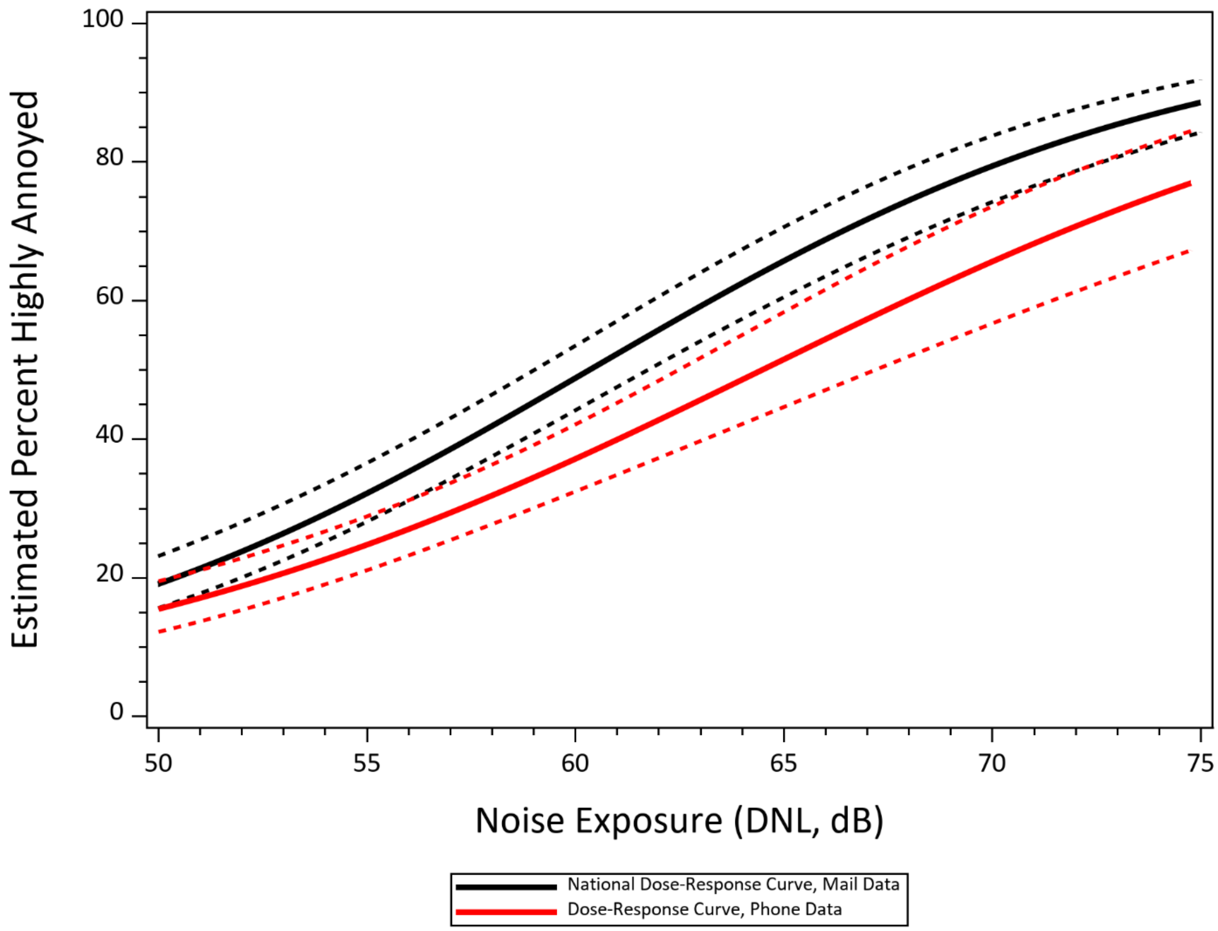

Figure D-1. Comparison of National Dose-response Curve (black lines) to Telephone Survey-derived Dose-response Curve (red lines), with 95 Percent Confidence Intervals on Annoyance for a given DNL (dashed lines)

Figure D-2 shows the curves of Figure D-1 with curves generated from subsets of respondents from both surveys. The blue curve represents the annoyance response to the mail survey, but limited to the households who also responded to the telephone survey (n=2,328). The green curve represents the annoyance response to the telephone survey, but for a subset of households where the same of respondent is thought to have answered both the mail and phone surveys -- as described in Section D.2.1 (n=1,050).

From Figure D-2, it is clear that there is very little difference in the annoyance reported in the mail survey between households who responded to the telephone survey versus all mail respondents (blue and black lines). However, there is a difference in annoyance levels reported in the telephone survey versus the mail survey (red and black lines). The reported telephone survey-derived annoyance level is generally lower than the reported mail annoyance level. Further, when we limit the phone data to those respondents we suspect are the same across modes, we see that they exhibit a similar dose-response to all phone respondents (green and red lines).

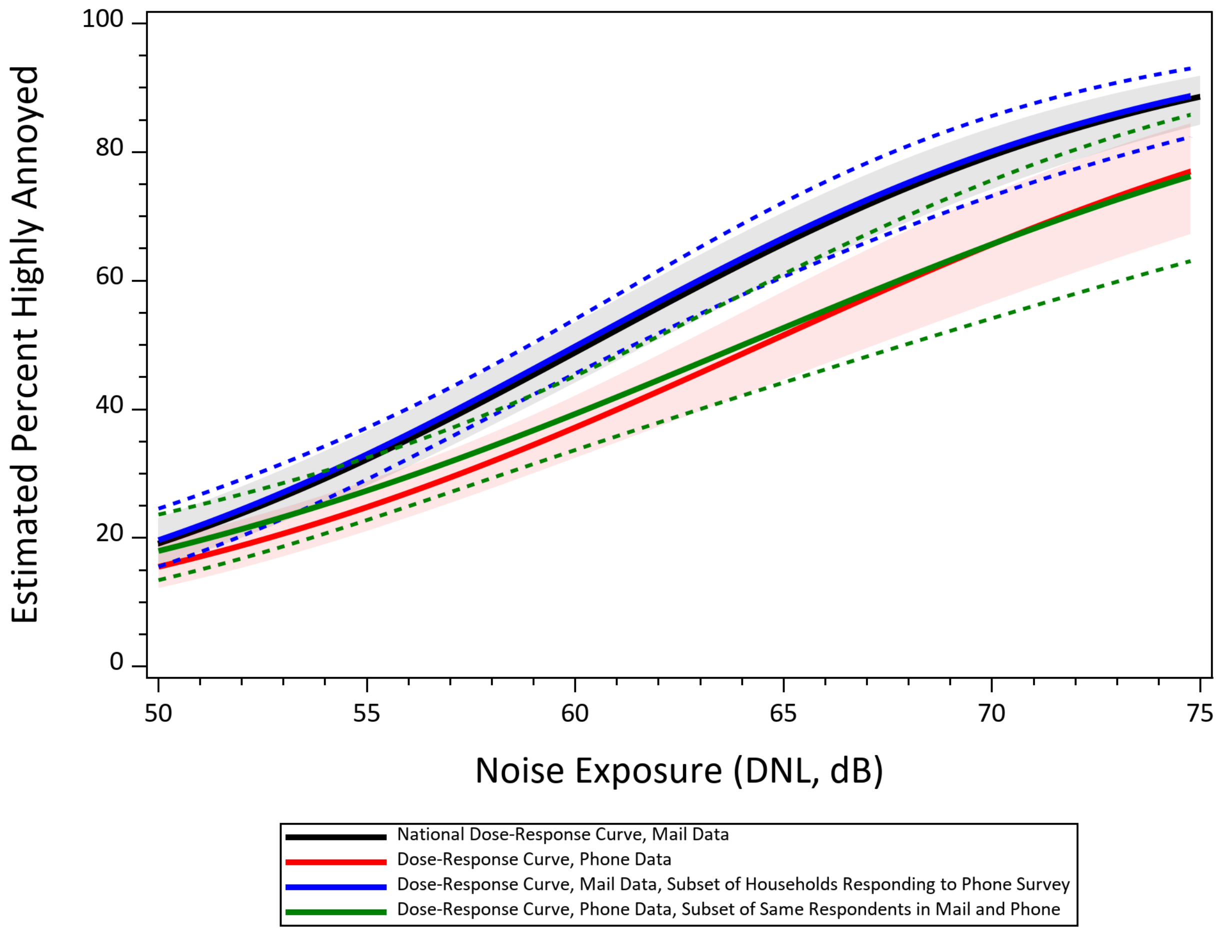

Figure D-2. Reported Annoyance as a Function of DNL for Mail and Telephone Respondents, with 95 Percent Confidence Intervals on Annoyance for a given DNL (dashed lines and shaded areas)

Table D-4 provides a cross tabulation of highly annoyed responses for the mail and telephone surveys for the telephone respondents. Nearly 78 percent (1,810) of respondents provided the same level of annoyance in both surveys (shown in bold).

Table D-4. Highly Annoyed Responses for Mail and Telephone Surveys for Telephone Respondents

Mail response	Telephone response	
	Not highly annoyed	Highly annoyed
Not highly annoyed	**1207 (52%)**	147 (6%)
Highly annoyed	371 (16%)	**603 (26%)**

Table D-5 is set-up identically to Table D-4 except the analysis was restricted to those in which it appears the same person (based on birth date) responded to both the mail and telephone surveys. In this subset, 836 (79 percent) of respondents provided the same level of annoyance in both surveys. We find that even for those respondents who we believe are the same for both surveys, the response to the survey was different between the two modes for more than 20 percent of respondents. This is essentially the same result as when looking at all telephone respondents. A paired t-test, comparing the mail response to the telephone response for those that responded to both surveys, yielded a p-value of less than 0.001, indicating a significant difference between the two responses.

Table D-5. Highly Annoyed Responses for Mail and Telephone Surveys where Telephone Respondent appears to be the Same as the Mail Respondent

Mail response	Telephone response	
	Not highly annoyed	Highly annoyed
Not highly annoyed	**550 (52%)**	76 (7%)
Highly annoyed	138 (13%)	**286 (27%)**

Table D-6 shows the inverse of Table D-5, i.e., it shows the annoyance responses across surveys in households where the respondent may be different, based on birth month and year, between the mail and telephone surveys. Here again, we see a similar trend in that the annoyance reported in the telephone survey trends lower on average. In this subset, 974 (76 percent) of respondents provided the same level of annoyance in both surveys. Where they differed, they were more likely to report lower annoyance in the telephone survey.

Table D-6. Highly Annoyed Responses for Mail and Telephone Surveys where Telephone Respondent appears to be Different than the Mail Respondent

Mail response	Telephone response	
	Not highly annoyed	Highly annoyed
Not highly annoyed	**657 (51%)**	71 (6%)
Highly annoyed	233 (18%)	**317 (25%)**

D.2.3 Hypotheses Explaining the Differences in Annoyance between Surveys

Keeping in mind that the majority of respondents did not change their annoyance report, there are several possible explanations for the difference in responses by mail and telephone among those who did change. We offer the following three hypotheses to explain the difference:

1. Respondents did not follow the random selection protocol (adult with next birthday) for the mail survey and instead the most annoyed respondent participated, whereas the telephone survey had higher adherence to the random selection protocol.

2. The telephone survey was impacted by non-response bias, whereas the more highly annoyed respondents were less inclined to participate.
3. Telephone respondents were exhibiting social desirability bias, whereby they reported lower levels of annoyance during the interviewer-administered questionnaire.

Each hypothesis is described below.

Hypothesis 1 – self-selection bias. This hypothesis supposes the more highly annoyed respondents self-selected into mail versus phone survey. The ACRP 02-35 study (Miller et al. 2014a) had an 86 percent adherence rate to its selection protocol, which is a better rate than in other studies (Lind, Link, and Oldendick 2000; Olson, Stange, and Smyth 2014). While the adherence rate was not calculated for the NES, it is not expected to explain the dose-response differences, because as indicated in Tables D-4 through D-6, percent highly annoyed tended to be higher for the mail survey; regardless of who in the household responded to the two survey modes.

Hypothesis 2 – non-response bias on the phone survey. The second hypothesis presumes that the more highly annoyed respondents in the mail survey did not participate in the phone survey. The curves presented in Figure D-2 do not support this hypothesis. When controlled for households that responded to the phone survey, we see that the mail-reported annoyance (blue line) is essentially the same as the full sample of mail respondents (which includes the approximately 75 percent of households who did not participate in the telephone survey).

Hypothesis 3 – *social desirability bias*. The third hypothesis presumes there is a mode effect, i.e., people respond differently when the survey was interviewer-administered (telephone) versus self-administered (mail). In other words, we may have observed what is termed a social desirability bias between the two modes (de Leeuw 2005; Kreuter et al. 2008). If this is the case, on average, respondents may have been less willing to report being highly annoyed during the interviewer-administered survey (telephone) than in the more anonymous self-administered mode (mail survey). The reason for this response is to sound more agreeable or exhibit more socially acceptable/desirable behavior. The mode effect between mail and telephone responses was explored in Chapter 8 of the ACRP 02-35 study and the results were inconclusive due to small sample sizes.

To further explore this concept in the NES data, Figure D-3 compares the average reported annoyance level on all items[10] in the survey across mail and telephone modes. The average annoyance level reported in the telephone surveys are the same or lower for all items, except for the two items titled “Other Noises” and “Other Problems.” Further, as evidenced in Figure D-2 above, when controlling for the same respondents across modes (green line), the phone percent highly annoyed is similar to the percent highly annoyed of all phone respondents (red line).

[10] These are parts ‘a’ through ‘m’ of the mail questionnaire’s question 5 and the telephone interview’s question 1. The questions were “Thinking about the last 12 months or so, when you are here at home, how much does *insert text from a-m* bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?”

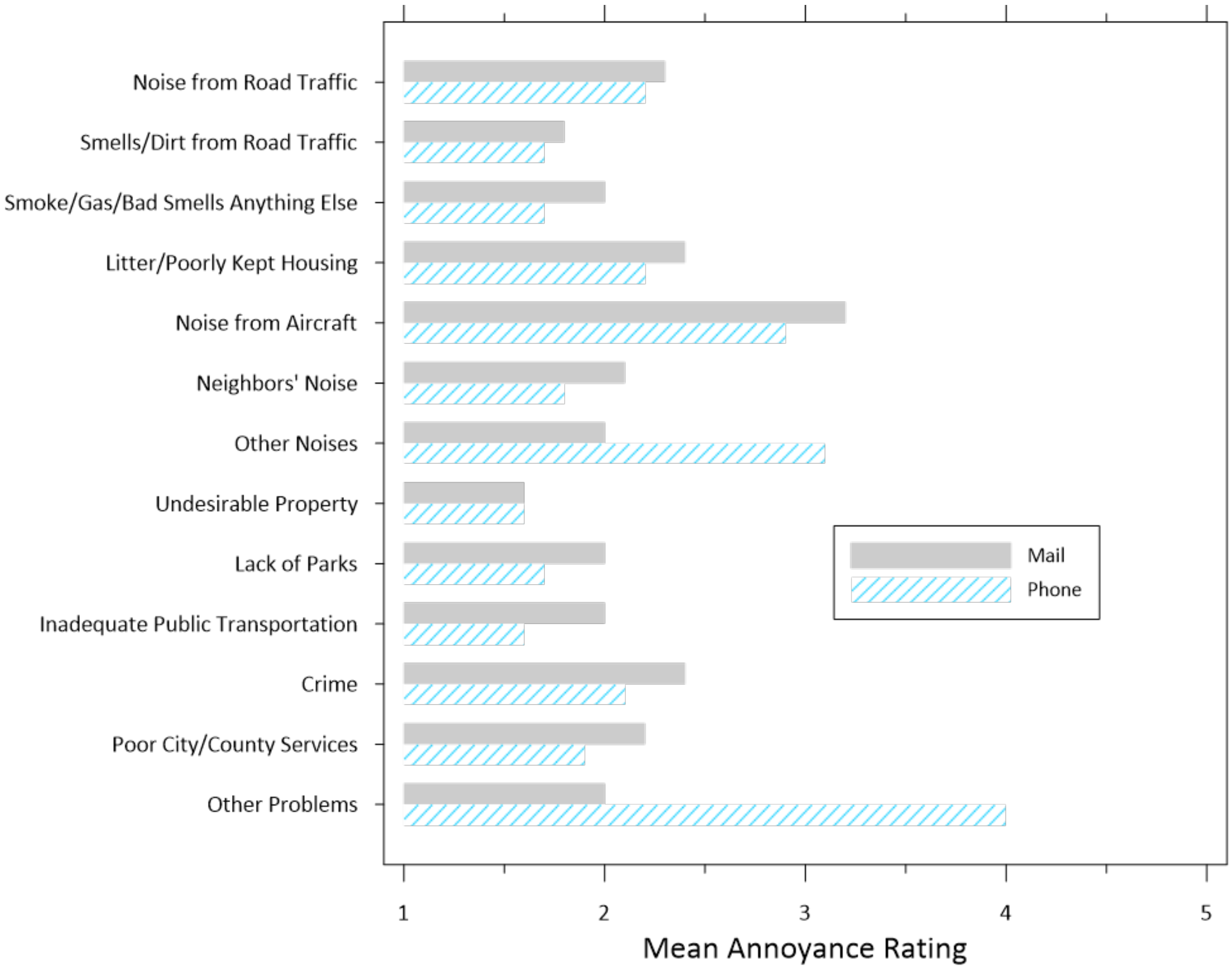

Figure D-3. Average Annoyance Reported on Mail and Telephone Surveys by Item

In conclusion, with the available evidence, the third hypothesis (social desirability) seems to be the best explanation for the difference in reported percent highly annoyed across survey modes. Given what is known about survey mode effects, we suggest the mail response was closer to the “truth” than the phone response because the respondents would have been less inclined to temper their responses in the self-administered mail survey. In addition, the mail survey obtains significantly higher response rates, thus capturing the percent highly annoyed from a larger set of the population.

D.3 Exploratory Factor Analysis

In order to better understand the relationship of the answers given by the respondents to their annoyance from aircraft noise in PALAC, an Exploratory Factor Analysis (EFA) was conducted.[11] In addition to the summary provided here, Section D.5 provides further technical details on EFA, including how the factors were developed.

Due to the potential non-response bias and because these analyses are based on unweighted data, caution should be used before utilizing these data to inform any potential actions. The phone survey findings should therefore be viewed as exploratory topics, which may provide direction for further research.

The telephone survey's questions resulted in 87 analytic variables[12], the focus of which was the variable PALAC (Question 1e). Of the remaining 86 variables, the 17 variables listed in Table D-7 were excluded from the EFA because of one of the following reasons:

1. Less than 50 percent of the respondents provided an answer
2. Exploring latent structures that represent demographic information is not desirable and any factor(s) identified would be hard to interpret
3. Their correlations to aircraft noise annoyance are highly similar to PALAC

The objective of an EFA is to find one or more groups of variables, called "factors", which summarize complex inter-relationships of observed variables. The EFA of the survey's 69 applicable variables (from 54 questions) resulted in the grouping of 32 variables into seven (7) factors, shown in Table D-8. To evaluate the importance of factor to the outcome of interest, i.e., to rank the factors, a set of multinomial logistic regression models[13] was run with PALAC as the outcome and each factor score as the predictor. The "pseudo R-square" value was output to reflect the amount of information gain after adding the predictor, compared to the model without any predictor. It is called *pseudo* because it does not reflect the amount of variance explained by the predictor as in a linear regression model.[14] However, similar to the regular R-square index, the larger the value of pseudo R-square, the stronger the relationship between PALAC and the extracted factor.

Table D-8 lists the pseudo R-square values for each Factor. Factor 7 (Startle, Frighten or Awaken) had the largest pseudo R-square value meaning it had the strongest association with the PALAC rating, followed by Factor 3 (General traffic noise/smells rating) then Factor 4 (Safety concerns).

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[11] Using the SAS procedure called PROC FACTOR

[12] To facilitate interpretation of EFA estimates, questions with nominal options (e.g., categories that do not have a natural order such as male/female) need to be dummy-coded. The number of dummy variables is one less than the valid response levels, where one level is chosen as a reference group to avoid redundant information. The result is that we end up with more analytic variables for the EFA than numbered survey questions. Further, some question numbers comprise multiple questions, such as the annoyance questions in Q1 (e.g., 1a, 1b, 1c, etc.).

[13] Using PROC LOGISTIC in SAS

[14] Pseudo R-square is an analog of the usual R-square in multiple linear regression.

Table D-7. Variables Excluded from the EFA

Reason for Excluding from EFA	Variable Name	Telephone Survey Question No.	Telephone Survey Question
Less than 50% of respondents provided an answer (primarily due to skip patterns)	PALOtherNse	1gOS	{T12H}, how much does <OTHER NOISE> bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
	PALOthProb	1mOS	{T12H}, how much does <OTHER PROBLEM> bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
	PHearAC	6	Have you ever **heard the sound from an aircraft** when you were here at home? (y/n)
	PALACWake	8a	{T12H}, have the aircraft bothered, disturbed or annoyed you **by waking you up or keeping you awake at night**? Would you say extremely, very, moderately slightly, or not at all?
	PALACStartle	8b	{T12H}, have the aircraft bothered, disturbed or annoyed you **by startling or surprising you**? Would you say extremely, very, moderately slightly, or not at all?
	PALACFrighten	8c	{T12H}, have the aircraft bothered, disturbed or annoyed you **by frightening you**? Would you say extremely, very, moderately slightly, or not at all?
	PNumApts	9a	Approximately, how many apartments are there in your building?
	PALACGrd	17	{T12H}, how much have the **aircraft sitting on the ground or moving around on the ground** on the airport property bothered, disturbed or annoyed you: extremely, very, moderately, slightly, or not at all?
	PContactAP	26a	Was the **airport contacted** directly? (y/n)
Undesirable latency/Difficult Interpretation	PAgeCat	45	In what month and year were you born?
	PHighestEd	46	What is the **highest level of school** you have completed or the highest degree you have received?
	PGender	47	[ASKED IF INTERVIEWER WAS NOT SURE] Are you male or female?
	PHispanic	48	Are you Spanish, Hispanic, or Latino?
	PRaceEthnicity	49	What **race or races** do you consider yourself to be? [GIVEN A LIST and asked to SELECT ALL THAT APPLY.]
	PHHIncome	50	What is the approximate **total income** from everyone in this household including such things as wages, salary, interest, pensions, or government payments? Would you say [READ RESPONSES]: [IF THEY REFUSE TO ANSWER, PROBE:] Is it less than 25 thousand dollars a year? From 25 to 50 thousand? 50 to 100 thousand? 100 to 200 thousand? Or over 200 thousand a year?
Highly similar to PALAC	PGenNseRtAC	5	{T12}, what number from 0 to 10 best shows **how much you are bothered, disturbed or annoyed by the noise from aircraft**?
	PRespBothrdACNse	37	To summarize your opinion about aircraft noise in this neighborhood, please consider all we have discussed and use a zero to four opinion thermometer where zero is not at all annoyed, four is extremely annoyed and one to three are in between. What number from zero to four shows **how much you are bothered or annoyed by aircraft noise in this neighborhood**?

{T12} is an abbreviation for the phrase "Thinking about the last 12 months or so,"
{T12H} is an abbreviation for the phrase "Thinking about the last 12 months or so, when you are here at home,"

Table D-8. Factors and their Composition, sorted by their Pseudo R-square Value

Factor	Factor Theme	Pseudo R-Square	Question No.	Variable Name	Survey Question
7	Startle, Frighten or Awaken	0.373	7a	PACWake	Has an aircraft ever **waked you up or kept you awake** at night when you are at home? (y/n)
			7b	PACStartle	Has an aircraft ever **startled or surprised** you when you are at home? (y/n)
			7c	PACFrighten	Has an aircraft ever **frightened** you when you are at home? (y/n)
3	General traffic noise/smells rating	0.247	1a	PALNseTraffic	{T12H}, how much does **noise from cars, trucks or other road traffic** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1b	PALSmellTraffic	{T12H}, how much does **smells or dirt from road traffic** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1c	PALSmellOther	{T12H}, how much does **smoke, gas or bad smells from anything else** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			3	PGenNseRt	Now please rate noise on a 0 to 10 opinion scale for how much the noise bothers, disturbs or annoys you when you are here at home. First about **noise in general**. {T12}, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the noise in general when you are here at home?
			4	PGenNseRtTraffic	{T12}, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by the **noise from cars or trucks or other road traffic**?
4	Safety concerns	0.175	40	PCNACCrash	When you are at home or around the neighborhood, how fearful or concerned are you that an **aircraft might crash nearby**: Are you extremely, very, moderately, slightly, or not at all concerned that an aircraft might crash?
			41	PCNACHurtYou	When you are at home, how concerned are you that an **aircraft crash might actually hurt you or your own property**: Are you extremely, very, moderately, slightly, or not at all concerned that an aircraft might hurt you or your property?
			43	PCNTrnCrash	When you are at home or around the neighborhood, how **fearful or concerned are you that there might be a passenger train or freight train derailment or crash nearby**? Are you extremely, moderately, slightly, or not at all concerned that there might be a train crash?
2	Airport effort to deal with aircraft noise	0.17	28	PResInfluenAP	How much do you think that **residents' actions and views can influence <AIRPORT> noise policy**? Do you think that residents' views can very greatly influence policy, greatly influence policy, moderately influence, slightly influence, or not at all influence policy?
			30	PAPRcgnzRes	To what extent do you think <AIRPORT> **officials recognize the community residents' feelings about aircraft noise?** Do you think the officials recognize the residents' feelings extremely well, very well, moderately well, slightly, or not at all?
			32	PAPTrusted	How completely do you feel you can **trust the <AIRPORT> officials to work fairly with the community by following official, agreed-upon procedures and providing accurate information?** Do you feel you can rely upon the <AIRPORT> officials completely, considerably, moderately, slightly or not at all?
			31	PAPInformRes	How fully do you feel the <AIRPORT> **officials keep community residents informed about the planning for airport changes?** Do you think the officials keep communities extremely well informed, very well informed, moderately well informed, slightly informed, or not at all informed?

Abbreviations: {T12H} Thinking about the last 12 months or so, when you are here at home; {T12} Thinking about the last 12 months or so.

Factor	Factor Theme	Pseudo R-Square	Question No.	Variable Name	Survey Question
1	Concerns or complaints with neighborhood	0.153	1b	PALSmellTraffic	{T12H}, how much does **smells or dirt from road traffic** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1c	PALSmellOther	{T12H}, how much does **smoke, gas or bad smells from anything else** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1d	PALLitter	{T12H}, how much does **litter or poorly kept up housing** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1f	PALNeighbor	{T12H}, how much does your **neighbors' noise or other activities** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1h	PALBusiness	{T12H}, how much does **undesirable business, institutional or industrial property** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1i	PALNoParks	{T12H}, how much does a **lack of parks or green spaces** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1j	PALPubTransit	{T12H}, how much does **inadequate public transportation** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1k	PALCrime	{T12H}, how much does the **amount of neighborhood crime** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1l	PALCitySvces	{T12H}, how much does **poor city or county services** bother, disturb, or annoy you: not at all, slightly, moderately, very, or extremely?
			1m	POthProb	Are there any other problems that you notice when you are here at home?
			2	PRateNeighborhood	Now considering how you feel about everything in your neighborhood, how would you **rate your neighborhood as a place to live** on a scale from 0 to 10 where 0 is worst and 10 is best?
5	Knowledge of aircraft noise issues	0.066	18	PKnowCommIssues	How **knowledgeable are you about noise and other community environmental issues** in the <BASECITY> area: Are you extremely knowledgeable, very knowledgeable, moderately knowledgeable, slightly knowledgeable, or not at all knowledgeable?
			21	PLrnMedia	How much have you **learned about your community's aircraft noise issues from media reports in the newspaper or on radio or TV**: a great deal, somewhat, a little or nothing at all?
			22	PLrnLocalInfo	How much have you **learned about your community's aircraft noise issues from a community newspaper or other more local organization, newsletter or local internet source:** a great deal, somewhat, a little or nothing at all?
			25	PCommGroup	Are any **community groups or other organizations trying to reduce aircraft noise or don't you know?** y/n
			26	PHHActOnACNse	Have you or anyone in your household **ever tried to get something done about aircraft noise** such as telephoning the airport, sending a message, writing a letter, contacting an official, going to a meeting, joining a group or doing something else? y/n
6	Beliefs about noise reduction by officials or pilots	0.016	33a	PRedACNseAPOff	How much do you think the **officials who run <AIRPORT> could reduce the aircraft noise** around here: Could the officials who run <AIRPORT> reduce the noise very greatly, greatly, moderately, slightly or not at all?
			33b	PRedACNseAPOthGov	How much do you think **other government officials could reduce the aircraft noise around here:** Could other government officials reduce the noise very greatly, greatly, moderately, slightly or not at all?
			33c	PRedACNseAPilots	How much do you think the **pilots flying the planes could reduce the aircraft noise around here:** Could the pilots flying the planes reduce the noise very greatly, greatly, moderately, slightly or not at all?

Abbreviations: {T12H} Thinking about the last 12 months or so, when you are here at home; {T12} Thinking about the last 12 months or so.

Twenty-two questions from the phone survey were not well represented by the extracted factor structure. In other words, each of these questions has a weak connection with the other questions in the survey. Therefore, they could not be grouped with others through EFA. These 22 questions' association with PALAC were evaluated and ranked by their pseudo R-square value. Table D-9 shows the Factors from Table D-8 and the remaining 22 questions and their pseudo R-square values – overall and for each of four (4) strata of aircraft noise exposure in 5-dB intervals of DNL.[15]

The top eight (8) values overall and within each DNL stratum have been color-coded to provide a visual of the trends in rankings across the DNL strata. As shown in Table D-9, key takeaways are:

- Factor 7 was the highest ranked in all but one DNL strata and Factor 3 was the second highest, except in the 65+ stratum, where the two Factors switched rankings
- Questions 39 (PACPctFlyOverHCAT: What percent fly directly over your property) or 23 (PNbrsViewACNse: Closest neighbors making their views known about aircraft noise) came into the top-5 ranking in many DNL strata
- Factors 5 and 6 were outranked by several individual variables
- Question 29 (PhomeInsulat: Has your home been sound insulated) was the lowest ranked variable or Factor

Note that while Question 29 (PHomeInsulat: Has your home been sound insulated?) had the lowest overall value among all ranked factors and variables, it may have been due to a misunderstanding of the survey question. The intended purpose for this question/variable was to determine if respondents whose homes were sound insulated through an FAA-sponsored residential sound insulation program were more or less annoyed than those who were not sound insulated. About ten percent of the respondents were not sure if their homes had been sound insulated. Of the remainder, about two-thirds indicated their home had been sound insulated and these respondents had a lower mean percent highly annoyed by aircraft noise. However, a significant proportion of those who claimed their homes were sound insulated also did not live in proximity to the airport and, therefore, were not likely to be eligible for FAA-sponsored sound insulation.[16]

The poor performance of this variable is, therefore, likely due to the wording of the question, which did not make it sufficiently clear that it was referring to FAA-sponsored residential sound insulation programs. Some respondents may have also considered their home sound insulated if only limited treatments had been applied, such as for a media room. Additionally, many homes have some form of insulation for non-acoustical purposes, which may have caused further confusion with this question.

[15] The dose-response curve from the mail component of the NES was based on responses in five (5) intervals/strata of DNL: 50-55 decibels (dB), 55-60 dB, 60-65 dB, 65-70 dB and 70 DNL or more ("70+"). As the telephone survey had only 52 respondents in the 70+ stratum, that group was combined with the 65-70 dB stratum to allow for increased statistical power. The combined stratum is denoted as "65+".

[16] FAA sound insulation eligibility requires that homes are exposed to DNL of at least 65 dB. For complete residential sound insulation eligibility requirements, see FAA Order 5100.38D, National Policy, Airport Improvement Program Handbook, September 30, 2014.

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Table D-9. Ranking Factors and Questions by DNL Stratum

Factor	Question No.	Variable Name	Factor Theme or Survey Question	Pseudo R-Square Values (with rank of top 8) Overall	DNL Stratum (dB) 50-55	55-60	60-65	65+
F7			Startle, Frighten or Awaken	0.373 (1)	0.319 (1)	0.377 (1)	0.348 (1)	0.300 (2)
F3			General traffic noise/smells rating	0.247 (2)	0.201 (2)	0.239 (2)	0.273 (2)	0.314 (1)
F4			Safety concerns	0.175 (3)	0.148 (4)	0.109 (7)	0.177 (5)	0.150 (8)
F2			Airport effort to deal with aircraft noise	0.170 (4)	0.148 (5)	0.165 (3)	0.166 (6)	0.179 (6)
F1			Concerns or complaints with neighborhood	0.153 (5)	0.124 (8)	0.139 (4)	0.187 (3)	0.186 (5)
n/a	39	PACPctFlyOverHCAT	Thinking about all the aircraft you notice when you are at home, about **what percent fly directly over your property?**	0.152 (6)	0.156 (3)	0.134 (5)	0.132 (7)	0.217 (3)
n/a	23	PNbrsViewACNse (1)	How about your **closest neighbors making their views known about aircraft noise:** Have they clearly made their views known, have they revealed only a little about their views, or have they kept their views to themselves?	0.150 (7)	0.129 (6)	0.132 (6)	0.179 (4)	0.188 (4)
n/a	14	PACNseChg	Since you moved here, has the total **amount of aircraft noise increased, decreased or stayed about the same?**	0.118 (8)	0.128 (7)	0.090 (7)	0.125 (8)	0.164 (7)
n/a	44	PDangerTrf	Which type of **traffic, if any, do you feel is the most dangerous for you or your property** when you are here at home: road traffic, railway trains or aircraft?	0.095	0.097	0.045	0.115	0.120
n/a	15	PACNseFuture (1)	What do you think **aircraft noise will be like here in the next few years:** Do you think the total amount of aircraft noise will increase, decrease or stay about the same here?	0.092	0.095	0.066	0.103	0.128
F5			Knowledge of aircraft noise issues	0.066	0.063	0.041	0.044	0.104
n/a	36	PRespSenstve	How **sensitive are you generally to noise** of all kinds: extremely sensitive, very sensitive, moderately sensitive, slightly sensitive, or not at all sensitive?	0.057	0.075	0.078	0.070	0.097
n/a	24	PAuthDisputes (1)	As far as you know, have there ever been **disputes between airport authorities and community residents about aircraft noise** around <AIRPORT>? y/n	0.043	0.023	0.054	0.059	0.081
n/a	38	PACTakeOffLand (1)	Are most of the aircraft that you notice from your home **coming down for a landing at the airport, taking off from the airport, are about half landing and about half taking off, are they doing something else, or don't you know?**	0.031	0.041	0.056	0.039	0.071
n/a	42	PCNTrfAccdnt	When you are at home or around the neighborhood, **how fearful or concerned are you that there might be car or truck road traffic accidents nearby:** Are you extremely, moderately, slightly, or not at all concerned that there might be a road traffic crash?	0.029	0.058	0.045	0.058	0.110
n/a	34	PAPRedACNse (1)	How fully do you feel the <AIRPORT> officials **keep community residents informed about the planning for airport changes?** Do you think the officials keep communities extremely well informed, very well informed, moderately well informed, slightly informed, or not at all informed?	0.028	0.025	0.048	0.051	0.064

Factor	Question No.	Variable Name	Factor Theme or Survey Question	Pseudo R-Square Values (with rank of top 8) Overall	DNL Stratum (dB) 50-55	55-60	60-65	65+
n/a	35	PAPImportant	How **important do you think that <AIRPORT> is** for the <BASECITY> area: Is <AIRPORT> extremely important, very important, moderately important, slightly important or not at all important?	0.026	0.038	0.039	0.060	0.071
n/a	12	PHrOutsideCAT	Think about those weeks in the year when you spend the most time out-of-doors in your yard or on your porch, deck or balcony. At that time of year, **how many hours a week would you say you are out-of-doors at home?**	0.025	0.031	0.019	0.003	0.019
n/a	16	PHrdACGrd	When you are at home, have you **ever heard aircraft sitting on the ground or moving around on the ground** on the airport property? y/n	0.016	0.023	0.062	0.055	0.063
F6			Beliefs about noise reduction by officials or pilots	0.016	0.026	0.012	0.010	0.017
n/a	11	PWkDayNotHome	How many of the five weekdays from Monday through Friday are you usually out away from home most of the day that is 8 hours or more? Are you usually away, on all five weekdays, or fewer weekdays, or are you usually not away on any weekday? **How many weekdays are you usually away?**	0.012	0.030	0.031	0.043	0.060
n/a	19	PAPTripsYrCAT	About how many **trips a year do you and other members of your household make from the <AIRPORT>?** One trip is considered as round-trip travel and includes all family members traveling together. If any family members travel separately, please count those as separate trips as long as they use <AIRPORT>.	0.010	0.030	0.019	0.042	0.062
n/a	9	PBldgTp	Which of the following best **describes the building** where you live?	0.009	0.029	0.022	0.038	0.065
n/a	1g1	POtherNse	Are there **any other noises you hear** when you are here at home? y/n	0.007	0.021	0.012	0.011	0.015
n/a	13	PYrMovedCAT	In what **year and month did you move to your home** here?	0.006	0.019	0.018	0.041	0.089
n/a	27	PWayToComplain (2)	If someone wants to make a complaint about aircraft noise these days, do you know **if there is a convenient way to contact <AIRPORT>?** y/n	0.004	0.007	0.006	0.005	0.032
n/a	10	POwnRent	Do you **own your home or are you renting?**	0.003	0.007	0.005	0.010	0.052
n/a	20	PWrkAtAP	Do you or anyone else in your household **work at <AIRPORT> or work for a company or organization that does business with <AIRPORT>?** y/n	0.002	0.007	0.003	0.008	0.036
n/a	29	PHomeInsulate	Has your home been sound insulated? y/n	0.002	0.006	0.004	0.021	0.025

(1)"Don't Know" was a valid response
(2) "Don't Know" was recoded to "No"

Rank/Color:	1	2	3	4	5	6	7	8

D.4 Characteristics of Highly and Not-highly Annoyed Respondents

Continuing to explore the potential cause of aircraft noise annoyance and examine why some people are highly annoyed by aircraft noise or not, a Classification and Regression Tree (CART) analysis was performed to identify the characteristics of highly and not-highly annoyed respondents. CART analysis is a decision tree method to identify and select predictors that are strongly associated with an outcome while accounting for confounding effects. When a large number of predictors are involved, CART allows for an exploration of complex interactions among predictors. Variable selection in CART is based on the measures of variable importance and overall model performance is evaluated in terms of prediction accuracy through cross-validation. More accurate prediction on the outcome indicates a better model fit.

The CART model employed here was used to identify the factors/variables that best predict a respondent's probability of being highly annoyed (or not). To control for the influence of aircraft noise exposure measured by DNL, CART analysis was conducted separately within four DNL strata. The results of the CART analysis are presented below while technical details are in Section D.6.

Tables D-10 through D-13 present the variables selected in the final model for each DNL stratum, followed by a description of HA and not HA based on the scores of the selected variables. The order of the variables in each stratum reflects the importance of the variables in the decision tree analysis, from highest to lowest. The CART analysis resulted in some strata having a greater number of important variables than other strata.

In all DNL strata, Factor 7 (startled, frightened, or awakened) was found to be the most important predictor of annoyance. With the exception of the DNL 65+ stratum, the CART analysis found additional contributing factors/variables. Each of these additional variables was interrelated with the other items, i.e., a person did not need to exhibit all of these factors to be highly annoyed (or not) and combinations of these variables were at play. However, the presence or absence of Factor 7 was a strong predictor of the degree of aircraft noise annoyance, regardless of the other characteristics.

Table D-10. Variables Selected and Characteristics of HA and Not HA, DNL 50-55 dB

Variable Selected		Description	
		Not Highly Annoyed	Highly Annoyed
Factor 7	Startle, Frighten or Awaken	They are not startled, frightened, or awakened by aircraft.	They are started, frightened, or awakened by aircraft
Factor 2	Airport effort to deal with aircraft	They believe the airport is working collaboratively with them.	They do not believe the airport is working collaboratively with them.
Factor 5	Knowledge of aircraft noise issues	They do not learn much about the aircraft noise issue from various sources.	They learn a lot about the aircraft noise issue from various sources.
Factor 4	Safety concerns	They are not concerned with possible accident or damage from aircraft or road traffic	They are concerned with possible accident or damage from aircraft or road traffic

Table D-11. Variables Selected and Characteristics of HA and Not HA, DNL 55-60 dB

Variable Selected		Description	
		Not Highly Annoyed	Highly Annoyed
Factor 7	Startle, Frighten or Awaken	They are not startled, frightened, or awakened by aircraft.	They are started, frightened, or awakened by aircraft
Factor 3	General traffic noise/smells rating	They are not annoyed by the traffic noise or smells in their neighborhood.	They are annoyed by the traffic noise and smells in their neighborhood.

Table D-12. Variables Selected and Characteristics of HA and Not HA, DNL 60-65 dB

Variable Selected		Description	
		Not Highly Annoyed	Highly Annoyed
Factor 7	Startle, Frighten or Awaken	They are not startled, frightened, or awakened by	They are started, frightened, or awakened by aircraft
Factor 2	Airport effort to deal with aircraft	They believe the airport is working collaboratively with	They do not believe the airport is working collaboratively with
PNbrsViewACNse (Q#23)	Phone Neighbors Views Known On Aircraft Noise	Their neighbors do not reveal their views on aircraft noise.	Their neighbors make their views on aircraft noise clearly known.

Table D-13. Variables Selected and Characteristics of HA and Not HA, DNL 65+ dB

Variable Selected		Description	
		Not Highly Annoyed	Highly Annoyed
Factor 7	Startle, Frighten or Awaken	They are not startled, frightened, or awakened by aircraft.	They are startled, frightened, or awakened by aircraft

D.5 Technical Details of the Exploratory Factor Analysis

This section provides the technical details on factor development for the Exploratory Factor Analysis presented in Section D.3. Section D.5.1 describes how the data was prepared. Section D.5.2 explains how the seven factors were derived. Section D.5.3 shows the loadings and distributions for each of the factors.

D.5.1 Data Preparation

Data preparation began with screening out variables because of missing data and other reasons explained in Section D.4. Data preparation concluded with recoding and dummy coding of variables and treating missing values as described in the following two subsections, respectively.

D.5.1.1 Recode and Dummy Code Variables

Some variables had high levels of "Don't Know" responses, which in most cases would be treated as missing. However, we recoded the "Don't Know" response and included it in the analysis if it met one of two conditions:

- If the question is phrased "Do you know…", then a response of "Don't Know" should be combined with "No" response, e.g., PWayToComplain.
- "Don't Know" indicates that respondents do not have enough information to express an opinion and thus provides useful data on the topic, e.g., PACNseFuture, PACTakeOffLand, PAPRedACNse, PAuthDisputes, PNbrsViewACNse, PCommGroup.

If a variable is nominal, meaning its categories do not have a natural order (e.g. male/female for gender), then we need to dummy code it so the EFA estimates are interpretable. The dummy variables take the value of 0 and 1 to indicate the presence of a response category. The number of dummy variables is one less than the valid response levels of a particular variable, where one level is chosen as a reference group to avoid redundant information. For example, PBldgTp (building type) was replaced by 5-1=4 dummy variables, among which PBldgT1=1 if PBldgTp=1, =0 if PBldgTp= 2,3,4,5 etc. The dummy coding was applied to PBldgTp and PDangerTrf where "Don't Know" was treated as a true missing value, whereas "Don't Know" was valid and used as reference group in the variables PACNseFuture, PACTakeOffLand, PAPRedACNse, PAuthDisputes, PNbrsViewACNse, and PCommGroup.

D.5.1.2 Treatment of Missing Values

Even after data cleaning and recoding, missing values in the remaining variables still caused problems when producing the covariance matrix. To address this we used the following strategy:

- Used pairwise correlation as the input dataset for the EFA. Unlike standard correlation, which deletes the whole record if any missing values are present, pairwise correlation uses all available observations when calculating the correlation between two variables.
- Calculated factor scores for all records using values derived from multiple imputation to replace missing values. Multiple imputation is a statistical technique to fill in missing values by drawing values from a distribution determined by the non-missing variables. This process was repeated multiple times to obtain approximately unbiased estimates of parameters.

D.5.2 Factor Structure Exploration

A primary reason for using EFA is to examine, in a multi-dimensional way, the 'total variance' present in the data. The convention is to consider the total variance as equal to the number of variables analyzed in the EFA. The extent to which a substantial portion of the total variance is explained by far fewer than observed variables, allows us to reduce the dimensionality of the data to a much smaller number of factors.

The following three subsections describe the process for determining the number of factors selected as well as the choices of extraction and rotation methods. The final factor structure is presented in Section D.5.2.4.

D.5.2.1 Scree Plot

The number of factors was determined by examining a scree plot with factors on the x-axis and eigenvalues on the y-axis. Eigenvalues reflect the amount of variance explained by each factor and are produced through principal components analysis. Here, the variance was represented in terms of scores, which sum to the total number of variables in the model, i.e., 69. As shown in Figure D-4, the amount of variance accounted for by the seventh factor and beyond was small and the points form a nearly flat line. However, the first six factors only account for 33 percent of variance in the data. To achieve at least 50 percent explained variance, the number of factors kept was 16. For the initial run, we kept a large number of factors to check the internal association of the variables.

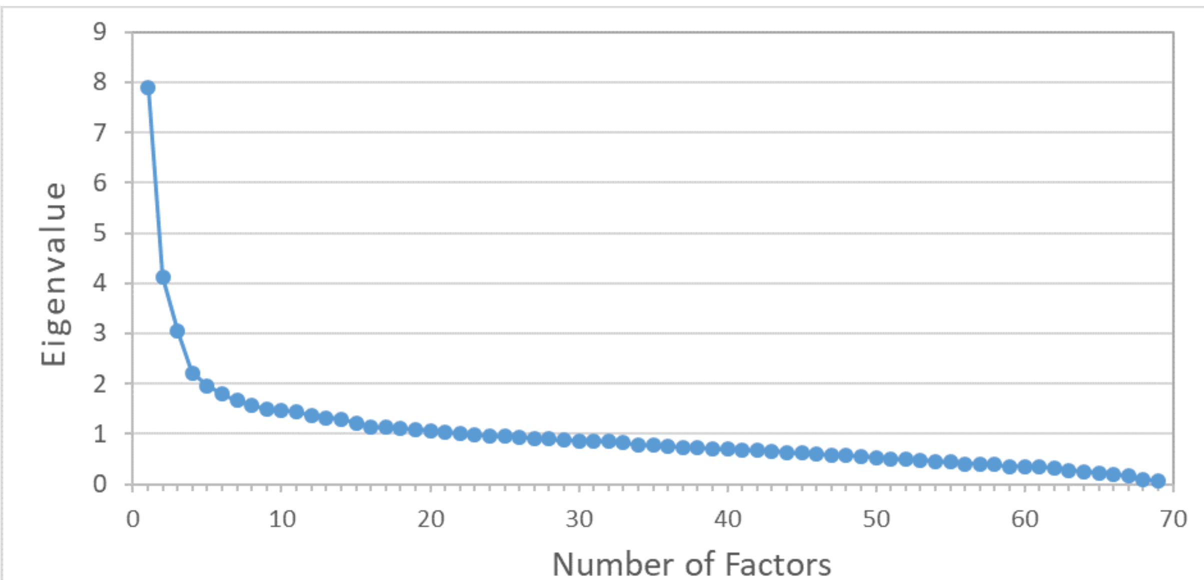

Figure D-4. Scree Plot of Eignenvalues

D.5.2.2 Factor Extraction

The two most commonly used extraction methods are principle axis factoring (PAF) with iterated communalities and maximum likelihood (ML). PAF looks for the least number of factors that explain the shared variance (communality) of observed variables. In the iterated principal factor methods, the communality values are estimated from the loadings obtained from the previous communality estimates. ML extraction seeks to discover factors and factor loadings that optimally reproduce the observed correlation matrix. However, the ML method assumes that the observed variables are normally distributed, which is not held for discrete Likert-scale questions in the current analysis. Since PAF is robust to the requirement of normality, the PAF method was employed to produce factor loadings of every observed variable on every extracted factor.

Factor loadings are the weights of each factor on observed variables. Factor loadings can be positive or negative, which reflect the positive or negative correlations in the correlation matrix. A negative factor loading means that a high value on an observed variable is associated with a low score on the factor. The size, i.e., absolute value, of the loadings determines how the extracted factor is interpreted. As a starting point, an absolute value of 0.3 was the minimum level to consider whether a factor contributes to an observed variable, and an absolute value of 0.5 was considered practically significant. If a variable has low loadings on all extracted factors, this means the particular variable is not well represented in the common factor space.

D.5.2.3 Rotation

The purpose of rotation is to achieve a simple and interpretable factor structure. A simple structure usually means most variables have a large loading on one single factor and small loadings on the others. If the factors are assumed to be uncorrelated with one another, then the rotation is orthogonal, whereas the factors are allowed to be correlated under the oblique rotations. The “promax”, an oblique rotation method, was chosen in the current analysis to reflect a more realistic assumption on the relationship between factors, while retaining a simple structure.

If a variable was not loaded highly on any factor after rotation, we excluded the variable from the EFA for its weak association with the other variables in the model. The variables kept were those with a factor loading greater than or equal to 0.25 on one factor in the initial run and 0.3 for later runs. They were loaded on a factor with at least two other questions. If several dummy variables from the same question were loaded on the same factor, we excluded them. This process was repeated until a factor structure where most of variables have only one factor loading over 0.3 was achieved. During the process, 37 variables were excluded. In the end, we extracted seven factors from the 31 variables remaining in the model.

Once the factor structure was decided, factor scores – linear compositions of the observed variables – were calculated and output. The scores were standardized to a mean of 0 and variance of 1 to be used in subsequent analysis. Factor scores were not calculated if any missing values were present. Therefore, we ran 10 imputations to fill in missing values and calculated 10 factor scores for each record based on the imputed data. The final factor scores were obtained by averaging over the 10 factor scores. This analysis included a set of ANOVA, using final factor scores as outcomes and PALAC as a group variable, to test possible group differences among the five rating levels of PALAC. ANOVA, reported as F-test and its associated degrees of freedom, was used to test the null hypothesis that there was no group difference between the factor score means. If the p-value of the F-test was less than 0.05, we rejected the null hypothesis and concluded a significant difference existed.

D.5.2.4 Final Extracted Factors

The variance explained by the seven extracted factors are presented in Table D-16. Among the seven factors, Factor 1 explained the most variance among the 31 variables remaining in the EFA, followed by Factor 3. Table D-17 is the correlation matrix of the extracted factors. We can see that Factor 1 was positively correlated with Factor 3, while Factor 2 and Factor 7 were negatively correlated.

Table D-16. Variance Explained by Extracted Factors Ignoring Other Factors

Factor	Variance
1	4.844
2	2.831
3	4.455
4	3.056
5	2.139
6	1.797
7	2.655

Table D-17. Correlation Matrix of Extracted Factors

Factor	1	2	3	4	5	6	7
1	1	-0.282	0.592	0.329	0.177	0.120	0.300
2	-0.282	1	-0.302	-0.300	0.072	0.060	-0.389
3	0.592	-0.302	1	0.360	0.240	0.146	0.380
4	0.329	-0.300	0.360	1	0.199	0.155	0.370
5	0.177	0.072	0.240	0.199	1	0.243	0.154
6	0.120	0.060	0.146	0.155	0.243	1	0.110
7	0.300	-0.389	0.380	0.370	0.154	0.110	1

Based on the patterns of rotated factor loadings, the seven factors represent the following domains in the phone interview.

- Factor 1: Concerns or complaints with neighborhood
- Factor 2: Airport effort to deal with aircraft noise
- Factor 3: General traffic noise/smells rating
- Factor 4: Safety concerns
- Factor 5: Knowledge of aircraft noise issues
- Factor 6: Beliefs about noise reduction by officials or pilots
- Factor 7: Startle, Frighten or Awaken

D.5.3 Factor Loadings and Distributions

This section presents the variables with absolute values of factor loading greater than 0.3 on extracted factors. In addition to the EFA results, the chi-square tests between the variables and PALAC are also included in the tables. The chi-square test was used to evaluate the dependence between two categorical variables. A p-value less than 0.05 means the two variables are dependent. This additional information is to support further investigation on the interview questions and their relationship with the aircraft annoyance measure.

D.5.3.1 Factor 1: Concerns or Complaints with Neighborhood

Table D-18 presents the variables loaded highly on Factor 1. Using the factor score, the ANOVA result indicates significant group difference between the five rating levels in PALAC ($F_{(4, 2319)}$ = 108.69, p < 0.0001).

In Figure D-5 and similar upcoming figures, the boxplots present the distribution of factor scores on the y-axis by the five rating levels of PALAC on the x-axis. In the boxplot, the length of the box represents the distance between the 25th and 75th percentiles, which is called the interquartile range (IQR); the diamond within the box represents the group mean; the horizontal line in the box represents the group median; and the vertical line connects the box and 1.5 times IQR; and the circles are the potential outliers. Any cases falling outside of

3 times IQR are labeled with their record ID. In Figure D-5, the 564th record has an extremely large factor score on Factor 1 versus the other records which selected PALAC=1.

Figure D-5 shows a clearly ascending trend of group means across the five rating levels from 1-Not at all to 5-Extremely bothered/annoyed by aircraft noise. That is, the more annoyed by aircraft noise, the higher the factor score on concerns or complaints with their neighborhood.

The multiple comparison is further used to investigate where the significant difference exists among the five levels of PALAC. The Scheffé's test was employed to control the experiment-wise error rate for all possible contrasts of the group means. The results indicate that the only insignificant difference was between the means of factor scores on PALAC=1 (Not at all) and PALAC=2 (Slightly). All other pairwise comparisons were significant with p less than 0.05.

Table D-18. Questions with High Factor Loadings on Factor 1 (ranked by absolute value of loading)

Variable	Label	Q#	Factor Loading	p value for chi-square test
PALCrime	Phone AL: Crime	1k	0.674	< 0.0001
PALCitySvces	Phone AL: Poor City County Services	1l	0.641	< 0.0001
PALLitter	Phone AL: Litter Poorly Kept Housing	1d	0.615	< 0.0001
PALNoParks	Phone AL: Lack of Parks	1i	0.580	< 0.0001
PRateNeighborhood	Phone Neighborhood Rating	2	-0.580	< 0.0001
PALPubTransit	Phone AL: Inadequate Public Transportation	1j	0.496	< 0.0001
PALNeighbor	Phone AL: Neighbors Noise	1f	0.417	< 0.0001
PALBusiness	Phone AL: Undesirable Business Property	1h	0.410	< 0.0001
POthProb	Phone Other Annoying Problems	1m1	0.322	< 0.0001
PALSmellTraffic*	Phone AL: Smells Dirt from Traffic	1b	0.304	< 0.0001
PALSmellOther*	Phone AL: Smoke Gas Bad Smells Else	1c	0.302	< 0.0001

* PALSmellTraffic and PALSmellOther have factor loadings higher than 0.3 on Factor 3.

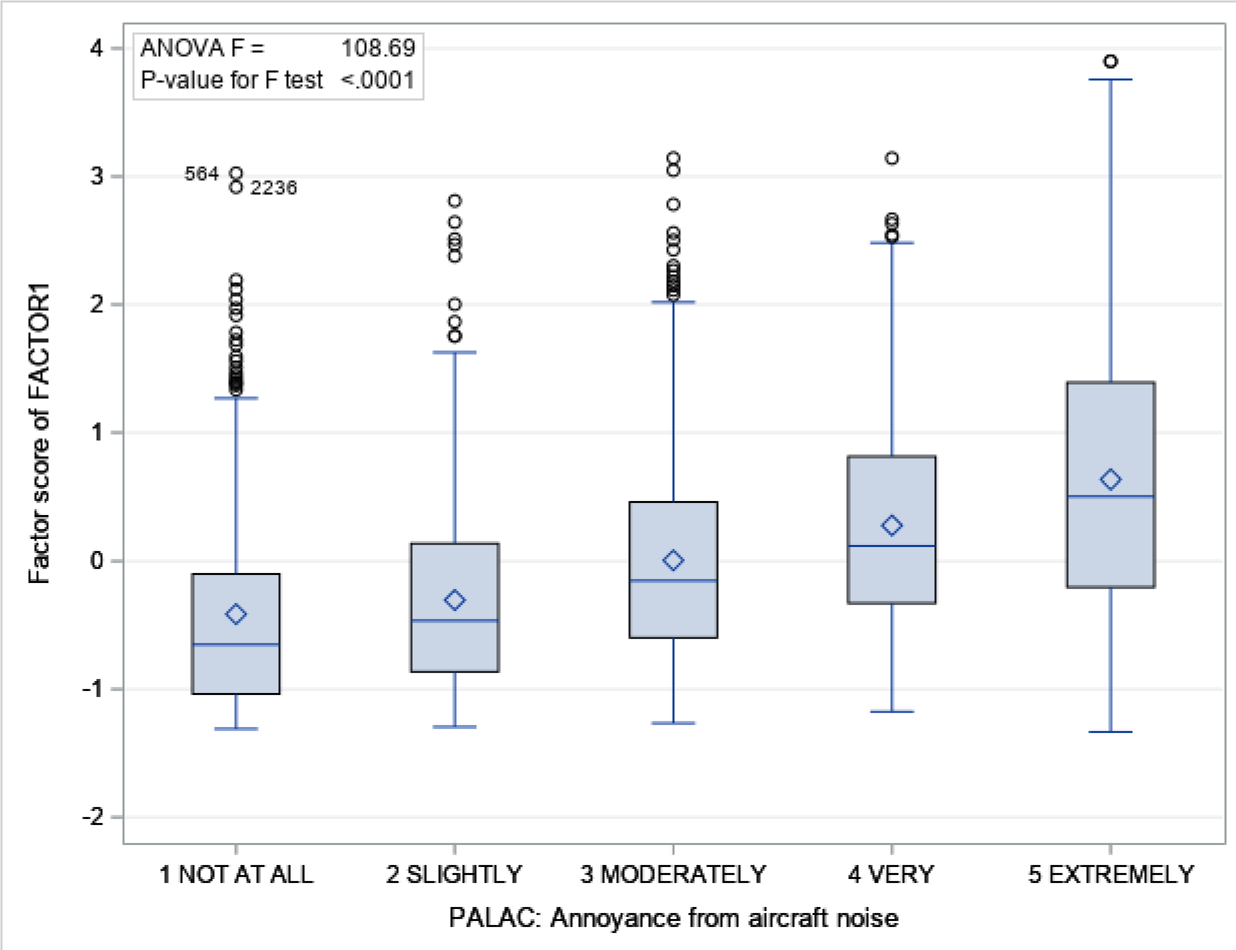

Figure D-5. Distribution of Factor Scores by PALAC for Factor 1

D.5.3.2 Factor 2: Airport Effort to Deal with Aircraft Noise

Table D-19 presents the four variables loaded highly on Factor 2, which are mainly about airport efforts to deal with aircraft noise. The ANOVA was significant ($F_{(4, 2319)}$ = 121.92, $p < 0.0001$), and the descending pattern in the distribution of factor scores in Figure D-6 shows that the less respondents believed the airport is making an effort to resolve the aircraft noise issues, the more annoyed they were by aircraft noise. All pairwise comparisons were significant with p less than 0.05, except the comparison between PALAC=1 (Not at all) and 2 (Slightly).

Table D-19. Questions with High Factor Loadings on Factor 2 (ranked by absolute value of loading)

Variable	Label	Q#	Factor Loading	p value for chi-square test
PAPTrusted	Phone Can Trust Airport to Work Fairly	32	0.787	< 0.0001
PAPInformRes	Phone Airport Keeps Residents Informed	31	0.735	< 0.0001
PAPRcgnzRes	Phone Airport Recognize Residents Feelings	30	0.700	< 0.0001
PResInfluenAP	Phone Can Residents Action Influence Airport	28	0.369	< 0.0001

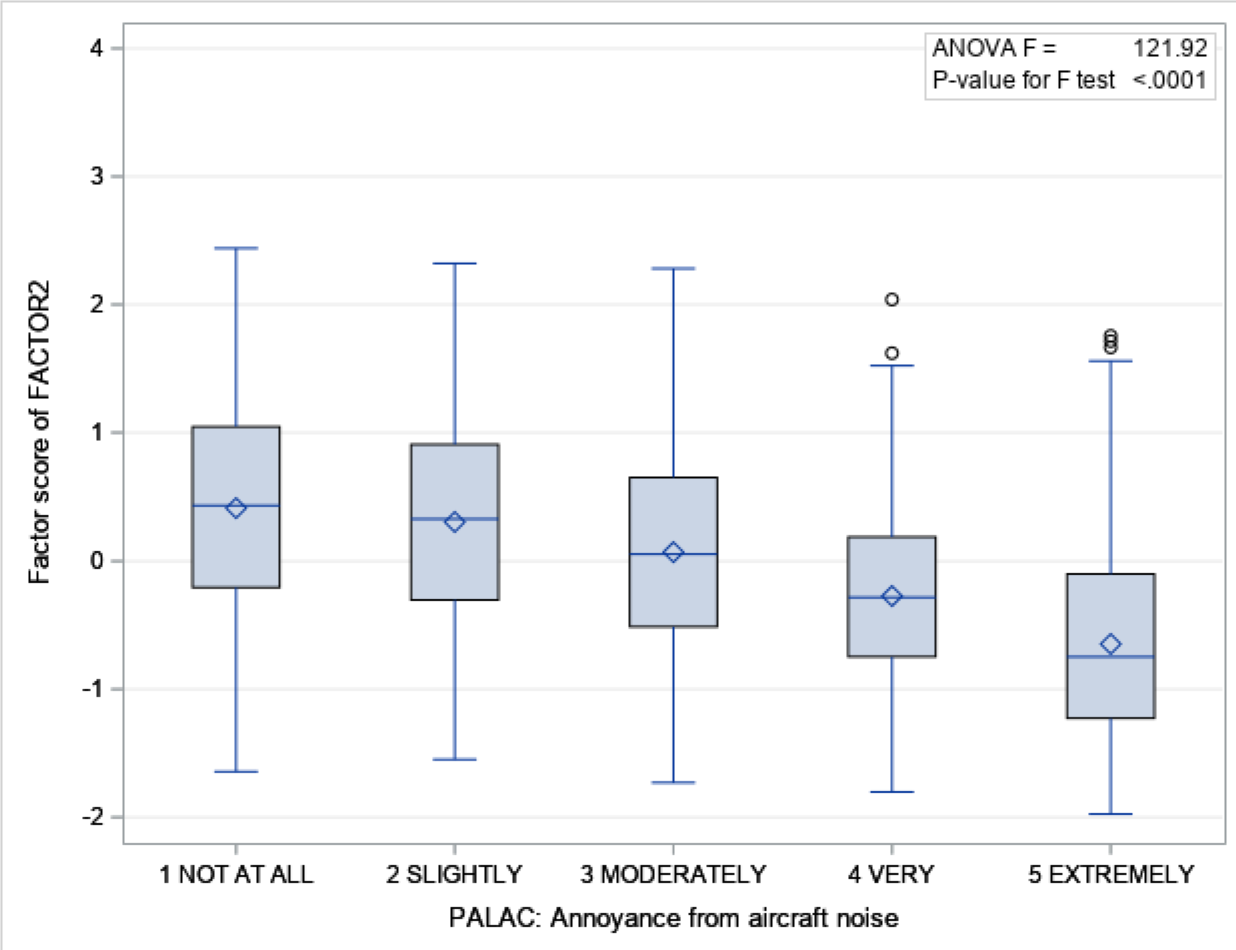

Figure D-6. Distribution of Factor Scores by PALAC for Factor 2

D.5.3.3 Factor 3: General Traffic Noise/Smells Rating

Table D-20 presents the five variables loaded highly on Factor 3. Two of the five questions loaded highly on Factor 3 relate to traffic noise, which was also strongly related to the general noise rating. The significant group difference on PALAC ($F_{(4,2,319)}$ = 200.67, p < 0.0001) and the trend of the group means in Figure D-7 indicate that respondents' attitude towards the noise and smells were consistent regardless of the types of noise. All pairwise comparisons were significant with p less than 0.05.

Table D-20. Questions with High Factor Loadings on Factor 3 (ranked by absolute value of loading)

Variable	Label	Q#	Factor Loading	p value for chi-square test
PGenNseRtTraffic	Phone General Noise from Traffic Rating	4	0.818	< 0.0001
PALNseTraffic	Phone AL: Noise from Traffic	1a	0.766	< 0.0001
PGenNseRt	Phone General Noise Rating	3	0.576	< 0.0001
PALSmellTraffic*	Phone AL: Smells Dirt from Traffic	1b	0.411	< 0.0001
PALSmellOther*	Phone AL: Smoke Gas Bad Smells Else	1c	0.318	< 0.0001

* PALSmellTraffic and PALSmellOther have factor loadings higher than 0.3 on Factor 3.

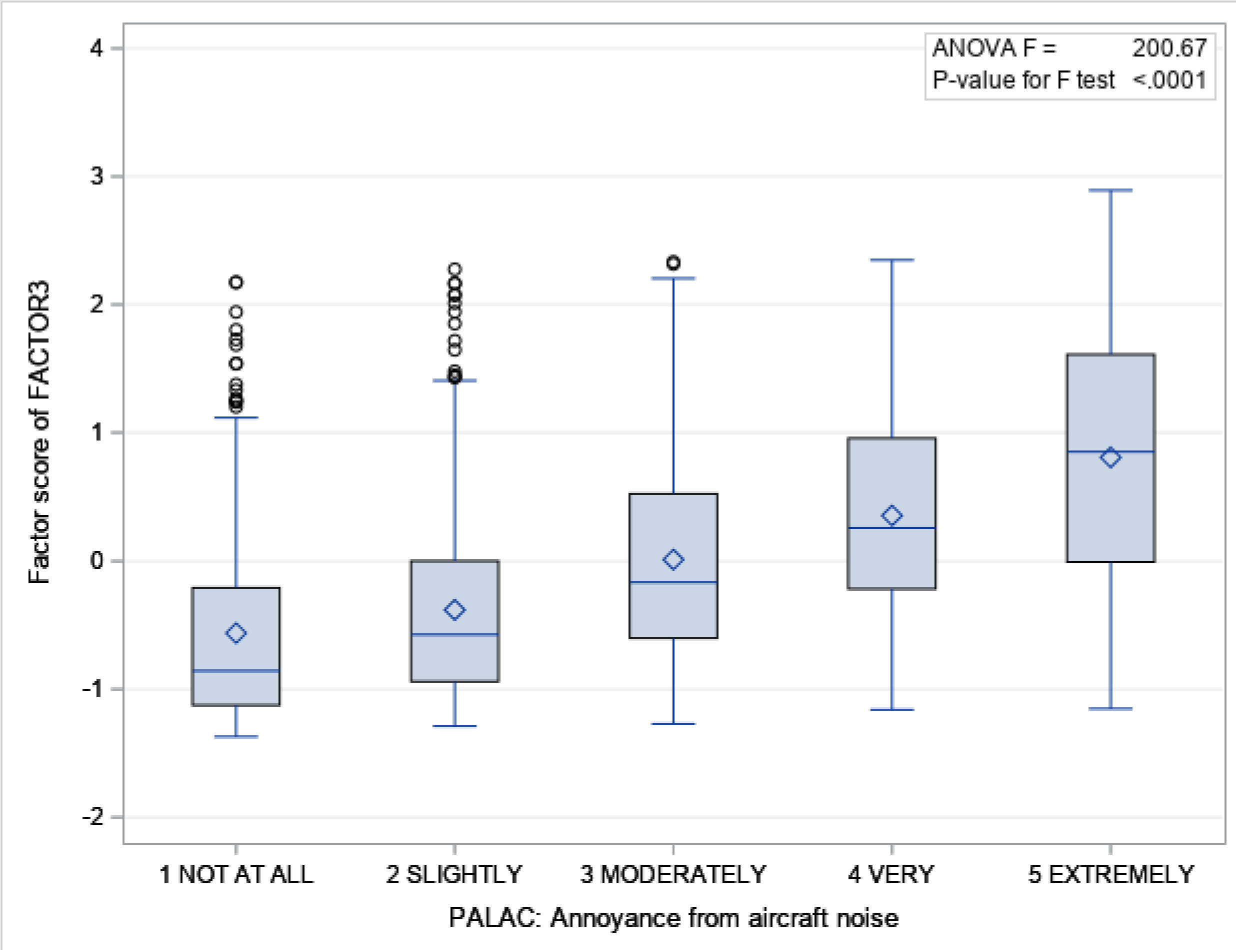

Figure D-7. Distribution of Factor Scores by PALAC for Factor 3

D.5.3.4 Factor 4: Safety Concerns

Table D-21 presents the three variables loaded highly on Factor 4, which relates to safety concerns and possible accidents. The ANOVA indicated a significant group difference ($F_{(4, 2319)}$ = 137.34, p < 0.0001). The trend shown in Figure D-8 shows the more people were bothered/annoyed by aircraft noise, the more they were concerned with accidents from aircraft and train modes of transportation. All pairwise comparisons were significant, with the exception of the comparisons between PALAC=1 (Not at all) and PALAC=2 (Slightly).

Table D-21. Questions with High Factor Loadings on Factor 4 (ranked by absolute value of loading)

Variable	Label	Q#	Factor Loading	p value for chi-square test
PCNACHurtYou	Phone Concern: Aircraft Hurt You or Property	41	0.925	< 0.0001
PCNACCrash	Phone Concern: Aircraft Crash Nearby	40	0.834	< 0.0001
PCNTrnCrash	Phone Concern: Train Crash Nearby	43	0.318	< 0.0001

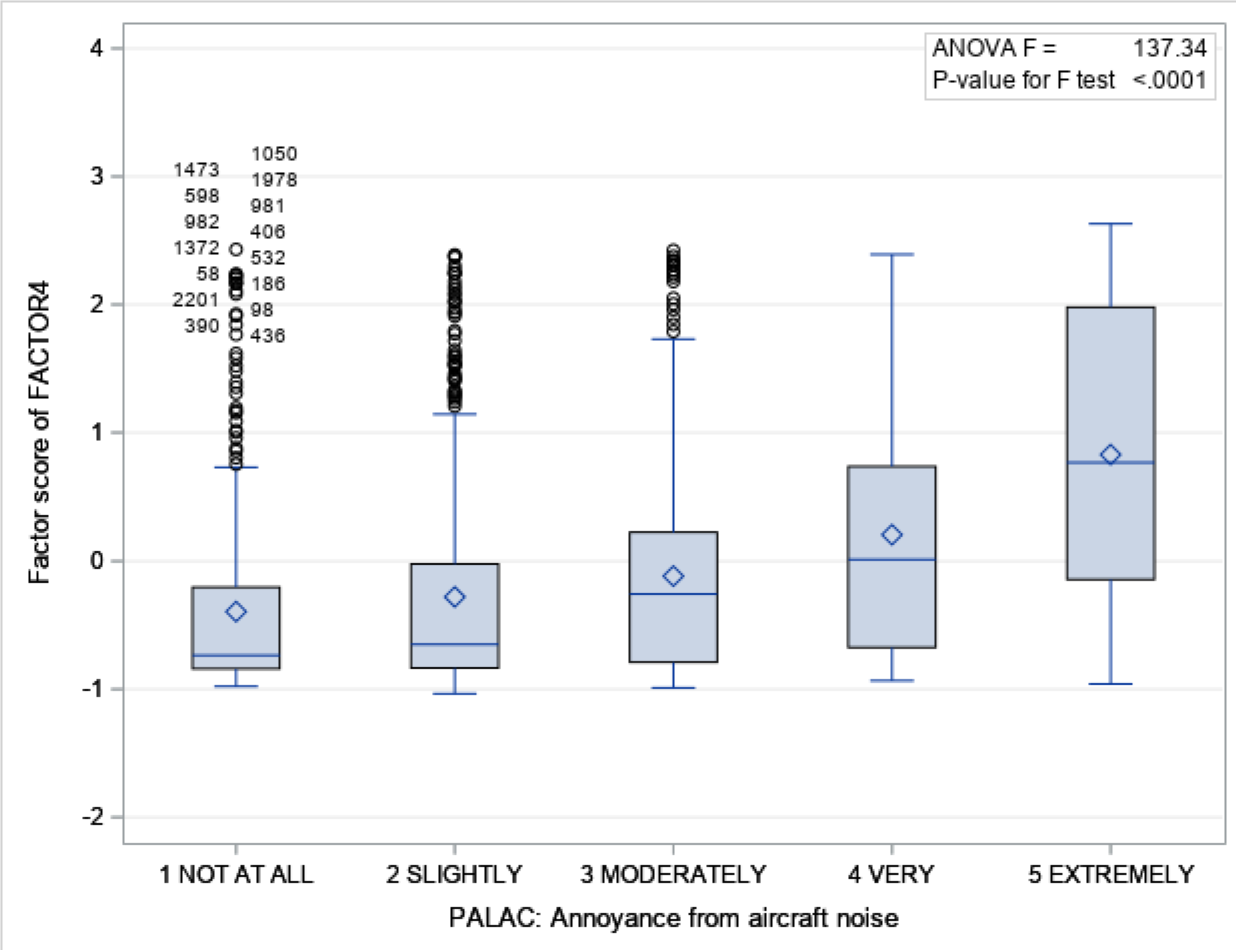

Figure D-8. Distribution of Factor Scores by PALAC for Factor 4

D.5.3.5 Factor 5: Knowledge of Aircraft Noise Issues

Table D-22 presents the five variables loaded highly on Factor 5, which relates to respondents' knowledge of aircraft noise issues. The ANOVA indicated significant group difference on PALAC ($F_{(4, 2319)} = 42.55$, $p < 0.0001$). The trend shown in Figure D-9 shows the more respondents were annoyed by aircraft noise, the more knowledge they have about the issue. The pairwise comparisons were not significant between PALAC=1 (Not at all) and 2 (Slightly), and between PALAC=3 (Moderately) and 4 (Very).

Table D-22. Questions with High Factor Loadings on Factor 5 (ranked by absolute value of loading)

Variable	Label	Q#	Factor Loading	p value for chi-square test
PLrnLocalInfo	Phone Learn Aircraft Noise Issues: Local Info	22	0.767	< 0.0001
PLrnMedia	Phone Learn Aircraft Noise Issues: Media	21	0.688	< 0.0001
PCommGroup*	Phone Community Groups Reduce Aircraft	25	0.421	< 0.0001
PHHActOnACNse	Phone HH Done Anything about Aircraft Noise	26	0.401	< 0.0001
PKnowCommIssues	Phone Knowledgeable About Community Issues	18	0.371	< 0.0001

* Dummy coded PCommGroup for the presence of "Group Is"

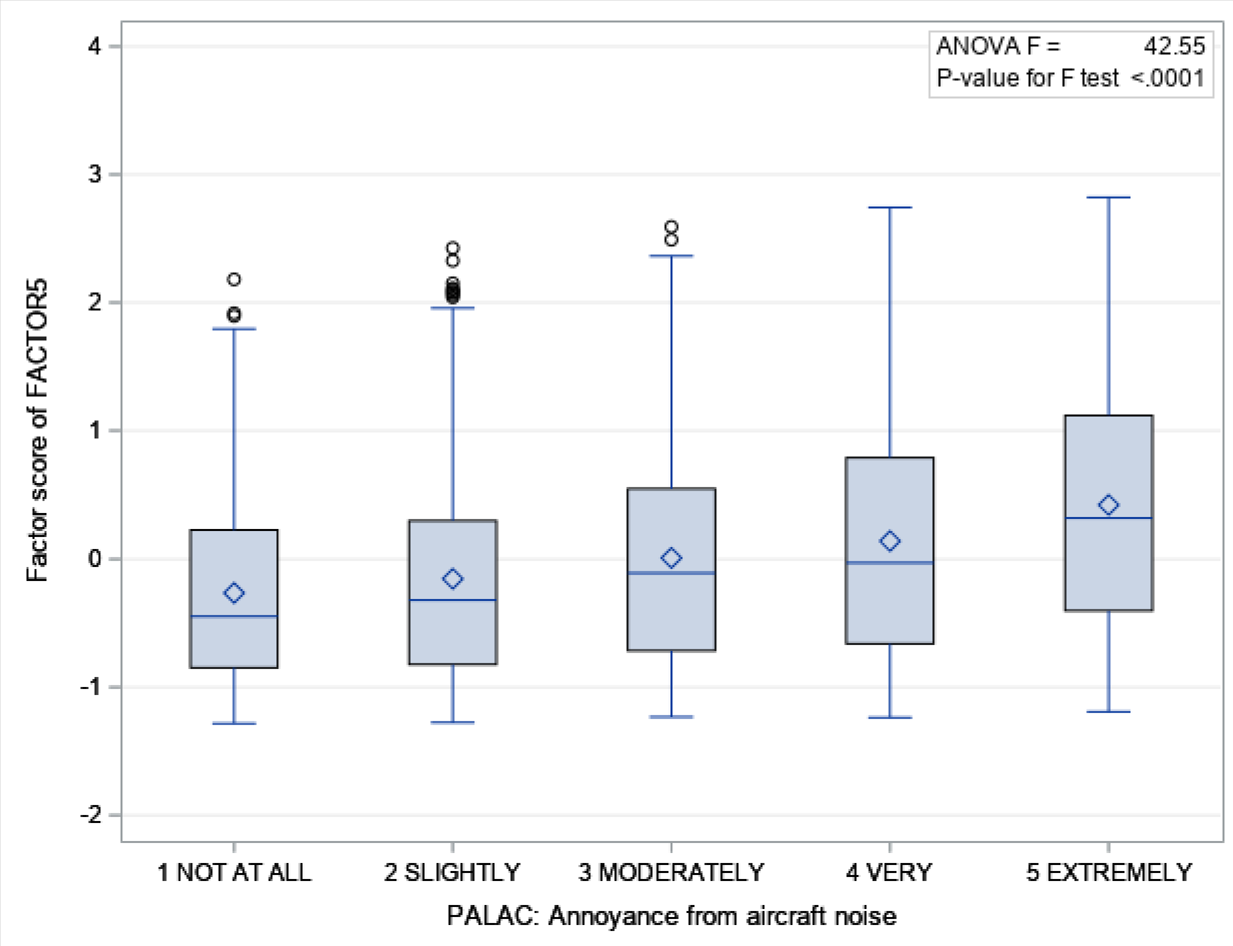

Figure D-9. Distribution of Factor Scores by PALAC for Factor 5

D.5.3.6 Factor 6: Beliefs About Noise Reduction by Officials or Pilots

Table D-23 presents the three variables loaded highly on Factor 6 and Figure D-10 shows the trend of Factor 6 with PALAC. The ANOVA test was significant ($F_{(4, 2319)}$ = 9.69, p < 0.0001). People who were more annoyed by aircraft noise have relatively stronger beliefs that officials or pilots could reduce the noise. The significant pairwise comparisons happened between PALAC=5 (Extremely) and the three adjacent less annoyed groups.

Table D-23. Questions with High Factor Loadings on Factor 6 (ranked by absolute value of loading)

Variable	Label	Q#	Factor Loading	p value for chi-square test
PRedACNseAPOthGov	Phone Could Other Gov Officials Reduce Noise	33b	0.812	< 0.0001
PRedACNseAPOff	Phone Could Officials of Airport Reduce Noise	33a	0.788	< 0.0001
PRedACNseAPilots	Phone Could Pilots Reduce Noise	33c	0.328	0.0028

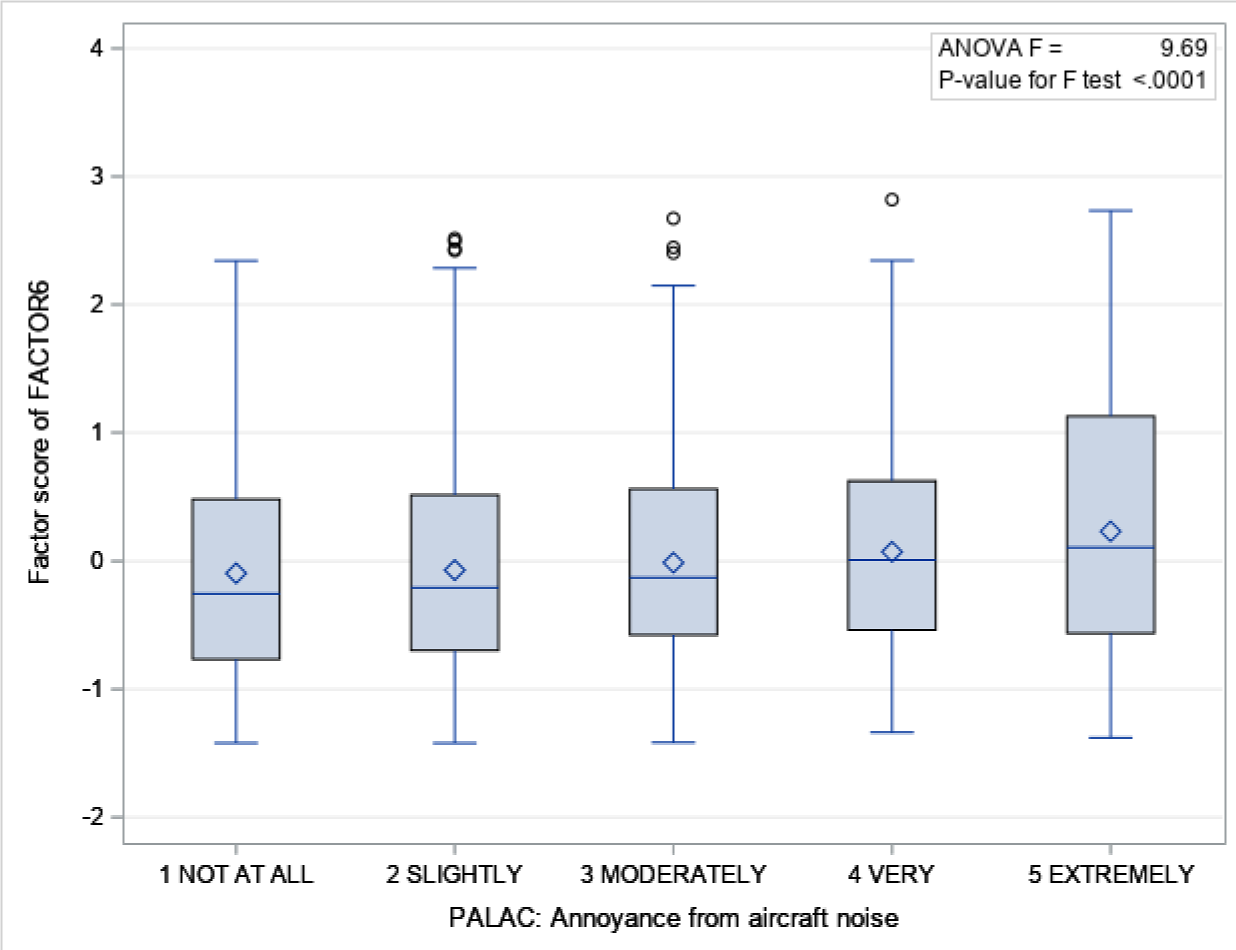

Figure D-10. Distribution of Factor Scores by PALAC for Factor 6

D.5.3.7 Factor 7: Startle, Frighten or Awaken

As shown in Table D-24, the three variables loaded highly on Factor 7 mainly concern disturbances from aircraft noise. It is not surprising the distribution of factor scores also indicated a significant group difference on PALAC ($F_{(4, 2319)}$ = 368.63, $p < 0.0001$). Figure D-11 shows a similar ascending pattern as in Factor 1 (Figure D-5), meaning the more annoyed by aircraft noise, the greater the startle/fright/awakening from aircraft noise. The pairwise comparisons suggest all tests were significant with p less than 0.05.

Table D-24. Questions with High Factor Loadings on Factor 7 (ranked by absolute value of loading)

Variable	Label	Q#	Factor Loading	p value for chi-square test
PACStartle	Phone Ever Startled Surprised from Aircraft	7b	0.651	< 0.0001
PACFrighten	Phone Ever Frightened from Aircraft	7c	0.569	< 0.0001
PACWake	Phone Ever Waked up from Aircraft	7a	0.476	< 0.0001

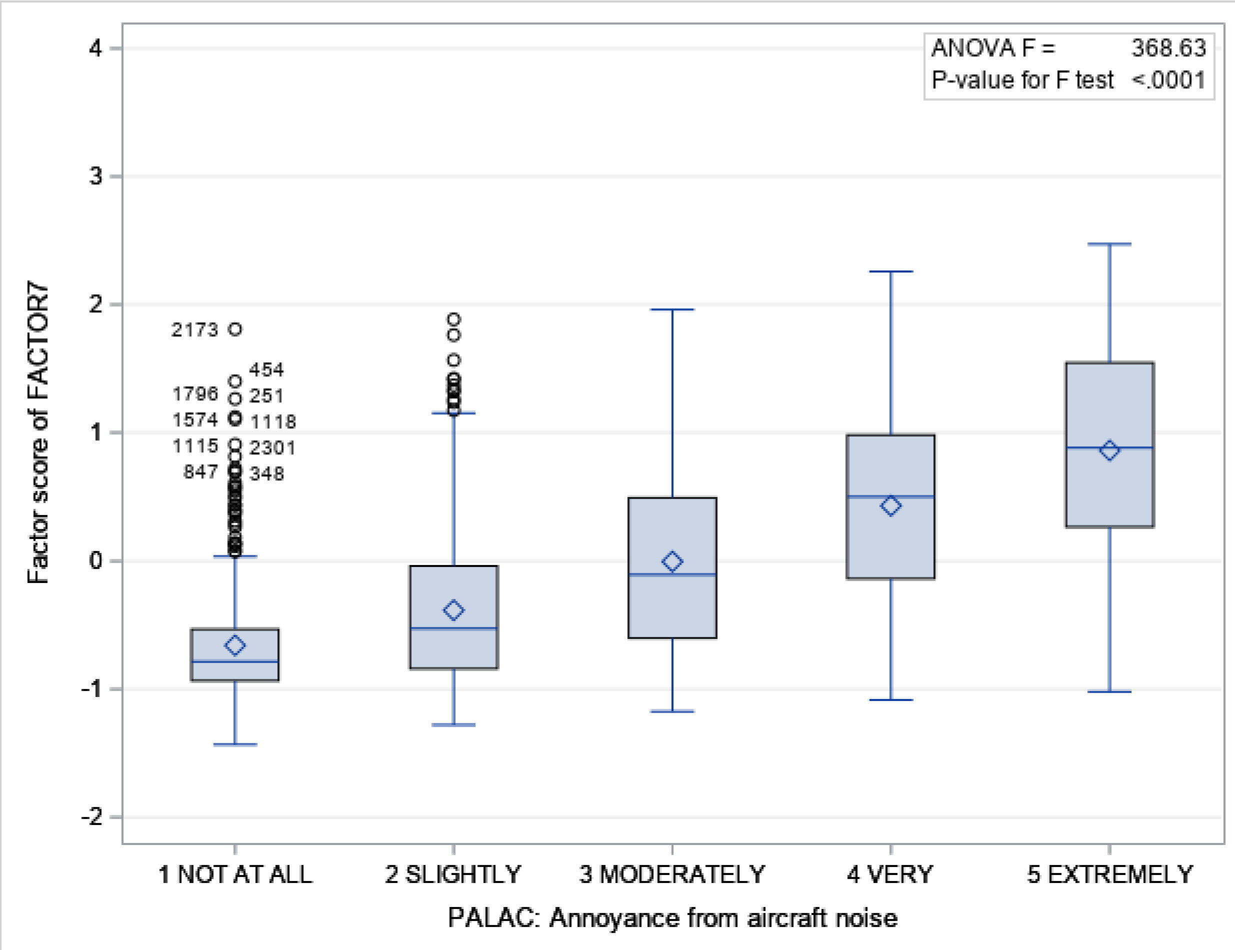

Figure D-11. Distribution of Factor Scores by PALAC for Factor 7

D.6 Technical Details of the CART Analysis

This section contains the supporting details of the Classification and Regression Tree (CART) analysis reported in Section D.4 to characterize highly and not highly annoyed (HA) respondents. Section D.6.1 describes the process for identifying significant predictors of HA by aircraft noise. Section D.6.2 describes the CART analysis procedures and model performance.

D.6.1 Identify Significant Predictors Using Logistic Regression

The HA respondents were defined to have PALAC (annoyance from aircraft noise) equal to a rating of 4 (Very) or 5 (Extremely). To describe the characteristics of HA respondents, we first ran a set of logistic regressions with the dichotomous HA indicator (i.e., HA=1 if highly annoyed, 0 otherwise) and each factor or variable as predictor. If the two HA groups were found to have significant group difference on any factor or variable, it means this factor or variable could be used to distinguish people's reaction on high annoyance. Here, we included five of the six demographic variables in the analysis excluded from the original EFA (see Section D.3). The variable PGender was the one demographic variable excluded from both analyses because of its high proportion of missing values.

Among all the predictors, 23 were found to have significant group difference on HA (meaning the p-value is less than 0.05). The predictors with a significant effect on HA and the direction of the response (not HA vs. HA) are shown in Table D-25. For each factor or question in the table, a respondent with data described in the "Not highly annoyed" column was more likely to be not HA, while a respondent with data described in the "Highly annoyed" column was more likely to be HA. For example, a respondent who reported in PACPctFlyOverH that less than 20 percent of flights are directly over their home was not likely to be HA, while a respondent who indicated in PDangerTrf that aircraft are the most dangerous for themselves and their property at home was likely to be HA. For the factors derived through EFA, the group comparison was based on factor score calculated using factor loadings. The "High" and "Low" results in the table are in terms of the mean of the factor scores. It is worth noting that among the demographic variables excluded from the original EFA, only age group (PAgeCat) was found to be significant.

With further processing described in Section D.6.2, Table D-25 supports the conclusions presented in Section D.4, i.e., the characteristics of highly and not highly annoyed respondents.

D.6.2 CART Analysis by DNL Band

The logistic regression models in the previous section only analyzed the simple relationship between the highly annoyed groups and the predictors. To account for possible confounding effects within the predictors, and to identify the ones with highest predictive power on HA, we further ran a CART analysis using only the significant predictors from Table D-25 for each stratum separately to control for the influence of aircraft noise exposure in 5-dB intervals of DNL. CART analysis is a decision tree method having the same goal as the more common parametric methods, such as linear or logistic regression. The objective was to identify the factors/variables that best predict a respondent's probability of being highly annoyed (or not) at a given DNL. In other words, holding DNL constant (within the group range), what best explains whether or not a respondent will indicate they are highly annoyed by aircraft noise.

Table D-25. Predictors with Significant Effect on HA and Direction of the Response

Predictor	Label	Question No.	Not Highly Annoyed	Highly Annoyed
DNL_Group			50-55	60+
Factor1	Concerns or complaints with neighborhood		Low	High
Factor2	Airport effort to deal with aircraft noise		High	Low
Factor3	General traffic noise/smells rating		Low	High
Factor4	Safety concerns		Slightly low	Slightly high
Factor5	Knowledge of aircraft noise issues		Slightly low	Slightly high
Factor6	Beliefs about noise reduction by officials or pilots		Slightly low	Slightly high
Factor7	Startle, Frighten or Awaken		Low	High
PAgeCat	Phone Categorical Age (Derived from PMonthBorn and PYearBorn)	45	65+, or 18-29	60-64
PACPctFlyOverHCAT	Phone Categorical Percent Aircraft Fly Directly Over (Derived from PACPctFlyOverH)	39	20% -	60% +
PNbrsViewACNse	Phone Neighbors Views Known On Aircraft Noise	23	Keep to themselves	Revealed a little or made clearly known
PACNseChg	Phone Aircraft Noise Increase Decrease Same	14	Stay the same or decreased	Increased
PDangerTrf	Phone Most Danger: Traffic Trains Aircraft	44	Road traffic or None	Aircraft
PACNseFuture	Phone Aircraft Noise in Next Few Years	15	Stay the same or decreased	Increased
PRespSenstve	Phone Sensitive to Noise	36	Not at all or slightly	Very or Extremely
PAuthDisputes	Phone Disputes between Airport and Residents	24	No	Yes
PACTakeOffLand	Phone Aircraft Landing Taking off Both	38	Don't know	About half and half
PCNTrfAccdnt	Phone Concern: Traffic Accidents Nearby	42	Not at all or slightly	Very or Extremely
PAPRedACNse	Phone Authorities Taken Steps Reduce Noise	34	Don't know or Yes	No
PAPImportant	Phone Importance of Airport for City	35	Extremely or slightly or not at all	Very
PHrOutsideCAT	Phone Categorical Hours Week Out-of-Doors (Derived from PHrOutside)	12	13-	21+
PHrdACGrd	Phone Heard Aircraft on the Ground	16	No	Yes
POtherNse	Phone Other Annoying Noise	1g1	No	Yes

In CART, observations are partitioned recursively into smaller sections and a model is fitted in each section. This process is called tree building and a formed section is represented by a node. When the outcome variable is continuous, regression trees are built; whereas classification trees are employed when the outcome variable is categorical. Compared to the parametric methods, CART does not make any distribution assumptions. It offers several sophisticated methods to deal with missing values. When a large number of predictors are involved, CART allows identifying complex interactions between predictors. CART is a useful tool to identify and select predictors that are strongly associated with an outcome.

The variable selection relies on the measures of variable importance. The PROC HPSPLIT function in SAS, for example, evaluates the variable importance based on two types of measures. The count-based measures, e.g., Count in the SAS output, record the number of times in the tree that a particular predictor appears in a split. The residual sum of squares (RSS, a comparison between predicted and observed values)-based measures are based on the change of RSS when a split is made. In the SAS output, the RSS-based measure is called Importance. Another measure, Relative (importance) is calculated as the importance of a particular variable divided by the maximum importance among all the variables that appear in the tree. Larger values indicate a higher importance of that variable in predicting the outcome. These measures are not comparable across models.

The classification tree was built in the current study and the model was evaluated with "10-fold cross-validation".[17] Cross-validation is a method to assess model performance on unseen data. "10-fold" means the training dataset is randomly divided into 10 folds and one fold, called the validation set, gets excluded during tree building. The built tree was later fit to the holdout fold (validation set) to test how well the model performs with new data. Classification accuracy of the tree model was reported as a measure of model performance. Classification accuracy is the number of persons that have been correctly assigned to the HA group or not HA group. A high accuracy means a better model-fit to the data. And the closer the accuracy between the training set and the validation set, the better the model will predict future data.

Table D-26 shows the classification accuracy for training and cross-validation within each DNL stratum. An accuracy of 80 percent indicates stable/good performance, which is seen in the 50-55 and 55-60 DNL strata. With accuracies between 73 percent and 78 percent, the higher DNL strata had slightly less stable performance. For DNL 50-55 and DNL 60-65, the classification accuracy of the final tree model was slightly higher in the training data than in the validation set, indicating that the model was slightly overfitting the training set. The classification accuracy for DNL 65+ was the lowest among the four DNL strata. This may be due to the small sample size (n=254), which reduced the ability to detect a clear pattern in this group.

Table D-26. Model Performance by DNL Stratum

Classification Accuracy	DNL Stratum (dB)			
	50-55	55-60	60-65	65+
Training	85%	82%	78%	74%
Cross-Validation	80%	81%	73%	73%

[17] Using PROC HPSPLIT in SAS

D.7 Caveats and Cautions

The detailed questions used for the phone questionnaire were not appropriate for the mail questionnaire because the subject matter would have disclosed the purpose of the survey and potentially biased responses to the aircraft annoyance question. Further, the longer content when presented in a mail survey format would likely depress response rates and potentially reduce the statistical representativeness of the findings.

For efficiency, the implemented design of the phone survey relied on re-surveying mail survey respondents. As a result, the phone survey may be subject to a degree of increased non-response bias, i.e., the mail survey had its own non-response and the phone survey's respondents were a subset of those with additional non-response at that stage.

Due to the potential non-response bias and because these analyses are based on unweighted data, caution should be used before utilizing these data to inform any potential actions. The phone survey findings should therefore be viewed as exploratory topics, which may provide direction for further research. Lastly, we do not expect perfect consistency between the mail and phone responses because a different person within the same household may have responded to each survey (see Section D.2.1).

Appendix E Nonresponse Bias Analysis

The U.S. Office of Management and Budget provides guidelines for evaluating potential nonresponse bias:

> A variety of methods can be used to examine nonresponse bias, for example, make comparisons between respondents and nonrespondents across subgroups using available sample frame variables. In the analysis of unit nonresponse, consider a multivariate modeling of response using respondent and nonrespondent frame variables to determine if nonresponse bias exists. Comparison of the respondents to known characteristics of the population from an external source can provide an indication of possible bias, especially if the characteristics in question are related to the survey's key variables. OMB (2006, pp. 16-17)

Section E.1 shows the results of a multivariate modeling of the probability, or propensity, to respond to the survey using sample frame variables that are known for both respondents and nonrespondents. Section E.2 compares characteristics of the respondents from each airport to demographic statistics from the 2010 census and the 2010-2014 American Community Survey (ACS). The set of addresses inside the DNL 50 dB contour for each airport forms an area of irregular shape that does not correspond to census geographic divisions such as census blocks or block groups. Thus, Census Bureau statistics such as the percentage of the population that is Hispanic are unavailable for the study region and for the noise strata within each airport's study region. Section E.2 compares demographic statistics for respondents to the Neighborhood Environmental Survey with statistics from the set of census blocks or block groups that contain sampled addresses.

An additional assessment of nonresponse bias was conducted by constructing nonresponse-adjusted weights and refitting the national curve with these weights. The results of that analysis are in Appendix G (Section G.3).

E.1 Response Propensity Analysis

The primary variable of interest, annoyance to aircraft noise, is of course unknown for the nonrespondents. Nonresponse bias can only be evaluated for variables that are available for both respondents and nonrespondents. For this survey, there is limited information from external sources that can be used to provide an indication of possible bias, because the target population for the NES was addresses exposed to DNL 50 dB or higher and the study region has irregular shape.

The main information available for evaluating potential nonresponse bias comes from the sampling frame information about the sampled addresses. Table E-1 lists the available variables, which represent characteristics known for all sampled addresses, both respondent and nonrespondent, of each airport community. The variables consist of:

- The values of DNL associated with each address in the sample
- Statistics from the 2010 decennial census giving characteristics of the census block containing the address. Each variable is in the form of a percentage of the persons or households in the census block having that characteristic. Note that these variables do not give characteristics of the address itself, but merely of the census block containing the address. Thus, an address may be in a census block with a high percentage of Hispanic residents, but the household members living at that address may be non-Hispanic.
- Statistics from the 2010-2014 ACS giving characteristics of the census block group containing the address. The "five-year" ACS estimates were used because they are available for smaller geographic regions than the one-year estimates (US Census Bureau 2017). Although 2010 census information is

available for census blocks, which are smaller than the block groups published by the ACS, the census had only 10 questions and did not measure income or poverty.

- Information provided by the sample vendor about the characteristics of the address. The variable "Phone match" takes on the value 1 if there is a landline telephone number linked to the address and 0 otherwise. Having a matching phone number has been found to be associated with higher response propensities and with demographic characteristics (Olson and Buskirk 2015). The other characteristic used from the vendor is whether the address is a single-family or multi-family dwelling unit.

Table E-1. Variables Used in Nonresponse Bias Analysis

Variable	Description
DNL	Day-Night Average Sound Level (dB) for each address in the selected sample
Phone match	Landline phone number available from vendor address database: yes vs. no
Multi-family dwelling	Multi-family vs. Single-family housing indicator: yes vs. no
% pop age 65+	Percentage of population age 65 and over in census block (Census 2010)
% pop age < 18	Percentage of population under age 18 in census block (Census 2010)
% pop black	Percentage of population who are black in census block (Census 2010)
% pop hispanic	Percentage of population who are Hispanic in census block (Census 2010)
% pop < poverty level	Percentage of population below poverty in census block group (ACS 2010-14)
% pop with college degree	Percentage of population with college degree in census block group (ACS 2010-14)
% rented HHs	Percentage of housing units that are rented in census block (Census 2010)
% 1-person HHs	Percentage of households containing a single person in census block group (ACS 2010-14)

The main analysis to evaluate potential nonresponse bias was a multivariate modeling of response using the sample frame characteristics from Table E-1. We fit a logistic regression model to the addresses in the selected sample[18] to examine the relationship between being a respondent to the survey and the covariates given in Table E-1. Each airport was fit separately to allow assessment of whether the relationship between propensity to respond and the covariates differs across airports.

The general logistic regression model used for the nonresponse bias analysis has the form:

$$\mathrm{P(household\ responds\ to\ survey)} = \frac{\exp(\beta_0 + \beta_1 DNL + \beta_2 x_2 + \cdots + \beta_k x_k)}{1 + \exp(\beta_0 + \beta_1 DNL + \beta_2 x_2 + \cdots + \beta_k x_k)}, \quad \text{(E.1)}$$

where DNL is the noise exposure level at that address (from the final DNL computations described in Section 7.5), and $x_2 \ldots x_k$ are other characteristics that are known for that sampled address. The coefficients, p-values, and odds ratios for the logistic regression model for each airport are given in Table E-2. A positive coefficient means that higher values of the covariate are associated with higher response rates, while a negative coefficient means that higher values of the covariate are associated with lower response rates.

The logistic regression model in Equation (E.1) can alternatively be written as:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 DNL + \beta_2 x_2 + \cdots + \beta_k x_k, \quad \text{(E.2)}$$

where p is the probability that someone at the sampled address responds to the survey, DNL is the noise exposure level at that address, and $x_2 \ldots x_k$ are other characteristics that are known for that sampled address.

[18] Addresses that were returned by the Post Office as undeliverable were considered ineligible and not included. Across all 20 airports, a total of 25,467 addresses were used in the modeling.

The coefficients in the logistic regression model may be interpreted as follows: each coefficient gives the expected change in the log odds ratio $\ln\left(\frac{p}{1-p}\right)$ associated with a change of one unit in the covariate when all of the other covariates are held the same. Alternatively, the exponentiated value of the coefficient gives the percentage change in the odds ratio $\frac{p}{1-p}$ associated with a unit change in the covariate. Thus, in the model for the AUS airport, the exponentiated coefficient for Multi-family dwelling is $\exp(-1.0354) =$ 0.36. This may be interpreted as meaning that the estimated odds of responding to the survey are about one-third as great for a household that lives in a single family dwelling as for a household with the same level of the other covariates that lives in a multi-family dwelling.

The coefficients in the model may be used to obtain an estimate of the probability that a household with specified characteristics provides a response to the survey, called the response propensity. Thus, a household in the AUS airport community that has DNL 60 dB; has a matching telephone number; that lives in a multi-family housing unit; lives in a census block in which 20 percent of residents are age 65 and over, 10 percent of residents are under age 18, 15 percent are black, 10 percent are Hispanic, and 10 percent of households rent the housing unit; that lives in a block group in which 1 percent of residents are below the poverty level, 50 percent of the residents have a college degree, and 20 percent of the households have one person, has the following predicted probability of responding to the survey:

$$\text{Predicted probability of responding to survey} = \frac{e^{(-.9920)}}{1+e^{(-.9920)}} = 0.2705, \qquad \text{(E.3)}$$

where the value -0.9920 is calculated using the regression coefficients in Table E-2 as

-0.9920 = 1.4771 - 0.0268 (60) + 0.0226 (1) – 1.0354 (1) + 0.0077 (20) - 0.0218 (0.10) + 0.0083 (0.15) + 0.0079 (0.10) -0.0059 (0.10) – 0.0009 (0.01) + 0.0011 (0.50) – 0.0105 (0.20).

Table E-2. Logistic Regression Response Propensity Model Coefficients for Each Airport

Airport Identifier	Number of Eligible Cases	Variable	Beta	Beta Std Error	Beta p-value	Beta Lower CL	Beta Upper CL	Odds Ratio	Odds Ratio Lower CL	Odds Ratio Upper CL
ABQ	1310	Intercept	3.1374	1.7455	0.0723	-0.3084	6.5415			
		DNL	-0.0718	0.0318	0.0241	-0.1343	-0.0093	0.9307	0.8744	0.9908
		Phone match: yes vs. no	0.6290	0.1271	0.0000	0.3802	0.8786	1.8758	1.4626	2.4075
		Multi-family dwelling: yes vs. no	-0.6052	0.2119	0.0043	-1.0262	-0.1943	0.5460	0.3584	0.8234
		% pop age 65+	0.0110	0.0097	0.2575	-0.0079	0.0301	1.0110	0.9921	1.0305
		% pop age < 18	-0.0158	0.0080	0.0479	-0.0315	-0.0001	0.9843	0.9690	0.9999
		% pop black	-0.0213	0.0083	0.0098	-0.0378	-0.0053	0.9789	0.9629	0.9947
		% pop hispanic	-0.0007	0.0040	0.8650	-0.0084	0.0071	0.9993	0.9916	1.0072
		% pop < poverty level	0.0080	0.0059	0.1773	-0.0036	0.0196	1.0080	0.9964	1.0198
		% pop with college degree	0.0094	0.0058	0.1030	-0.0019	0.0208	1.0095	0.9981	1.0210
		% rented HHs	-0.0069	0.0030	0.0213	-0.0128	-0.0011	0.9931	0.9872	0.9989
		% 1-person HHs	0.0164	0.0070	0.0196	0.0028	0.0303	1.0165	1.0028	1.0307
ALB	982	Intercept	-3.6088	1.3615	0.0080	-6.2981	-0.9550			
		DNL	0.0637	0.0220	0.0038	0.0208	0.1072	1.0658	1.0210	1.1132
		Phone match: yes vs. no	0.3407	0.1462	0.0198	0.0546	0.6280	1.4060	1.0561	1.8739
		Multi-family dwelling: yes vs. no	-0.1812	0.1770	0.3058	-0.5288	0.1656	0.8342	0.5893	1.1801
		% pop age 65+	-0.0085	0.0074	0.2549	-0.0232	0.0061	0.9916	0.9771	1.0061
		% pop age < 18	-0.0007	0.0109	0.9463	-0.0221	0.0207	0.9993	0.9781	1.0209
		% pop black	-0.0055	0.0115	0.6352	-0.0280	0.0171	0.9946	0.9724	1.0172
		% pop hispanic	-0.0161	0.0162	0.3198	-0.0482	0.0155	0.9840	0.9529	1.0156
		% pop < poverty level	-0.0126	0.0125	0.3143	-0.0373	0.0118	0.9875	0.9634	1.0119
		% pop with college degree	0.0053	0.0053	0.3155	-0.0050	0.0157	1.0053	0.9950	1.0159
		% rented HHs	-0.0013	0.0034	0.7098	-0.0080	0.0054	0.9987	0.9921	1.0054
		% 1-person HHs	0.0055	0.0051	0.2859	-0.0046	0.0156	1.0055	0.9954	1.0158
ATL	1478	Intercept	0.1355	0.8232	0.8692	-1.4837	1.7455			
		DNL	-0.0209	0.0116	0.0698	-0.0436	0.0017	0.9793	0.9573	1.0017
		Phone match: yes vs. no	0.5568	0.1258	0.0000	0.3105	0.8037	1.7450	1.3641	2.2339
		Multi-family dwelling: yes vs. no	-0.6027	0.1842	0.0011	-0.9654	-0.2426	0.5473	0.3808	0.7845
		% pop age 65+	0.0068	0.0065	0.2924	-0.0060	0.0195	1.0068	0.9941	1.0197
		% pop age < 18	0.0019	0.0079	0.8059	-0.0134	0.0174	1.0019	0.9867	1.0176
		% pop black	-0.0049	0.0042	0.2480	-0.0131	0.0034	0.9952	0.9870	1.0034
		% pop hispanic	-0.0025	0.0060	0.6744	-0.0143	0.0092	0.9975	0.9858	1.0092
		% pop < poverty level	0.0106	0.0052	0.0428	0.0003	0.0209	1.0107	1.0003	1.0211
		% pop with college degree	0.0042	0.0058	0.4665	-0.0072	0.0157	1.0042	0.9928	1.0158
		% rented HHs	-0.0024	0.0027	0.3781	-0.0078	0.0029	0.9976	0.9922	1.0030
		% 1-person HHs	0.0141	0.0054	0.0096	0.0035	0.0248	1.0142	1.0035	1.0251

Airport Identifier	Number of Eligible Cases	Variable	Beta	Beta Std Error	Beta p-value	Beta Lower CL	Beta Upper CL	Odds Ratio	Odds Ratio Lower CL	Odds Ratio Upper CL
AUS	1456	Intercept	1.4771	1.1598	0.2028	-0.7915	3.7575			
		DNL	-0.0268	0.0180	0.1364	-0.0621	0.0083	0.9736	0.9398	1.0084
		Phone match: yes vs. no	0.0226	0.1178	0.8479	-0.2088	0.2530	1.0228	0.8116	1.2879
		Multi-family dwelling: yes vs. no	-1.0354	0.1618	0.0000	-1.3563	-0.7215	0.3551	0.2576	0.4860
		% pop age 65+	0.0077	0.0065	0.2389	-0.0053	0.0204	1.0077	0.9948	1.0206
		% pop age < 18	-0.0218	0.0093	0.0191	-0.0402	-0.0036	0.9784	0.9606	0.9964
		% pop black	0.0083	0.0042	0.0488	0.0001	0.0167	1.0084	1.0001	1.0168
		% pop hispanic	0.0079	0.0050	0.1152	-0.0019	0.0179	1.0080	0.9981	1.0180
		% pop < poverty level	-0.0059	0.0052	0.2621	-0.0162	0.0044	0.9941	0.9839	1.0044
		% pop with college degree	-0.0009	0.0074	0.9079	-0.0155	0.0135	0.9991	0.9846	1.0136
		% rented HHs	0.0011	0.0029	0.7123	-0.0047	0.0069	1.0011	0.9953	1.0069
		% 1-person HHs	-0.0105	0.0067	0.1183	-0.0237	0.0026	0.9896	0.9765	1.0026
BDL	1016	Intercept	-0.9570	1.1838	0.4188	-3.2876	1.3584			
		DNL	0.0036	0.0175	0.8365	-0.0306	0.0380	1.0036	0.9698	1.0387
		Phone match: yes vs. no	0.5781	0.1372	0.0000	0.3097	0.8477	1.7826	1.3630	2.3344
		Multi-family dwelling: yes vs. no	-0.1765	0.1923	0.3587	-0.5545	0.2003	0.8382	0.5744	1.2218
		% pop age 65+	0.0218	0.0078	0.0052	0.0066	0.0372	1.0220	1.0066	1.0379
		% pop age < 18	-0.0004	0.0098	0.9668	-0.0197	0.0188	0.9996	0.9805	1.0190
		% pop black	0.0125	0.0101	0.2155	-0.0070	0.0326	1.0125	0.9930	1.0332
		% pop hispanic	0.0094	0.0113	0.4027	-0.0126	0.0319	1.0095	0.9875	1.0324
		% pop < poverty level	0.0161	0.0100	0.1077	-0.0035	0.0360	1.0163	0.9965	1.0366
		% pop with college degree	0.0018	0.0050	0.7257	-0.0080	0.0116	1.0018	0.9920	1.0116
		% rented HHs	-0.0118	0.0033	0.0003	-0.0183	-0.0054	0.9883	0.9819	0.9946
		% 1-person HHs	0.0062	0.0081	0.4402	-0.0095	0.0222	1.0063	0.9905	1.0224
BFI	1226	Intercept	-1.3543	1.0342	0.1904	-3.3867	0.6700			
		DNL	0.0043	0.0151	0.7770	-0.0254	0.0340	1.0043	0.9749	1.0346
		Phone match: yes vs. no	0.0640	0.1273	0.6152	-0.1859	0.3132	1.0661	0.8303	1.3678
		Multi-family dwelling: yes vs. no	-0.0632	0.1723	0.7136	-0.4013	0.2747	0.9387	0.6695	1.3161
		% pop age 65+	0.0217	0.0076	0.0044	0.0069	0.0369	1.0220	1.0069	1.0376
		% pop age < 18	0.0168	0.0089	0.0595	-0.0007	0.0343	1.0169	0.9993	1.0349
		% pop black	-0.0068	0.0053	0.2013	-0.0172	0.0036	0.9933	0.9830	1.0036
		% pop hispanic	-0.0064	0.0057	0.2656	-0.0178	0.0048	0.9936	0.9824	1.0048
		% pop < poverty level	-0.0013	0.0054	0.8141	-0.0119	0.0092	0.9987	0.9882	1.0093
		% pop with college degree	0.0199	0.0052	0.0001	0.0099	0.0302	1.0201	1.0100	1.0307
		% rented HHs	-0.0050	0.0029	0.0834	-0.0107	0.0006	0.9950	0.9894	1.0006
		% 1-person HHs	0.0031	0.0046	0.4948	-0.0058	0.0121	1.0031	0.9942	1.0122

Airport Identifier	Number of Eligible Cases	Variable	Beta	Beta				Odds Ratio	Odds Ratio	
				Std Error	p-value	Lower CL	Upper CL		Lower CL	Upper CL
BIL	1058	Intercept	0.7605	1.6015	0.6349	-2.3816	3.9035			
		DNL	-0.0063	0.0294	0.8312	-0.0639	0.0514	0.9938	0.9381	1.0528
		Phone match: yes vs. no	0.2464	0.1372	0.0724	-0.0228	0.5151	1.2794	0.9775	1.6738
		Multi-family dwelling: yes vs. no	-0.1112	0.1758	0.5271	-0.4569	0.2329	0.8948	0.6333	1.2622
		% pop age 65+	0.0094	0.0091	0.3015	-0.0080	0.0278	1.0095	0.9920	1.0282
		% pop age < 18	-0.0011	0.0087	0.8947	-0.0182	0.0158	0.9989	0.9820	1.0160
		% pop black	0.0350	0.0407	0.3899	-0.0403	0.1217	1.0356	0.9605	1.1294
		% pop hispanic	-0.0150	0.0140	0.2840	-0.0425	0.0124	0.9851	0.9584	1.0125
		% pop < poverty level	0.0074	0.0177	0.6776	-0.0271	0.0425	1.0074	0.9732	1.0434
		% pop with college degree	-0.0020	0.0092	0.8291	-0.0200	0.0161	0.9980	0.9802	1.0163
		% rented HHs	-0.0106	0.0035	0.0027	-0.0176	-0.0037	0.9895	0.9826	0.9963
		% 1-person HHs	-0.0055	0.0072	0.4412	-0.0197	0.0086	0.9945	0.9805	1.0086
DSM	1023	Intercept	-0.7446	1.1354	0.5119	-2.9703	1.4836			
		DNL	0.0215	0.0188	0.2527	-0.0153	0.0584	1.0217	0.9848	1.0601
		Phone match: yes vs. no	0.8734	0.1345	0.0000	0.6107	1.1383	2.3949	1.8418	3.1216
		Multi-family dwelling: yes vs. no	-0.6480	0.2928	0.0269	-1.2310	-0.0810	0.5231	0.2920	0.9222
		% pop age 65+	-0.0001	0.0098	0.9936	-0.0193	0.0192	0.9999	0.9809	1.0194
		% pop age < 18	-0.0255	0.0102	0.0124	-0.0456	-0.0056	0.9749	0.9554	0.9944
		% pop black	0.0428	0.0143	0.0028	0.0148	0.0711	1.0438	1.0149	1.0737
		% pop hispanic	-0.0074	0.0085	0.3838	-0.0245	0.0091	0.9926	0.9758	1.0091
		% pop < poverty level	-0.0030	0.0066	0.6478	-0.0159	0.0099	0.9970	0.9842	1.0099
		% pop with college degree	-0.0045	0.0082	0.5845	-0.0207	0.0116	0.9955	0.9795	1.0117
		% rented HHs	-0.0055	0.0040	0.1666	-0.0134	0.0023	0.9945	0.9867	1.0023
		% 1-person HHs	-0.0013	0.0068	0.8467	-0.0147	0.0121	0.9987	0.9854	1.0122
DTW	1181	Intercept	-0.3964	1.2176	0.7448	-2.7874	1.9892			
		DNL	0.0002	0.0194	0.9903	-0.0377	0.0383	1.0002	0.9630	1.0390
		Phone match: yes vs. no	0.6855	0.1279	0.0000	0.4362	0.9379	1.9848	1.5468	2.5546
		Multi-family dwelling: yes vs. no	0.5597	0.2667	0.0359	0.0381	1.0852	1.7501	1.0388	2.9599
		% pop age 65+	-0.0014	0.0059	0.8179	-0.0130	0.0103	0.9986	0.9871	1.0103
		% pop age < 18	-0.0114	0.0084	0.1769	-0.0280	0.0051	0.9887	0.9723	1.0051
		% pop black	-0.0022	0.0020	0.2502	-0.0061	0.0016	0.9978	0.9939	1.0016
		% pop hispanic	0.0238	0.0134	0.0764	-0.0025	0.0503	1.0241	0.9975	1.0516
		% pop < poverty level	-0.0009	0.0047	0.8439	-0.0102	0.0082	0.9991	0.9899	1.0083
		% pop with college degree	0.0051	0.0057	0.3718	-0.0061	0.0164	1.0051	0.9939	1.0165
		% rented HHs	-0.0017	0.0034	0.6294	-0.0085	0.0051	0.9983	0.9915	1.0051
		% 1-person HHs	-0.0026	0.0055	0.6367	-0.0134	0.0082	0.9974	0.9867	1.0082

Airport Identifier	Number of Eligible Cases	Variable	Beta	Beta				Odds Ratio	Odds Ratio	
				Std Error	p-value	Lower CL	Upper CL		Lower CL	Upper CL
LAS	1510	Intercept	-0.2931	0.7984	0.7135	-1.8664	1.2669			
		DNL	0.0049	0.0124	0.6896	-0.0192	0.0294	1.0050	0.9810	1.0298
		Phone match: yes vs. no	0.2595	0.1287	0.0437	0.0063	0.5109	1.2962	1.0063	1.6668
		Multi-family dwelling: yes vs. no	-0.3061	0.1865	0.1007	-0.6722	0.0594	0.7363	0.5106	1.0612
		% pop age 65+	0.0050	0.0057	0.3787	-0.0063	0.0161	1.0050	0.9937	1.0162
		% pop age < 18	-0.0122	0.0095	0.1992	-0.0308	0.0064	0.9879	0.9697	1.0064
		% pop black	0.0181	0.0114	0.1143	-0.0044	0.0405	1.0182	0.9956	1.0413
		% pop hispanic	0.0021	0.0053	0.6880	-0.0083	0.0127	1.0022	0.9917	1.0128
		% pop < poverty level	-0.0055	0.0058	0.3459	-0.0170	0.0059	0.9945	0.9831	1.0059
		% pop with college degree	0.0003	0.0060	0.9583	-0.0114	0.0120	1.0003	0.9887	1.0121
		% rented HHs	-0.0067	0.0031	0.0296	-0.0127	-0.0007	0.9934	0.9874	0.9993
		% 1-person HHs	-0.0002	0.0044	0.9584	-0.0089	0.0085	0.9998	0.9911	1.0085
LAX	1441	Intercept	0.4017	0.8824	0.6489	-1.3286	2.1333			
		DNL	0.0051	0.0089	0.5648	-0.0123	0.0226	1.0051	0.9878	1.0228
		Phone match: yes vs. no	0.3199	0.1156	0.0056	0.0937	0.5469	1.3770	1.0983	1.7279
		Multi-family dwelling: yes vs. no	-0.0268	0.1361	0.8439	-0.2940	0.2398	0.9736	0.7452	1.2709
		% pop age 65+	0.0039	0.0106	0.7161	-0.0172	0.0247	1.0039	0.9829	1.0251
		% pop age < 18	-0.0260	0.0089	0.0036	-0.0435	-0.0085	0.9743	0.9574	0.9915
		% pop black	-0.0083	0.0035	0.0195	-0.0152	-0.0013	0.9918	0.9849	0.9987
		% pop hispanic	-0.0042	0.0044	0.3339	-0.0128	0.0044	0.9958	0.9872	1.0044
		% pop < poverty level	-0.0042	0.0066	0.5202	-0.0171	0.0086	0.9958	0.9830	1.0086
		% pop with college degree	-0.0016	0.0072	0.8195	-0.0157	0.0125	0.9984	0.9844	1.0125
		% rented HHs	-0.0074	0.0027	0.0071	-0.0128	-0.0020	0.9927	0.9873	0.9980
		% 1-person HHs	0.0095	0.0061	0.1178	-0.0024	0.0215	1.0096	0.9976	1.0217
LGA	1435	Intercept	1.5095	0.9012	0.0940	-0.2521	3.2832			
		DNL	-0.0232	0.0118	0.0485	-0.0463	-0.0002	0.9771	0.9547	0.9998
		Phone match: yes vs. no	0.0989	0.1168	0.3971	-0.1303	0.3276	1.1039	0.8779	1.3877
		Multi-family dwelling: yes vs. no	-0.2222	0.1488	0.1355	-0.5141	0.0697	0.8007	0.5980	1.0722
		% pop age 65+	0.0028	0.0067	0.6740	-0.0105	0.0158	1.0028	0.9895	1.0159
		% pop age < 18	-0.0053	0.0115	0.6461	-0.0279	0.0172	0.9948	0.9725	1.0173
		% pop black	0.0009	0.0036	0.8052	-0.0063	0.0080	1.0009	0.9937	1.0081
		% pop hispanic	-0.0036	0.0028	0.2072	-0.0091	0.0020	0.9965	0.9909	1.0020
		% pop < poverty level	0.0028	0.0052	0.5847	-0.0073	0.0130	1.0028	0.9927	1.0131
		% pop with college degree	0.0003	0.0058	0.9635	-0.0112	0.0117	1.0003	0.9889	1.0118
		% rented HHs	-0.0090	0.0028	0.0012	-0.0145	-0.0036	0.9910	0.9856	0.9964
		% 1-person HHs	0.0065	0.0058	0.2649	-0.0049	0.0179	1.0065	0.9951	1.0181

Airport Identifier	Number of Eligible Cases	Variable	Beta	Beta				Odds Ratio	Odds Ratio	
				Std Error	p-value	Lower CL	Upper CL		Lower CL	Upper CL
LIT	1272	Intercept	-0.5013	1.0547	0.6346	-2.5688	1.5684			
		DNL	-0.0027	0.0192	0.8864	-0.0404	0.0348	0.9973	0.9604	1.0354
		Phone match: yes vs. no	0.3358	0.1215	0.0057	0.0978	0.5741	1.3990	1.1027	1.7755
		Multi-family dwelling: yes vs. no	-0.3850	0.2669	0.1492	-0.9177	0.1313	0.6804	0.3995	1.1403
		% pop age 65+	0.0085	0.0061	0.1637	-0.0034	0.0205	1.0085	0.9966	1.0207
		% pop age < 18	0.0020	0.0056	0.7246	-0.0090	0.0130	1.0020	0.9910	1.0131
		% pop black	-0.0017	0.0024	0.4728	-0.0064	0.0030	0.9983	0.9936	1.0030
		% pop hispanic	0.0077	0.0102	0.4502	-0.0124	0.0277	1.0077	0.9877	1.0281
		% pop < poverty level	0.0086	0.0060	0.1497	-0.0031	0.0203	1.0086	0.9969	1.0205
		% pop with college degree	-0.0091	0.0084	0.2764	-0.0257	0.0072	0.9909	0.9747	1.0072
		% rented HHs	-0.0033	0.0027	0.2300	-0.0087	0.0021	0.9967	0.9913	1.0021
		% 1-person HHs	0.0049	0.0084	0.5602	-0.0116	0.0215	1.0049	0.9885	1.0217
MEM	1570	Intercept	0.7333	0.6831	0.2830	-0.6099	2.0695			
		DNL	-0.0126	0.0093	0.1778	-0.0309	0.0058	0.9875	0.9696	1.0058
		Phone match: yes vs. no	0.5846	0.1270	0.0000	0.3358	0.8339	1.7942	1.3990	2.3022
		Multi-family dwelling: yes vs. no	-0.2041	0.1706	0.2316	-0.5387	0.1305	0.8154	0.5835	1.1394
		% pop age 65+	0.0090	0.0073	0.2149	-0.0055	0.0232	1.0091	0.9946	1.0235
		% pop age < 18	-0.0094	0.0079	0.2306	-0.0248	0.0060	0.9906	0.9755	1.0060
		% pop black	-0.0035	0.0022	0.1131	-0.0079	0.0008	0.9965	0.9921	1.0008
		% pop hispanic	-0.0090	0.0069	0.1905	-0.0231	0.0040	0.9910	0.9771	1.0040
		% pop < poverty level	0.0001	0.0047	0.9894	-0.0092	0.0093	1.0001	0.9908	1.0093
		% pop with college degree	0.0029	0.0051	0.5643	-0.0071	0.0129	1.0029	0.9930	1.0129
		% rented HHs	-0.0028	0.0025	0.2716	-0.0077	0.0022	0.9972	0.9923	1.0022
		% 1-person HHs	-0.0080	0.0051	0.1147	-0.0180	0.0019	0.9920	0.9821	1.0019
MIA	1677	Intercept	-1.1313	0.9448	0.2311	-2.9931	0.7135			
		DNL	-0.0025	0.0122	0.8388	-0.0264	0.0216	0.9975	0.9740	1.0218
		Phone match: yes vs. no	0.4560	0.1186	0.0001	0.2235	0.6885	1.5777	1.2504	1.9907
		Multi-family dwelling: yes vs. no	0.0224	0.1327	0.8661	-0.2377	0.2828	1.0226	0.7884	1.3268
		% pop age 65+	0.0196	0.0047	0.0000	0.0104	0.0290	1.0198	1.0104	1.0294
		% pop age < 18	0.0078	0.0096	0.4161	-0.0110	0.0267	1.0078	0.9890	1.0270
		% pop black	-0.0018	0.0065	0.7827	-0.0146	0.0109	0.9982	0.9855	1.0110
		% pop hispanic	-0.0012	0.0052	0.8191	-0.0113	0.0090	0.9988	0.9887	1.0091
		% pop < poverty level	0.0011	0.0049	0.8243	-0.0084	0.0106	1.0011	0.9916	1.0106
		% pop with college degree	0.0064	0.0048	0.1791	-0.0030	0.0157	1.0064	0.9970	1.0158
		% rented HHs	-0.0052	0.0024	0.0278	-0.0098	-0.0006	0.9948	0.9902	0.9994
		% 1-person HHs	0.0042	0.0041	0.3057	-0.0038	0.0121	1.0042	0.9962	1.0122

Airport Identifier	Number of Eligible Cases	Variable	Beta	Beta				Odds Ratio	Odds Ratio	
				Std Error	p-value	Lower CL	Upper CL		Lower CL	Upper CL
ORD	1079	Intercept	1.0559	1.0273	0.3041	-0.9568	3.0745			
		DNL	-0.0135	0.0130	0.2988	-0.0389	0.0119	0.9866	0.9618	1.0120
		Phone match: yes vs. no	0.3777	0.1384	0.0064	0.1061	0.6490	1.4589	1.1119	1.9137
		Multi-family dwelling: yes vs. no	-0.2862	0.1708	0.0939	-0.6214	0.0489	0.7511	0.5372	1.0501
		% pop age 65+	0.0029	0.0068	0.6690	-0.0105	0.0161	1.0029	0.9896	1.0162
		% pop age < 18	0.0046	0.0102	0.6493	-0.0153	0.0247	1.0047	0.9848	1.0250
		% pop black	-0.0038	0.0077	0.6244	-0.0192	0.0113	0.9962	0.9809	1.0114
		% pop hispanic	-0.0055	0.0043	0.2047	-0.0141	0.0030	0.9945	0.9860	1.0030
		% pop < poverty level	0.0043	0.0079	0.5855	-0.0113	0.0198	1.0043	0.9888	1.0200
		% pop with college degree	0.0020	0.0059	0.7379	-0.0096	0.0136	1.0020	0.9904	1.0137
		% rented HHs	-0.0071	0.0028	0.0113	-0.0127	-0.0016	0.9929	0.9874	0.9984
		% 1-person HHs	-0.0091	0.0061	0.1336	-0.0210	0.0028	0.9910	0.9792	1.0028
SAV	1290	Intercept	4.0090	1.7147	0.0194	0.6586	7.3853			
		DNL	-0.0607	0.0287	0.0347	-0.1172	-0.0045	0.9411	0.8894	0.9955
		Phone match: yes vs. no	0.3773	0.1319	0.0042	0.1187	0.6361	1.4583	1.1260	1.8891
		Multi-family dwelling: yes vs. no	0.3436	0.1751	0.0497	0.0015	0.6885	1.4100	1.0015	1.9906
		% pop age 65+	-0.0062	0.0107	0.5651	-0.0273	0.0148	0.9939	0.9731	1.0149
		% pop age < 18	-0.0296	0.0102	0.0037	-0.0499	-0.0098	0.9708	0.9513	0.9903
		% pop black	-0.0123	0.0050	0.0137	-0.0222	-0.0027	0.9878	0.9781	0.9973
		% pop hispanic	-0.0074	0.0066	0.2617	-0.0206	0.0054	0.9926	0.9796	1.0054
		% pop < poverty level	-0.0008	0.0065	0.9061	-0.0136	0.0119	0.9992	0.9865	1.0120
		% pop with college degree	0.0005	0.0063	0.9355	-0.0118	0.0128	1.0005	0.9883	1.0129
		% rented HHs	-0.0099	0.0025	0.0001	-0.0148	-0.0050	0.9901	0.9853	0.9950
		% 1-person HHs	0.0026	0.0067	0.6956	-0.0105	0.0157	1.0026	0.9896	1.0158
SJC	1179	Intercept	-0.1317	0.9167	0.8857	-1.9311	1.6650			
		DNL	-0.0055	0.0144	0.7043	-0.0337	0.0227	0.9946	0.9669	1.0230
		Phone match: yes vs. no	0.3778	0.1440	0.0087	0.0955	0.6604	1.4591	1.1002	1.9356
		Multi-family dwelling: yes vs. no	-0.3204	0.1508	0.0336	-0.6165	-0.0251	0.7258	0.5398	0.9752
		% pop age 65+	0.0152	0.0075	0.0445	0.0006	0.0305	1.0153	1.0006	1.0309
		% pop age < 18	0.0032	0.0095	0.7324	-0.0153	0.0218	1.0032	0.9848	1.0221
		% pop black	0.0189	0.0168	0.2600	-0.0141	0.0523	1.0191	0.9860	1.0537
		% pop hispanic	-0.0026	0.0043	0.5491	-0.0109	0.0058	0.9975	0.9891	1.0058
		% pop < poverty level	0.0024	0.0069	0.7260	-0.0111	0.0158	1.0024	0.9889	1.0159
		% pop with college degree	0.0113	0.0042	0.0069	0.0032	0.0196	1.0114	1.0032	1.0198
		% rented HHs	-0.0060	0.0025	0.0159	-0.0109	-0.0011	0.9940	0.9891	0.9989
		% 1-person HHs	-0.0061	0.0057	0.2861	-0.0173	0.0051	0.9939	0.9829	1.0051

Airport Identifier	Number of Eligible Cases	Variable	Beta	Beta				Odds Ratio	Odds Ratio	
				Std Error	p-value	Lower CL	Upper CL		Lower CL	Upper CL
SYR	952	Intercept	-1.8944	1.3545	0.1620	-4.5661	0.7499			
		DNL	-0.0155	0.0200	0.4378	-0.0549	0.0237	0.9846	0.9466	1.0240
		Phone match: yes vs. no	0.5798	0.1589	0.0003	0.2691	0.8924	1.7857	1.3087	2.4409
		Multi-family dwelling: yes vs. no	-0.8742	0.2693	0.0012	-1.4092	-0.3511	0.4172	0.2443	0.7039
		% pop age 65+	0.0408	0.0096	0.0000	0.0223	0.0598	1.0416	1.0225	1.0616
		% pop age < 18	0.0368	0.0138	0.0076	0.0100	0.0641	1.0375	1.0100	1.0662
		% pop black	0.0088	0.0172	0.6073	-0.0250	0.0426	1.0089	0.9753	1.0436
		% pop hispanic	0.0031	0.0238	0.8961	-0.0437	0.0500	1.0031	0.9573	1.0512
		% pop < poverty level	0.0290	0.0165	0.0799	-0.0033	0.0617	1.0294	0.9967	1.0636
		% pop with college degree	0.0227	0.0080	0.0048	0.0070	0.0386	1.0229	1.0070	1.0393
		% rented HHs	-0.0079	0.0045	0.0789	-0.0167	0.0009	0.9922	0.9835	1.0009
		% 1-person HHs	0.0183	0.0092	0.0473	0.0003	0.0365	1.0185	1.0003	1.0371
TUS	1472	Intercept	1.2850	0.9181	0.1616	-0.5176	3.0842			
		DNL	-0.0126	0.0161	0.4336	-0.0440	0.0190	0.9875	0.9569	1.0192
		Phone match: yes vs. no	0.4793	0.1205	0.0001	0.2430	0.7155	1.6150	1.2751	2.0453
		Multi-family dwelling: yes vs. no	-0.1452	0.1529	0.3425	-0.4460	0.1540	0.8649	0.6402	1.1665
		% pop age 65+	-0.0079	0.0120	0.5076	-0.0317	0.0158	0.9921	0.9688	1.0159
		% pop age < 18	-0.0225	0.0114	0.0481	-0.0449	-0.0003	0.9778	0.9561	0.9997
		% pop black	0.0059	0.0183	0.7460	-0.0301	0.0466	1.0059	0.9703	1.0477
		% pop hispanic	-0.0018	0.0064	0.7747	-0.0144	0.0108	0.9982	0.9857	1.0108
		% pop < poverty level	-0.0042	0.0053	0.4281	-0.0146	0.0061	0.9958	0.9855	1.0061
		% pop with college degree	0.0053	0.0107	0.6205	-0.0157	0.0264	1.0053	0.9844	1.0268
		% rented HHs	-0.0064	0.0028	0.0236	-0.0119	-0.0009	0.9936	0.9882	0.9991
		% 1-person HHs	0.0032	0.0075	0.6644	-0.0114	0.0178	1.0032	0.9887	1.0180

Table E-3 gives the number of airports where each covariate was statistically significant at the 0.05, 0.01, and 0.001 levels of significance.[19] From the model, the following variables are significantly associated with having a higher response propensity for a majority of airports: having a matching telephone number and living in a census block with a high percentage of rented housing units. These variables have been demonstrated to be related to response rates in many other surveys (see, for example, Montaquila et al. 2013), and the NES fits the general pattern. Most importantly, the noise exposure level, measured by DNL, is not significantly associated with the probability of responding to the survey for the majority of airports.

Table E-3. Number of Airports Where Predictor Variable is Statistically Significant

Predictor Variable	Number of Airports where variable is statistically significant with:		
	p-value<.05	p-value<.01	p-value<.001
DNL	3	1	0
Phone match: yes vs. no	16	14	9
Multi-family dwelling: yes vs. no	7	3	1
% pop age 65+	5	4	2
% pop age < 18	6	2	0
% pop black	5	2	0
% pop hispanic	1	0	0
% pop < poverty level	1	0	0
% pop with college degree	3	3	1
% rented HHs	11	6	2
% 1-person HHs	2	0	0

[19] The statistical significance was determined individually for each airport, and the p-values in the table were not adjusted for multiple comparisons. If a multiple comparisons analysis is desired, a Bonferroni correction can be applied to the p-values in Table E-2.

E.2 Comparison with 2010 Census and American Community Survey Statistics

Although Census Bureau statistics on the demographics of the target are unavailable for the sampled region, demographic statistics can be calculated from decennial census information for a somewhat larger region consisting of the set of census blocks that encompass the sampled region. This can give a general idea of the concordance between the characteristics of the respondents and the population, although differences between the census estimates and estimates from the NES could be due to the mismatch between the area sampled (with noise exposure of DNL 50 dB and above) and the larger region that is contained in the census blocks.[20]

Demographic information was obtained from the 2010 census for each census block that contained at least one address in the sampled area. The census estimate of percent Hispanic for an airport community was calculated as (total number of Hispanic adults in the census blocks)/(total number of adults in the census blocks), with similar calculations to find the percent white non-Hispanic, percent male, and percent over age 50 or age 65.

Demographic statistics calculated from the NES are presented in Tables E-4 through E-8. These tables give the percentage of respondents who fall in each demographic category. The estimated percent Hispanic at ABQ in Table E-4, for example, is calculated as (number of respondents at ABQ who report Hispanic for ethnicity)/(number of respondents at ABQ who report a value for ethnicity). Thus, for ABQ, 55.3 percent of the respondents report being Hispanic; the percentage from the census blocks encompassing the sampling region is 60.3 percent. The confidence intervals for the percentages were calculated using a weight of one for every respondent and using the stratification from the sampling design.

Disagreement between the percentage calculated from the NES and the percentage from the 2010 census does not necessarily mean there is nonresponse bias. First, as noted above, the statistics from the 2010 census are for a larger area than the study region in each airport: if, for example, the Hispanic population in the encompassing census blocks is concentrated in the study region, and the households in the parts of those census blocks that are outside of the study region are predominantly non-Hispanic, then the NES percent Hispanic would be expected to be larger than the percent Hispanic from the 2010 census. Second, the census data were collected in 2010, and it is possible that the demographic composition of the region has shifted since then. Third, the NES statistics given are percentages of the respondents, and are not necessarily unbiased estimates of the study region population with those characteristics.[21] Nevertheless, very large differences between the NES statistics and the 2010 census percentages may indicate potential nonresponse bias.

[20] Data from the 2010 census were used for these comparisons instead of data from the more recent ACS because the ACS statistics are only available for the much larger geography of block groups rather than census blocks. If the ACS had been used, there would have been a large difference in the sizes of the regions being compared.

[21] Under design-based inference, sampling weights would be used for estimating population quantities such as the percentage Hispanic for the entire region. The base sampling weight for each responding adult would be calculated as the product of the reciprocal of the probability of selection for each address and the reciprocal of the number of adults in the household. But the NES was designed to estimate a regression relationship, and its design is not efficient for estimating percentages in the region. In most airports, the sampling fraction was much higher in high noise strata than in low noise strata. Thus, respondents in the low noise strata have much higher weights than respondents in the high noise strata. Consequently, weighted estimates rely almost entirely on the data from the low (50-55) noise strata and have much higher standard errors than the unweighted estimates. The unweighted estimates calculate the percentage of respondents in each demographic category. If the census proportions and household sizes are similar in each individual noise stratum, then the unweighted estimates should be approximately equal to the overall census proportions if there is no nonresponse bias.

Table E-4. Comparison with 2010 census: Percent Hispanic

Airport Identifier	Number of Respondents[a]	NES Percent Hispanic	95% Confidence Interval		Census 2010 Percent Hispanic[b]
			Lower	Upper	
ABQ	492	55.3	50.9	59.6	60.6
ALB	488	2.5	1.4	4.2	3.3
ATL	488	5.1	3.5	7.5	6.6
AUS	490	36.3	32.2	40.7	51.6
BDL	501	3.2	2.0	5.1	3.9
BFI	502	6.8	4.9	9.3	10.2
BIL	496	4.0	2.6	6.1	3.6
DSM	519	3.7	2.4	5.6	6.3
DTW	478	2.5	1.4	4.3	3.3
LAS	509	16.9	13.9	20.4	24.9
LAX	497	36.2	32.1	40.5	58.8
LGA	511	36.8	32.7	41.1	44.4
LIT	509	1.2	0.5	2.5	3.0
MEM	496	2.4	1.4	4.2	5.7
MIA	518	84.4	81.0	87.2	78.3
ORD	490	13.5	10.7	16.8	18.3
SAV	509	3.1	1.9	5.0	7.5
SJC	484	21.3	17.9	25.1	29.1
SYR	500	2.0	1.1	3.6	2.1
TUS	508	76.6	72.7	80.0	81.0

[a]Number of respondents with a valid response to the question.
[b]Percent of the population age 18 and over.

Table E-5. Comparison with 2010 census: Percent White non-Hispanic

Airport Identifier	Number of Respondents[a]	NES Percent White, Non-Hispanic	95% Confidence Interval		Census 2010 Percent White, Non-Hispanic[b]
			Lower	Upper	
ABQ	492	34.3	30.3	38.7	29.1
ALB	488	85.7	82.3	88.5	84.6
ATL	488	14.3	11.5	17.7	7.8
AUS	490	36.7	32.6	41.1	21.9
BDL	501	89.0	86.0	91.5	87.0
BFI	502	48.8	44.5	53.2	32.1
BIL	496	90.1	87.2	92.4	90.9
DSM	519	90.8	88.0	93.0	87.0
DTW	478	57.5	53.1	61.9	67.5
LAS	509	57.8	53.4	62.0	50.1
LAX	497	28.8	25.0	32.9	15.6
LGA	511	24.7	21.1	28.6	17.4
LIT	509	26.7	23.1	30.7	29.7
MEM	496	33.7	29.7	37.9	33.9
MIA	518	9.3	7.1	12.1	14.7
ORD	490	76.3	72.4	79.9	65.1
SAV	509	78.6	74.8	81.9	75.0
SJC	484	35.1	31.0	39.5	27.9
SYR	500	92.6	90.0	94.6	92.1
TUS	508	18.5	15.4	22.1	13.2

[a]Number of respondents with a valid response to the question.
[b]Percent of the population age 18 and over.

Table E-6. Comparison with 2010 census: Percent Male

Airport Identifier	Number of Respondents[a]	NES Percent Male	95% Confidence Interval		Census 2010 Percent Male[b]
			Lower	Upper	
ABQ	510	44.3	40.1	48.7	50.1
ALB	501	45.3	41.0	49.7	47.1
ATL	501	38.9	34.8	43.3	44.1
AUS	506	45.5	41.2	49.8	50.1
BDL	516	47.9	43.6	52.2	47.7
BFI	511	48.3	44.0	52.7	50.1
BIL	505	46.5	42.2	50.9	50.1
DSM	527	42.5	38.4	46.8	47.7
DTW	503	41.2	36.9	45.5	47.4
LAS	522	52.7	48.4	56.9	51.3
LAX	518	45.6	41.3	49.9	47.7
LGA	527	42.9	38.7	47.1	46.2
LIT	531	34.1	30.2	38.2	46.8
MEM	508	35.8	31.8	40.1	45.3
MIA	529	45.7	41.5	50.0	48.9
ORD	499	46.9	42.6	51.3	48.3
SAV	526	44.9	40.7	49.1	49.2
SJC	498	53.8	49.4	58.1	51.6
SYR	511	44.0	39.8	48.4	46.5
TUS	518	43.6	39.4	47.9	47.1

[a]Number of respondents with a valid response to the question.
[b]Percent of the population age 18 and over.

Table E-7. Comparison with 2010 census: Percent Over Age 50

Airport Identifier	Number of Respondents[a]	NES Percent over Age 50	95% Confidence Interval		Census 2010 Percent over Age 50
			Lower	Upper	
ABQ	504	67.3	63.0	71.2	35.4
ALB	495	71.1	67.0	74.9	46.8
ATL	495	59.6	55.2	63.8	30.9
AUS	503	50.7	46.3	55.0	31.2
BDL	508	69.1	64.9	73.0	46.2
BFI	507	52.9	48.5	57.2	38.7
BIL	505	61.2	56.9	65.3	45.0
DSM	526	61.2	57.0	65.3	41.7
DTW	492	67.1	62.8	71.1	43.2
LAS	522	54.8	50.5	59.0	33.9
LAX	513	51.9	47.5	56.1	30.6
LGA	518	58.3	54.0	62.5	37.5
LIT	521	72.2	68.2	75.8	45.3
MEM	501	59.7	55.3	63.9	35.7
MIA	524	63.4	59.2	67.4	37.5
ORD	495	57.6	53.2	61.9	42.0
SAV	522	61.3	57.1	65.4	42.6
SJC	496	34.9	30.8	39.2	25.8
SYR	505	70.7	66.6	74.5	48.0
TUS	509	60.5	56.2	64.7	33.0

[a]Number of respondents with a valid response to the question.

Table E-8. Comparison with 2010 census: Percent Over Age 65

Airport Identifier	Number of Respondents[a]	NES Percent over Age 65	95% Confidence Interval		Census 2010 Percent over Age 65
			Lower	Upper	
ABQ	504	27.0	23.3	31.0	12.0
ALB	495	37.6	33.4	41.9	20.4
ATL	495	26.5	22.8	30.5	9.0
AUS	503	26.4	22.8	30.5	11.7
BDL	508	30.1	26.3	34.2	18.6
BFI	507	20.5	17.2	24.2	14.1
BIL	505	25.9	22.3	29.9	16.5
DSM	526	27.8	24.1	31.7	17.1
DTW	492	33.9	29.9	38.2	16.8
LAS	522	19.9	16.7	23.6	12.3
LAX	513	23.8	20.3	27.7	10.2
LGA	518	27.2	23.6	31.2	15.3
LIT	521	35.1	31.1	39.3	18.3
MEM	501	23.6	20.0	27.5	13.2
MIA	524	34.7	30.8	38.9	18.0
ORD	495	28.1	24.3	32.2	19.8
SAV	522	29.1	25.4	33.2	17.7
SJC	496	13.5	10.8	16.8	9.0
SYR	505	38.0	33.9	42.3	21.9
TUS	509	28.1	24.4	32.2	12.3

[a]Number of respondents with a valid response to the question.

Tables E-4 and E-5 indicate that in AUS, LAS, LAX, and LGA, the NES percent Hispanic is lower, and the NES percent white non-Hispanic is higher, than the corresponding statistics from the 2010 census. For most of the other airports, the 2010 census percentage is inside or close to an endpoint of the confidence interval. The analysis in Chapter 9 gave no indication that the national dose-response curve differs for white non-Hispanic and minority respondents.

Table E-6 indicates that the percentage of male respondents from the NES is below 40 percent for LIT and MEM, which is statistically significantly lower than the 2010 census percentage. For the other airports, however, the 2010 census percent male is inside or is close to one of the endpoints of the NES confidence interval.

Tables E-7 and E-8, however, show that the percentages of NES respondents who are over age 50, or who are over age 65, are much higher than the corresponding population percentages from the 2010 census. On average, the percentage of NES respondents who are over age 50 is more than 20 percentage points higher than the 2010 census percent of adults who are over age 50; the average percentage of NES respondents who are over age 65 is more than 12 percentage points higher than the census percentage.

To investigate potential nonresponse bias caused by the overrepresentation of older respondents, Westat fit dose-response curves separately by age groups. An analysis by age group was not one of the pre-planned hypotheses treated in Chapter 9, but was undertaken here to investigate potential nonresponse bias in the curve. Table E-9 gives the logistic regression coefficients and confidence intervals for the models, which were fit to the data from all airports.[22] Figure E-1 displays the two curves for the over-50 and under-50 age groups, and Figure E-2 displays the two curves for the over-65 and under-65 age groups.

Table E-9. Model Coefficients for National Curve, by age group

Age Group	Intercept	Slope	Standard Error (Intercept)	Standard Error (Slope)	Lower 95% Confidence Limit (Intercept)	Upper 95% Confidence Limit (Intercept)	Lower 95% Confidence Limit (Slope)	Upper 95% Confidence Limit (Slope)
All	-8.4304	0.1397	0.5789	0.0098	-9.6420	-7.2187	0.1192	0.1602
Under 50	-8.4240	0.1386	0.6044	0.0104	-9.6890	-7.1590	0.1170	0.1603
Over 50	-8.5339	0.1418	0.6875	0.0116	-9.9727	-7.0950	0.1174	0.1662
Under 65	-8.3284	0.1384	0.6097	0.0101	-9.6045	-7.0522	0.1171	0.1598
Over 65	-8.6232	0.1414	0.8577	0.0152	-10.4185	-6.8279	0.1097	0.1731

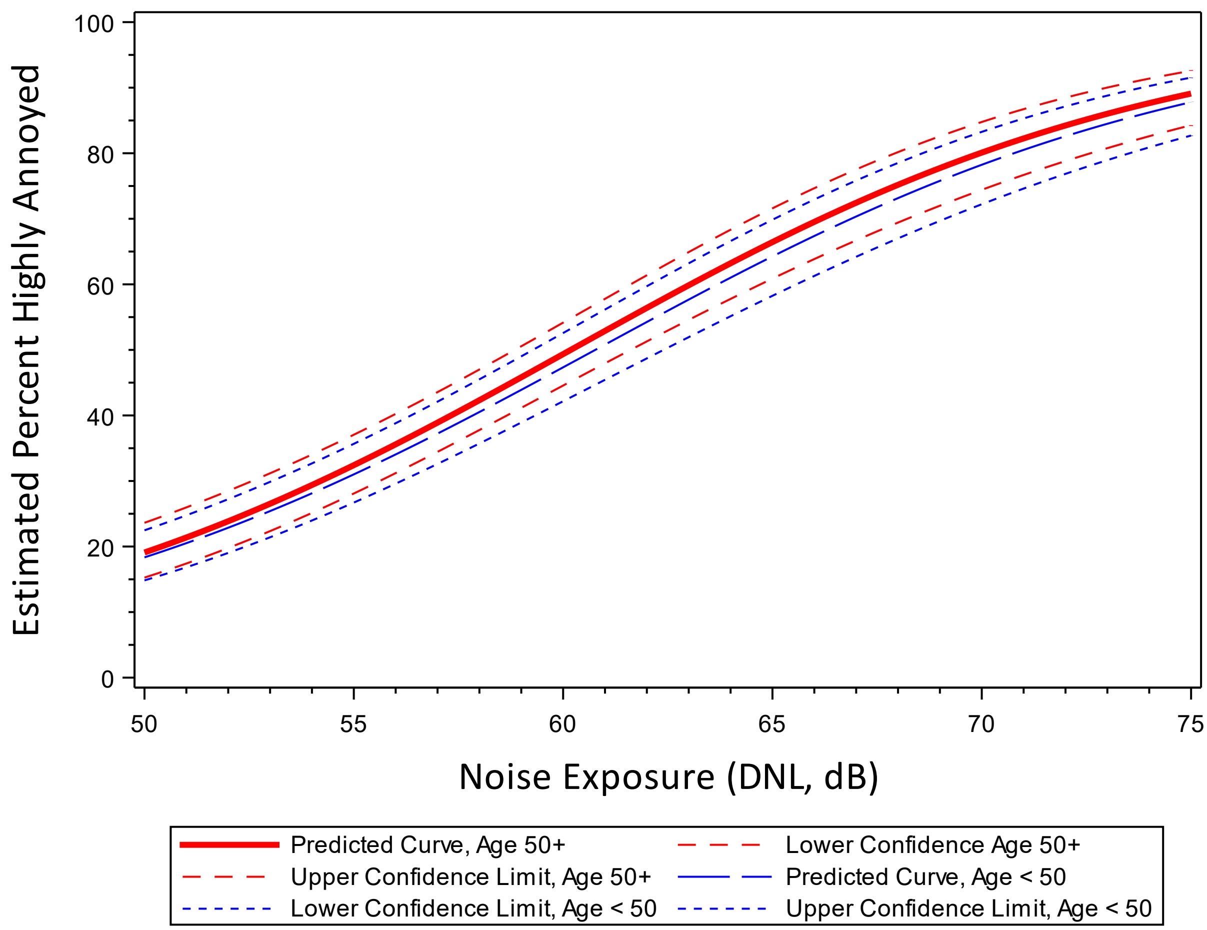

Figure E-1. National dose-response curves for respondents over age 50 and under age 50.

[22] Although the age group subsets have fewer observations, the standard errors for the national curve for each age group subset are only slightly larger than those for the full data set. This is because the primary source of variability for the model coefficients is the airport-to-airport variability, as discussed in Section G.2.

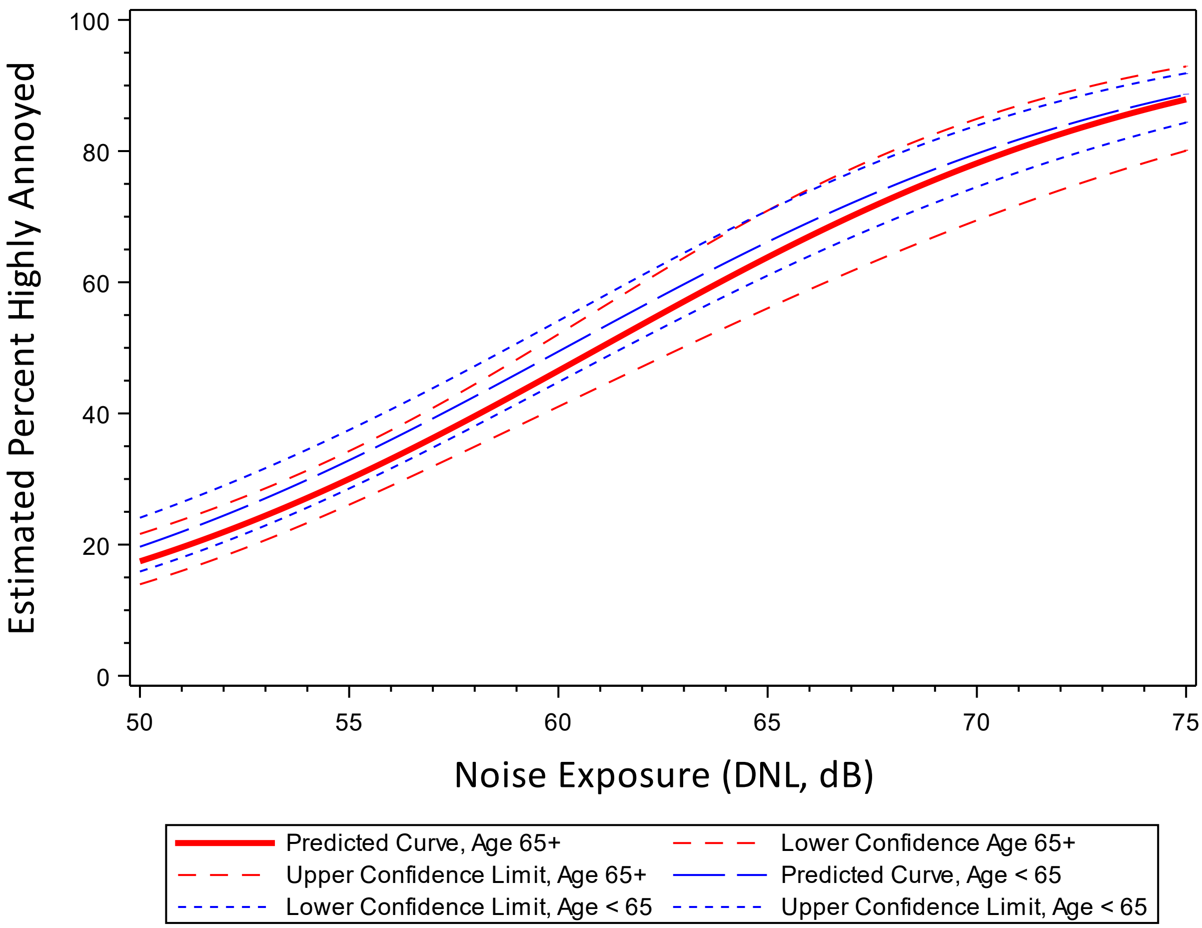

Figure E-2. National dose-response curves for respondents over age 65 and under age 65.

Note that an analysis fitting the model in Equation (9.2) with an indicator variable for OVER50 showed that the curves for the over-50 and under-50 age groups are not statistically significantly different (Q = 5.3; p-value > 0.05). The curves for the over-65 and under-65 age groups are statistically significantly different (Q = 14.7; p-value < 0.001). Figures E-1 and E-2, however, show only a small difference in the dose-response curves by age group.

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Analysis of the Neighborhood Environmental Survey

Volume 3 of 4

Contracts DTFACT-15-D-00008 and DTFACT-15-D-00007

HMMH Report No. 308520.004.001

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Contents of Volume 3

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Appendix F Noise Model Inputs

This appendix provides a summary of the basic data used for modeling each of the airports. This information is not intended to provide sufficient data to repeat the noise calculations. Because a complete year of radar flight track data was used to prepare modeling inputs for the INM, tabulating the full input data is not possible. If the computations are to be repeated, the FAA has access to the full set of INM runs and could produce additional results if desired.

These data are provided primarily as a possible aide to understanding why dose-response relationships differ across airports, and to convey a general sense of airspace use.

The data included are:

1. Name, location, number of runways and helipads, elevation, and notes on operations (ops). Helicopter operations are noted specifically because: 1) helicopter operations are generally on tracks and over locations different from those of fixed wing operations, and 2) helicopters operations may result in reports of higher annoyance at a given DNL value than do fixed wing operations. Knowing the location of the helicopter flight operations may help understand differences, airport to airport, in annoyance reactions.

2. Runway coordinates and physical parameters of elevation, width, usable length, length of displaced threshold and glide slope. Note the length reported here is from INM calculations and output files. Therefore the length may include rounding errors on the order of a few feet compared to published runway length or surveyed length.

3. ATADS counts, Scaled ATADS counts (scaled to the number of data days, if not 365; labeled "ATADS for Data Day" in the tables), radar flight tracks available (labeled "Database" in the tables), and the scale factors used to scale the radar flight track data to the Scaled ATADS counts.[1]

   In some cases, the radar flight track data had few or no operations identified in one or more ATADS categories. In these cases, the ATADS counts in these categories were added to those in related categories for scaling purposes. Details are provided in footnotes to individual airport tables below.

   In reviewing the analysis, it was found that a small number of operations had been rejected during data processing and their effects were not included. Subsequent analysis determined that these missing events had no effect on the results at the level of precision of the model. Details are provided in the following section and in footnotes to individual airport tables below.

4. Modeled average annual daily operations by major aircraft categories. This data will indicate which aircraft categories most frequently use the airport, but not necessarily which aircraft categories are the dominant contributor(s) to DNL.
   a. 'Day' and 'Night' in the tables refer to DNL periods, 7 a.m. to 10 p.m. and 10 p.m. to 7 a.m., respectively.
   b. All occurrences of 'A7D' INM type refers to the modeling of aircraft such as the T-45 Goshawk and AV-8 Harrier with the A-7D Corsair II.
   c. All occurrences of 'V22 Osprey' refer to the modeling of the V-22. The V-22 is a tiltrotor aircraft. It operates like a helicopter for takeoff and landing but like a fixed-wing aircraft for other flight modes. If a V-22 flight track originated or terminated at a helipad, the operation was modeled as an S65

[1] "Scale Factors" in the tables is the ratio of "ATADS for Data Days" to "Database"). Note that the ATADS tables for 2015 do not include a row for "ATADS for Data Days" because the scaling to 2015 ATADS was simplified, and the operations were scaled to the ATADS yearly totals.

helicopter. If the V-22 flight track originated or terminated at a runway end, the operations was modeled as a fixed-wing HS748A.

d. Total operations treat all supporting cells having "<0.01" as 0 operations. Furthermore, the Total operations columns count each circuit as two operations.

5. Numbers of modeled tracks -- counts of tracks by type of operation, i.e., arrival, departure and local (pattern), by general flow direction and by aircraft category. These are provided in conjunction with depictions of the radar flight tracks (see item #6) to give the reader a sense of the quantity of tracks depicted in the graphics. The counts are also provided to compute and show the percentage of events in each flow condition. Note that the total number of modeled tracks (converted to numbers of operations) will generally not equal the total annual numbers of operations (e.g., in the 'database' rows of item #3 above) because not all events captured by the radar flight tracking system are useable in modeling. In cases of insufficient tracks to model all events, single modeled tracks carried more than one operation so that the correct numbers of daily operations were modeled. Overall, each airport's total number of operations (derived from the track count) were within 200 of its modeled total annual flight operations.

6. Depictions of typical flight track distributions for the primary operating modes of the airport. These depictions are provided for different aircraft type categories and are generally produced using only a percentage (extracted by random sample) of the total radar flight tracks available; showing all tracks would, in many cases, result in solid areas of undifferentiated colors. To help the reader see trends, all tracks are shown at 10 percent transparency. Departure tracks are shown as green lines, Arrival tracks are red lines, and Local (pattern) tracks, if applicable, are shown as blue lines.

Missing Operations Discrepancies

In a detailed review of the modeling inputs, it was found the total modeled operations for nine of the 21 airports analyzed for the 2015 case did not precisely match the totals from the Air Traffic Activity Data System (ATADS) shown in the report. This was determined to be due to the INM rejecting a small number of operations in the final modeling stage that had not been rejected for the pre-model stage, which was used for scaling to the ATADS totals.

A sensitivity analysis was performed to estimate if the missing flight events would affect any of the airports' Day-Night Average Sound Levels (DNL) by more than 0.1 dB. If this analysis revealed potentially detectible noise increases within individual aircraft categories, then further analysis would be performed to address the effects of flight track distributions. Only BIL was determined to warrant this additional scrutiny, as detailed below.

Tables F-1 and F-2 show the equivalent missed events and the equivalent annual flight events modeled for the 2015 case for the nine airports, respectively.[2] For all airports except BIL, the missed flight events were less than one percent of the modeled total events in any aircraft category. For BIL, the missed flight events were less than two percent, except for the military jet fighter and military rotorcraft categories, which missed 29 percent and 17 percent, respectively. That said, the missed events constituted less than one-half of one percent of overall annual events at BIL.

The sensitivity analysis determined that these discrepancies would not result in an increase of the sound level within the precision of the model for any aircraft category at any airport, with the exception of military jets and military rotorcraft at BIL, with potential increases of DNL 1.1 dB and DNL 0.7 dB, respectively, of the

[2] Equivalent operations are calculated by multiplying the number of nighttime operations by 10, to account for the 10 dB weighting applied to nighttime operations for the calculation of DNL.

contributions from these categories. Note, however, that these contributions are small due to the small proportion of operations from these aircraft.

Table F-1. Equivalent Annual Events Missed for 2015, rounded

Airport ID	Comm'l Jet	Civilian Jet, Other	Civilian Prop	Civilian Rotorcraft	Military Jet, Fighter	Military Jet, Other	Military Prop	Military Rotorcraft	Total
ATL	1	-	-	-	-	-	-	-	1
BDL	-	-	-	5	-	-	-	3	8
BIL	-	25	315	35	2	-	-	10	387
DSM	-	-	4	3	-	-	-	-	7
LAX	2	-	-	-	-	-	-	-	2
MIA	1	-	-	-	-	-	-	-	1
SEA	-	-	8	-	-	-	-	-	8
SJC	-	-	1	-	-	-	-	-	1
TUS	-	-	-	-	-	7	-	-	7

Table F-2. Modeled Annual Equivalent Flight Events for 2015, rounded

Airport ID	Comm'l Jet	Civilian Jet, Other	Civilian Prop	Civilian Rotorcraft	Military Jet, Fighter	Military Jet, Other	Military Prop	Military Rotorcraft	Total
ATL	1,622,489	8,429	16,588	-	16	633	611	-	1,648,766
BDL	200,618	15,499	17,459	4,782	5	1,166	631	1,414	241,574
BIL	32,262	5,462	119,657	2,691	7	131	287	59	160,556
DSM	106,008	17,776	28,359	1,018	86	598	570	347	154,762
LAX	1,609,336	34,970	73,871	-	-	-	-	-	1,718,177
MIA	886,132	30,333	26,497	-	3	1,228	793	-	944,986
SEA	678,454	5,278	214,701	-	-	-	-	-	898,433
SJC	206,905	28,655	44,516	-	-	42	280	-	280,398
TUS	98,869	14,832	70,265	25,127	20,273	1,372	3,764	751	235,253

Further analysis was performed on BIL to determine if the spatial distribution of flight tracks within each of the aircraft categories would cause a substantial increase at potential respondent locations disproportionally impacted by this distribution. The flight tracks for the missing operations within an aircraft category were assumed to have the same spatial distribution as the modeled aircraft in that category, and the impact of this category on potential respondent locations was increased proportionally. The adjusted impacts for each of the categories were combined at each of the potential respondent locations to determine if the overall impact showed a detectable difference with the additional operations accounted for. It was determined the excess exposure due to missed operations did not exceed a DNL of 0.1 dB at any of these locations; therefore the effect of the missing operations was determined not to be substantial.

F.1 Albuquerque Intl Sunport, ABQ

Airport: Albuquerque International Sunport Airport
City: Albuquerque, NM
Runways: 3
Helipads: 2
Elevation: 5,355 feet MSL

Local Operation Notes: Circuits modeled at 1,000 feet AFE and 2,500 feet AFE. Split military tracks counted as local operations as long as they went at least 7 nautical miles from the airport center. C130 and C130E tracks with a maximum altitude above 7,500 feet MSL were assigned the 2,500 feet AFE profile. All KC135R aircraft tracks were assigned the 2,500 feet AFE profile. All other local tracks used the 1,000 feet AFE profile. Military circuit tracks with a maximum range of greater than 25 nautical miles and non-military tracks with a maximum range greater than 4.3 nautical miles were removed from modeling. No maximum altitude was used to remove tracks.

Helicopter Notes: Many helicopter operations: 7 percent of all operations. About half are military and half general aviation or air taxi. Variety of INM types. None counted as local operations. Several thousand V22 Osprey operations.

F.1.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
03	35.022248	-106.63060	5,305	150	10,000	0	3
08	35.044353	-106.62159	5,312	150	13,793	1,000	2.95
12	35.043533	-106.62075	5,312	150	6,000	0	3
21	35.041741	-106.60707	5,316	150	10,000	0	3
26	35.044063	-106.57552	5,355	150	13,793	0	3
30	35.033195	-106.60515	5,314	150	6,000	0	3
H1	35.047455	-106.59743	5,328	n/a	n/a	n/a	n/a
H2	35.035069	-106.61950	5,314	n/a	n/a	n/a	n/a

F.1.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.1.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	58,138	29,681	27,087	16,322	4,571	6,917	142,716	365
ATADS for Data Days	56,647	28,829	26,313	15,848	4,403	6,757	138,797	353
Database	54,693	27,233	20,538	9,157	1,004	2,411	115,036	353
Scale Factor	103.6%	105.9%	128.1%	173.1%	438.5%	280.3%	120.7%	n/a

F.1.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	49,603	25,089	27,243	17,218	3,281	1,750	124,184	365
Database	54,693	27,233	20,538	9,157	1,004	2,411	115,036	353
Scale Factor	90.7%	92.1%	132.6%	188.0%	326.8%	72.6%	108.0%	n/a

F.1.3 Modeled Annual Average Daily Numbers of Flight Events and Operations

F.1.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	79.59	12.40	91.99	81.32	10.67	91.99	0.01	-	0.01	160.93	23.07	184.00
Civilian Jet, Other	6.32	0.40	6.72	6.37	0.36	6.73	0.15	-	0.15	12.99	0.76	13.75
Civilian Prop	50.42	4.51	54.93	46.79	8.14	54.93	5.62	0.46	6.08	108.45	13.57	122.02
Civilian Rotorcraft	3.45	1.25	4.70	3.44	1.26	4.70	-	-	-	6.89	2.51	9.40
Military Jet, Fighter	1.96	-	1.96	1.95	0.01	1.96	0.02	-	0.02	3.95	0.01	3.96
Military Jet, Other	0.53	0.03	0.56	0.52	0.04	0.56	0.67	-	0.67	2.39	0.07	2.46
Military Prop	5.12	2.93	8.05	7.32	0.73	8.05	4.91	3.97	8.88	22.26	11.60	33.86
Military Rotorcraft	9.53	2.35	11.88	11.46	0.42	11.88	-	-	-	20.99	2.77	23.76
TOTAL	**156.92**	**23.87**	**180.79**	**159.17**	**21.63**	**180.80**	**11.38**	**4.43**	**15.81**	**338.85**	**54.36**	**393.21**

Note: Each circuit operation counted as two operations in Total Operations

F.1.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	69.63	10.85	80.48	71.15	9.33	80.48	-	-	-	140.78	20.18	160.96
Civilian Jet, Other	6.55	0.42	6.97	6.59	0.37	6.96	0.12	-	0.12	13.26	0.79	14.05
Civilian Prop	48.50	4.12	52.62	44.96	7.66	52.62	4.18	0.34	4.52	97.64	12.12	109.76
Civilian Rotorcraft	3.21	1.10	4.31	3.21	1.11	4.32	-	-	-	6.42	2.21	8.63
Military Jet, Fighter	2.12	-	2.12	2.12	0.01	2.13	<0.01	-	-	4.24	0.01	4.25
Military Jet, Other	0.58	0.04	0.62	0.57	0.05	0.62	0.17	-	0.17	1.32	0.09	1.41
Military Prop	5.56	3.18	8.74	7.95	0.79	8.74	1.27	1.03	2.30	14.78	5.00	19.78
Military Rotorcraft	10.36	2.55	12.91	12.45	0.45	12.90	-	-	-	22.81	3.00	25.81
TOTAL	**146.51**	**22.26**	**168.77**	**149.00**	**19.77**	**168.77**	**5.74**	**1.37**	**7.11**	**301.25**	**43.40**	**344.65**

Note: Each circuit operation counted as two operations in Total Operations

F.1.4 Modeled Tracks

Area Navigation (RNAV) procedures:

- 5 Standard Terminal Arrival Route (STAR) RNAV procedures published Jan 2013, started using Feb 2013
- 6 RNAV Required Navigation Performance (RNP) procedures (one for each runway) published Jan 2013, started using Feb 2013
- 2 RNAV Global Positioning System (GPS) procedures (03 and 08) published Jan 2013, started using Feb 2013
- 9 RNAV Standard Instrument Departure (SID) procedures published Jan 2013, started using Feb 2013

Total Tracks:

Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	26,703	7,888	26,054	7,679	89	6
Non-Jets, fixed-wing	13,679	5,592	14,133	3,737	925	176
Total	40,382	13,480	40,187	11,416	1,014	182

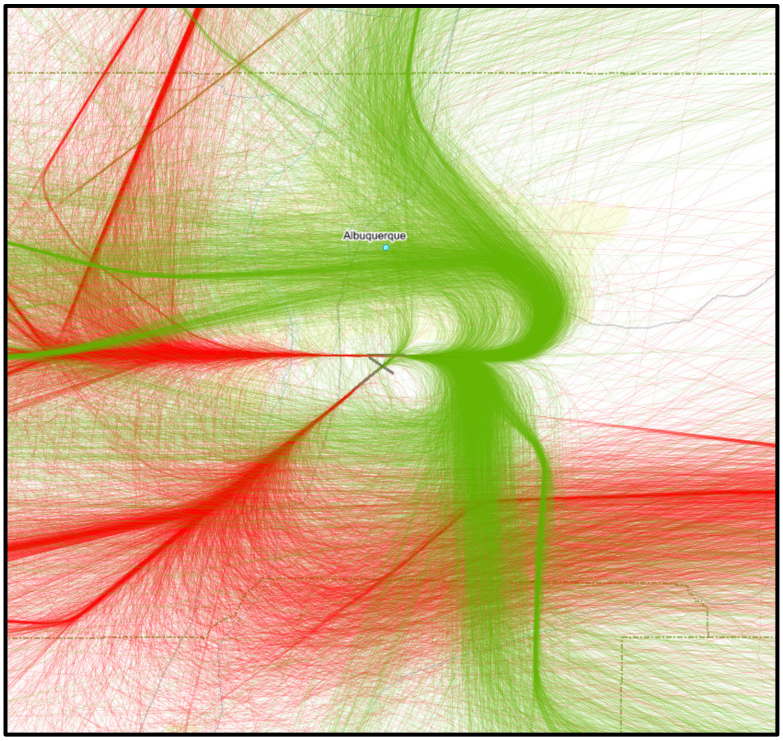
Aircraft Category	Arrivals	Departures	Locals
Helicopters*	3,555	3,624	-

Aircraft Category	Total			Percent	
	East	West	Total	East	West
Jets	52,846	15,573	68,419	77%	23%
Non-Jets, fixed-wing	28,737	9,505	38,242	75%	25%
Helicopters*	n/a	n/a	7,179	n/a	n/a
Total	81,583	25,078	113,840	76%	24%

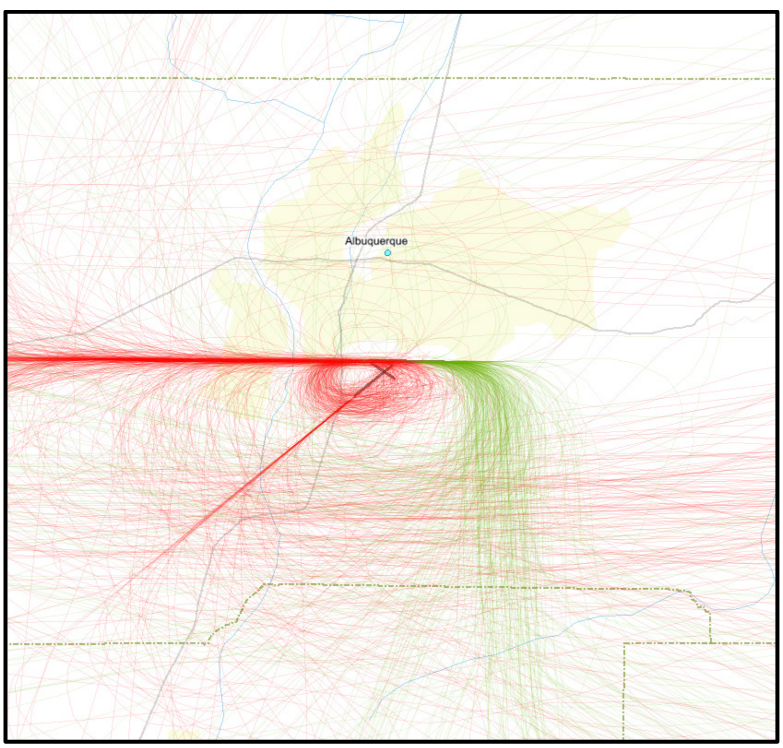
*V22 modeled as S65 are counted as Helicopters, those modeled as HS748A are counted as Non-Jets. The non-jet operations of the V22 are those when it operates with the propeller axis horizontal; the helicopter operations are when the propeller axis is vertical. If the radar flight track appeared to go to/from a helipad, that operation was assigned helicopter. If the radar flight track appeared to go to/from a runway end, the operation was assigned fixed-wing.

F.1.5 Representative Radar Flight Tracks

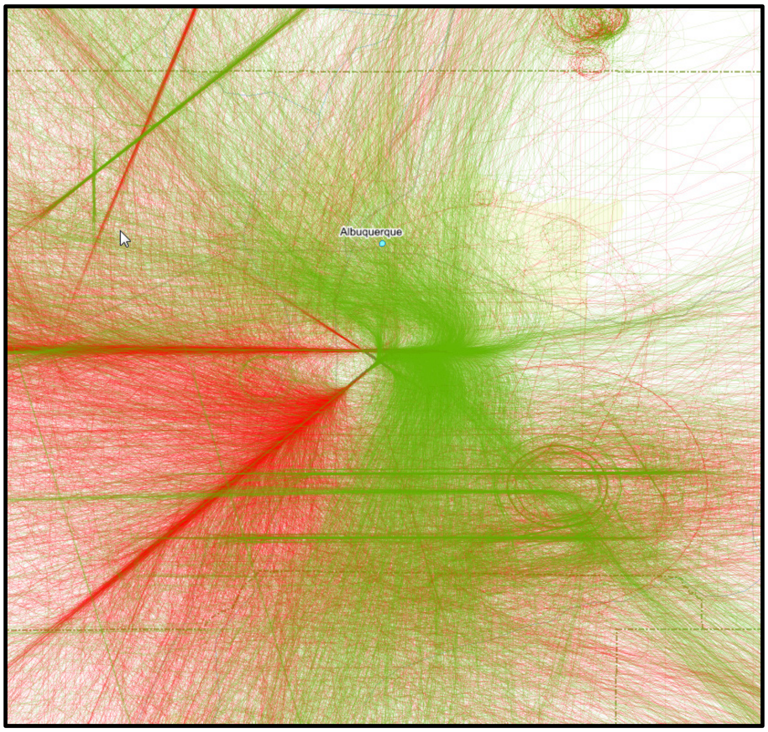
East Flow, Non-Military Jets – 33% Sample



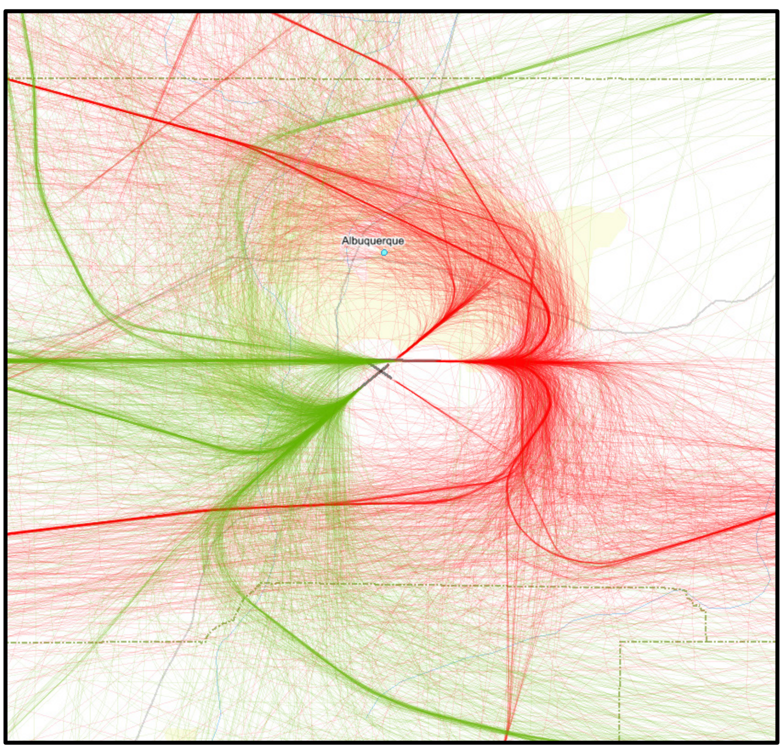
Military Jets – 33% Sample



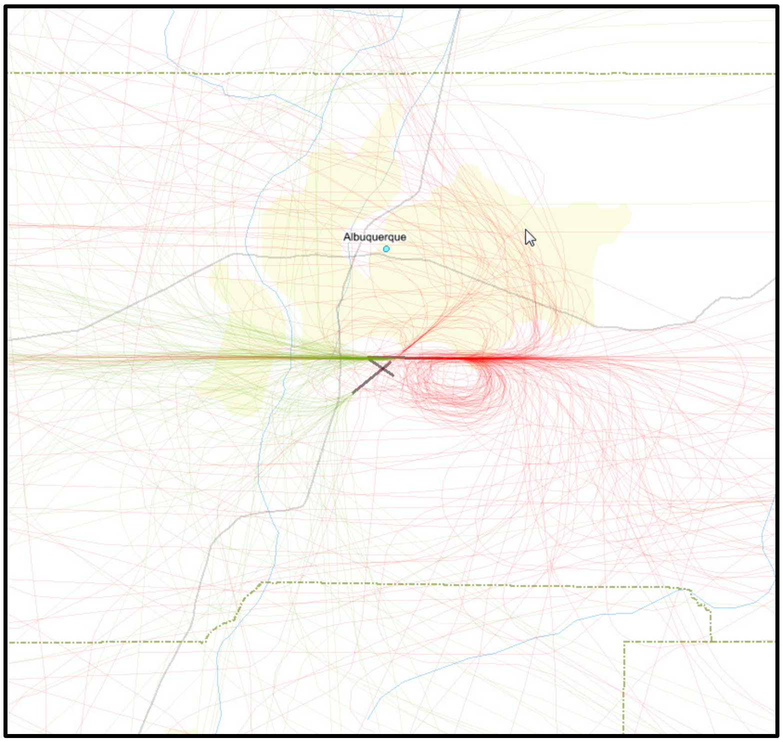
East Flow, Non-Jets – 33% Sample



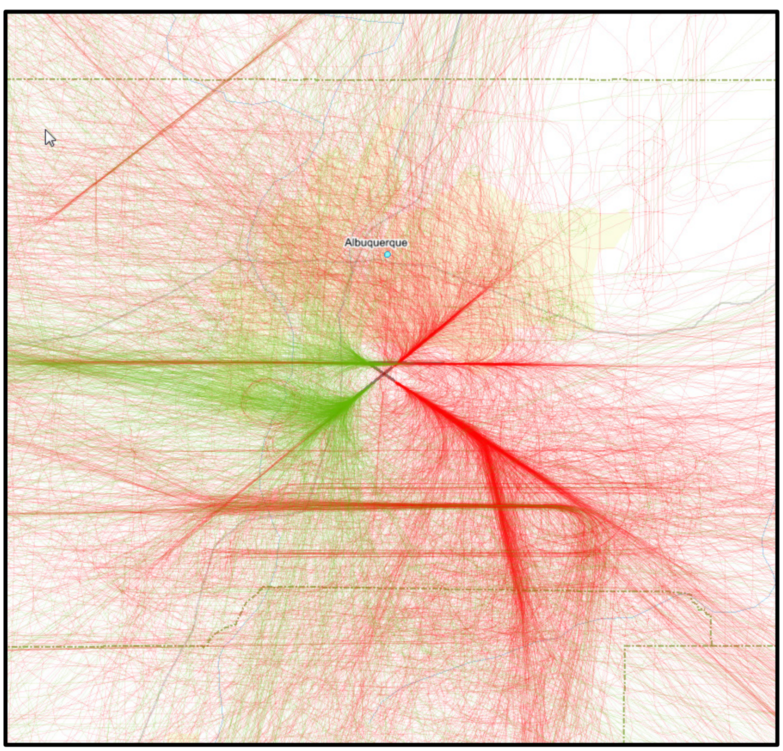
West Flow, Non-Military Jets – 33% Sample



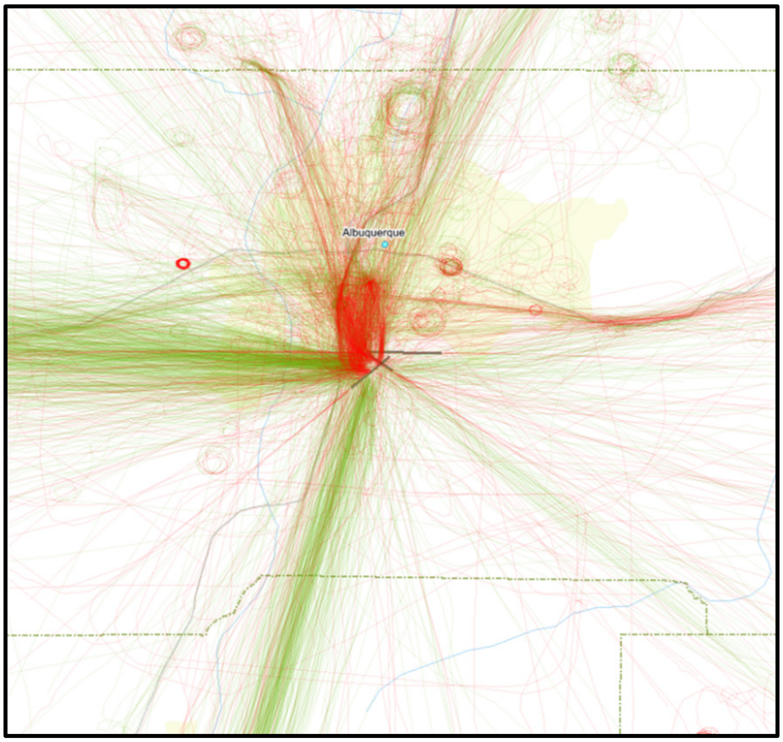
Military Jets - 33% Sample



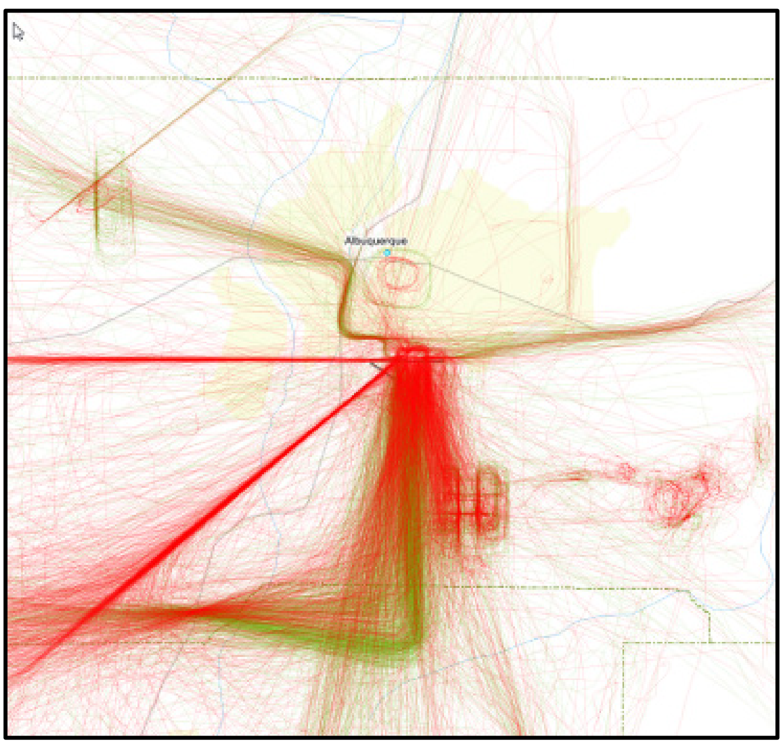
West Flow, Non-Jets - 33% Sample



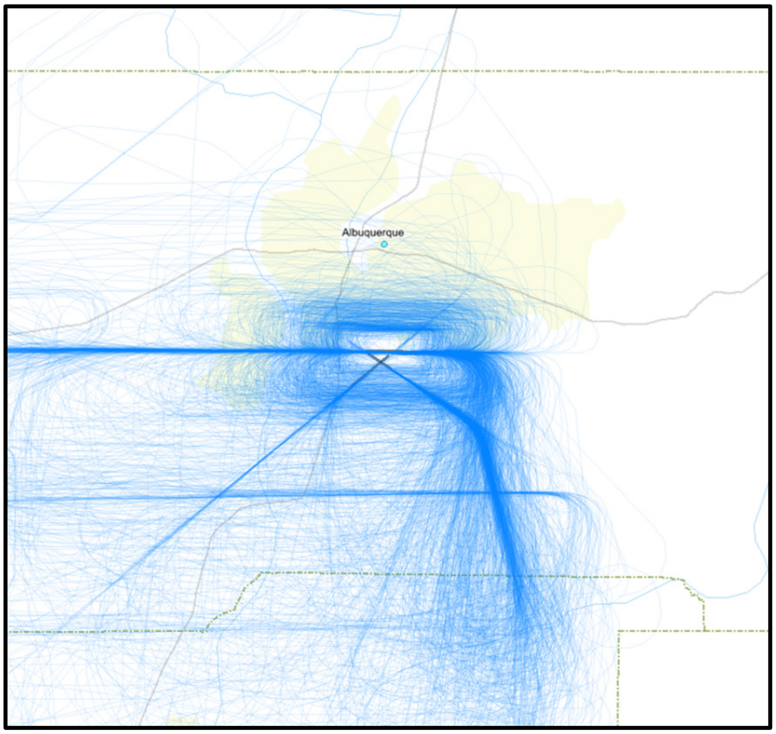
(all flows) Non-Military Helicopters – 100%



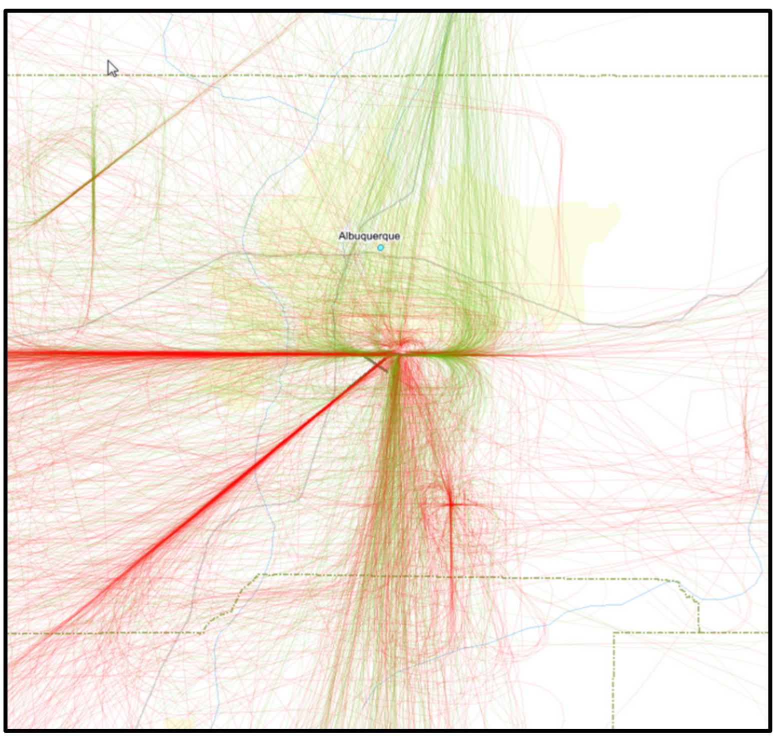
Military Helicopters – 100%



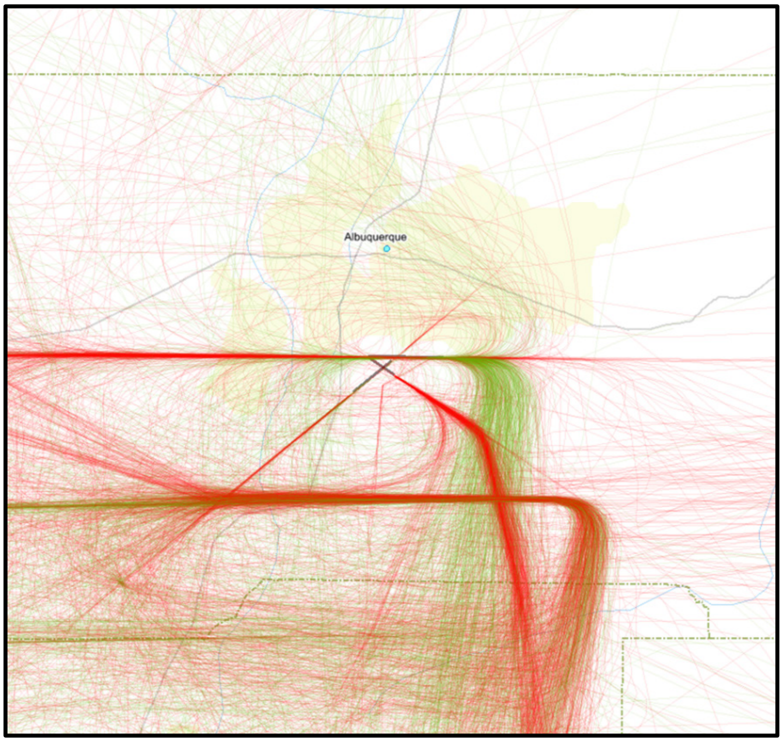
Local Operations – 100%



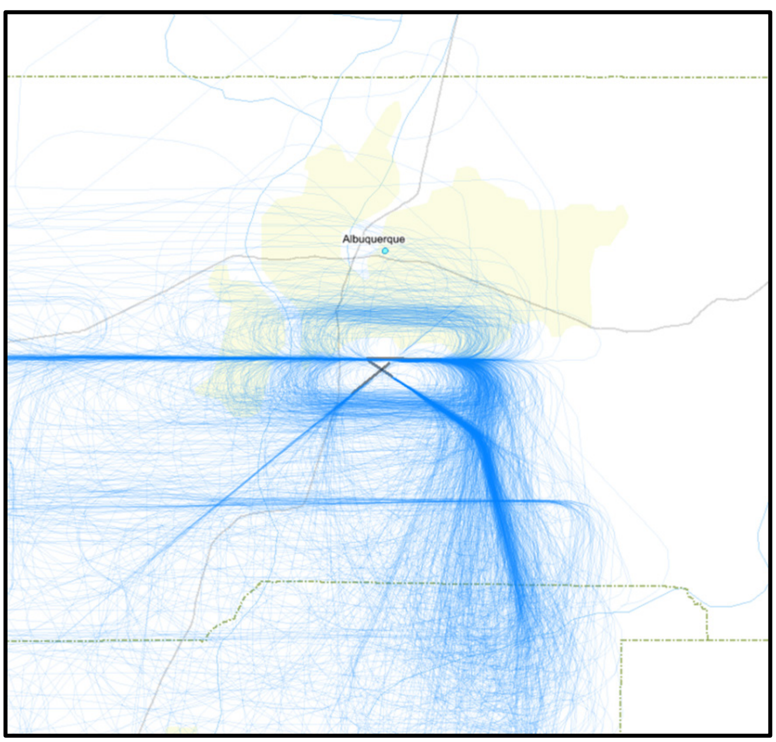
V22 Ospreys – 100%



C130 Arrivals and Departures – 100%



C130 Local Operations – 100%



F.1.6 Special KC135 Considerations

In INM, the KC135R has only one takeoff weight and it causes the aircraft to overrun ABQ's runway by thousands of feet. To avoid the overrun, the weight was reduced. As a KC135R is a derivative of a Boeing 707, the reduction in weight was based on INM's 707320 profile weights:

707320 - Max Take-off Weight= 334000

Stage 1 weight – 214000 (64.1% of Max TOW)
Stage 2 weight – 228000 (68.3% of Max TOW)
Stage 3 weight – 240000 (71.9% of Max TOW)
Stage 4 weight – 260000 (77.8% of Max TOW)

(There are stages 5, 6, and 7 but not needed for ABQ)

KC135R - Max Take-off Weight= 324000

Stage 1 weight – 208000 (64.2% of Max TOW)
Stage 2 weight – 221000 (68.2% of Max TOW)
Stage 3 weight – 233000 (71.9% of Max TOW)
Stage 4 weight – 252000 (77.8% of Max TOW)

Stage 1 weight was also used for circuit profile.

F.1.7 RNAV Procedures

RNAV STAR procedures:

COLTR ONE
KRKEE ONE
LOWBO ONE
LZZRD ONE
SNDIA ONE

RNAV Departure Procedures:

JEMEZ ONE
ADYOS ONE
ATOMK ONE
BOSQE ONE
DOOKK ONE
FYSTA ONE
GRZZZ ONE
JETOK ONE
MNZNO ONE
RDRNR ONE

RNAV RNP/GPS Procedures:

Y RWY 21

F.2 Albany Intl, ALB

Airport: Albany International Airport
City: Albany, NY
Runways: 2
Helipads: 2
Elevation: 285 feet MSL

Local Operation Notes: Circuits modeled at 1,500 feet AFE. Split tracks counted as local operations as long as they went at least 5 nautical miles from the airport center. Most of the split tracks were helicopters. Circuit tracks with a maximum altitude greater than 5,000 feet MSL were removed.

Helicopter Notes: Many operations, about 9 percent of daily operations. About half are military and half general aviation or air taxi. Variety of INM types. Some counted as local operations.

Other Notes: Some C130 activity at the airport.

F.2.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
01	42.737164	-73.804256	284	150	8,500	0	3
10	42.749150	-73.812091	276	150	7,200	0	3
19	42.760474	-73.805266	280	150	8,500	0	3
28	42.749777	-73.785302	276	150	7,200	1,202	3.35
HNG	42.744333	-73.802104	280	n/a	n/a	n/a	n/a
HGA	42.750989	-73.808866	285	n/a	n/a	n/a	n/a

F.2.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.2.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	22,527	26,065	13,716	3,194	7,327	1,778	74,607	365
ATADS for Data Days	22,434	25,940	13,700	3,187	7,297	1,764	74,322	363
Database	22,018	26,459	9,542	1,454	828	528	60,829	363
Scale Factor	101.9%	98.0%	143.6%	219.2%	881.3%	334.1%	122.2%	n/a

F.2.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	22,067	21,525	14,447	2,688	7,786	1,352	69,865	365
Database	22,018	26,459	9,542	1,454	828	528	60,829	363
Scale Factor	100.2%	81.4%	151.4%	184.9%	940.3%	256.1%	114.9%	n/a

F.2.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.2.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	32.87	12.41	45.28	36.06	9.26	45.32	0.02	-	0.02	68.97	21.67	90.64
Civilian Jet, Other	4.07	0.34	4.41	4.10	0.29	4.39	0.24	-	0.24	8.65	0.63	9.28
Civilian Prop	30.94	2.15	33.09	30.44	2.63	33.07	7.38	0.17	7.55	76.14	5.12	81.26
Civilian Rotorcraft	2.57	0.15	2.72	2.62	0.10	2.72	2.06	0.18	2.24	9.31	0.61	9.92
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	0.13	-	0.13	0.12	0.01	0.13	-	-	-	0.25	0.01	0.26
Military Prop	1.30	0.01	1.31	1.28	0.03	1.31	1.42	-	1.42	5.42	0.04	5.46
Military Rotorcraft	2.72	0.23	2.95	2.91	0.04	2.95	1.01	-	1.01	7.65	0.27	7.92
TOTAL	**74.60**	**15.29**	**89.89**	**77.53**	**12.36**	**89.89**	**12.13**	**0.35**	**12.48**	**176.39**	**28.35**	**204.74**

Note: Each circuit operation counted as two operations in Total Operations

F.2.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	30.21	11.90	42.11	33.49	8.61	42.10	0.03	-	0.03	63.73	20.51	84.24
Civilian Jet, Other	4.30	0.36	4.66	4.34	0.31	4.65	0.25	-	0.25	8.89	0.67	9.56
Civilian Prop	28.75	1.89	30.64	28.28	2.36	30.64	7.87	0.18	8.05	64.90	4.43	69.33
Civilian Rotorcraft	2.41	0.13	2.54	2.45	0.09	2.54	2.20	0.20	2.40	7.06	0.42	7.48
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	0.11	-	0.11	0.10	0.01	0.11	-	-	-	0.21	0.01	0.22
Military Prop	1.09	0.01	1.10	1.08	0.02	1.10	1.09	-	1.09	3.26	0.03	3.29
Military Rotorcraft	2.29	0.20	2.49	2.45	0.04	2.49	0.78	-	0.78	5.52	0.24	5.76
TOTAL	**69.16**	**14.49**	**83.65**	**72.19**	**11.44**	**83.63**	**12.22**	**0.38**	**12.60**	**153.57**	**26.31**	**179.88**

Note: Each circuit operation counted as two operations in Total Operations

F.2.4 Modeled Tracks

RNAV procedures:

- 0 STAR RNAV procedures
- 2 RNAV RNP procedures (01 and 19)
- 4 RNAV GPS procedures (one for each runway)
- 0 RNAV (SID) procedures

Total Tracks:

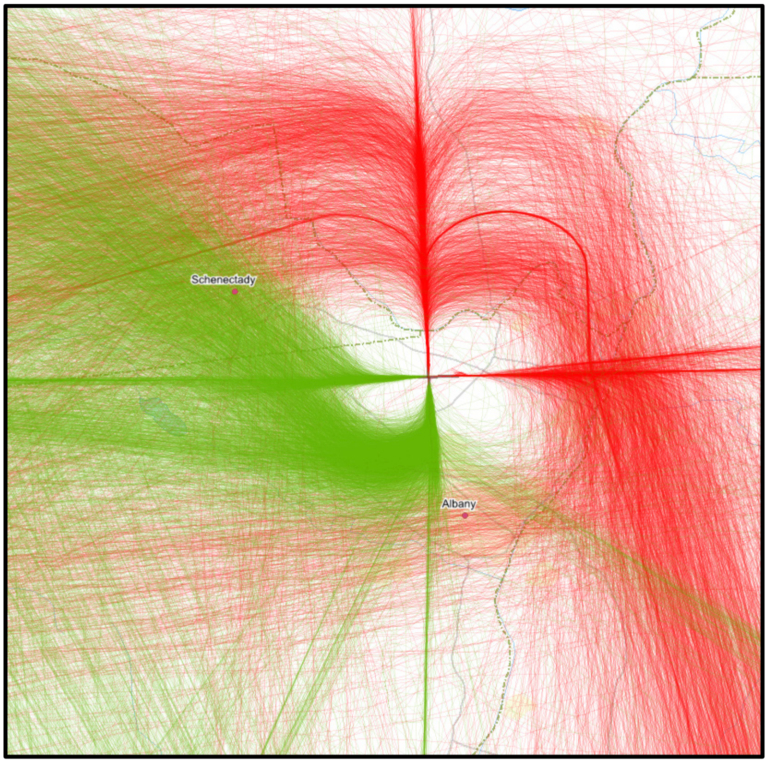
Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	9,652	7,971	9,482	7,986	8	3
Non-Jets, fixed-wing	4,765	6,376	5,238	5,500	62	386
Total	14,417	14,347	14,720	13,486	70	389

Aircraft Category	Arrivals	Departures	Locals
Helicopters	1,593	1,348	-

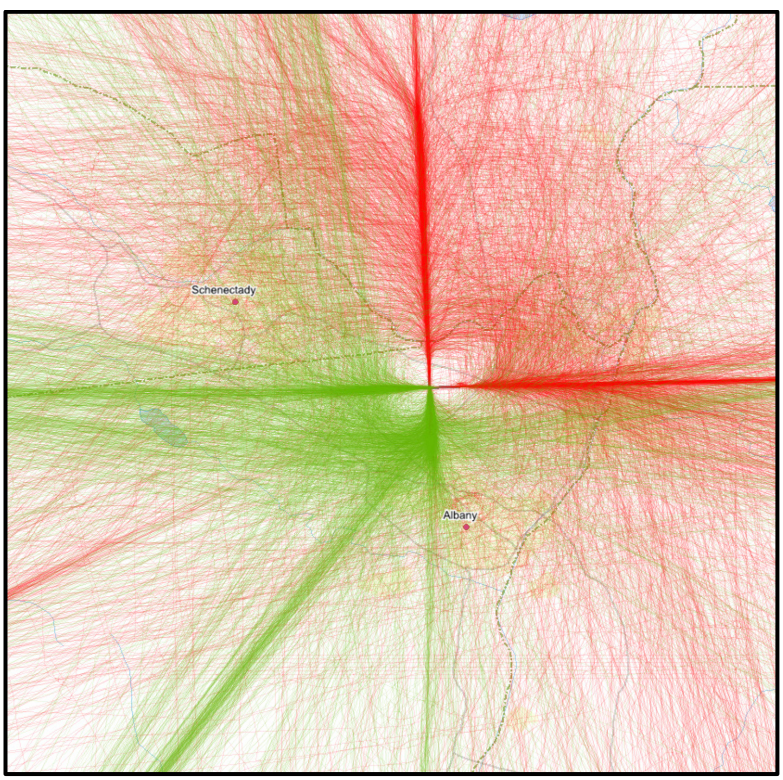
Aircraft Category	Total			Percent	
	East	West	Total	East	West
Jets	19,142	15,960	35,102	55%	45%
Non-Jets, fixed-wing	10,065	12,262	22,327	45%	55%
Helicopters	n/a	n/a	2,941	n/a	n/a
Total	29,207	28,222	60,370	51%	49%

F.2.5 Representative Radar Flight Tracks

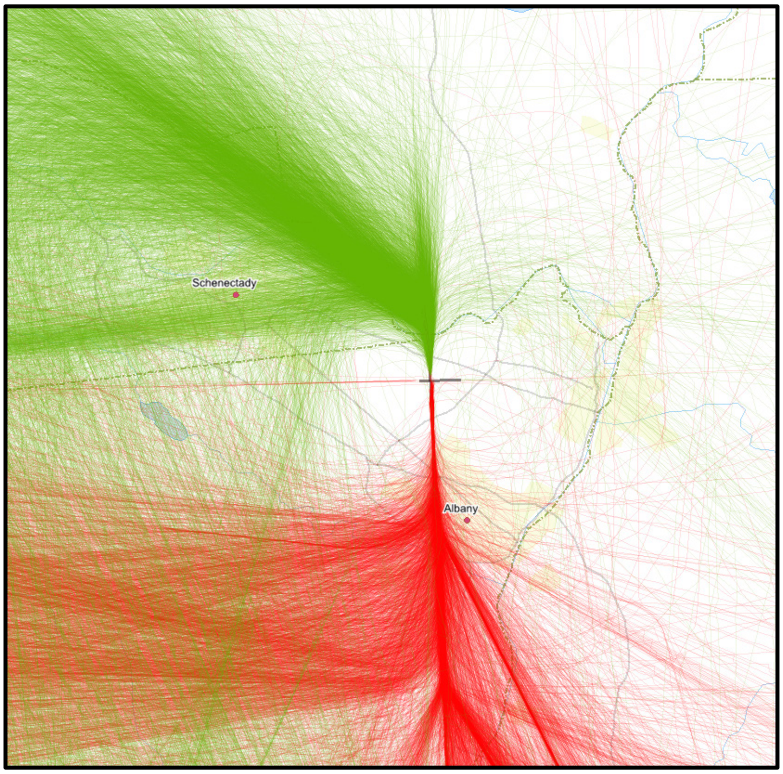
West Flow, Non-Military Jets – 50% Sample



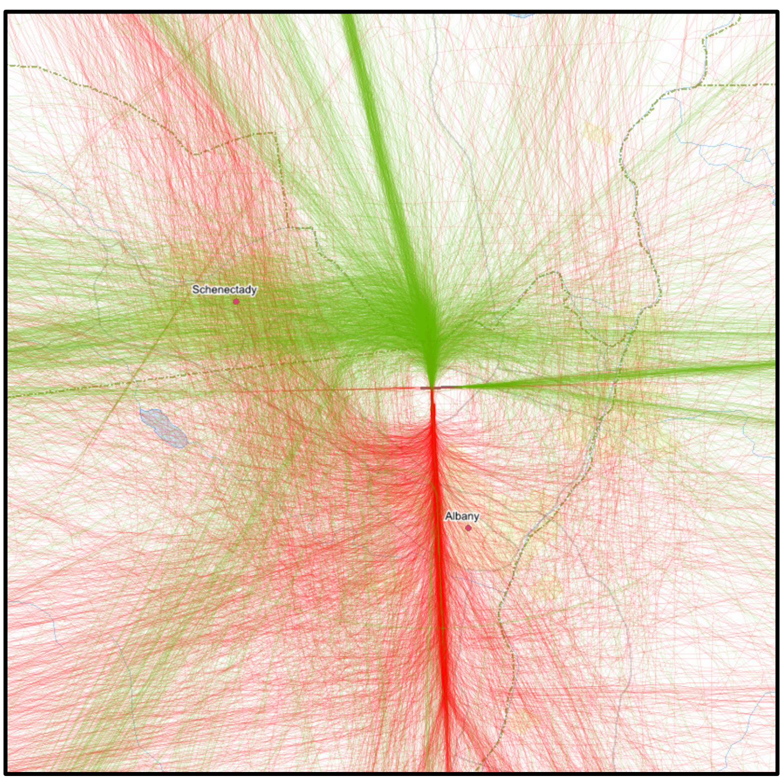
Non-Jets - 50% Sample



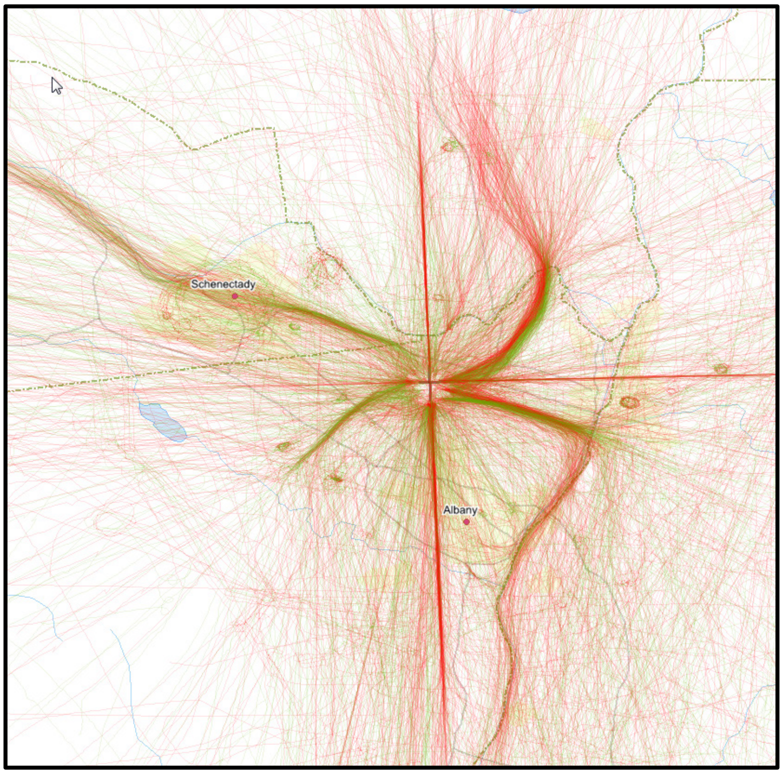
East Flow, Non-Military Jets – 50% Sample



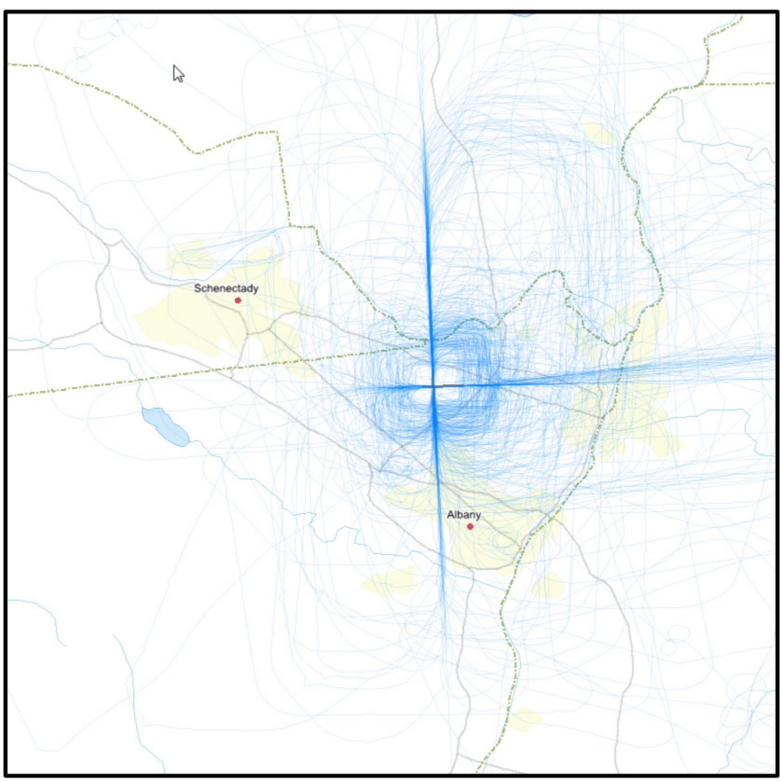
Non-Jets – 50% Sample



Helicopters – 100%



Local Operations – 100%



F.3 Hartsfield-Jackson Atlanta Intl, ATL

Airport: Hartsfield-Jackson Atlanta International Airport
City: Atlanta, GA
Runways: 5
Helipads: 0
Elevation: 1,027 feet MSL

Local Operation Notes: No local operations modeled.

Helicopter Notes: No Helicopters modeled.

Other Notes: Very busy airport with mostly commercial jet operations. One 2015 operation (of 882,497 total operations) was not modeled due to a processing error. This omission has no effect within the precision of the model.

F.3.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
08L	33.64953	-84.43900	1,015	150	9,000	0	3
08R	33.64679	-84.43840	1,024	150	10,000	0	3
09L	33.63470	-84.44800	1,019	150	12,390	0	3
09R	33.63181	-84.44800	1,026	150	9,000	0	3
10	33.62027	-84.44790	1,000	150	9,000	0	3
26R	33.64954	-84.40950	990	150	9,000	0	3
26L	33.64679	-84.40550	995	150	10,000	0	3
27R	33.63470	-84.40730	977	150	12,390	500	3
27L	33.63182	-84.41840	985	150	9,000	0	3
28	33.62028	-84.41830	998	150	9,000	0	3

F.3.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.3.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	734,894	178,130	7,753	300	0	0	921,077	365
ATADS (Data Days)	734,894	178,130	7,753	300	0	0	921,077	365
Database	731,581	176,109	5,199	79	0	0	912,968	365
Scale Factor	100.5%	101.1%	149.1%	379.7%	0	0	100.9%	n/a

F.3.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	780,326*	94,223	7,291	657	0	0	882,497	365
Database	731,581	176,109	5,199	79	0	0	912,968	365
Scale Factor	106.7%	53.5%	140.2%	831.6%	0	0	96.7%	n/a

*1 fewer operation was modeled due to processing error; Affected DNL by less than 0.1 dB (estimated).

F.3.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.3.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	1,134.91	104.70	1,239.61	1,109.53	130.08	1,239.61	-	-	-	2,244.44	234.78	2,479.22
Civilian Jet, Other	6.20	0.56	6.76	6.09	0.67	6.76	-	-	-	12.29	1.23	13.52
Civilian Prop	12.62	2.35	14.97	12.93	2.05	14.98	-	-	-	25.55	4.40	29.95
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.01	-	0.01	0.01	-	0.01	-	-	-	0.02	-	0.02
Military Jet, Other	0.25	0.01	0.26	0.24	0.02	0.26	-	-	-	0.49	0.03	0.52
Military Prop	0.11	0.03	0.14	0.12	0.02	0.14	-	-	-	0.23	0.05	0.28
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**1,154.10**	**107.65**	**1,261.75**	**1,128.92**	**132.84**	**1,261.76**	**-**	**-**	**-**	**2,283.02**	**240.49**	**2,523.51**

Note: Each circuit operation counted as two operations in Total Operations

F.3.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Day	Day	Night	Total	Day	Night	Total
Commercial Jet	1,091.06	101.06	1,192.12	1,064.20	127.93	1,192.13	-	-	-	2,155.26	228.99	2,384.25
Civilian Jet, Other	5.83	0.53	6.36	5.73	0.63	6.36	-	-	-	11.56	1.16	12.72
Civilian Prop	7.93	1.58	9.51	8.17	1.35	9.52	-	-	-	16.10	2.93	19.03
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.02	-	0.02	0.02	-	0.02	-	-	-	0.04	-	0.04
Military Jet, Other	0.55	0.02	0.57	0.53	0.04	0.57	-	-	-	1.08	0.06	1.14
Military Prop	0.23	0.08	0.31	0.26	0.04	0.30	-	-	-	0.49	0.12	0.61
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**1,105.62**	**103.27**	**1,208.89**	**1,078.91**	**129.99**	**1,208.90**	**-**	**-**	**-**	**2,184.53**	**233.26**	**2,417.79**

Note: Each circuit operation counted as two operations in Total Operations

F.3.4 Modeled Tracks

RNAV procedures:

- 7 STAR RNAV procedures.
- 10 RNAV GPS procedures (one for each runway).
- 16 RNAV (SID) procedures.

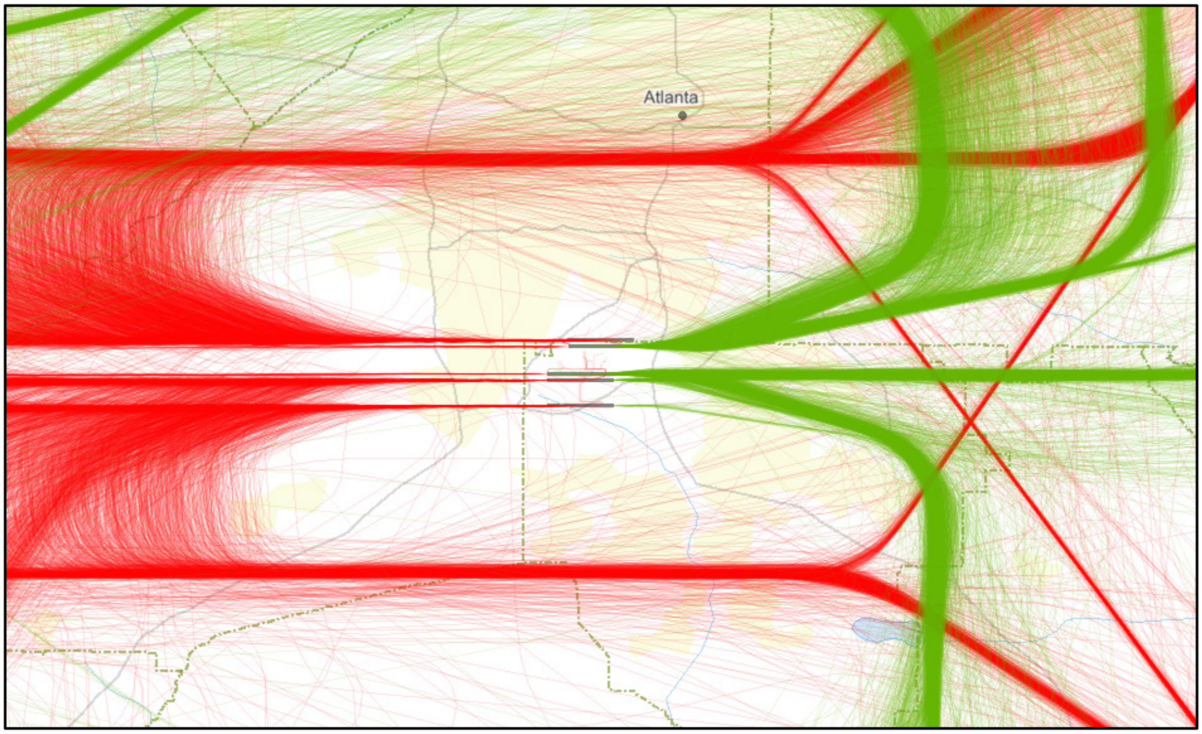
Total Tracks:

	Arrivals		Departures		Locals	
Aircraft Category	East	West	East	West	East	West
Jets	180,787	271,671	180,158	270,791	-	-
Non-Jets, fixed-wing	1,993	2,967	1,826	2,774	-	-
Total	182,780	274,638	181,984	273,565	-	-

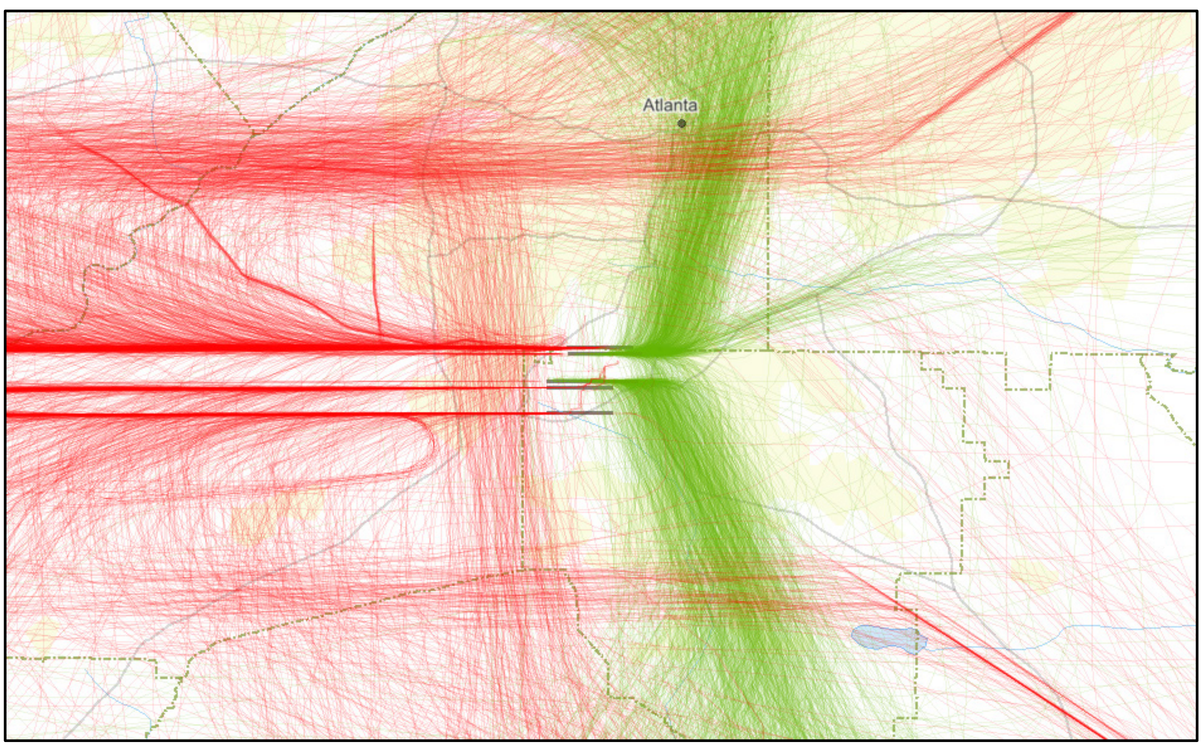
	Total			Percent	
Aircraft Category	East	West	Total	East	West
Jets	360,945	542,462	903,407	40%	60%
Non-Jets, fixed-wing	3,819	5,741	9,560	40%	60%
Helicopters	n/a	n/a	-	n/a	n/a
Total	364,764	548,203	912,967	40%	60%

F.3.5 Representative Radar Flight Tracks

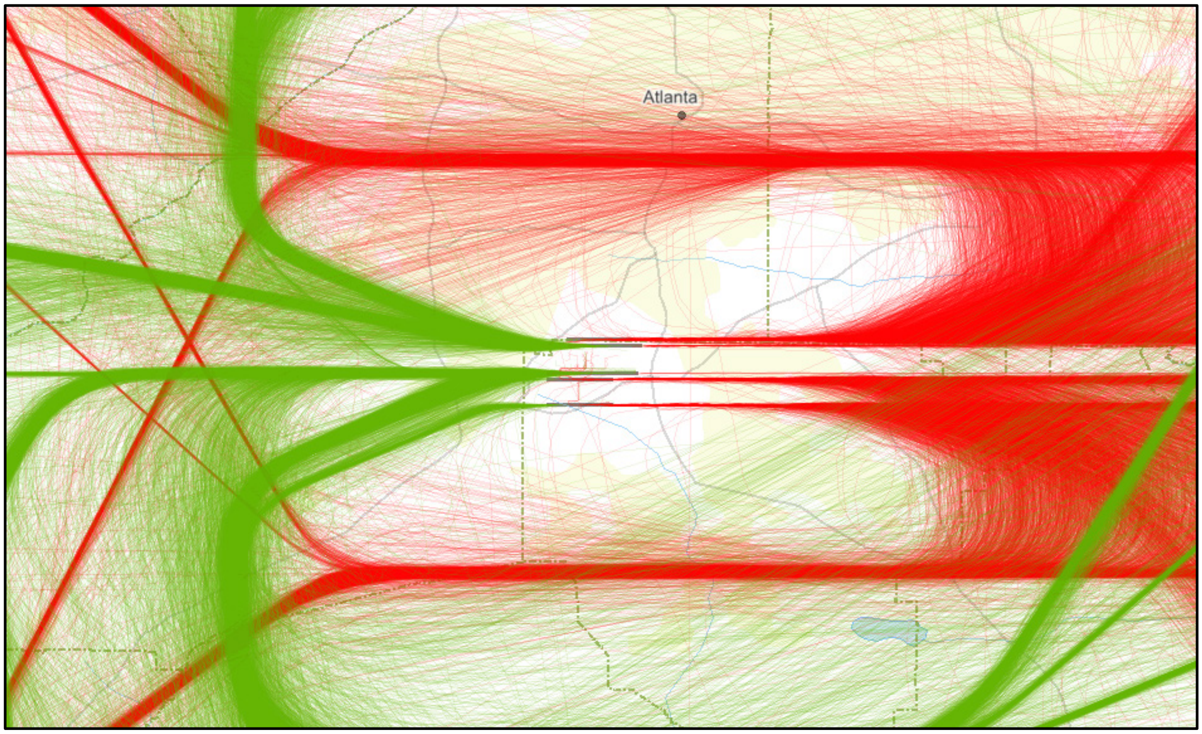
East Flow, Jets – 5% Sample



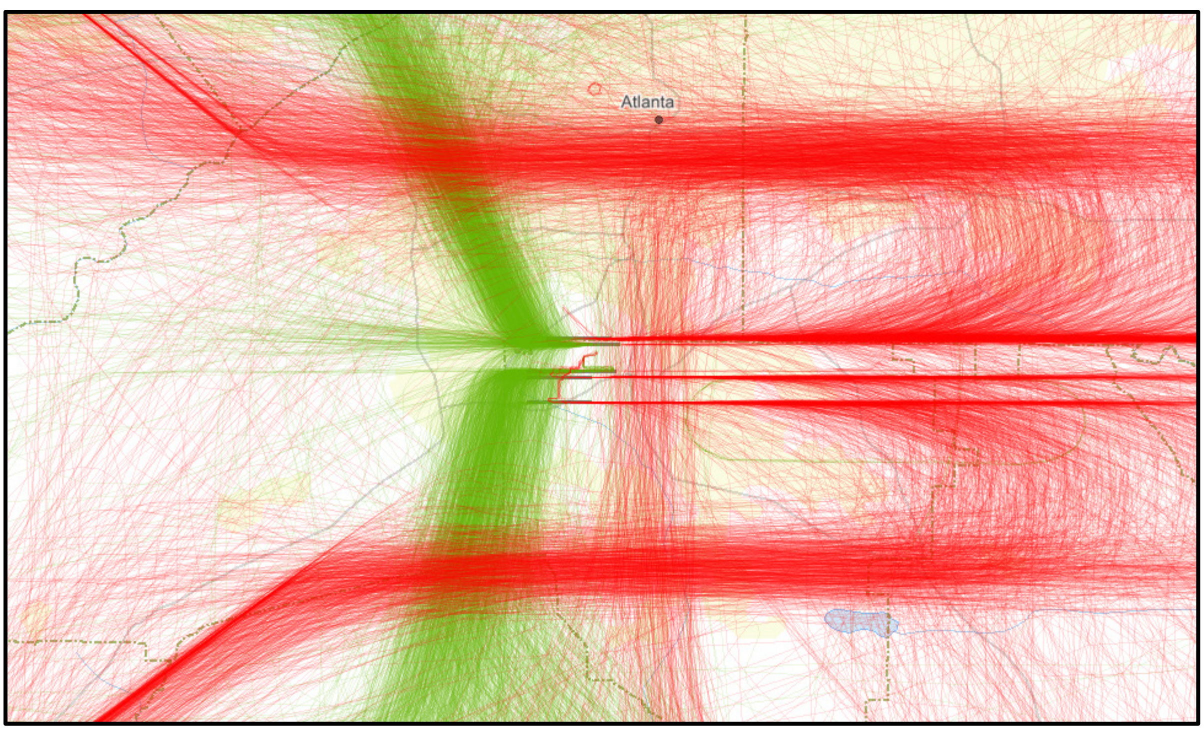
Non-Jets – 100% Sample



West Flow, Jets – 5% Sample



Non-Jets – 100% Sample



F.4 Austin-Bergstrom Intl, AUS

Airport: Austin-Bergstrom International Airport
City: Austin, TX
Runways: 2
Helipads: 3
Elevation: 544 feet MSL

Local Operation Notes: Circuits modeled at 1,000 feet AFE and 2,000 feet AFE. Split tracks counted as non-local operations as long as they went at least 7 nautical miles from the airport center. Circuit tracks that had a maximum altitude under 2,000 feet MSL used the 1,000 feet AFE profile. All other circuit operations used 2,000 feet AFE profile. Circuit tracks with a maximum range of greater than 25 nautical miles or a maximum altitude greater than 4,500 feet MSL were removed from modeling.

Helicopter Notes: About 3 percent of daily operations. About half are military and half general aviation or air taxi. Variety of INM types. None counted as local operations.

F.4.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
17L	30.203830	-97.657891	492	150	9,000	0	3
17R	30.213613	-97.679365	542	150	12,248	0	3
35L	30.179946	-97.678475	488	150	12,248	0	3
35R	30.179091	-97.657244	474	150	9,000	0	3
H1	30.202627	-97.655529	483	n/a	n/a	n/a	n/a
H2	30.187290	-97.661013	477	n/a	n/a	n/a	n/a
H3	30.179500	-97.673200	477	n/a	n/a	n/a	n/a

F.4.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.4.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	99,611	16,367	50,287	5,947	2,166	540	174,918	365
ATADS for Data Days	99,126	16,320	50,058	5,909	2,152	540	174,105	363
Database	96,439	16,706	40,171	2,437	1,468	48	157,269	363
Scale Factor	102.8%	97.7%	124.6%	242.5%	146.6%	1125.0%	110.7%	n/a

F.4.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	114,068	15,358	49,146	8,002	3,871	748	191,193	365
Database	96,439	16,706	40,171	2,437	1,468	48	157,269	363
Scale Factor	118.3%	91.9%	122.3%	328.4%	263.7%	1558.3%	121.6%	n/a

F.4.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.4.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	121.85	26.70	148.55	133.93	14.62	148.55	-	-	-	255.78	41.32	297.10
Civilian Jet, Other	22.24	1.42	23.66	22.31	1.35	23.66	0.09	-	0.09	44.73	2.77	47.50
Civilian Prop	47.76	4.28	52.04	47.51	4.53	52.04	2.82	0.05	2.87	100.91	8.91	109.82
Civilian Rotorcraft	2.72	0.99	3.71	2.95	0.77	3.72	-	-	-	5.67	1.76	7.43
Military Jet, Fighter	0.91	0.01	0.92	0.90	0.02	0.92	0.03	-	0.03	1.87	0.03	1.90
Military Jet, Other	0.55	-	0.55	0.55	-	0.55	-	-	-	1.10	-	1.10
Military Prop	3.41	0.15	3.56	3.49	0.07	3.56	0.71	-	0.71	8.32	0.22	8.54
Military Rotorcraft	2.81	0.31	3.12	3.04	0.08	3.12	-	-	-	5.85	0.39	6.24
TOTAL	**202.25**	**33.86**	**236.11**	**214.68**	**21.44**	**236.12**	**3.65**	**0.05**	**3.70**	**424.23**	**55.40**	**479.63**

Note: Each circuit operation counted as two operations in Total Operations

F.4.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	137.85	30.57	168.42	151.73	16.69	168.42	-	-	-	289.58	47.26	336.84
Civilian Jet, Other	21.84	1.39	23.23	21.90	1.33	23.23	0.17	-	0.17	43.91	2.72	46.63
Civilian Prop	46.63	4.12	50.75	46.41	4.34	50.75	5.08	0.09	5.17	98.12	8.55	106.67
Civilian Rotorcraft	2.63	0.94	3.57	2.84	0.73	3.57	-	-	-	5.47	1.67	7.14
Military Jet, Fighter	1.24	0.01	1.25	1.22	0.03	1.25	0.04	-	0.04	2.50	0.04	2.54
Military Jet, Other	0.74	-	0.74	0.74	-	0.74	-	-	-	1.48	-	1.48
Military Prop	4.62	0.20	4.82	4.73	0.09	4.82	0.99	-	0.99	10.34	0.29	10.63
Military Rotorcraft	3.80	0.41	4.21	4.11	0.10	4.21	-	-	-	7.91	0.51	8.42
TOTAL	**219.35**	**37.64**	**256.99**	**233.68**	**23.31**	**256.99**	**6.28**	**0.09**	**6.37**	**459.31**	**61.04**	**520.35**

Note: Each circuit operation counted as two operations in Total Operations

F.4.4 Modeled Tracks

RNAV procedures:

- 1 STAR (Arrival) RNAV procedure
- 0 RNAV RNP procedures
- 4 RNAV GPS procedures (one for each runway)
- 1 RNAV SID procedure (not used in May of 2013)

Total Tracks:

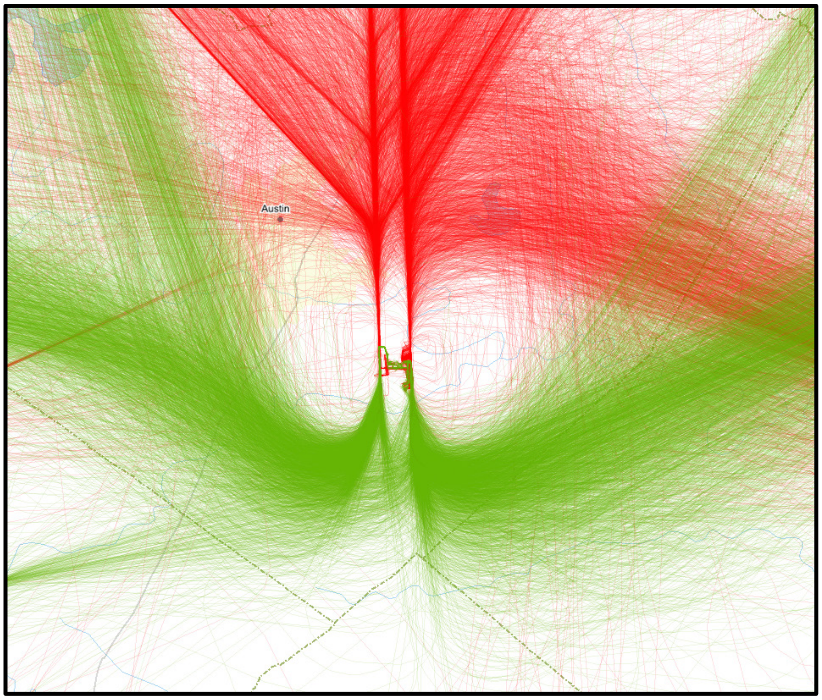
Aircraft Category	Arrivals North	Arrivals South	Departures North	Departures South	Locals North	Locals South
Jets	18,685	41,609	18,433	41,259	8	16
Non-Jets, fixed-wing	4,977	11,577	4,580	11,277	231	503
Total	23,662	53,186	23,013	52,536	239	519

Aircraft Category	Arrivals	Departures	Locals
Helicopters	1,643	1,713	-

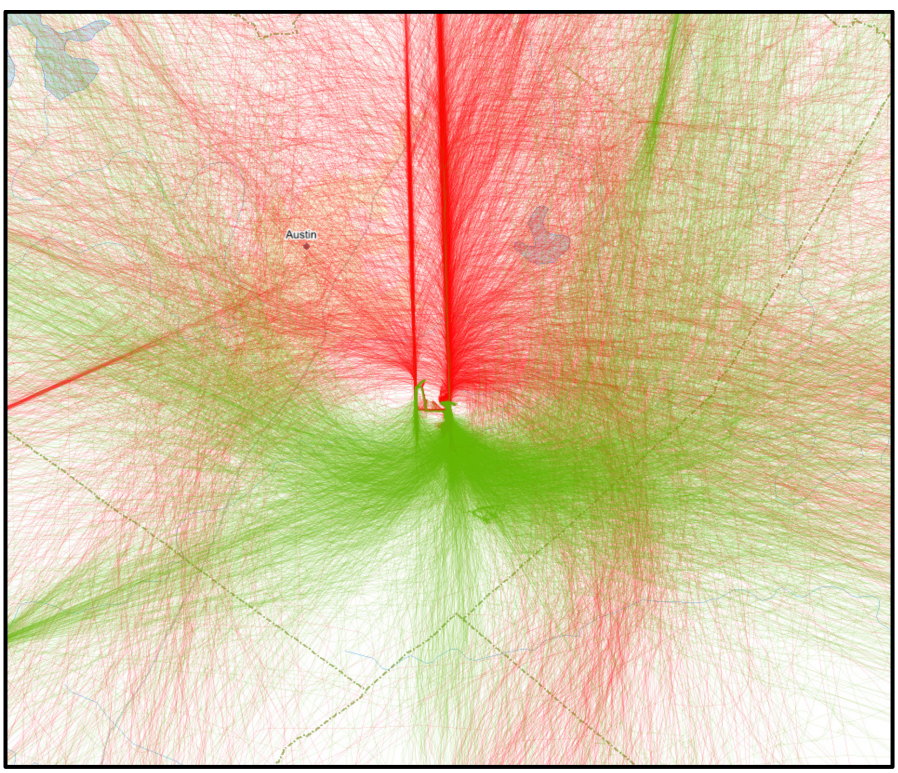
Aircraft Category	Total North	Total South	Total	Percent North	Percent South
Jets	37,126	82,884	120,010	31%	69%
Non-Jets, fixed-wing	9,788	23,357	33,145	30%	70%
Helicopters	n/a	n/a	3,356	n/a	n/a
Total	46,914	106,241	156,511	31%	69%

F.4.5 Representative Radar Flight Tracks

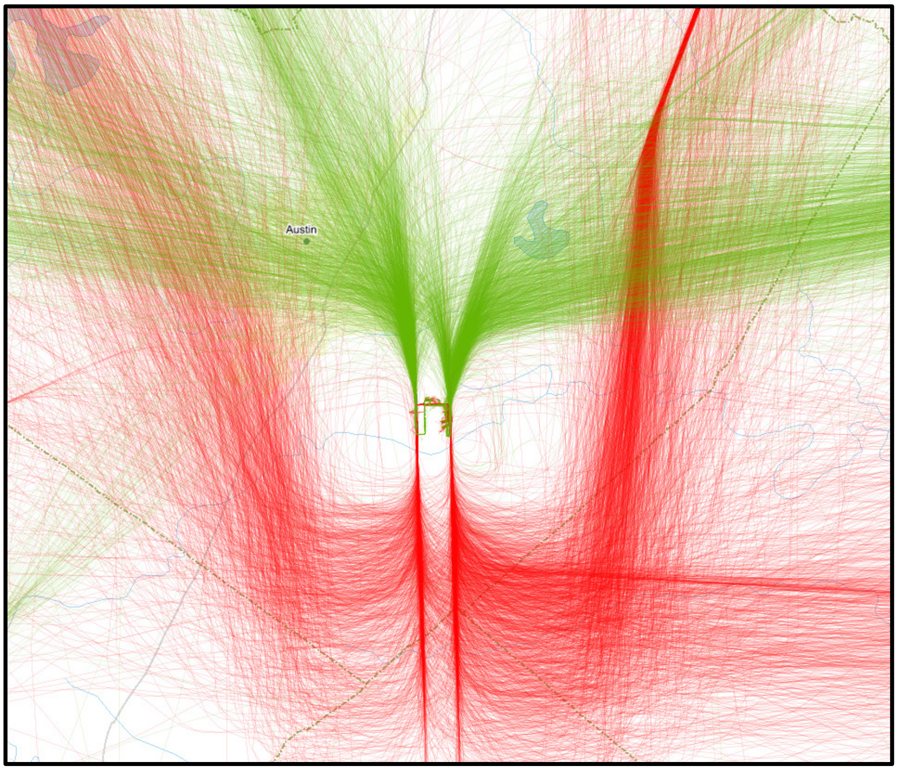
South Flow, Jets – 15% Sample



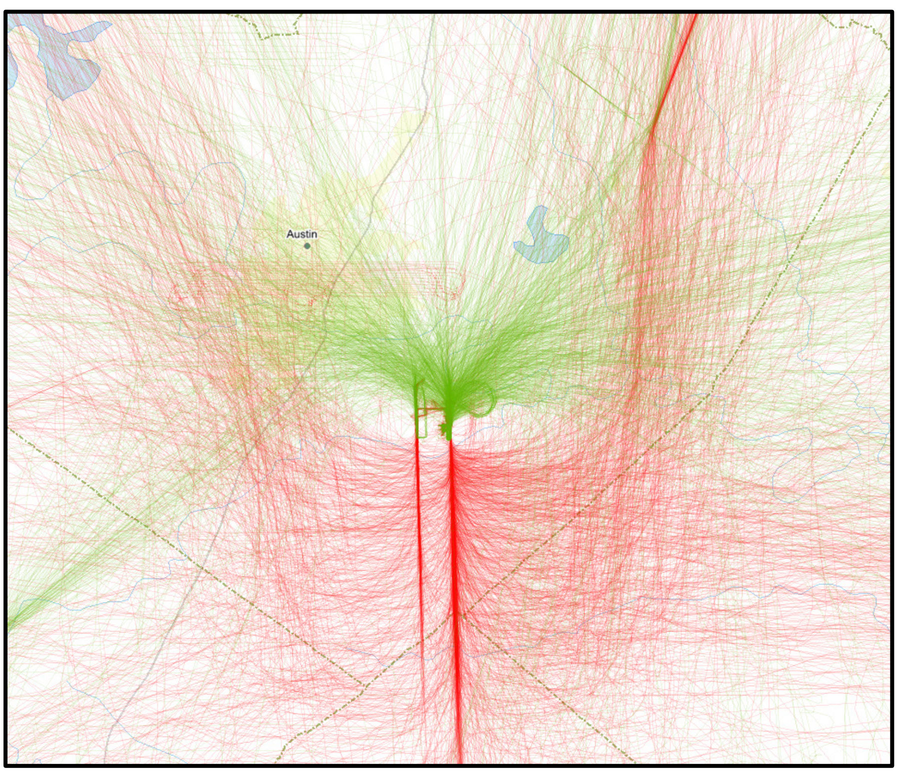
Non-Jets – 33% Sample



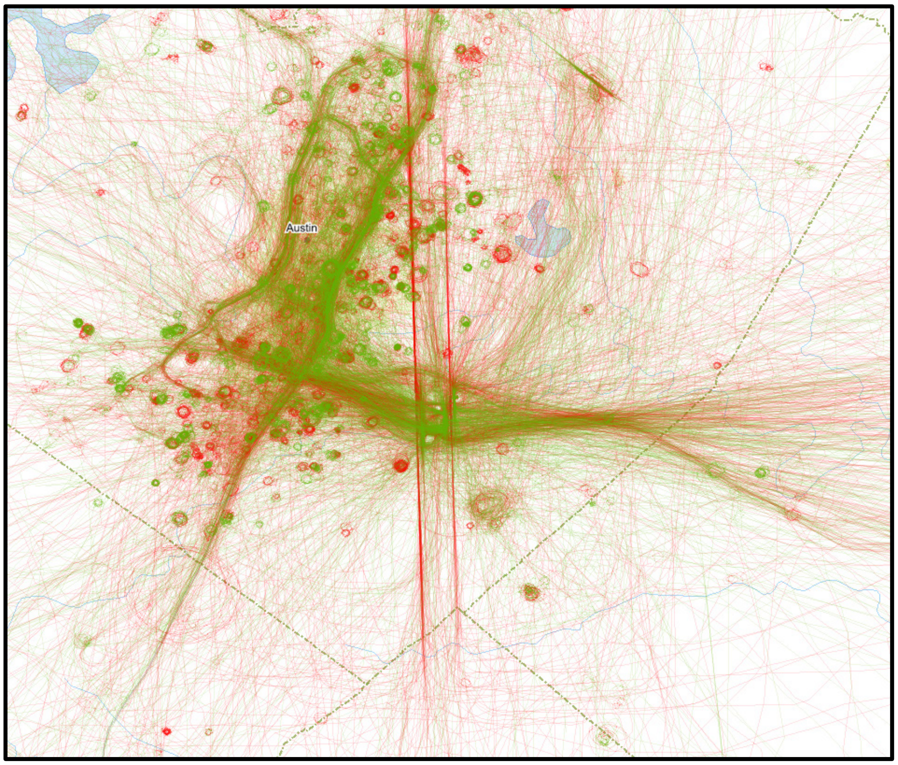
North Flow, Jets – 15% Sample



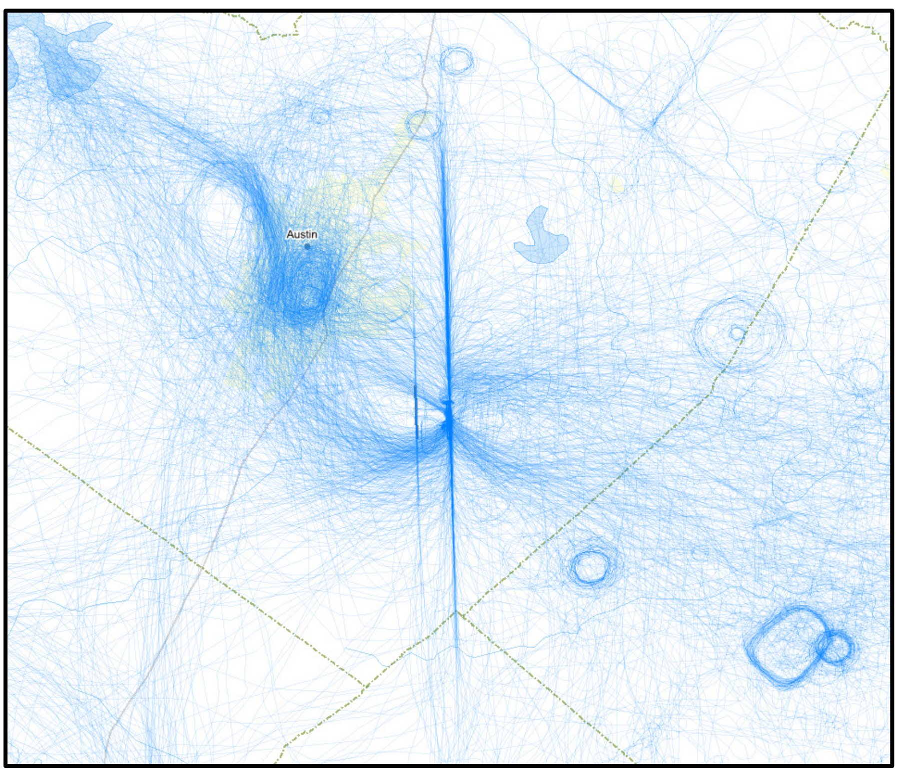
Non-Jets – 33% Sample



Helicopters – 100%



Local Operations – 100%



F.5 Bradley Intl, BDL

Airport: Bradley International Airport
City: Windsor Locks, CT
Runways: 3
Helipads: 3
Elevation: 173 feet MSL

Local Operation Notes: Circuits modeled at 1,700 feet AFE. Split tracks counted as non-local operations as long as they went at least 7 nautical miles from the airport center.

Helicopter Notes: About 4 percent of daily operations. About half are military and half general aviation or air taxi. Most operations are Sikorsky S70 or Sikorsky S76 aircraft. None counted as local operations.

Other Notes: Mostly commercial jet operations. Most local operations are jets. Eight 2015 operations (of 93,508 total operations) were not modeled due to a processing error. This omission has no effect within the precision of the model.

F.5.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
01	41.933725	-72.679620	171	100	4,268	475	3
06	41.932014	-72.696580	173	200	9,510	0	3
15	41.942397	-72.693253	169	150	6,847	0	3.5
19	41.945433	-72.679883	169	100	4,268	0	3
24	41.950664	-72.672133	161	200	9,510	0	3
33	41.929257	-72.675266	168	150	6,847	0	3
H1	41.944333	-72.676475	173	n/a	n/a	n/a	n/a
H2	41.938504	-72.693176	191	n/a	n/a	n/a	n/a
H3	41.936442	-72.674303	195	n/a	n/a	n/a	n/a

F.5.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.5.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	50,124	27,460	14,874	3,258	459	90	96,265	365
ATADS (Data Days)	49,897	27,353	14,854	3,249	459	90	95,902	363
Database	48,603	26,440	11,203	2,779	440	48	89,513	363
Scale Factor	102.7%	103.5%	132.6%	116.9%	104.3%	187.5%	107.1%	n/a

F.5.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	55,948	20,477	14,010	2,602	392	78	93,507	365
Database	48,603	26,440	11,203	2,779	440	48	89,513*	363
Scale Factor	115.1%	77.4%	125.1%	93.6%	89.1%	162.5%	104.5%	n/a

*5 fewer civilian rotorcraft and 3 fewer military rotorcraft ops modeled due to processing error; Affected DNL by less than 0.1 dB (est.)

F.5.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.5.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	75.08	20.96	96.04	79.22	16.82	96.04	-	-	-	154.30	37.78	192.08
Civilian Jet, Other	11.54	1.09	12.63	11.58	1.05	12.63	0.49	0.03	0.52	24.10	2.20	26.30
Civilian Prop	12.67	2.12	14.79	13.43	1.36	14.79	0.11	-	0.11	26.32	3.48	29.80
Civilian Rotorcraft	3.09	0.32	3.41	2.92	0.48	3.40	-	-	-	6.01	0.80	6.81
Military Jet, Fighter	0.01	-	0.01	0.01	-	0.01	-	-	-	0.02	-	0.02
Military Jet, Other	1.84	0.01	1.85	1.83	0.02	1.85	0.12	-	0.12	3.91	0.03	3.94
Military Prop	0.76	0.02	0.78	0.74	0.04	0.78	-	-	-	1.50	0.06	1.56
Military Rotorcraft	1.71	0.13	1.84	1.82	0.01	1.83	-	-	-	3.53	0.14	3.67
TOTAL	**106.70**	**24.65**	**131.35**	**111.55**	**19.78**	**131.33**	**0.72**	**0.03**	**0.75**	**219.69**	**44.49**	**264.18**

Note: Each circuit operation counted as two operations in Total Operations

F.5.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	75.17	22.34	97.51	80.11	17.40	97.51	-	-	-	155.28	39.74	195.02
Civilian Jet, Other	10.88	1.03	11.91	10.92	0.99	11.91	0.42	0.03	0.45	22.22	2.05	24.27
Civilian Prop	10.30	1.63	11.93	10.90	1.05	11.95	0.09	-	0.09	21.29	2.68	23.97
Civilian Rotorcraft	2.91	0.30	3.21	2.74	0.45	3.19	-	-	-	5.65	0.75	6.40
Military Jet, Fighter	0.01	-	0.01	0.01	-	0.01	-	-	-	0.02	-	0.02
Military Jet, Other	1.47	<0.01	1.47	1.47	0.01	1.48	0.11	-	0.11	3.05	0.01	3.06
Military Prop	0.61	0.02	0.63	0.60	0.03	0.63	-	-	-	1.21	0.05	1.26
Military Rotorcraft	1.37	0.10	1.47	1.45	0.01	1.46	-	-	-	2.82	0.11	2.93
TOTAL	**102.72**	**25.42**	**128.14**	**108.20**	**19.94**	**128.14**	**0.62**	**0.03**	**0.65**	**211.54**	**45.39**	**256.93**

Note: Each circuit operation counted as two operations in Total Operations

F.5.4 Modeled Tracks

RNAV procedures:

- 0 STAR RNAV procedure
- 3 RNAV RNP procedures (runways 06, 15, and 24)
- 4 RNAV GPS procedures (runways 06, 15, 24, and 33)
- 0 RNAV (SID) procedures

Total Tracks:

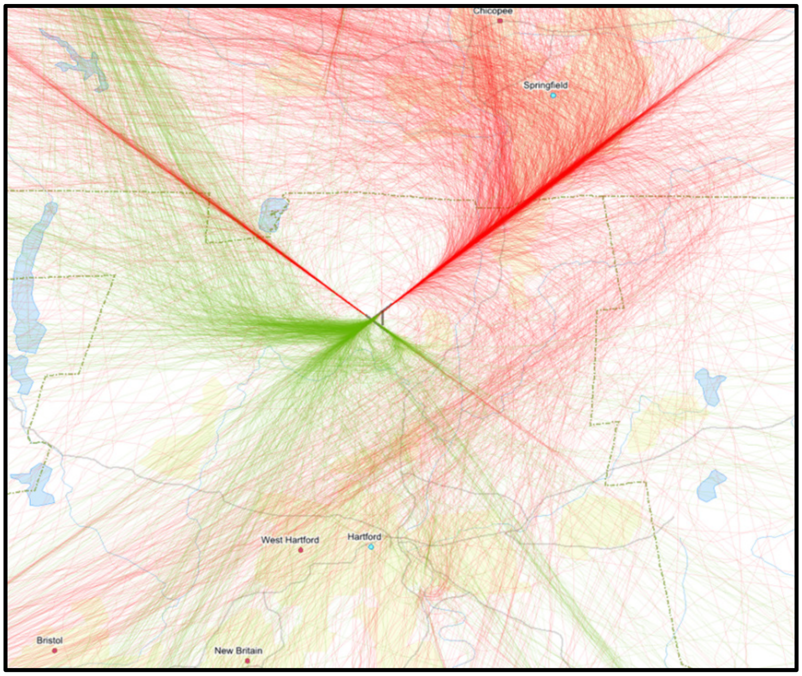
	Arrivals		Departures		Locals	
Aircraft Category	North	South	North	South	North	South
Jets	22,702	15,502	25,490	12,242	148	59
Non-Jets, fixed-wing	3,355	1,819	3,924	1,076	25	12
Total	26,057	17,321	29,414	13,318	173	71

Aircraft Category	Arrivals	Departures	Locals
Helicopters	1,526	1,382	-

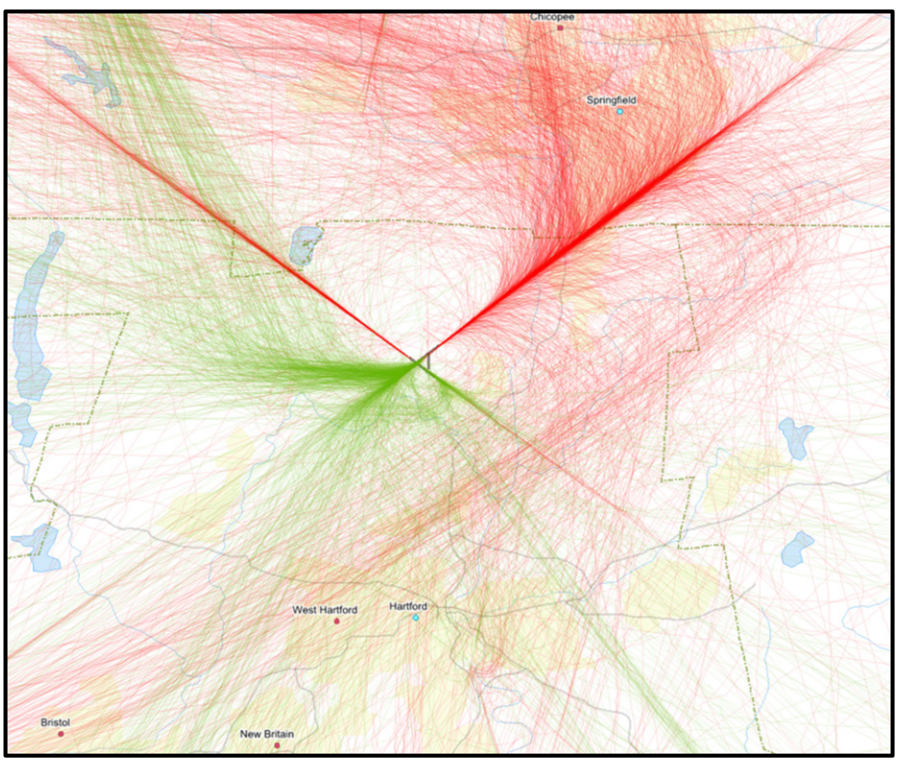
	Total			Percent	
Aircraft Category	North	South	Total	North	South
Jets	48,340	27,803	76,143	63%	37%
Non-Jets, fixed-wing	7,304	2,907	10,211	72%	28%
Helicopters	n/a	n/a	2,908	n/a	n/a
Total	55,644	30,710	89,262	64%	36%

F.5.5 Representative Radar Flight Tracks

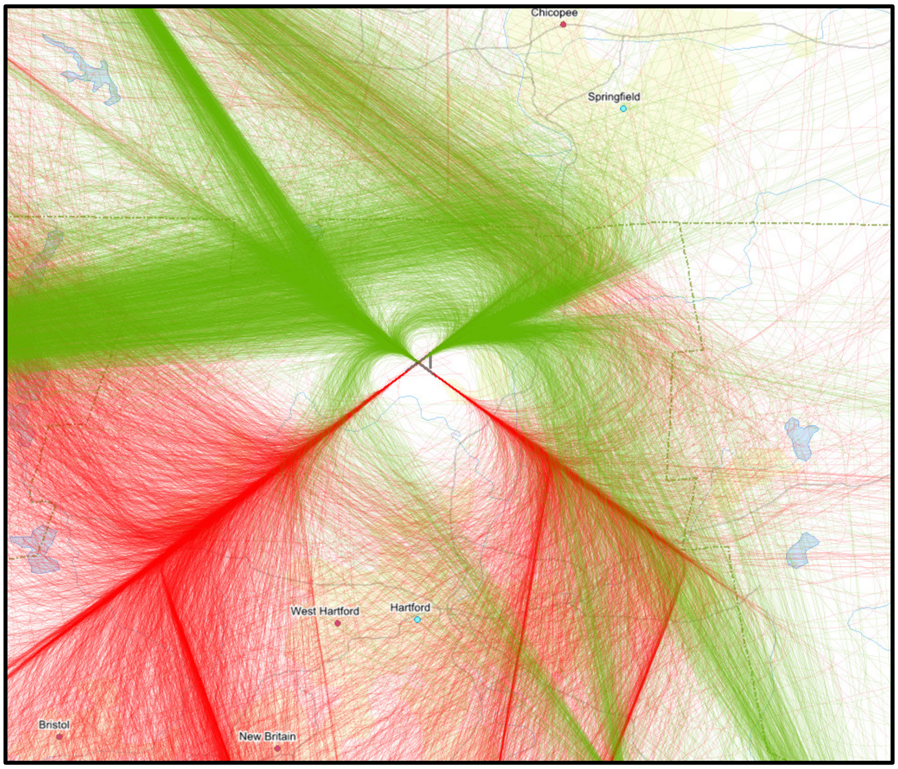
South Flow, Jets – 25% Sample



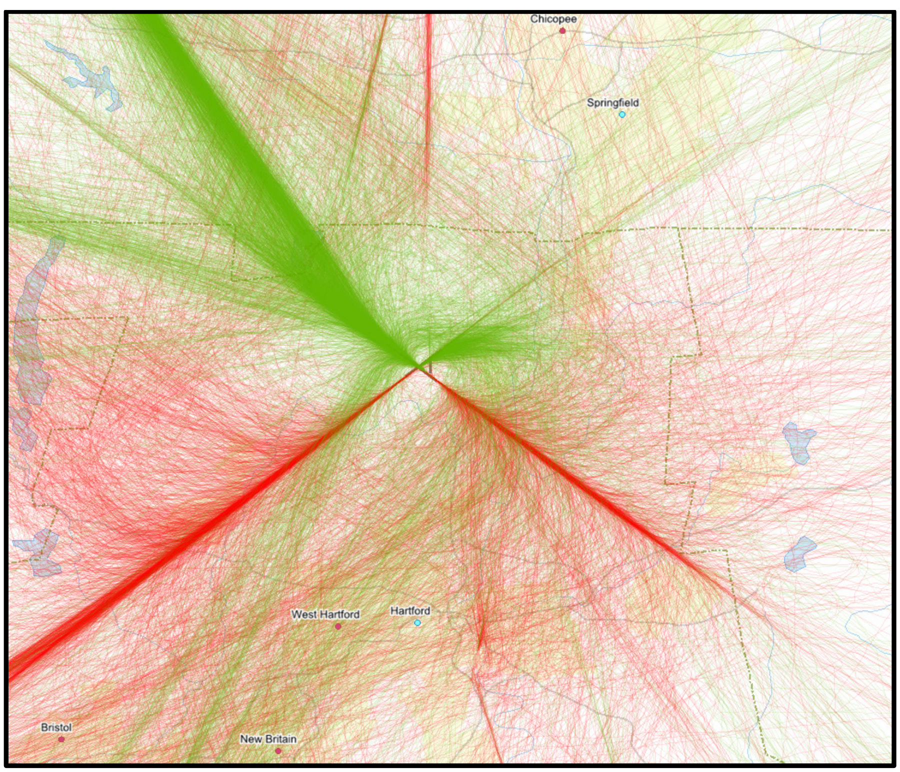
Non-Jets – 100%



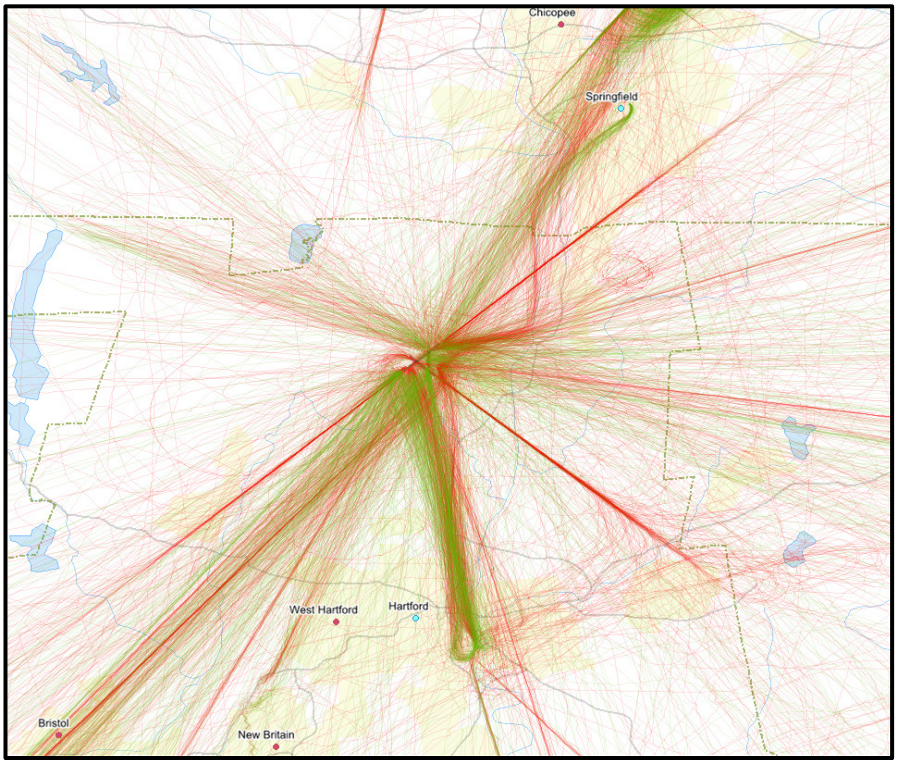
North Flow, Jets – 25% Sample



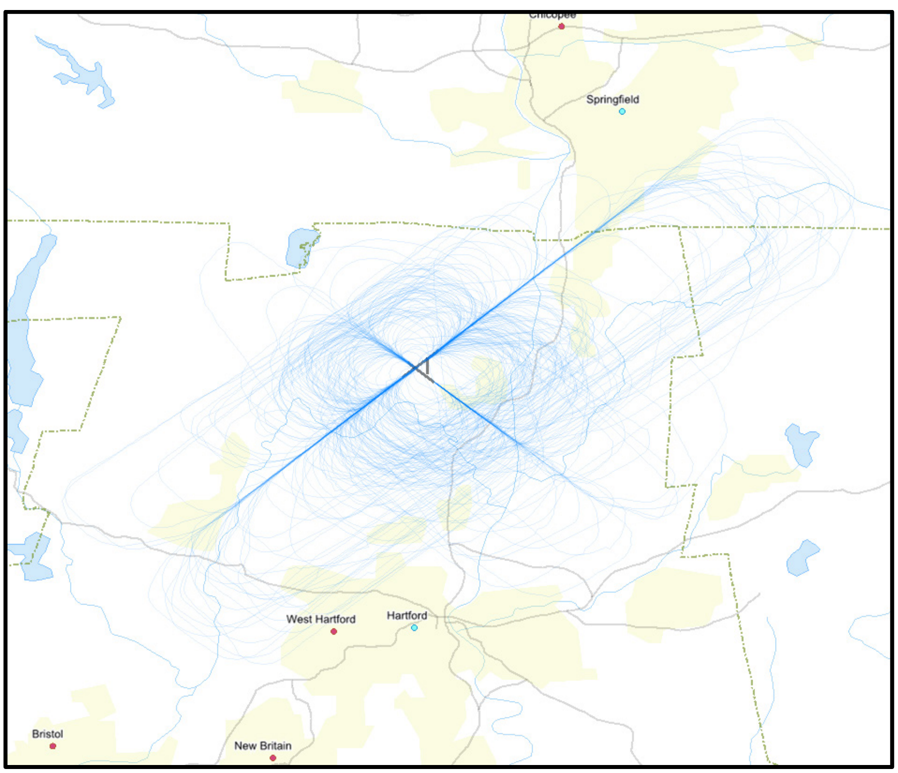
Non-Jets – 100%



Helicopters – 100%



Local Operations – 100%



F.6 Boeing Field / King County Intl, BFI

Airport: Boeing Field / King County International Airport
City: Seattle, WA
Runways: 2
Helipads: 0
Elevation: 21 feet MSL

Local Operation Notes: Circuits modeled at 979 feet AFE for runways 31L and 31R, and 779 feet AFE for runways 31R and 13L. Circuit tracks with a maximum range of greater than 3.5 nautical miles were removed from modeling.

Helicopter Notes: Very few operations modeled.

Other Notes: Mostly Non-Jet operations. Note that SEA operations were also modeled because those operations will add to the overall DNL exposures of survey subjects who live in some of the lower exposure areas produced by BFI operations. See Section F.7 for SEA-specific information. This section presents BFI information only. Local military operations were modeled as local civilian operations due to the low number of operations identified as military in the radar flight track data.

F.6.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
13L	47.538018	-122.30746	18	100	3,710	250	3
13R	47.540543	-122.31136	17	200	10,000	0	3
31L	47.516751	-122.29124	21	200	1,0000	880	3.1
31R	47.529193	-122.30000	17	100	3,710	375	3

F.6.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.6.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	9,001	35,240	94,596	668	47,138*	373*	187,016	365
ATADS for Data Days	9,001	35,240	94,596	668	47,511	0	187,016	365
Database	8,553	18,691	47,253	451	9,824	0	84,772	365
Scale Factor	105.2%	188.5%	200.2%	148.1%	483.6%	0	220.6%	n/a

*Local Military operations were modeled as Local Civil operations due to the low number of military tracks in the database.

F.6.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	10,896	28,809	84,280	1,056	39,770*	760*	165,571	365
Database	8,553	18,691	47,253	451	9,824	0	84,772	365
Scale Factor	127.4%	154.1%	178.4%	234.1%	412.6%	0	195.3%	n/a

*Local Military operations were modeled as Local Civil operations due to (only) 6 military tracks in the database.

F.6.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.6.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	22.18	4.19	26.37	23.28	3.09	26.37	-	-	-	45.46	7.28	52.74
Civilian Jet, Other	39.12	4.34	43.46	38.88	4.58	43.46	-	-	-	78.00	8.92	86.92
Civilian Prop	106.96	13.40	120.36	107.04	13.31	120.35	62.20	2.89	65.09	338.40	32.49	370.89
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.63	-	0.63	0.62	<0.01	0.62	-	-	-	1.25	-	1.25
Military Jet, Other	0.13	<0.01	0.13	0.14	-	0.14	-	-	-	0.27	-	0.27
Military Prop	0.15	<0.01	0.15	0.15	-	0.15	-	-	-	0.30	-	0.30
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**169.17**	**21.93**	**191.10**	**170.11**	**20.98**	**191.09**	**62.20**	**2.89**	**65.09**	**463.68**	**48.69**	**512.37**

Note: Each circuit operation counted as two operations in Total Operations

F.6.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	21.68	4.73	26.41	23.05	3.35	26.40	-	-	-	44.73	8.08	52.81
Civilian Jet, Other	34.85	3.87	38.72	34.64	4.08	38.72	-	-	-	69.49	7.95	77.44
Civilian Prop	93.37	11.35	104.72	93.40	11.31	104.71	53.06	2.46	55.52	239.83	25.12	264.95
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.99	-	0.99	0.99	0.01	1.00	-	-	-	1.98	0.01	1.99
Military Jet, Other	0.21	0.01	0.22	0.22	-	0.22	-	-	-	0.43	0.01	0.44
Military Prop	0.23	0.01	0.24	0.24	-	0.24	-	-	-	0.47	0.01	0.48
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**151.33**	**19.97**	**171.30**	**152.54**	**18.75**	**171.29**	**53.06**	**2.46**	**55.52**	**356.93**	**41.18**	**398.11**

Note: Each circuit operation counted as two operations in Total Operations

F.6.4 Modeled Tracks

Departures are green, Arrivals are red, Local operations are in blue.

RNAV procedures:

- 0 STAR (Arrival) RNAV procedure
- 1 RNAV RNP procedures (Runway 13R)
- 1 RNAV GPS procedures (Runway 13R)
- 0 RNAV SID procedures

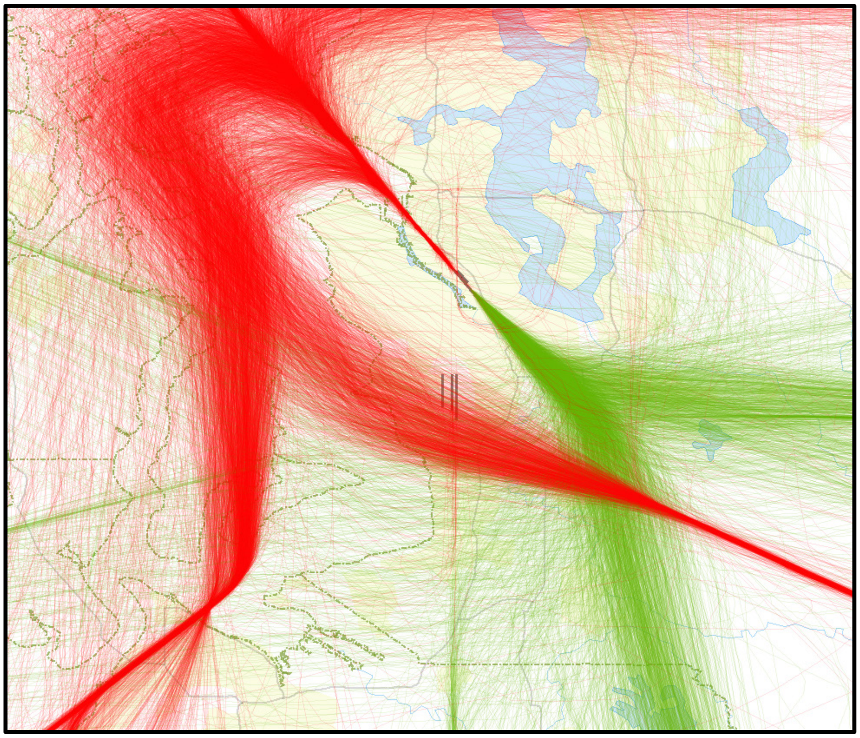
Total Tracks:

Aircraft Category	Arrivals East	Arrivals West	Departures East	Departures West	Locals East	Locals West
Jets	11,395	4,206	11,135	4,264	-	-
Non-Jets, fixed-wing	15,311	7,812	12,192	8,633	3,500	1,412
Total	26,706	12,018	23,327	12,897	3,500	1,412

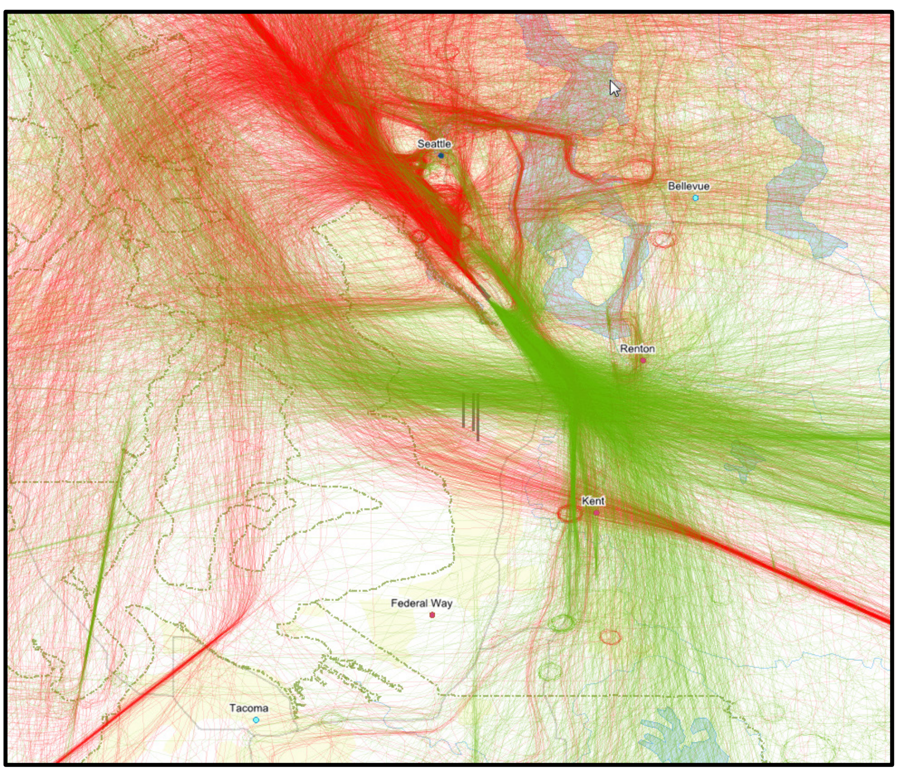
Aircraft Category	Total East	Total West	Total Total	Percent East	Percent West
Jets	22,530	8,470	31,000	73%	27%
Non-Jets, fixed-wing	31,003	17,857	48,860	63%	37%
Helicopters	n/a	n/a	-	n/a	n/a
Total	53,533	26,327	79,860	67%	33%

F.6.5 Representative Radar Flight Tracks

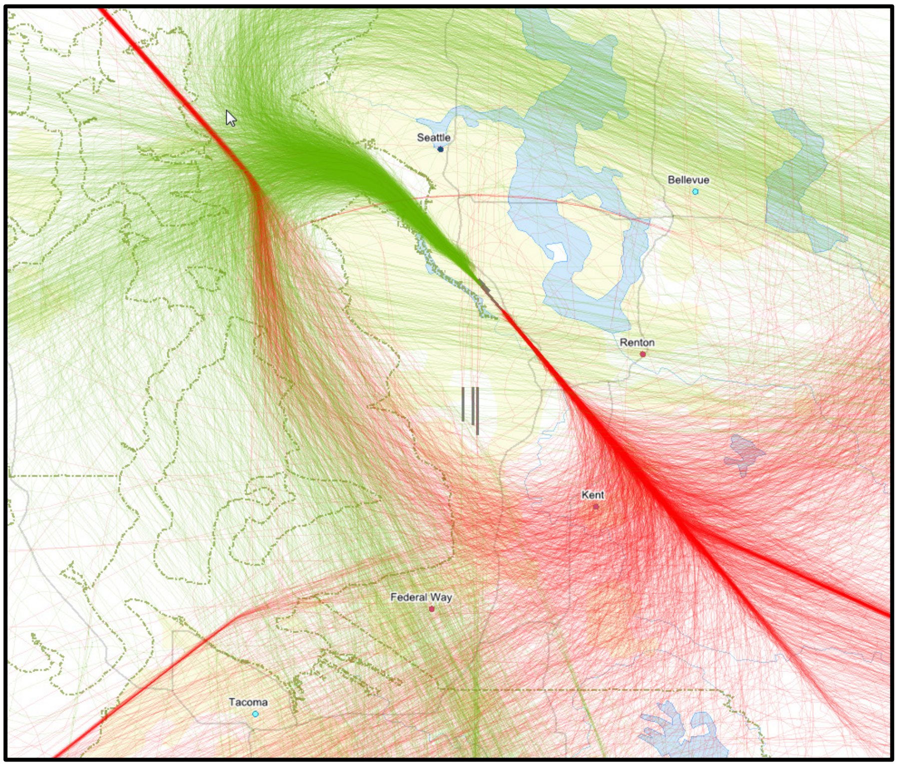
East Flow, Jets – 50% Sample



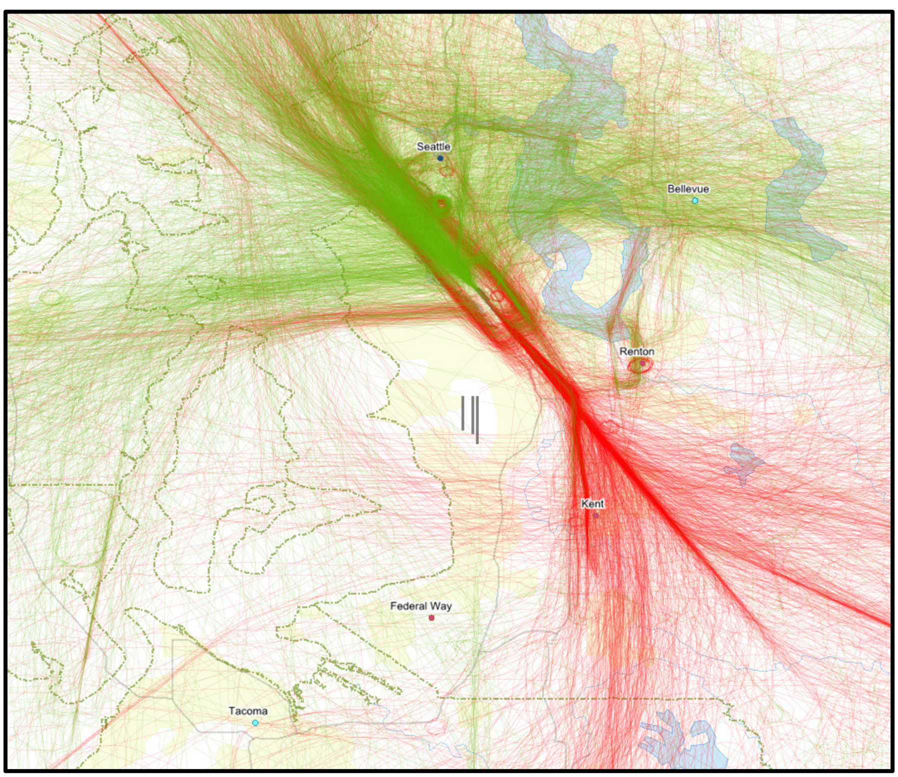
Non-Jets – 33% Sample



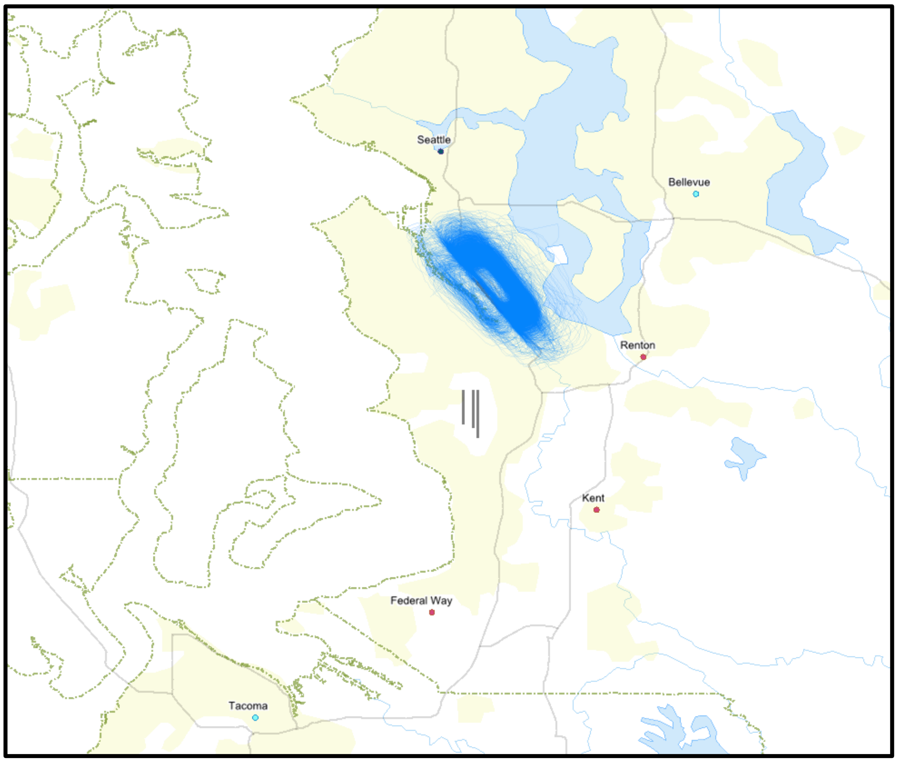
West Flow, Jets – 50% Sample



Non-Jets – 33% Sample



Local Operations – 100%



F.7 Seattle-Tacoma International Airport (SEA) Considerations

SEA is not one of the twenty airports selected for the survey. However, the residents near the BFI airport get several overflights from the nearby SEA airport. Therefore, SEA was modeled as an individual airport, but the results were added together with the BFI results. This was done because the combination of both airport operations were certain to affect annoyance, particularly in areas where overflights from both airports occur.

Local operations (circuits) at SEA were ignored and not modeled as they would not likely affect cumulative noise exposure at BFI.

Airport: Seattle-Tacoma International Airport
City: Seattle, WA
Runways: 3
Helipads: 0
Elevation: 432 feet MSL

Local Operation Notes: No local operations modeled

Helicopter Notes: No helicopter operations modeled

Other Notes: SEA has implemented new RNAV procedures since this modeling was done, although they are unlikely to cause a change of more than 1 dB DNL in the modeled contour levels. Eight 2015 operations (of 308,918 total operations) were not modeled due to a processing error. This omission has no effect within the precision of the model.

F.7.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
16C	47.463808	-122.310985	430.0	150	9,426	0	3
16L	47.463795	-122.307752	432.0	150	11,901	0	3
16R	47.463836	-122.317858	415.0	150	8,500	0	3
34C	47.437970	-122.311211	363.0	150	9,426	0	3
34L	47.440534	-122.318059	356.0	150	8,500	0	3
34R	47.431171	-122.308039	347.0	150	11,901	0	2.8

F.7.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.7.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	291,282	14,026	3,523*	87*	0	0	308,918	365
ATADS for Data Days	291,282	14,026	3,610	0	0	0	308,918	365
Database	288,687	13,743	1,363	0	0	0	303,793	365
Scale Factor	100.9%	102.1%	264.9%	0	0	0	101.7%	n/a

* Military operations were modeled as General Aviation due to the low number of military tracks in the database.

F.7.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	368,722	8,401	4,160	125 (1)	0	0	381,408	365
Database	288,687	13,743	1,363	0	0	0	303,793 (2)	365
Scale Factor	127.7%	61.1%	314.4%	0	0	0	125.5%	n/a

Notes:
1) 125 Military operations from ATADS were ignored due to no military tracks in the database.
2) 4 fewer civilian propeller operations modeled due to processing error; Affected overall DNL by less than 0.1 dB (estimated).

F.7.3 Modeled Average Annual Daily Number of Flight Events and Operations

F.7.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	247.25	48.36	295.61	245.94	49.67	295.61	-	-	-	493.19	98.03	591.22
Civilian Jet, Other	2.87	0.29	3.16	2.76	0.40	3.16	-	-	-	5.63	0.69	6.32
Civilian Prop	110.98	13.43	124.41	111.70	12.71	124.41	-	-	-	222.68	26.14	248.82
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	-	-	-	-	-	-	-	-	-	-	-	-
Military Prop	-	-	-	-	-	-	-	-	-	-	-	-
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**361.10**	**62.08**	**423.18**	**360.40**	**62.78**	**423.18**	**-**	**-**	**-**	**721.50**	**124.86**	**846.36**

Note: Each circuit operation counted as two operations in Total Operations

F.7.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	310.63	61.14	371.77	308.99	62.78	371.77	-	-	-	619.62	123.92	743.54
Civilian Jet, Other	3.31	0.33	3.64	3.18	0.46	3.64	-	-	-	6.49	0.79	7.28
Civilian Prop	129.93	16.96	146.89	131.14	15.76	146.90	-	-	-	261.07	32.72	293.79
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	-	-	-	-	-	-	-	-	-	-	-	-
Military Prop	-	-	-	-	-	-	-	-	-	-	-	-
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**443.87**	**78.43**	**522.30**	**443.31**	**79.00**	**522.31**	**-**	**-**	**-**	**887.18**	**157.43**	**1,044.61**

Note: Each circuit operation counted as two operations in Total Operations

F.7.4 Modeled Tracks

RNAV procedures:

- 2 STAR (Arrival) RNAV procedures
- 6 RNAV RNP procedures
- 6 RNAV GPS procedures
- 3 RNAV SID procedures

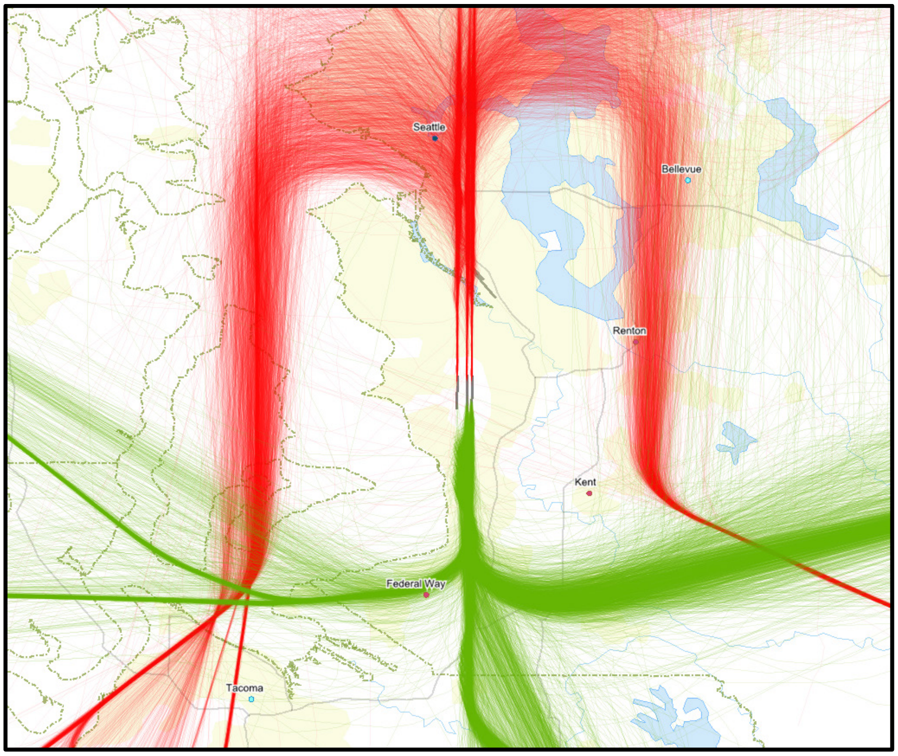
Total Tracks:

Aircraft Category	Arrivals		Departures		Locals	
	North	South	North	South	North	South
Jets	32,843	75,214	30,229	76,413	-	-
Non-Jets, fixed-wing	12,665	32,139	12,750	31,539	-	-
Total	45,508	107,353	42,979	107,952	-	-

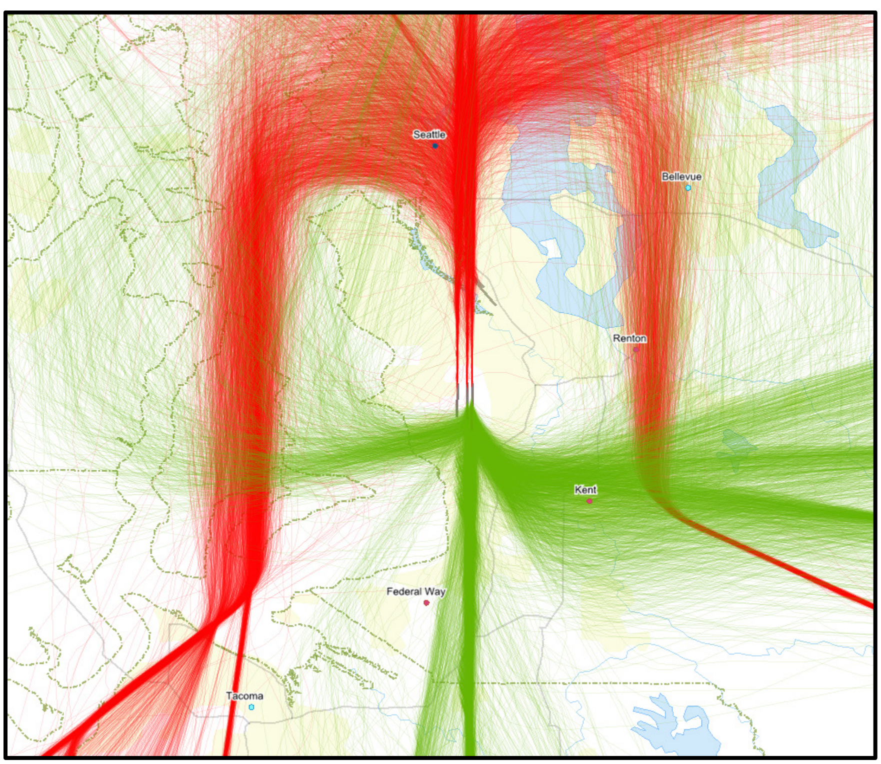
Aircraft Category	Total			Percent	
	North	South	Total	North	South
Jets	63,072	151,627	214,699	29%	71%
Non-Jets, fixed-wing	25,415	63,678	89,093	29%	71%
Helicopters	n/a	n/a	-	n/a	n/a
Total	88,487	215,305	303,792	29%	71%

F.7.5 Representative Radar Flight Tracks

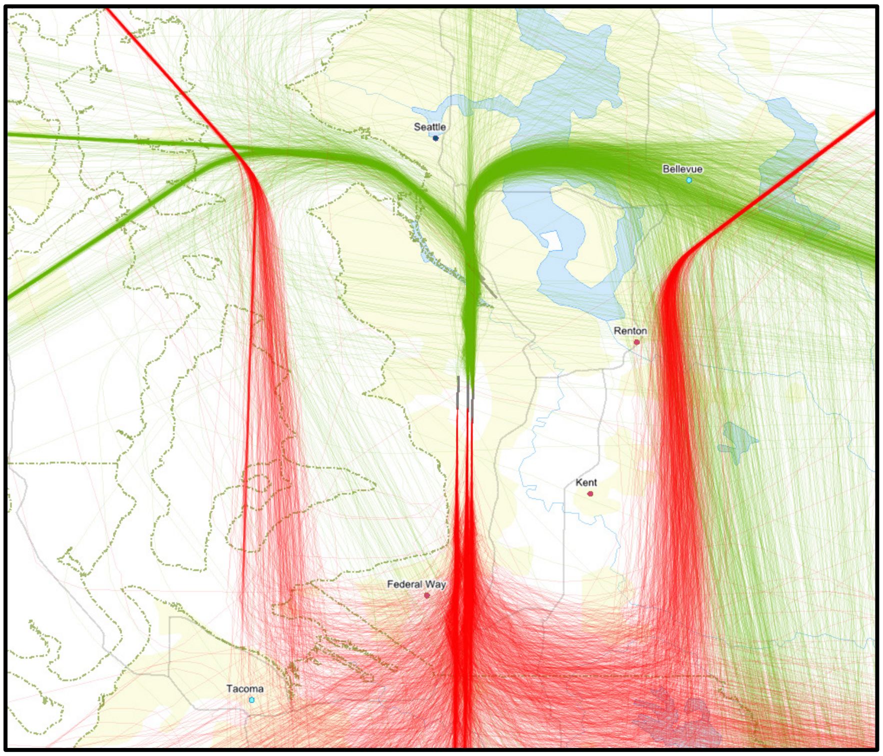
South Flow, Jets – 7% Sample



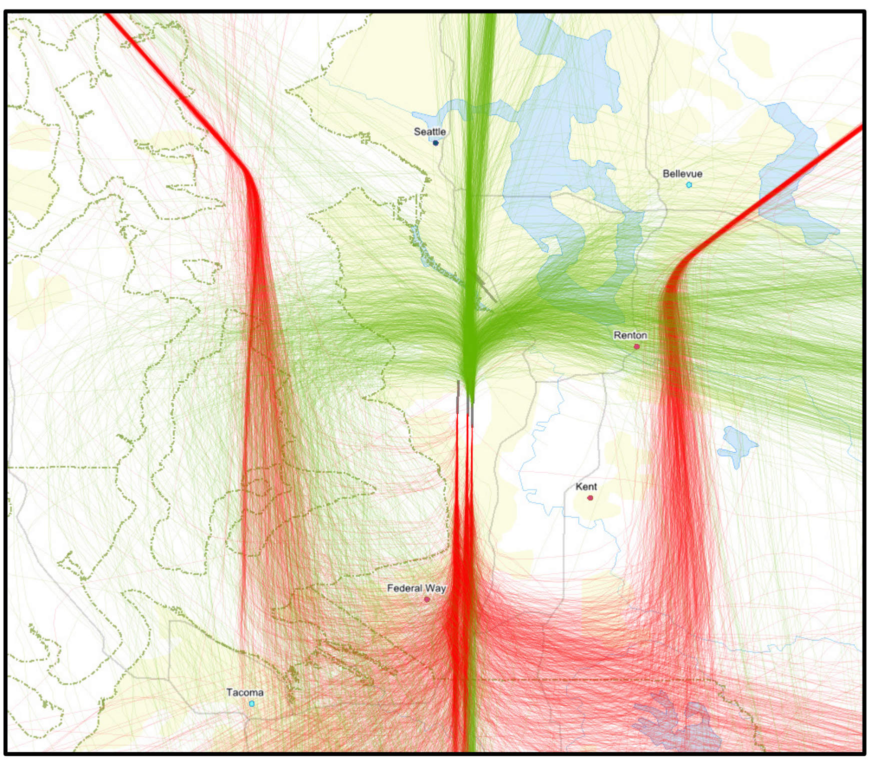
Non-Jets – 15% Sample



North Flow, Jets – 7% Sample



Non-Jets – 15% Sample



F.8 Billings Logan Intl, BIL

Airport: Billings Logan International Airport
City: Billings, MT
Runways: 3
Helipads: 1
Elevation: 3,652 feet MSL

Local Operation Notes: Circuits modeled at 1,000 feet AFE and 3,000 feet AFE. Split tracks counted as non-local operations. Local tracks that had a maximum range under 8 nautical miles used the 1,000 feet AFE profile. All other local operations used 3,000 feet AFE profile.

Helicopter Notes: Moderate number of helicopter operations, but about half of them were removed because the hospital is too close to the airport to model them in INM. None counted as local operations.

Other Notes: Mostly Non-Jet operations. There were 275 operations from 2015 (of 81,122 total operations) that were not modeled due to a processing error. This omission has no effect within the precision of the model.

F.8.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
07	45.807679	-108.55841	3,636	75	5,503	0	3
10L	45.812731	-108.55482	3,584	150	10,521	0	3
10R	45.809195	-108.56283	3,652	75	3,800	0	3
25	45.809255	-108.53694	3,534	75	5,503	0	3
28L	45.805338	-108.54898	3,607	75	3,800	0	3
28R	45.802049	-108.51651	3,488	150	10,521	0	3
H1	45.805147	-108.54373	3,597	n/a	n/a	n/a	n/a

F.8.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.8.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	10,203	26,096	25,541	480	18,732	70	81,122	365
ATADS (Data Days)	10,033	25,702	25,144	476	18,358	70	79,783	359
Database	9,086	22,553	14,884	324	6,082	24	52,953	359
Scale Factor	110.4%	114.0%	168.9%	146.9%	301.8%	291.7%	150.7%	n/a

F.8.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	10,036	26,516	26,303	385	17,674	126	81,040	365
Database	9,086	22,553	14,884	324	6,082	24	52,953*	359
Scale Factor	110.5%	117.6%	176.7%	118.8%	290.6%	525.0%	153.0%	n/a

*275 fewer operations modeled due to processing error; Consisted of 10 civilian (non-commercial jet), 218 civilian propeller, 35 civilian rotorcraft, 2 military jet fighter and 10 military rotorcraft operations; Affected overall DNL by less than 0.1 dB (estimated).

F.8.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.8.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	14.20	3.07	17.27	14.18	2.99	17.17	-	-	-	28.38	6.06	34.44
Civilian Jet, Other	4.48	0.26	4.74	4.52	0.24	4.76	0.27	0.03	0.30	9.54	0.56	10.10
Civilian Prop	51.41	9.22	60.63	51.28	9.44	60.72	24.13	1.14	25.27	150.95	20.94	171.89
Civilian Rotorcraft	2.03	0.12	2.15	1.93	0.22	2.15	-	-	-	3.96	0.34	4.30
Military Jet, Fighter	0.01	-	0.01	0.01	-	0.01	-	-	-	0.02	-	0.02
Military Jet, Other	0.10	0.01	0.11	0.10	-	0.10	0.08	-	0.08	0.36	0.01	0.37
Military Prop	0.46	-	0.46	0.46	<0.01	0.46	0.02	-	0.02	0.96	-	0.96
Military Rotorcraft	0.09	-	0.09	0.08	<0.01	0.08	-	-	-	0.17	-	0.17
TOTAL	**72.78**	**12.68**	**85.46**	**72.56**	**12.89**	**85.45**	**24.50**	**1.17**	**25.67**	**194.34**	**27.91**	**222.25**

Note: Each circuit operation counted as two operations in Total Operations

F.8.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	14.39	3.09	17.48	14.36	3.02	17.38	-	-	-	28.75	6.11	34.86
Civilian Jet, Other	4.69	0.27	4.96	4.72	0.26	4.98	0.26	0.02	0.28	9.67	0.55	10.22
Civilian Prop	53.36	9.50	62.86	53.32	9.74	63.06	23.23	1.10	24.33	129.91	20.34	150.25
Civilian Rotorcraft	2.12	0.12	2.24	1.90	0.23	2.13	-	-	-	4.02	0.35	4.37
Military Jet, Fighter	0.01	-	0.01	0.01	-	0.01	-	-	-	0.02	-	0.02
Military Jet, Other	0.08	0.01	0.09	0.08	-	0.08	0.15	-	0.15	0.31	0.01	0.32
Military Prop	0.37	-	0.37	0.37	<0.01	0.37	0.03	-	0.03	0.77	-	0.77
Military Rotorcraft	0.07	-	0.07	0.07	<0.01	0.07	-	-	-	0.14	-	0.14
TOTAL	**75.09**	**12.99**	**88.08**	**74.83**	**13.25**	**88.08**	**23.67**	**1.12**	**24.79**	**173.59**	**27.36**	**200.95**

Note: Each circuit operation counted as two operations in Total Operations

F.8.4 Modeled Tracks

RNAV procedures:

- 0 STAR RNAV procedure
- 0 RNAV RNP procedures
- 4 RNAV GPS procedures (runways 07, 10L, 25, and 28R)
- 0 RNAV (SID) procedures

Total Tracks:

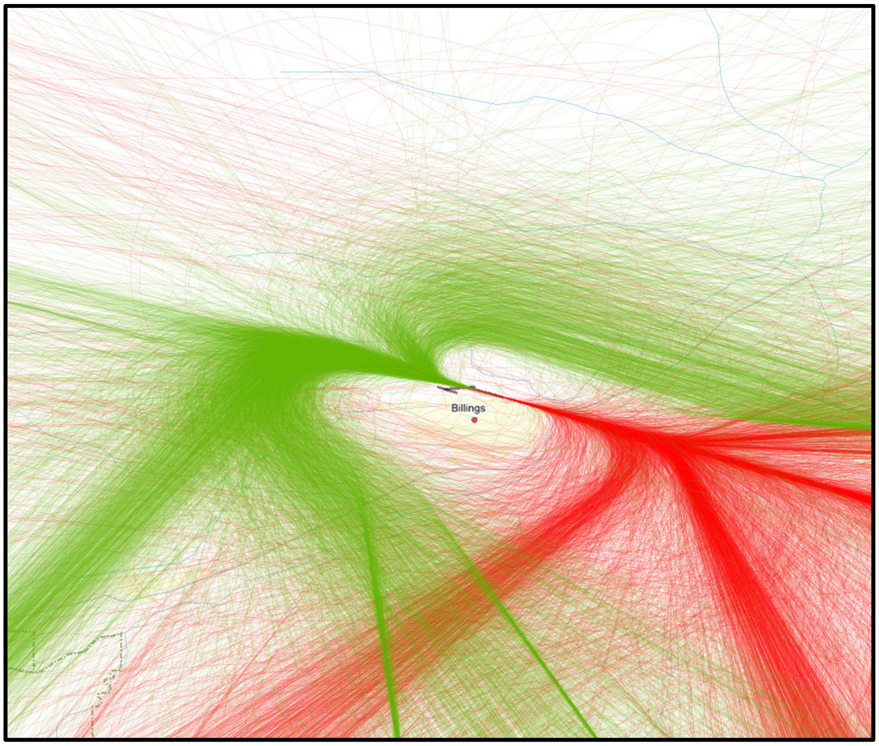
Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	1,693	4,868	1,570	5,114	12	33
Non-Jets, fixed-wing	5,495	11,055	3,319	12,711	563	2,445
Total	7,188	15,923	4,889	17,825	575	2,478

Aircraft Category	Arrivals	Departures	Locals
Helicopters	421	434	-

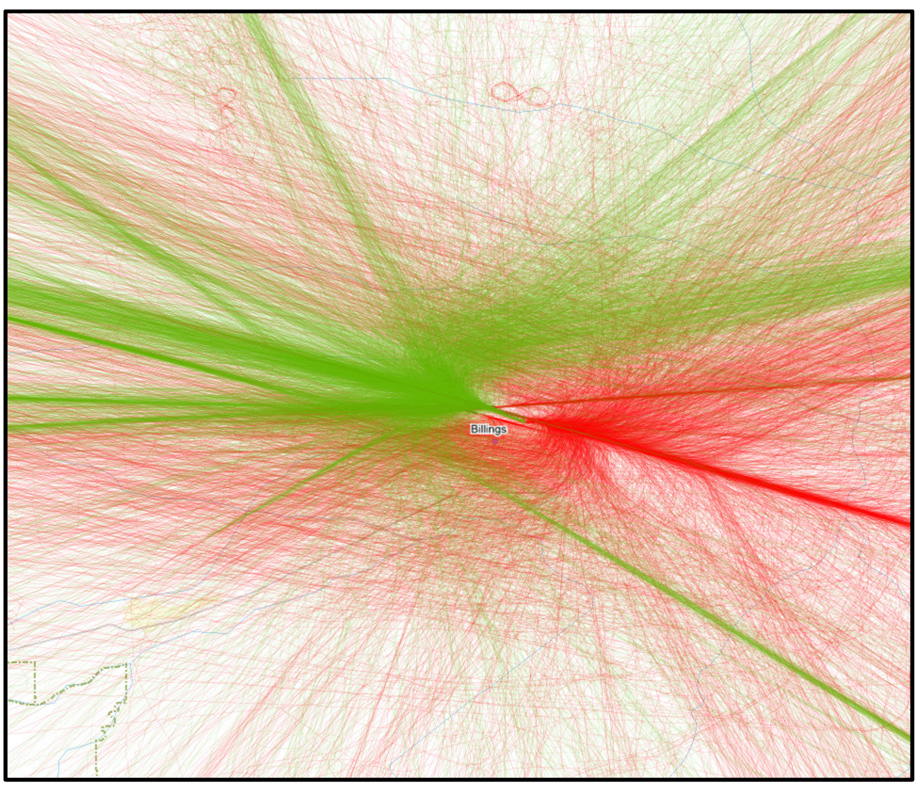
Aircraft Category	Total			Percent	
	East	West	Total	East	West
Jets	3,275	10,015	13,290	25%	75%
Non-Jets, fixed-wing	9,377	26,211	35,588	26%	74%
Helicopters	n/a	n/a	855	n/a	n/a
Total	12,652	36,226	49,733	26%	74%

F.8.5 Representative Radar Flight Tracks

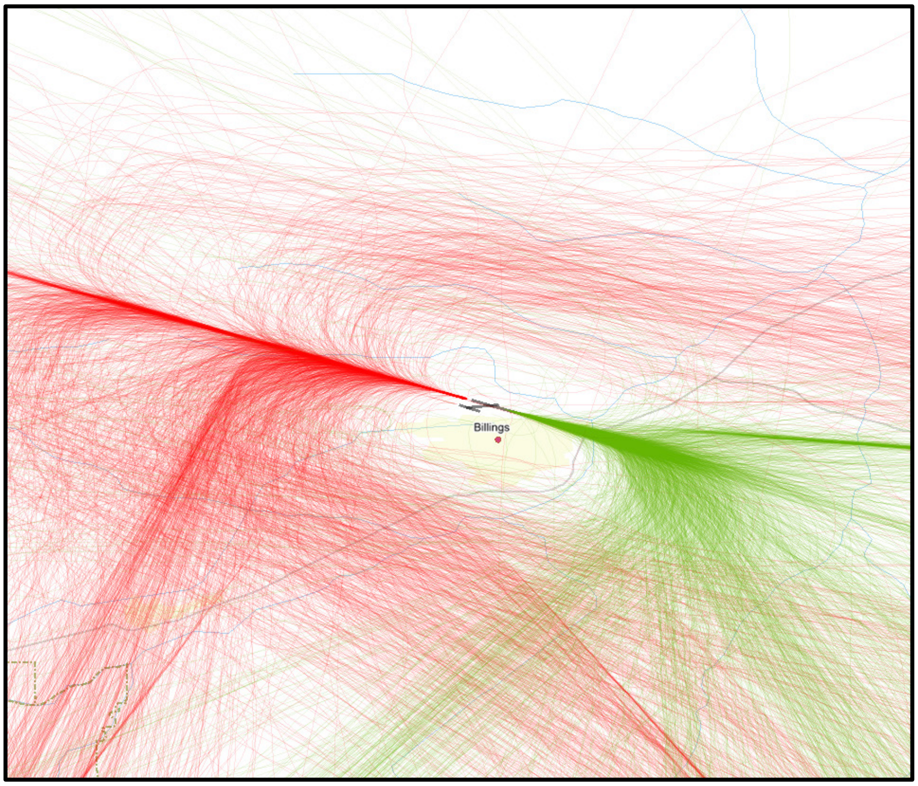
West Flow, Jets – 100%



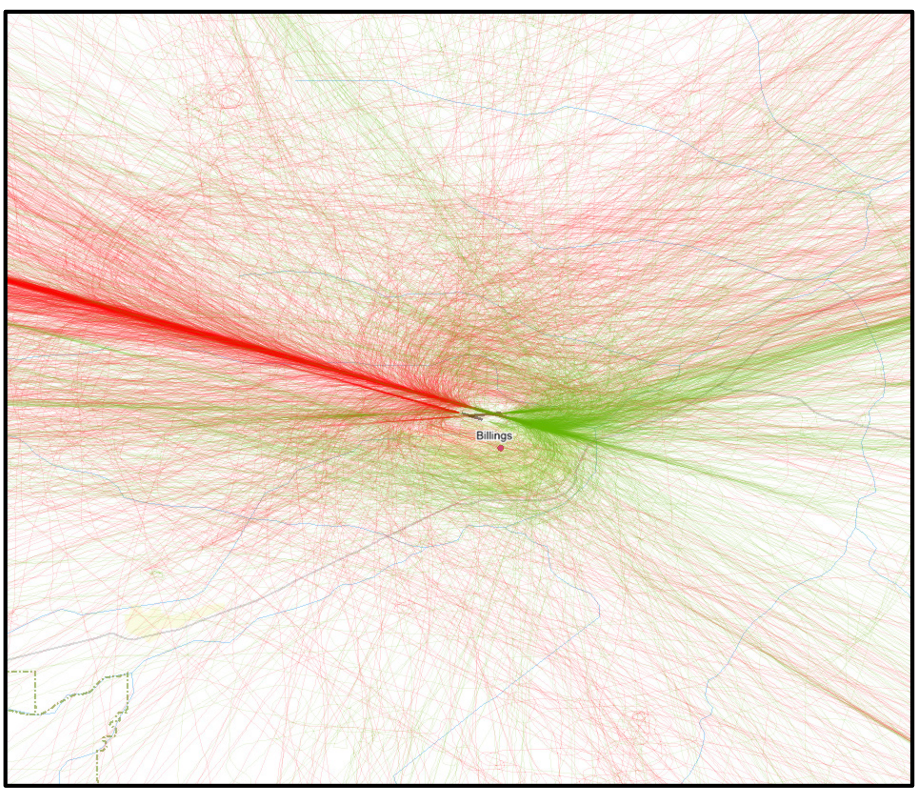
Non-Jets – 33% Sample



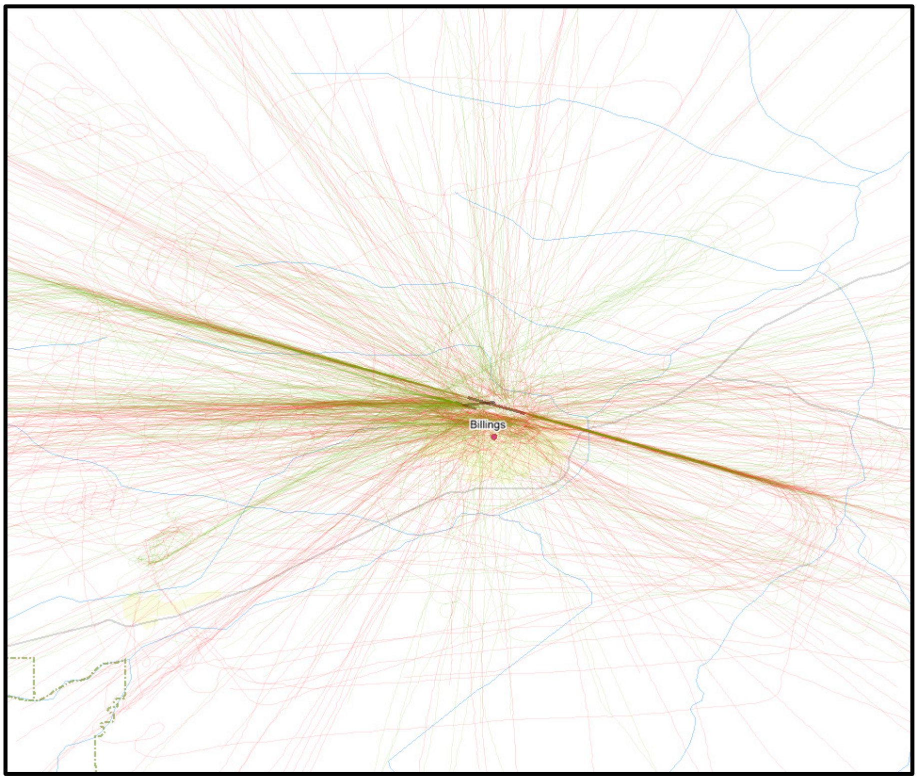
East Flow, Jets – 100%



Non-Jets – 33% Sample



Helicopters – 100%



F.9 Des Moines Intl, DSM

Airport: Des Moines International Airport
City: Des Moines, IA
Runways: 2
Helipads: 1
Elevation: 958 feet MSL

Local Operation Notes: Circuits modeled at 1,000 feet AFE and 2,000 feet AFE. Split tracks that went at least 7 nautical miles from the airport center were counted as non-local operations, the rest were counted as local operations. Circuit tracks that had a maximum range under 7 nautical miles used the 1,000 feet AFE profile. All other local operations used 2,000 feet AFE profile. Circuit tracks with a maximum range of greater than 35 nautical miles or a maximum altitude greater than 3,800 feet MSL were removed from modeling.

Helicopter Notes: Relatively small number of operations, less than one percent of daily operations. Mostly general aviation or air taxi. Variety of INM types. A few counted as local operations.

Other Notes: Mostly commercial jet operations. Relatively small number of total operations. Seven 2015 operations (of 77,647 total operations) were not modeled due to a processing error. This omission has no effect within the precision of the model.

F.9.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
05	41.523368	-93.677112	916	150	9,003	0	3
13	41.545606	-93.674454	912	150	9,002	0	3
23	41.537949	-93.650568	934	150	9,003	0	3
31	41.528967	-93.650153	958	150	9,002	0	3
H1	41.534179	-93.657656	930	n/a	n/a	n/a	n/a

F.9.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.9.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	20,323	22,875	24,974	2,377	5,605	1,493	77,647	365
ATADS (Data Days)	20,216	22,813	24,897	335	5,591	260	74,112	363
Database	19,787	21,474	20,056	247	765	48	62,377	363
Scale Factor	102.2%	106.2%	124.1%	135.6%	730.8%	541.7%	118.8%	n/a

Note: F-16s stopped flying at DSM, so ATADS scaled accordingly. See D.8.6.

F.9.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS(1)	28,354	11,402	23,900	1,069	4,175	487	69,387	365
Database	19,787	21,474	20,056	247	765	48	62,377 (2)	363
Scale Factor	143.3%	53.1%	119.2%	432.8%	545.8%	1014.6%	111.2%	n/a

Notes:

1) The F-16 adjustments used for 2012-2013 do not apply to the 2015 ATADS counts.
2) 4 fewer civilian propeller and 3 fewer civilian rotorcraft operations modeled due to processing error; Affected overall DNL by less than 0.1 dB (estimated).

F.9.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.9.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	47.11	9.36	56.47	46.63	9.85	56.48	-	-	-	93.74	19.21	112.95
Civilian Jet, Other	13.13	0.72	13.85	11.98	1.86	13.84	0.14	-	0.14	25.39	2.58	27.97
Civilian Prop	21.24	1.42	22.66	19.67	3.01	22.68	7.00	0.50	7.50	54.91	5.43	60.34
Civilian Rotorcraft	0.45	0.13	0.58	0.49	0.08	0.57	0.06	-	0.06	1.06	0.21	1.27
Military Jet, Fighter	0.04	-	0.04	0.04	-	0.04	-	-	-	0.08	-	0.08
Military Jet, Other	0.14	<0.01	0.14	0.13	0.01	0.14	0.24	-	0.24	0.75	0.01	0.76
Military Prop	0.19	<0.01	0.19	0.20	-	0.20	0.12	-	0.12	0.63	-	0.63
Military Rotorcraft	0.08	0.01	0.09	0.08	<0.01	0.08	-	-	-	0.16	0.01	0.17
TOTAL	**82.38**	**11.64**	**94.02**	**79.22**	**14.81**	**94.03**	**7.56**	**0.50**	**8.06**	**176.72**	**27.45**	**204.17**

Note: Each circuit operation counted as two operations in Total Operations

F.9.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	43.34	10.03	53.37	42.80	10.56	53.36	-	-	-	86.14	20.59	106.73
Civilian Jet, Other	12.60	0.69	13.29	11.50	1.79	13.29	0.10	-	0.10	24.20	2.48	26.68
Civilian Prop	19.51	0.98	20.49	18.37	2.14	20.51	5.23	0.37	5.60	43.11	3.49	46.60
Civilian Rotorcraft	0.41	0.12	0.53	0.45	0.07	0.52	0.04	-	0.04	0.90	0.19	1.09
Military Jet, Fighter	0.12	-	0.12	0.12	-	0.12	-	-	-	0.24	-	0.24
Military Jet, Other	0.44	0.01	0.45	0.43	0.02	0.45	0.45	-	0.45	1.32	0.03	1.35
Military Prop	0.61	0.01	0.62	0.62	-	0.62	0.22	-	0.22	1.45	0.01	1.46
Military Rotorcraft	0.25	0.03	0.28	0.27	0.01	0.28	-	-	-	0.52	0.04	0.56
TOTAL	**77.28**	**11.87**	**89.15**	**74.56**	**14.59**	**89.15**	**6.04**	**0.37**	**6.41**	**157.88**	**26.83**	**184.71**

Note: Each circuit operation counted as two operations in Total Operations

F.9.4 Modeled Tracks

RNAV procedures:

- 0 STAR RNAV procedure
- 0 RNAV RNP procedures
- 4 RNAV GPS procedures (one for each runway)
- 0 RNAV (SID) procedures

Total Tracks:

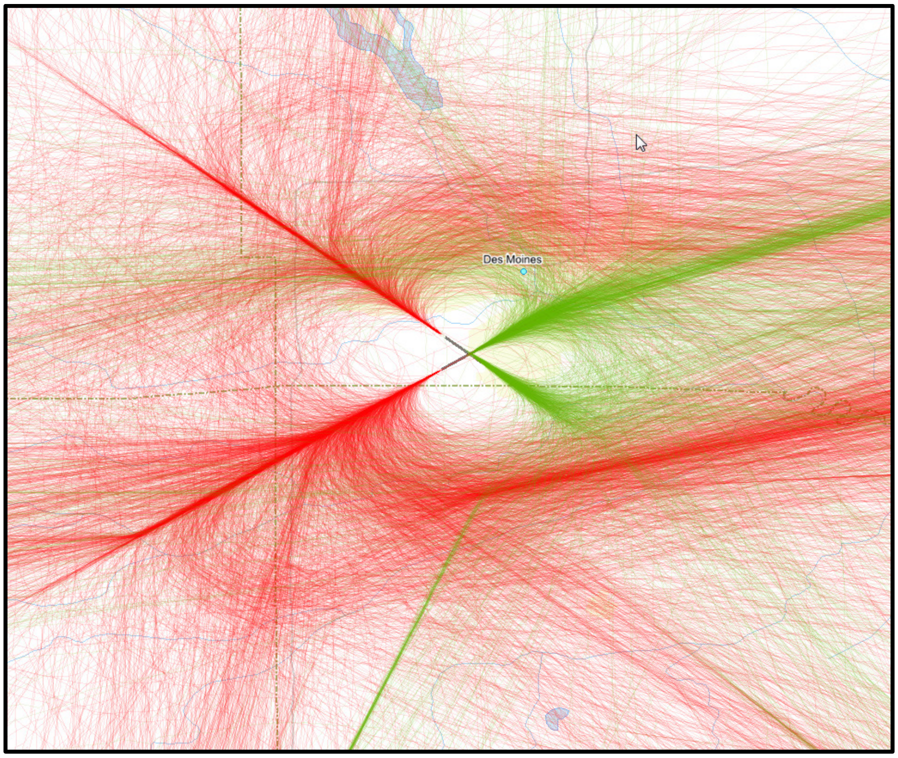
Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	11,537	12,421	4,930	18,809	6	14
Non-Jets, fixed-wing	2,725	4,256	1,447	5,223	121	186
Total	14,262	16,677	6,377	24,032	127	200

Aircraft Category	Arrivals	Departures	Locals
Helicopters	185	185	-

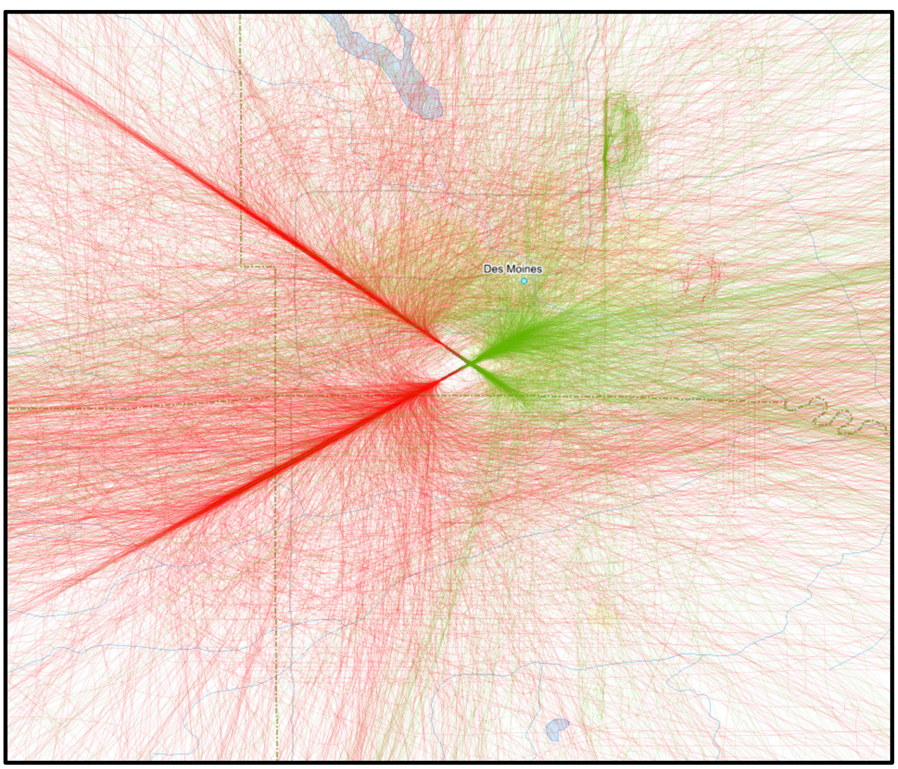
Aircraft Category	Total			Percent	
	East	West	Total	East	West
Jets	16,473	31,244	47,717	35%	65%
Non-Jets, fixed-wing	4,293	9,665	13,958	31%	69%
Helicopters	n/a	n/a	370	n/a	n/a
Total	20,766	40,909	62,045	34%	66%

F.9.5 Representative Radar Flight Tracks

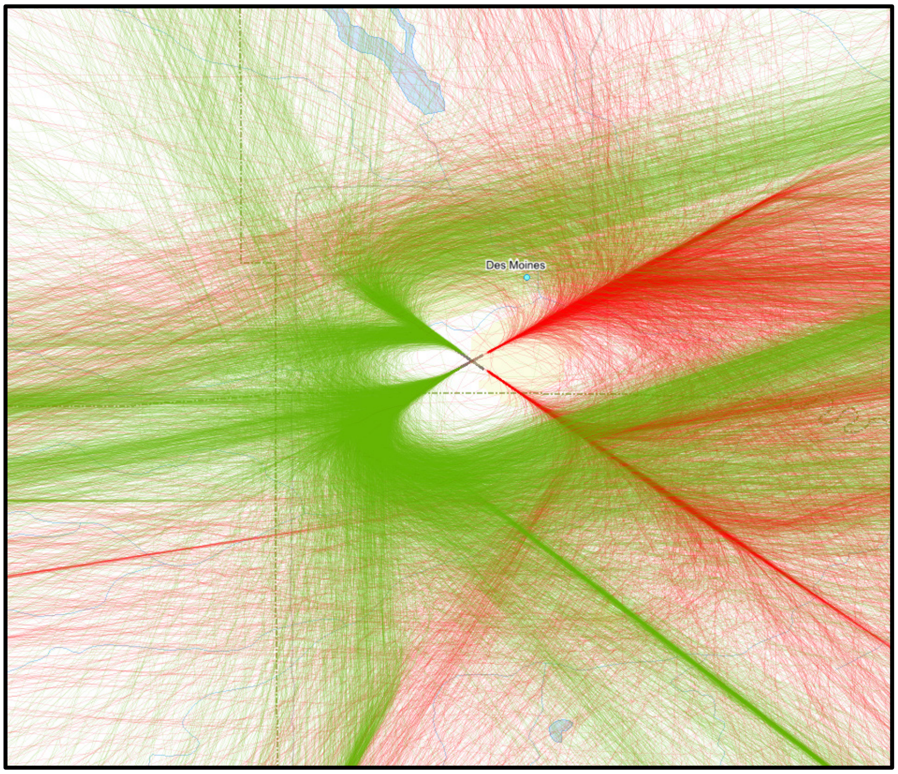
East Flow, Jets – 33% Sample



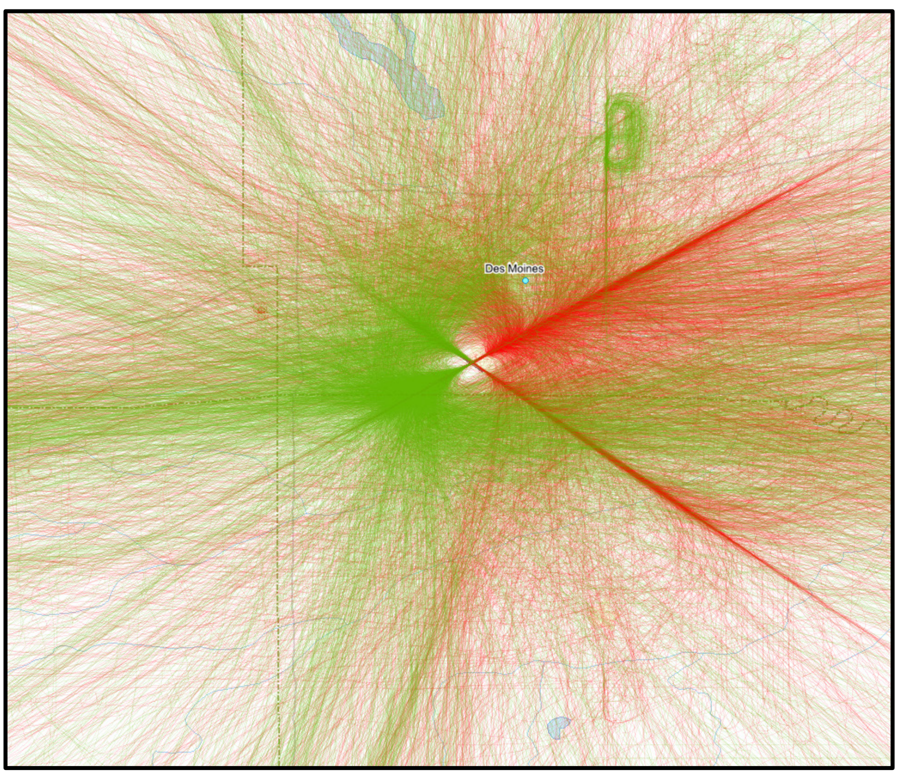
Non-Jets – 100%



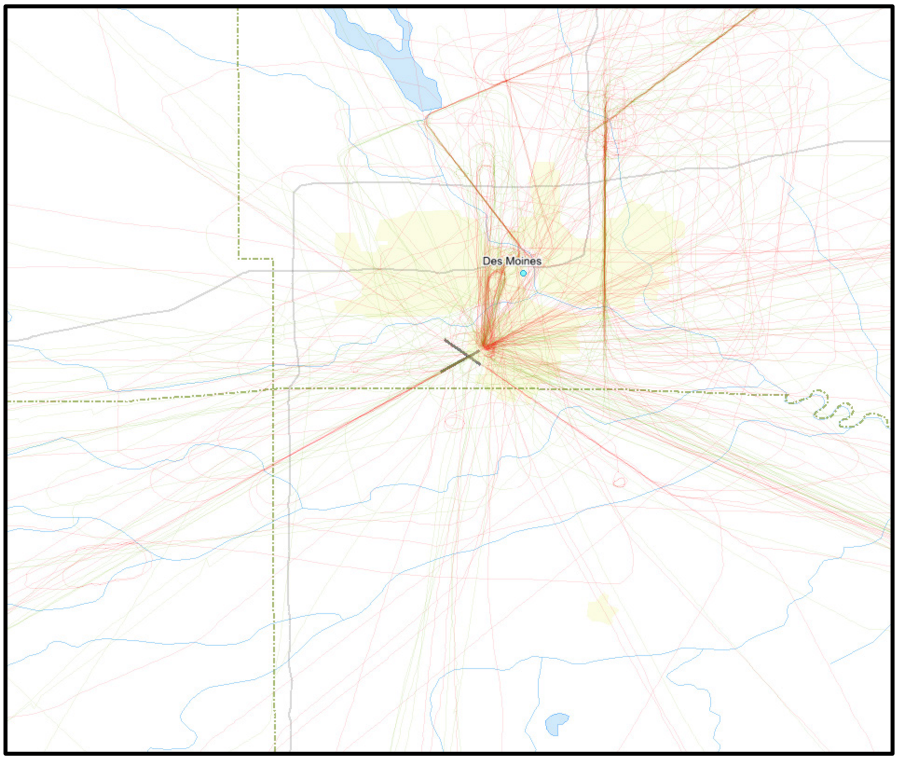
West Flow, Jets – 33% Sample



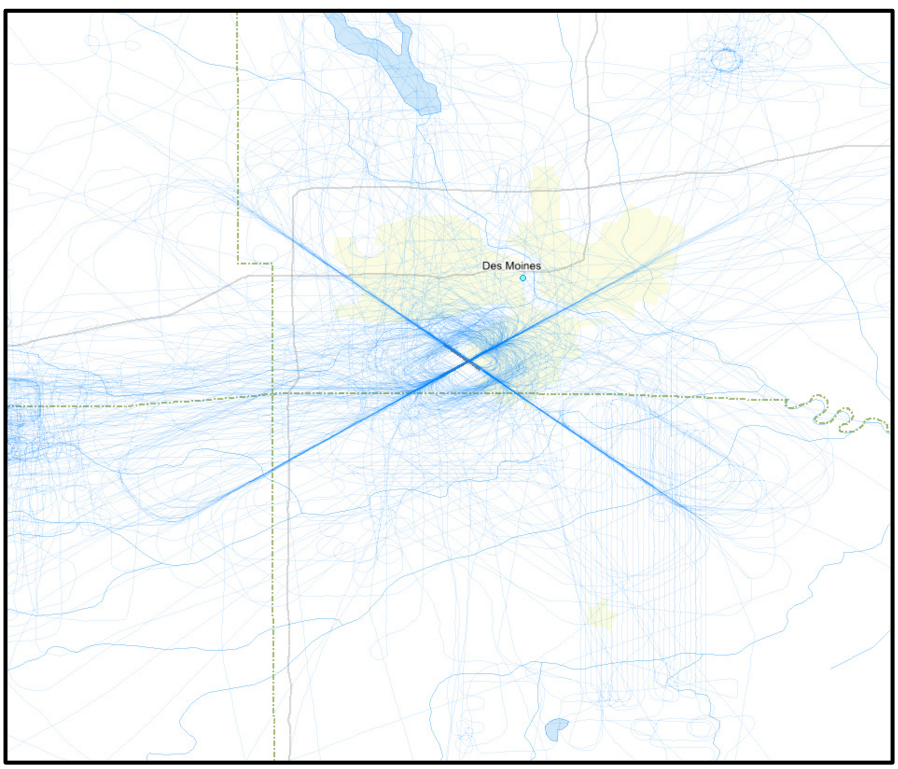
Non-Jets – 100%



Helicopters – 100%



Local Operations – 100%



F.9.6 F-16 Consideration

According to news articles online, the F16s at the airport discontinued service on September 8, 2013. Therefore, all the F16s were removed from the modeling. This decreased the number of military operations at the airport from 2,377 annual ops to 337 annual ops. This is close to the decrease seen in the ATADS after Sept 2013. For the period of June 2012 through Sept 8, 2013, ATADS shows 2,254 annual ops, whereas for the period Sept 9, 2013 through May 2014, it shows 636 annual ops.

For local military, this database had very few usable operations, so the operations were rescaled using data from ATADS. For the period of June 2012 through Sept 8, 2013, ATADS shows 1713 annual local ops, whereas for the period of October 2013 through Sept 9, 2013, it shows 130 annual local ops. The value of 130 was used as a rescaling factor for the local military ops.

F.10 Detroit Metropolitan Wayne County, DTW

Airport: Detroit Metropolitan Wayne County Airport
City: Detroit, MI
Runways: 6
Helipads: 0
Elevation: 646 feet MSL

Local Operation Notes: No local operations modeled.

Helicopter Notes: No helicopter operations modeled.

Other Notes: Mostly commercial jet operations.

F.10.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
03L	42.207835	-83.351219	636	200	8,501	0	3
03R	42.195615	-83.351802	633	150	10,001	0	3
04L	42.202173	-83.384000	645	150	10,000	0	3
04R	42.202324	-83.371268	637	200	12,003	0	3
09L	42.216967	-83.363168	639	150	8,708	0	3
09R	42.199015	-83.361729	636	150	8,500	0	3
21L	42.219682	-83.334070	632	150	10,001	0	3
21R	42.228293	-83.336143	632	200	8,501	0	3
22L	42.231213	-83.349991	636	200	12,003	0	3
22R	42.226245	-83.366281	642	150	10,000	0	3
27L	42.199538	-83.330369	629	150	8,500	0	3
27R	42.217506	-83.331032	635	150	8,708	0	3

F.10.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.10.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	228,862	189,154	5,889	188	0	0	424,093	365
ATADS for Data Days	228,862	189,154	5,889	188	0	0	424,093	365
Database	226,378	188,890	5,439	42	0	0	420,749	365
Scale Factor	101.1%	100.1%	108.3%	447.6%	0	0	100.8%	n/a

F.10.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	276,898	96,533	5,843	102	0	0	379,376	365
Database	226,378	188,890	5,439	42	0	0	420,749	365
Scale Factor	122.3%	51.1%	107.4%	242.9%	0	0	90.2%	n/a

F.10.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.10.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	521.85	46.61	568.46	524.45	44.01	568.46	-	-	-	1,046.30	90.62	1,136.92
Civilian Jet, Other	5.48	0.54	6.02	5.55	0.47	6.02	-	-	-	11.03	1.01	12.04
Civilian Prop	5.18	1.03	6.21	5.54	0.67	6.21	-	-	-	10.72	1.70	12.42
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.02	-	0.02	0.02	-	0.02	-	-	-	0.04	-	0.04
Military Jet, Other	0.14	0.01	0.15	0.14	0.01	0.15	-	-	-	0.28	0.02	0.30
Military Prop	0.07	0.01	0.08	0.07	0.01	0.08	-	-	-	0.14	0.02	0.16
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**532.74**	**48.20**	**580.94**	**535.77**	**45.17**	**580.94**	**-**	**-**	**-**	**1,068.51**	**93.37**	**1,161.88**

Note: Each circuit operation counted as two operations in Total Operations

F.10.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	460.21	49.21	509.42	466.82	42.60	509.42	-	-	-	927.03	91.81	1,018.84
Civilian Jet, Other	5.44	0.53	5.97	5.50	0.47	5.97	-	-	-	10.94	1.00	11.94
Civilian Prop	3.47	0.69	4.16	3.65	0.51	4.16	-	-	-	7.12	1.20	8.32
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.01	-	0.01	0.01	-	0.01	-	-	-	0.02	-	0.02
Military Jet, Other	0.08	0.01	0.09	0.08	0.01	0.09	-	-	-	0.16	0.02	0.18
Military Prop	0.04	0.01	0.05	0.04	0.01	0.05	-	-	-	0.08	0.02	0.10
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**469.25**	**50.45**	**519.70**	**476.10**	**43.60**	**519.70**	**-**	**-**	**-**	**945.35**	**94.05**	**1,039.40**

Note: Each circuit operation counted as two operations in Total Operations

F.10.4 Modeled Tracks

RNAV procedures:

- 0 STAR (Arrival) RNAV procedures
- 0 RNAV RNP procedures
- 8 RNAV GPS procedures (runways 03R, 04L, 04R, 21L, 22L, 22R, 27L, 27R)
- 0 RNAV SID (Departure) procedures

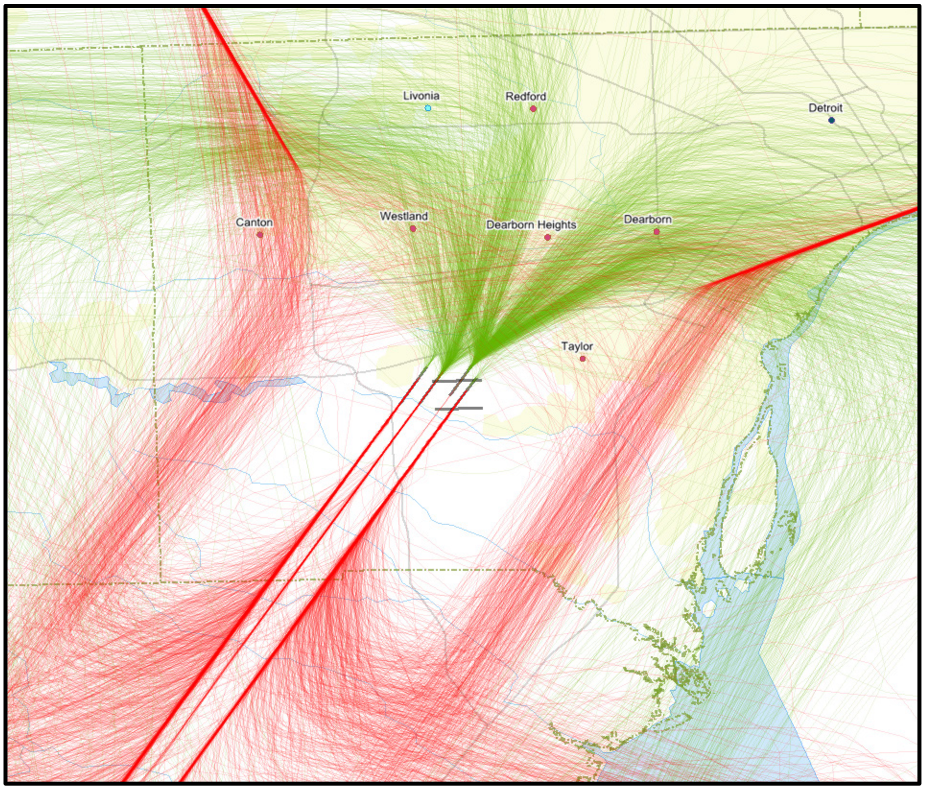
Total Tracks:

	Arrivals		Departures		Locals	
Aircraft Category	North	South	North	South	North	South
Jets	53,049	155,412	52,667	155,339	-	-
Non-Jets, fixed-wing	564	1,679	520	1,519	-	-
Total	53,613	157,091	53,187	156,858	-	-

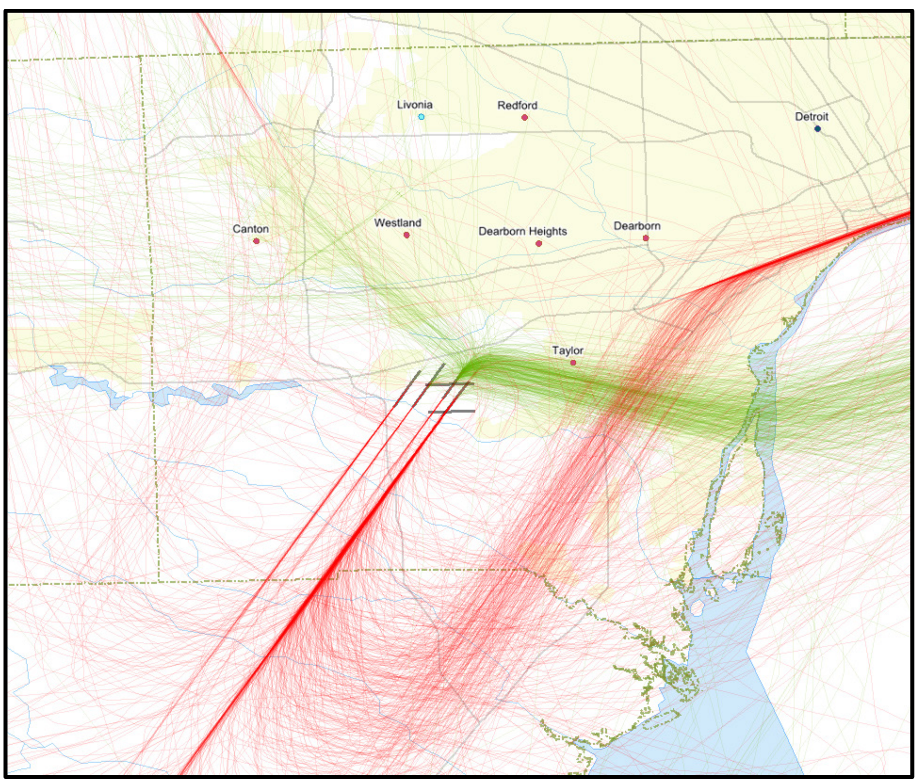
	Total			Percent	
Aircraft Category	North	South	Total	North	South
Jets	105,716	310,751	416,467	25%	75%
Non-Jets, fixed-wing	1,084	3,198	4,282	25%	75%
Helicopters	n/a	n/a	-	n/a	n/a
Total	106,800	313,949	420,749	25%	75%

F.10.5 Representative Radar Flight Tracks

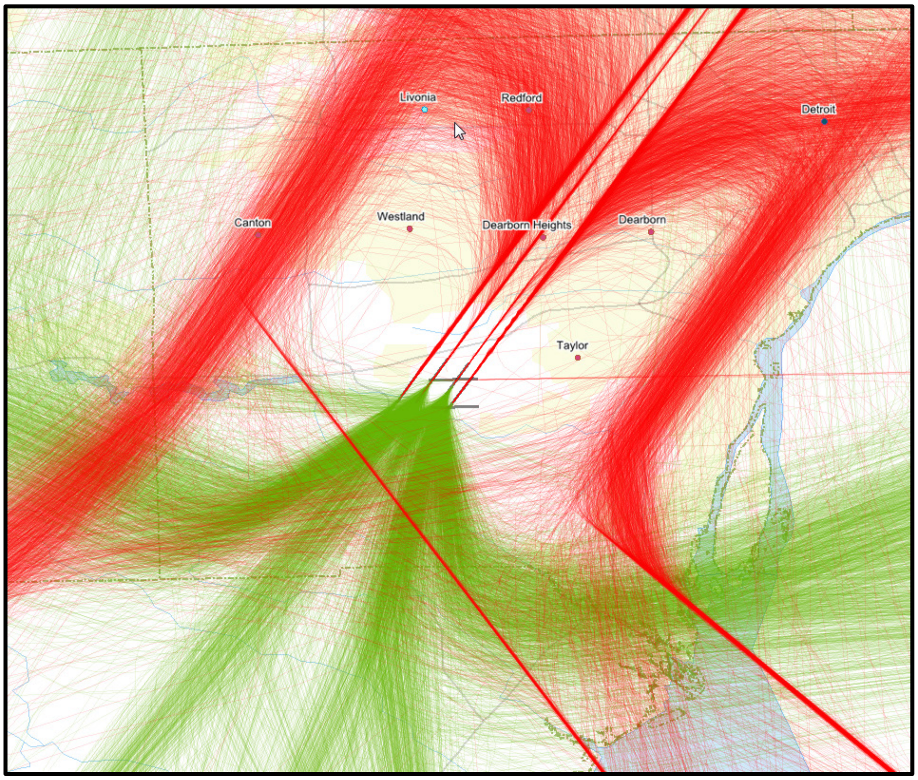
North Flow, Jets – 3% Sample



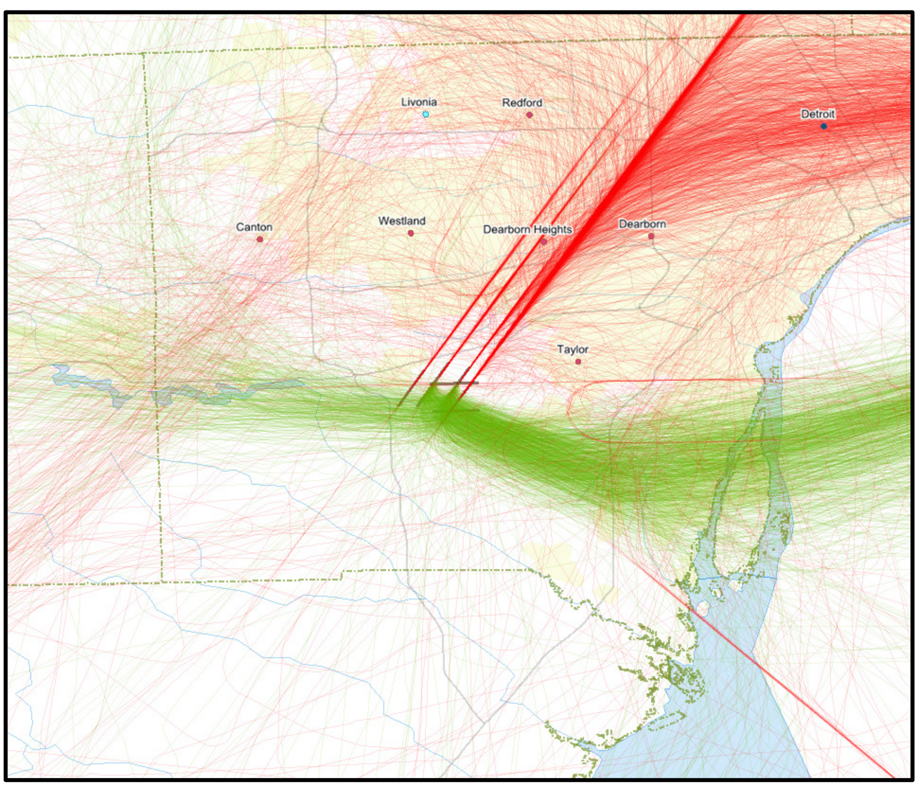
All Non-Jets – 100%



South Flow, Jets – 3% Sample



Non-Jets – 100%



F.11 McCarran Intl, LAS

Airport: McCarran International Airport
City: Las Vegas, NV
Runways: 4
Helipads: 0
Elevation: 2,181 feet MSL

Local Operation Notes: No local operations modeled.

Helicopter Notes: Large number of operations, about 21 percent of total daily operations. Mostly air tours along the strip or sightseeing to the east of the city. None are counted as local.

Other Notes: Mostly commercial operations.

F.11.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
01L	36.075333	-115.17036	2,181	150	8,985	584	3.4
01R	36.074244	-115.16749	2,176	150	9,775	491	3
07L	36.076367	-115.17019	2,179	150	14,510	2,139	3
07R	36.073627	-115.16143	2,157	150	10,526	0	3
19L	36.098591	-115.15355	2,078	150	9,775	878	3
19R	36.097712	-115.15755	2,089	150	8,985	0	3
25L	36.073657	-115.12582	2,048	150	10,526	0	3
25R	36.076407	-115.12110	2,033	150	14,510	1,397	3
H1	36.088301	-115.16612	2,144	n/a	n/a	n/a	n/a
H2	36.078883	-115.17135	2,179	n/a	n/a	n/a	n/a
H3	36.096150	-115.16168	2,107	n/a	n/a	n/a	n/a

F.11.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.11.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	340,088	135,940	45,507	1,249	0	0	522,784	365
ATADS for Data Days	340,088	135,940	45,507	1,249	0	0	522,784	365
Database	334,969	122,483	39,534	508	0	0	497,494	365
Scale Factor	101.5%	111.0%	115.1%	245.9%	0	0	105.1%	n/a

F.11.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	349,606	128,971	44,706	1,595	0	0	524,878	365
Database	334,969	122,483	39,534	508	0	0	497,494	365
Scale Factor	104.4%	105.3%	113.1%	314.0%	0	0	105.5%	n/a

F.11.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.11.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	432.86	56.14	489.00	416.04	72.96	489.00	-	-	-	848.90	129.10	978.00
Civilian Jet, Other	46.48	3.96	50.44	46.06	4.38	50.44	-	-	-	92.54	8.34	100.88
Civilian Prop	26.00	1.75	27.75	24.93	2.82	27.75	-	-	-	50.93	4.57	55.50
Civilian Rotorcraft	140.57	6.67	147.24	136.45	10.80	147.25	-	-	-	277.02	17.47	294.49
Military Jet, Fighter	0.51	-	0.51	0.51	-	0.51	-	-	-	1.02	-	1.02
Military Jet, Other	0.36	0.01	0.37	0.35	0.02	0.37	-	-	-	0.71	0.03	0.74
Military Prop	0.82	0.02	0.84	0.74	0.09	0.83	-	-	-	1.56	0.11	1.67
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**647.60**	**68.55**	**716.15**	**625.08**	**91.07**	**716.15**	**-**	**-**	**-**	**1,272.68**	**159.62**	**1,432.30**

Note: Each circuit operation counted as two operations in Total Operations

F.11.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	443.25	57.61	500.86	425.98	74.87	500.85	-	-	-	869.23	132.48	1,001.71
Civilian Jet, Other	45.66	3.89	49.55	45.25	4.30	49.55	-	-	-	90.91	8.19	99.10
Civilian Prop	25.03	1.69	26.72	23.99	2.73	26.72	-	-	-	49.02	4.42	53.44
Civilian Rotorcraft	133.37	6.33	139.70	129.46	10.24	139.70	-	-	-	262.83	16.57	279.40
Military Jet, Fighter	0.65	-	0.65	0.65	-	0.65	-	-	-	1.30	-	1.30
Military Jet, Other	0.45	0.02	0.47	0.44	0.03	0.47	-	-	-	0.89	0.05	0.94
Military Prop	1.05	0.02	1.07	0.95	0.12	1.07	-	-	-	2.00	0.14	2.14
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**649.46**	**69.56**	**719.02**	**626.72**	**92.29**	**719.01**	**-**	**-**	**-**	**1,276.18**	**161.85**	**1,438.03**

Note: Each circuit operation counted as two operations in Total Operations

F.11.4 Modeled Tracks

RNAV procedures:

- 0 RNAV RNP procedures
- 3 RNAV GPS procedures (runways 01R, 19L, 19R)
- 6 RNAV SID (Departure) procedures

Total Tracks:

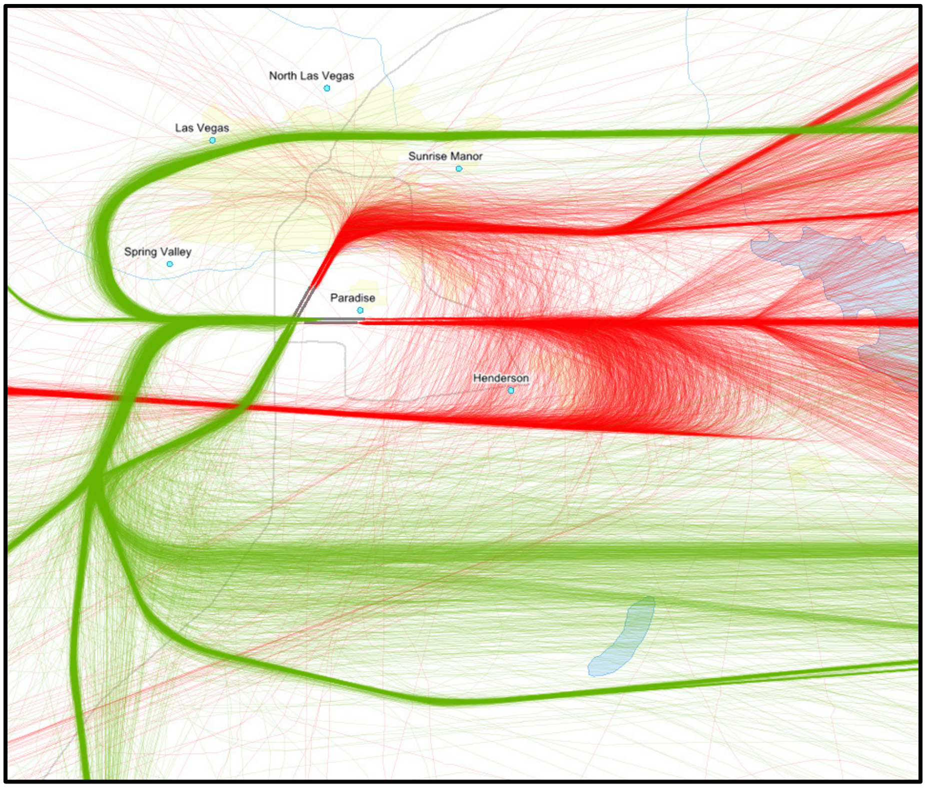
Aircraft Category	Arrivals North	Arrivals South	Departures North	Departures South	Locals North	Locals South
Jets	26,119	167,314	47,714	142,292	-	-
Non-Jets, fixed-wing	1,776	7,736	1,969	6,093	-	-
Total	27,895	175,050	49,683	148,385	-	-

Aircraft Category	Arrivals	Departures	Locals
Helicopters	45,818	50,663	-

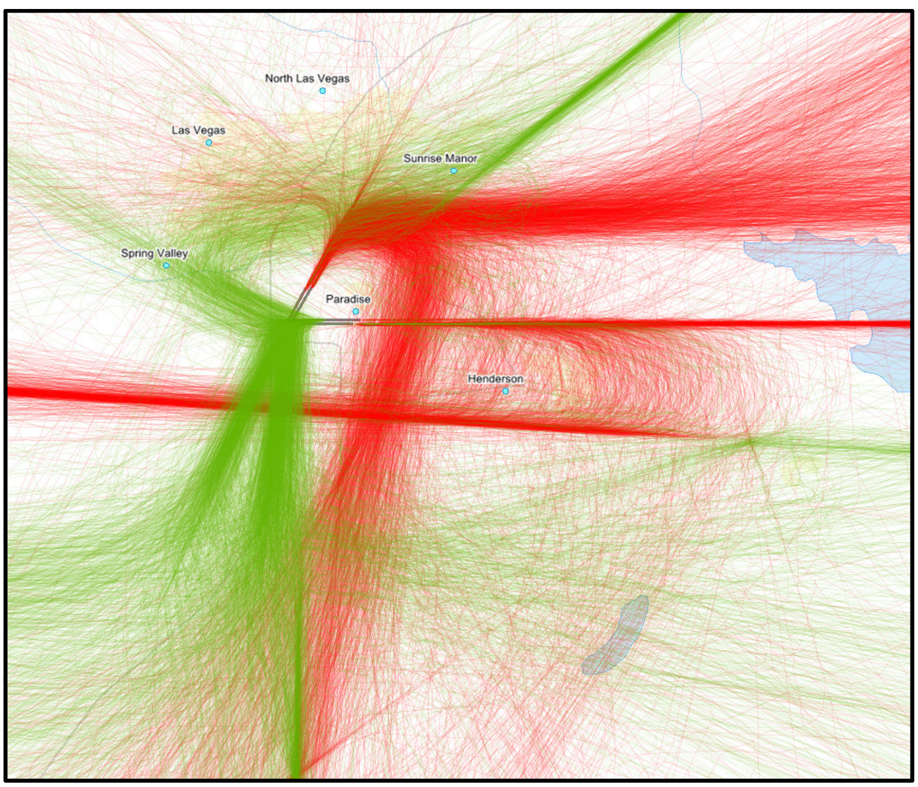
Aircraft Category	Total North	Total South	Total Total	Percent North	Percent South
Jets	73,833	309,606	383,439	19%	81%
Non-Jets, fixed-wing	3,745	13,829	17,574	21%	79%
Helicopters	n/a	n/a	96,481	n/a	n/a
Total	77,578	323,435	497,494	19%	81%

F.11.5 Representative Radar Flight Track

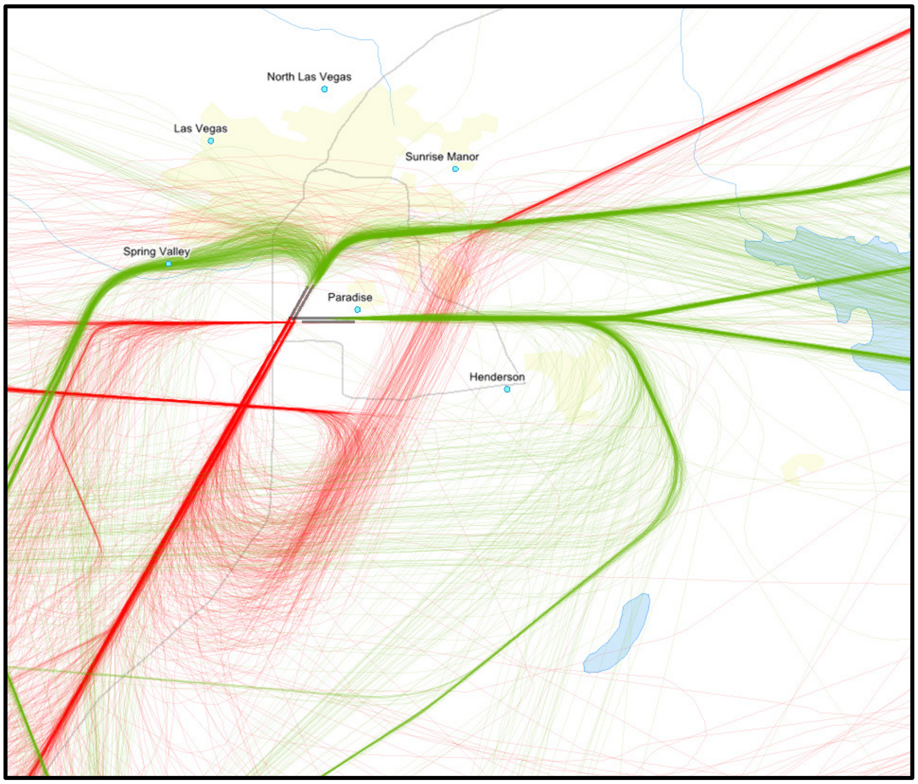
South Flow, Jets – 3% Sample



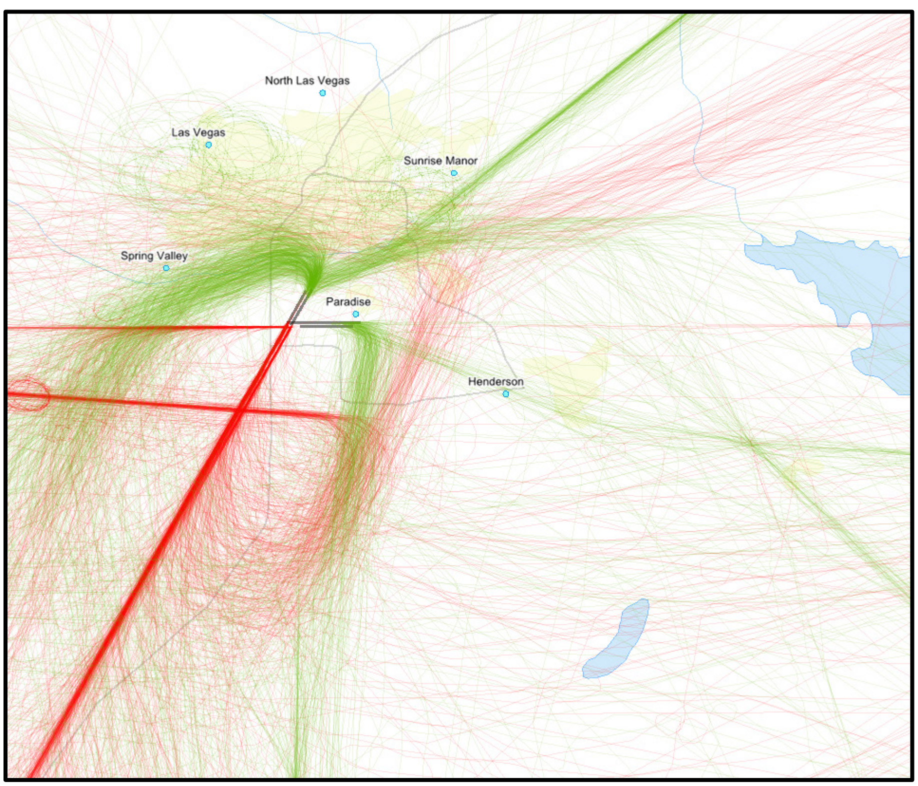
Non-Jets – 50% Sample



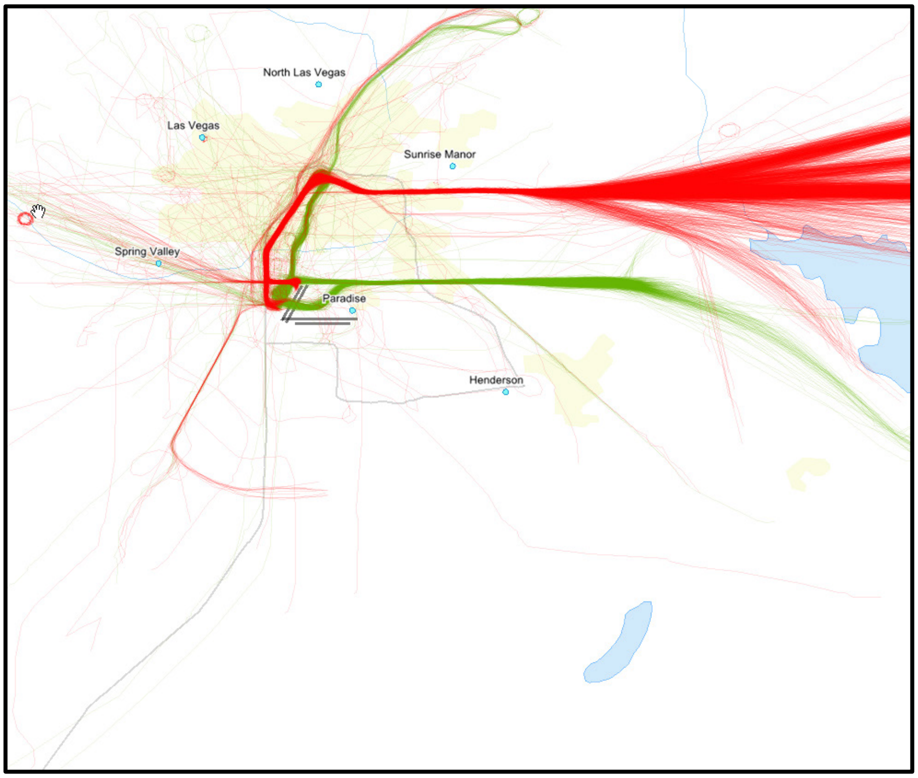
North Flow, Jets – 3% Sample



Non-Jets – 50% Sample



Helicopter operations – 8% Sample



F.12 Los Angeles Intl, LAX

Airport: Los Angeles International Airport
City: Los Angeles, CA
Runways: 4
Helipads: 0
Elevation: 125 feet MSL

Local Operation Notes: No local operations modeled.
Helicopter Notes: No helicopter operations modeled.
Other Notes: Mostly commercial operations. Two 2015 operations (of 654,501 total operations) were not modeled due to a processing error. This omission has no effect within the precision of the model. Military operations were modeled as general aviation operations due to the low number of operations identified as military in the radar flight track data.

F.12.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
06L	33.949108	-118.43115	112	150	8,925	0	3
06R	33.946743	-118.43532	108	150	10,285	331	3
07L	33.935826	-118.41934	118	150	12,091	0	3
07R	33.933644	-118.41901	119	200	11,095	0	3
24L	33.950190	-118.40166	111	150	10,285	0	3
24R	33.952100	-118.40194	117	150	8,925	0	3
25L	33.937358	-118.38271	98	200	11,095	0	3
25R	33.939873	-118.37977	92	150	12,091	957	3

F.12.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.12.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	483,251	96,002	18,192*	2,556*	0	0	600,001	365
ATADS (Data Days)	483,251	96,002	20,748	0	0	0	600,001	365
Database	478,707	96,147	18,211	0	0	0	593,065	365
Scale Factor	100.9%	99.8%	113.9%	0	0	0	101.2%	n/a

*Military operations modeled as General Aviation due to the low number of military tracks in the database.

F.12.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	570,445 (1)	61,681	20,344 (2)	2,023 (2)	8 (3)	0	654,501	365
Database	478,707	96,147	18,211	0	0	0	593,065	365
Scale Factor	119.2%	64.2%	122.8%	0	0	0	110.4%	n/a

Notes: 1) Two fewer air carrier operations modeled due to processing error.
2) Military operations modeled as General Aviation due to no military tracks in the database.
3) Ignored due to low ops.

F.12.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.12.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	615.63	114.37	730.00	576.35	153.65	730.00	-	-	-	1,191.98	268.02	1,460.00
Civilian Jet, Other	19.54	2.39	21.93	19.32	2.61	21.93	-	-	-	38.86	5.00	43.86
Civilian Prop	63.15	6.84	69.99	61.60	8.39	69.99	-	-	-	124.75	15.23	139.98
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	-	-	-	-	-	-	-	-	-	-	-	-
Military Prop	-	-	-	-	-	-	-	-	-	-	-	-
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**698.32**	**123.60**	**821.92**	**657.27**	**164.65**	**821.92**	**-**	**-**	**-**	**1,355.59**	**288.25**	**1,643.84**

Note: Each circuit operation counted as two operations in Total Operations

F.12.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	689.65	130.73	820.38	643.52	176.86	820.38	-	-	-	1,333.17	307.59	1,640.76
Civilian Jet, Other	21.06	2.58	23.64	20.83	2.81	23.64	-	-	-	41.89	5.39	47.28
Civilian Prop	47.96	4.58	52.54	46.31	6.23	52.54	-	-	-	94.27	10.81	105.08
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	-	-	-	-	-	-	-	-	-	-	-	-
Military Prop	-	-	-	-	-	-	-	-	-	-	-	-
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**758.67**	**137.89**	**896.56**	**710.66**	**185.90**	**896.56**	**-**	**-**	**-**	**1,469.33**	**323.79**	**1,793.12**

Note: Each circuit operation counted as two operations in Total Operations

F.12.4 Modeled Tracks

RNAV procedures:

- 3 STAR (Arrival) RNAV procedures
- 7 RNAV RNP procedures (All runways except 25R)
- 8 RNAV GPS procedures (All runways)
- 7 RNAV SID (Departure) procedures

Total Tracks*:

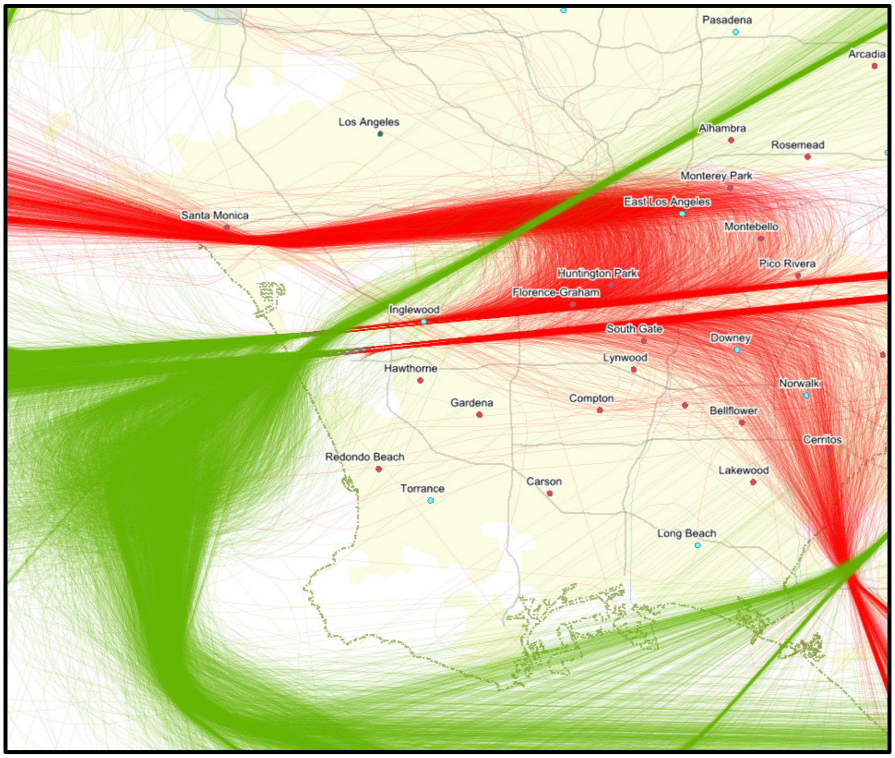
Aircraft Category	Arrivals East	Arrivals West	Departures East	Departures West	Locals East	Locals West
Jets	14,998	256,582	4,117	266,937	-	-
Non-Jets, fixed-wing	1,017	24,306	418	24,689	-	-
Total	16,015	280,888	4,535	291,626	-	-

Aircraft Category	Total East	Total West	Total Total	Percent East	Percent West
Jets	19,115	523,519	542,634	4%	96%
Non-Jets, fixed-wing	1,435	48,995	50,430	3%	97%
Helicopters	n/a	n/a	-	n/a	n/a
Total	20,550	572,514	593,064	3%	97%

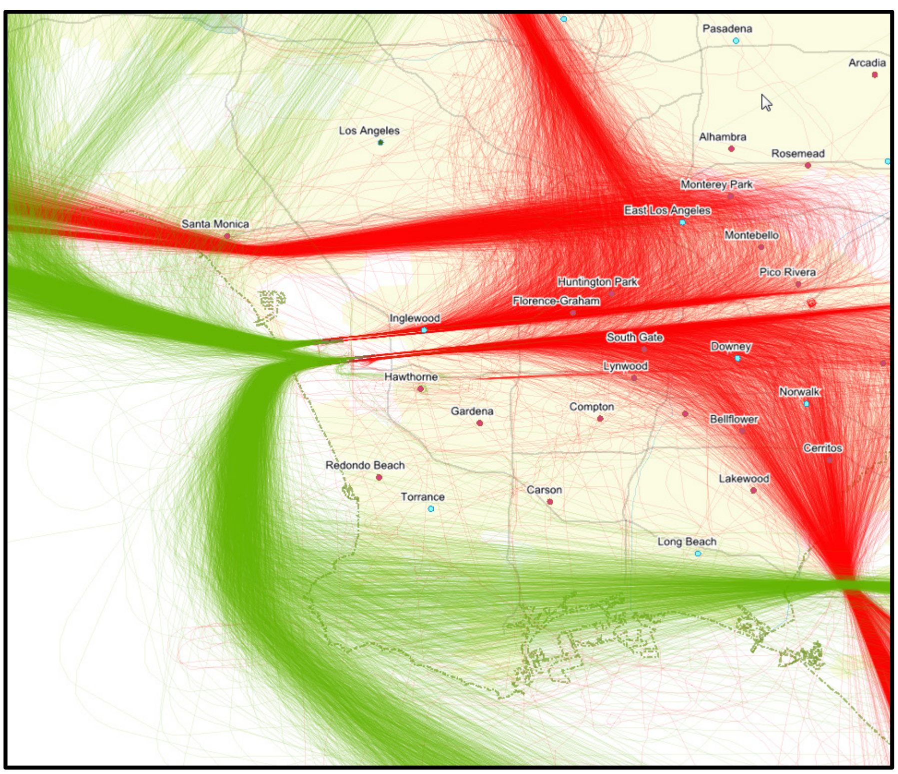
*LAX's nighttime "contra-flow", also known as its "over-ocean" condition, is included, via the tracks' runway assignment and operation type, in the east and west flow counts.

F.12.5 Representative Radar Flight Tracks

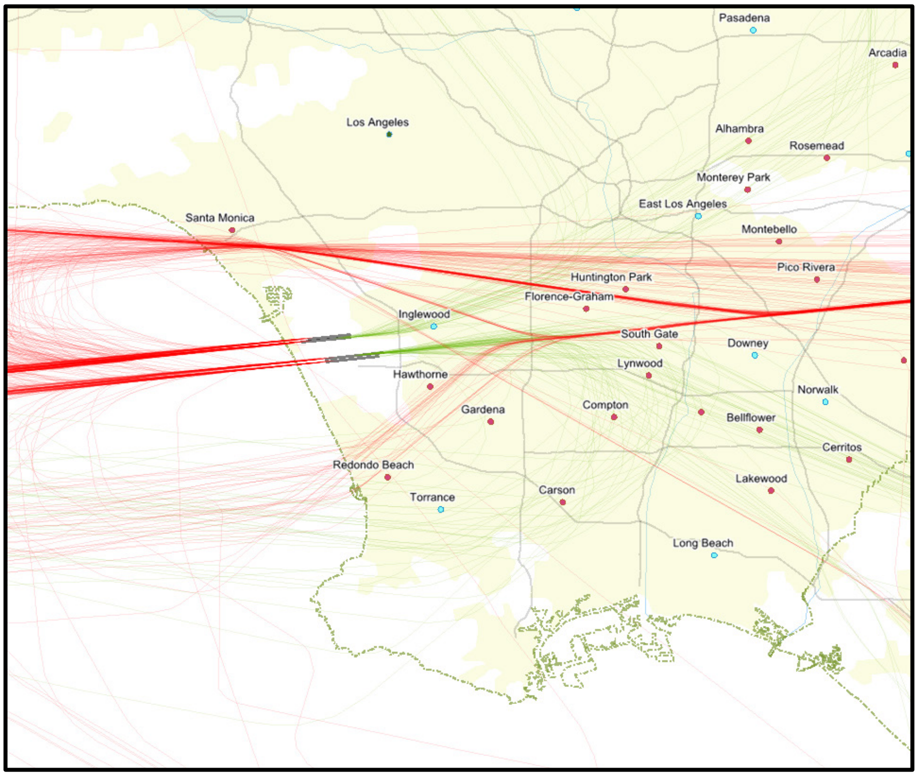
West Flow, Jets – 3% Sample



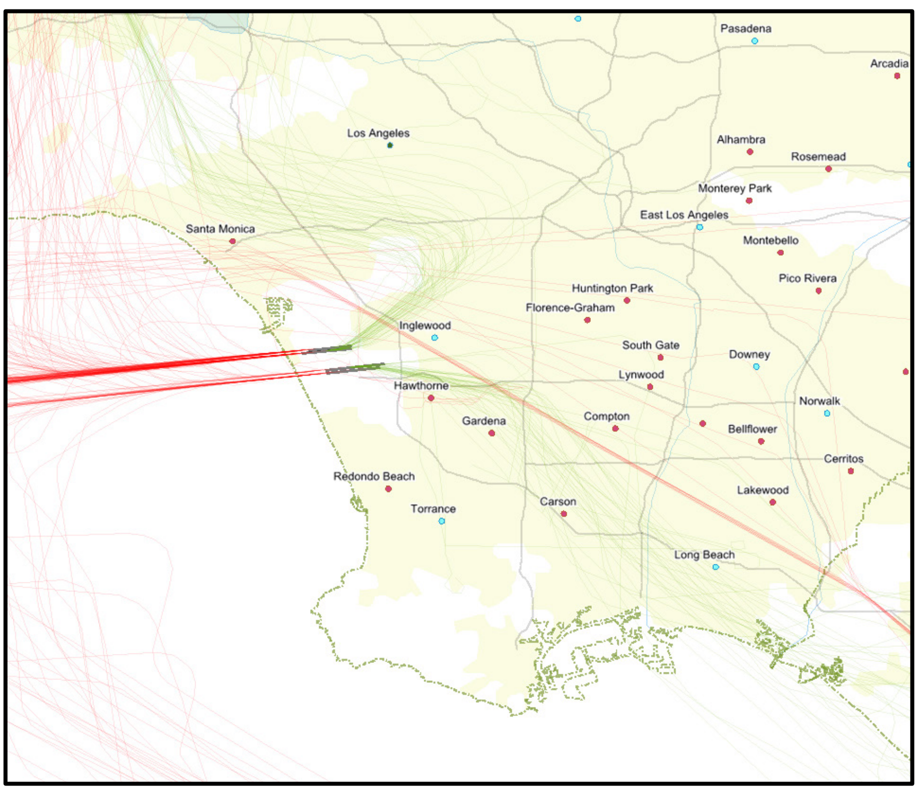
Non-Jets – 20% Sample



East Flow, Jets – 3%



Non-Jets – 20%



F.13 LaGuardia, LGA

Airport: LaGuardia Airport
City: New York, NY
Runways: 2
Helipads: 1
Elevation: 20 feet MSL

Local Operation Notes: No local operations modeled.

Helicopter Notes: A small number of helicopter operations modeled.

Other Notes: Mostly commercial operations. Military operations were modeled as general aviation operations due to the low number of operations identified as military in the radar flight track data.

F.13.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
04	40.769165	-73.884120	21	150	7,001	0	3
13	40.782297	-73.878522	12	150	7,003	0	3.1
22	40.785437	-73.870672	12	150	7,001	0	3
31	40.772071	-73.857112	7	150	7,003	0	3
H1	40.776008	-73.880967	19	60	60	0	3

F.13.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.13.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	291,723	73,223	6,876	302	0	0	372,124	365
ATADS for Data Days (preliminary)	291,723	73,223	6,873 (1)	294 (1)	0	0	372,113	362 (2)
ATADS for Data Days	291,723	73,223	7,167	0	0	0	372,113	362
Database	283,507	70,293	4,360	0	0	0	358,160	362
Scale Factor	102.9%	104.2%	164.4%	0	0	0	103.9%	n/a

Notes:
1) Military operations modeled as General Aviation due to the low number of military tracks in the database.
2) Three days (10/29/2012, 10/30/2012, 10/31/2012) have no operations in the database due to Superstorm Sandy, and thus were not counted.

F.13.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	307,548	54,211	6,178	425*	0	0	368,362	365
Database	283,507	70,293	4,360	0	0	0	358,160	362
Scale Factor	108.5%	77.1%	151.4%	0	0	0	102.8%	n/a

* Military operations modeled as General Aviation due to the no military tracks in the database.

F.13.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.13.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	452.14	45.75	497.89	452.96	44.92	497.88	-	-	-	905.10	90.67	995.77
Civilian Jet, Other	7.19	0.79	7.98	7.24	0.74	7.98	-	-	-	14.43	1.53	15.96
Civilian Prop	7.32	0.28	7.60	7.23	0.36	7.59	-	-	-	14.55	0.64	15.19
Civilian Rotorcraft	0.48	0.02	0.50	0.48	0.02	0.50	-	-	-	0.96	0.04	1.00
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	-	-	-	-	-	-	-	-	-	-	-	-
Military Prop	-	-	-	-	-	-	-	-	-	-	-	-
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**467.13**	**46.84**	**513.97**	**467.91**	**46.04**	**513.95**	**-**	**-**	**-**	**935.04**	**92.88**	**1,027.92**

Note: Each circuit operation counted as two operations in Total Operations

F.13.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	448.48	46.61	495.09	449.79	45.30	495.09	-	-	-	898.27	91.91	990.18
Civilian Jet, Other	6.63	0.73	7.36	6.67	0.68	7.35	-	-	-	13.30	1.41	14.71
Civilian Prop	5.64	0.24	5.88	5.59	0.29	5.88	-	-	-	11.23	0.53	11.76
Civilian Rotorcraft	0.45	0.02	0.47	0.44	0.02	0.46	-	-	-	0.89	0.04	0.93
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	-	-	-	-	-	-	-	-	-	-	-	-
Military Prop	-	-	-	-	-	-	-	-	-	-	-	-
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**461.20**	**47.60**	**508.80**	**462.49**	**46.29**	**508.78**	**-**	**-**	**-**	**923.69**	**93.89**	**1,017.58**

Note: Each circuit operation counted as two operations in Total Operations

F.13.4 Modeled Tracks

RNAV procedures:

- 0 STAR (Arrival) RNAV procedures
- 2 RNAV RNP procedures (runways 04 and 22)
- 4 RNAV GPS procedures (all runways)
- 5 RNAV SID (Departure) procedures

Total Tracks:

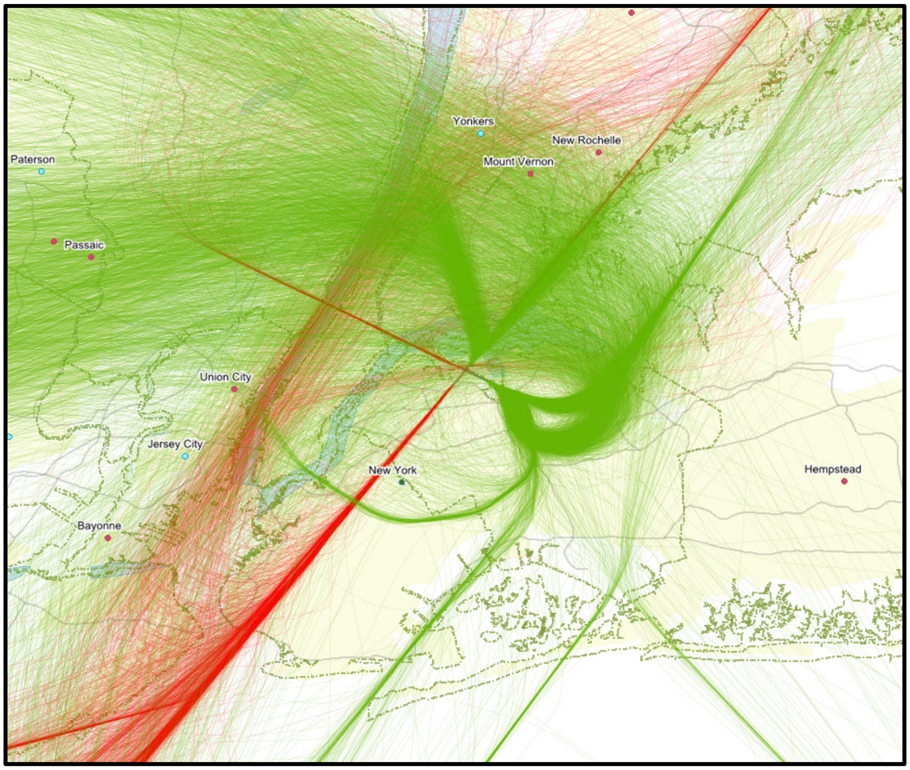
Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	38,633	141,357	128,821	44,354	-	-
Non-Jets, fixed-wing	537	1,980	1,819	497	-	-
Total	39,170	143,337	130,640	44,851	-	-

Aircraft Category	Arrivals	Departures	Locals
Helicopters	117	45	-

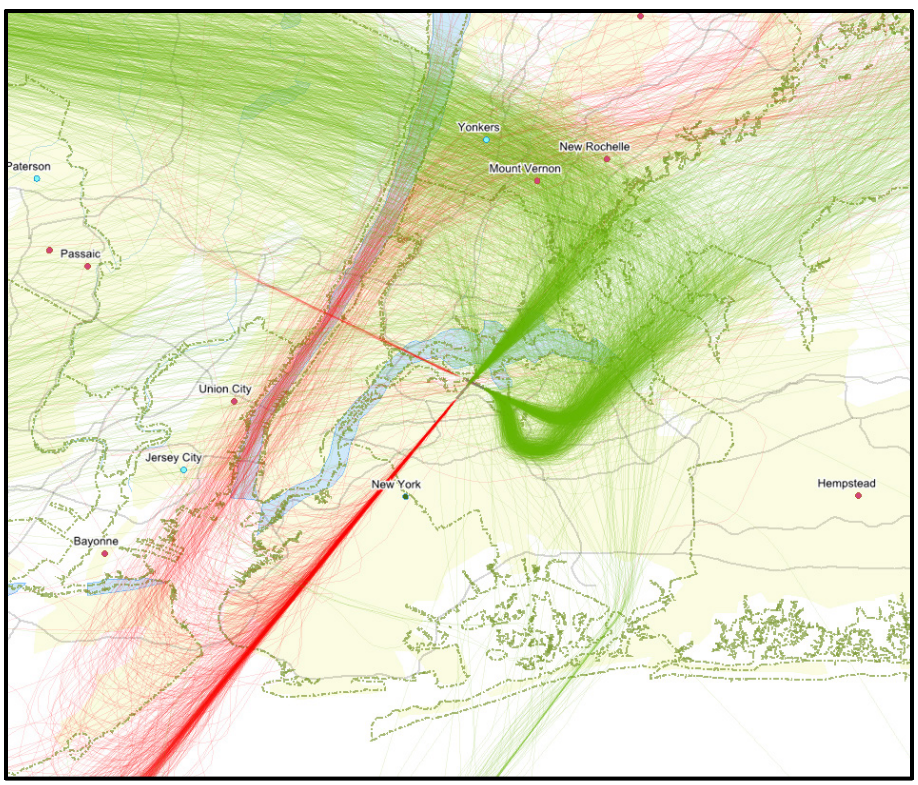
Aircraft Category	Total			Percent	
	East	West	Total	East	West
Jets	167,454	185,711	353,165	47%	53%
Non-Jets, fixed-wing	2,356	2,477	4,833	49%	51%
Helicopters	n/a	n/a	162	n/a	n/a
Total	169,810	188,188	358,160	47%	53%

F.13.5 Representative Radar Flight Tracks

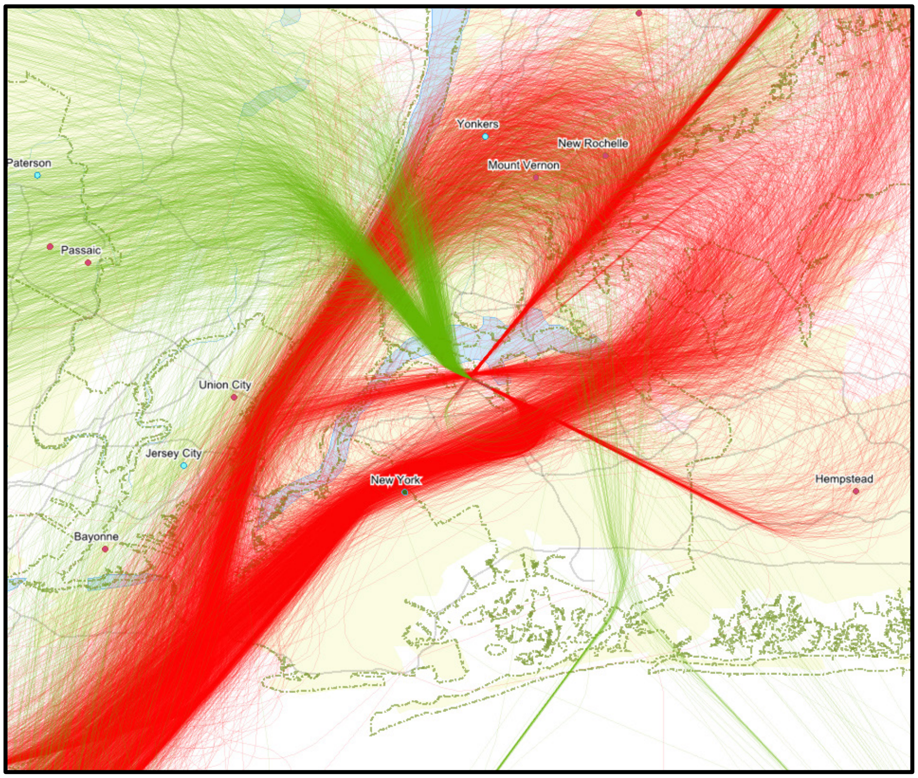
East Flow, Jets – 4% Sample



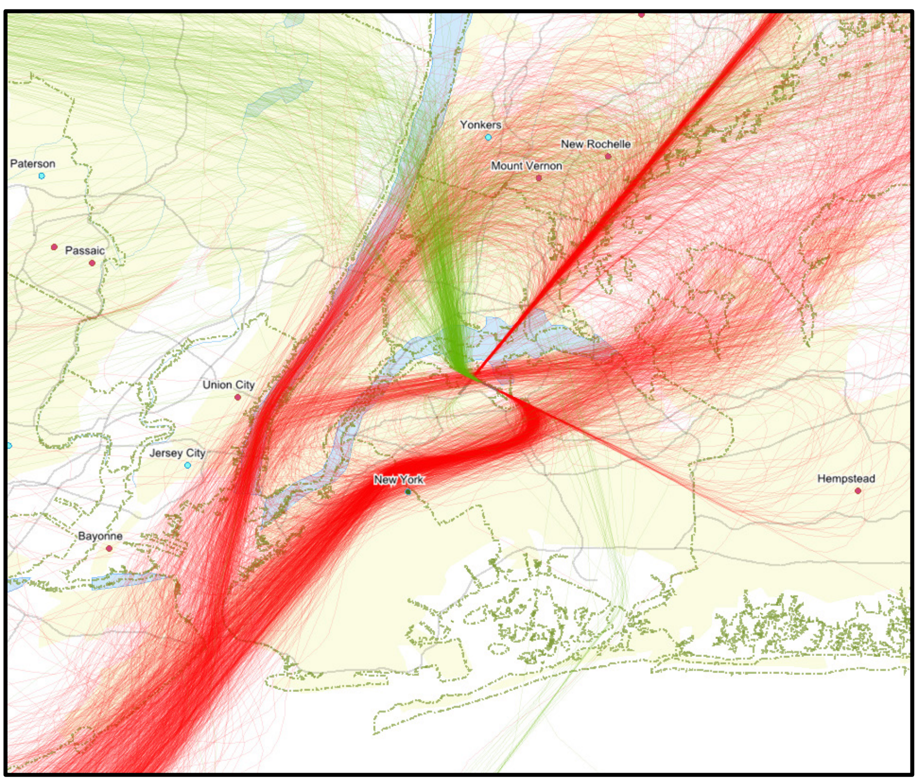
Non-Jets – 100%



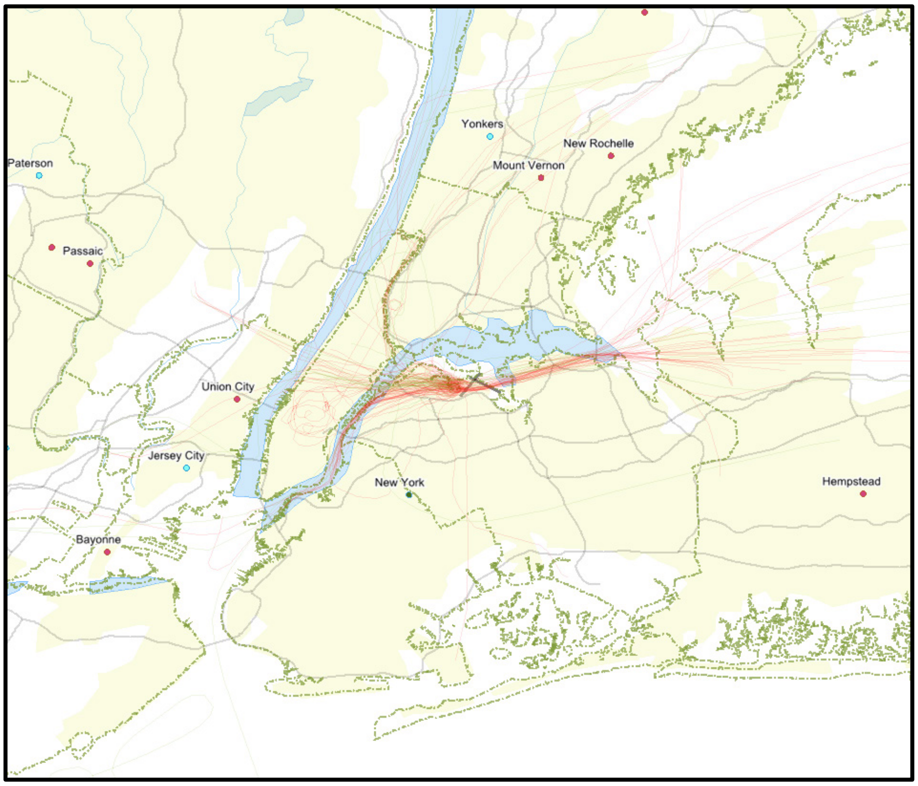
West Flow, Jets – 4% Sample



Non-Jets – 100%



Helicopters – 100%



F.14 Bill and Hillary Clinton National Airport / Adams Field, LIT

Airport: Bill and Hillary Clinton National Airport (also called Adams Field)
City: Little Rock, AR
Runways: 3
Helipads: 1
Elevation: 262 feet MSL

Local Operation Notes: Circuits modeled at 1,000 feet AFE and 2,000 feet AFE. Split tracks not counted as local operations. Circuit tracks with a maximum range of greater than 20 nautical miles or a maximum altitude of over 4,000 feet MSL were removed from modeling.

Helicopter Notes: Mostly general aviation and air taxi (to nearby hospital), about 4 percent of total daily operations. Variety of INM types. None counted as local operations.

Other Notes: Mostly commercial jet operations. Relatively large number of C130 circuit events. Military airfield ~10 nautical miles northeast of LIT.

F.14.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
06L	33.949108	-118.43115	112	150	8,925	0	3
06R	33.946743	-118.43532	108	150	10,285	331	3
07L	33.935826	-118.41934	118	150	12,091	0	3
07R	33.933644	-118.41901	119	200	11,095	0	3
24L	33.950190	-118.40166	111	150	10,285	0	3
24R	33.952100	-118.40194	117	150	8,925	0	3
25L	33.937358	-118.38271	98	200	11,095	0	3
25R	33.939873	-118.37977	92	150	12,091	957	3

F.14.2 ATADS and Radar Flight Track Data Operations Summary

F.14.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	19,860	24,555	40,373	8,337	4,538	7,761	105,424	365
ATADS for Data Days	19,762	24,462	40,249	8,307	4,536	7,761	105,077	363
Database	19,381	24,345	35,817	3,918	1,322	2,656	87,439	363
Scale Factor	102.0%	100.5%	112.4%	212.0%	343.1%	292.2%	120.2%	n/a

F.14.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	20,341	14,272	35,839	7,609	13,931	7,047	99,039	365
Database	19,381	24,345	35,817	3,918	1,322	2,656	87,439	363
Scale Factor	105.0%	58.6%	100.1%	194.2%	1053.8%	265.3%	113.3%	n/a

F.14.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.14.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	48.80	6.84	55.64	48.30	7.34	55.64	0.29	-	0.29	97.68	14.18	111.86
Civilian Jet, Other	15.51	0.97	16.48	15.36	1.13	16.49	1.01	0.03	1.04	32.89	2.16	35.05
Civilian Prop	37.93	2.00	39.93	37.34	2.59	39.93	4.58	0.35	4.93	84.43	5.29	89.72
Civilian Rotorcraft	3.36	0.94	4.30	3.35	0.95	4.30	-	-	-	6.71	1.89	8.60
Military Jet, Fighter	0.22	-	0.22	0.20	0.02	0.22	0.02	-	0.02	0.46	0.02	0.48
Military Jet, Other	3.12	0.02	3.14	3.14	-	3.14	0.81	-	0.81	7.88	0.02	7.90
Military Prop	6.53	0.70	7.23	6.65	0.59	7.24	9.15	0.71	9.86	31.48	2.71	34.19
Military Rotorcraft	0.85	<0.01	0.85	0.84	0.01	0.85	-	-	-	1.69	0.01	1.70
TOTAL	**116.32**	**11.47**	**127.79**	**115.18**	**12.63**	**127.81**	**15.86**	**1.09**	**16.95**	**263.22**	**26.28**	**289.50**

Note: Each circuit operation counted as two operations in Total Operations

F.14.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	38.62	5.90	44.52	38.17	6.35	44.52	0.89	-	0.89	77.68	12.25	89.93
Civilian Jet, Other	13.81	0.86	14.67	13.67	1.00	14.67	3.09	0.09	3.18	30.57	1.95	32.52
Civilian Prop	33.01	1.53	34.54	32.49	2.04	34.53	14.05	1.07	15.12	79.55	4.64	84.19
Civilian Rotorcraft	2.62	0.70	3.32	2.59	0.73	3.32	-	-	-	5.21	1.43	6.64
Military Jet, Fighter	0.20	-	0.20	0.19	0.01	0.20	0.01	-	0.01	0.40	0.01	0.41
Military Jet, Other	2.86	0.02	2.88	2.88	-	2.88	0.74	-	0.74	6.48	0.02	6.50
Military Prop	5.98	0.64	6.62	6.09	0.54	6.63	8.31	0.64	8.95	20.38	1.82	22.20
Military Rotorcraft	0.77	<0.01	0.77	0.77	0.01	0.78	-	-	-	1.54	0.01	1.55
TOTAL	**97.87**	**9.65**	**107.52**	**96.85**	**10.68**	**107.53**	**27.09**	**1.80**	**28.89**	**221.81**	**22.13**	**243.94**

Note: Each circuit operation counted as two operations in Total Operations

F.14.4 Modeled Tracks

RNAV procedures:

- 0 STAR RNAV procedures.
- 6 RNAV GPS procedures (one for each runway).
- 0 RNAV departure procedures.

Total Tracks:

Aircraft Category	Arrivals		Departures		Locals	
	North	South	North	South	North	South
Jets	10,492	15,712	10,262	15,543	70	174
Non-Jets, fixed-wing*	5,310	8,552	5,422	8,027	59	521
C130	347	495	192	110	380	789
Total	16,149	24,759	15,876	23,680	509	1,484

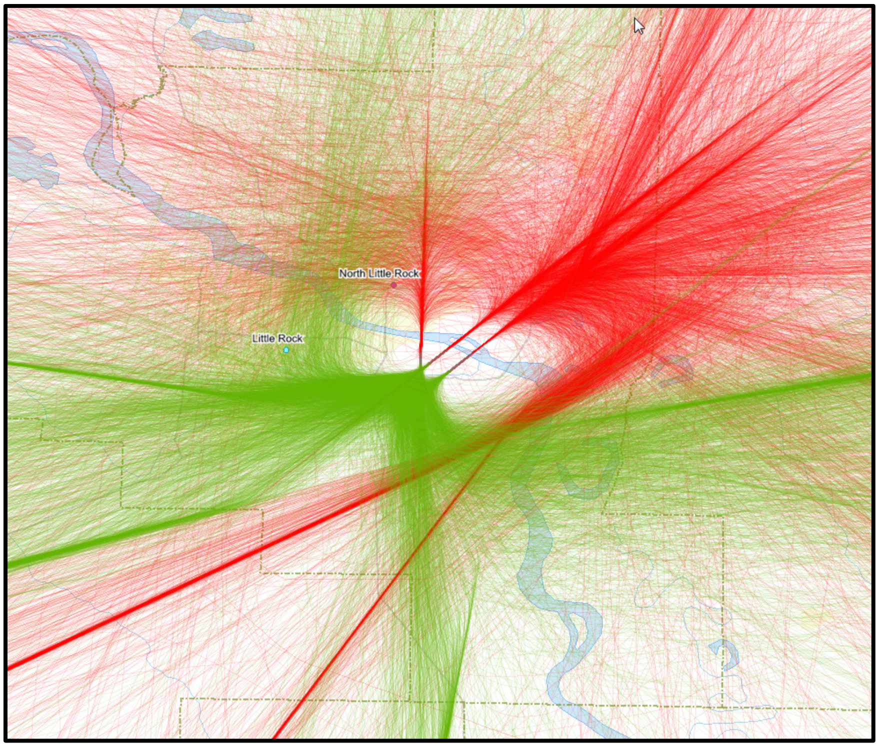
Aircraft Category	Arrivals	Departures	Locals
Helicopters	1,517	1,480	-

Aircraft Category	Total			Percent	
	North	South	Total	North	South
Jets	20,824	31,429	52,253	40%	60%
Non-Jets, fixed-wing*	10,791	17,100	27,891	39%	61%
C130	919	1,394	2,313	40%	60%
Helicopters	n/a	n/a	2,997	n/a	n/a
Total	32,534	49,923	85,454	39%	61%

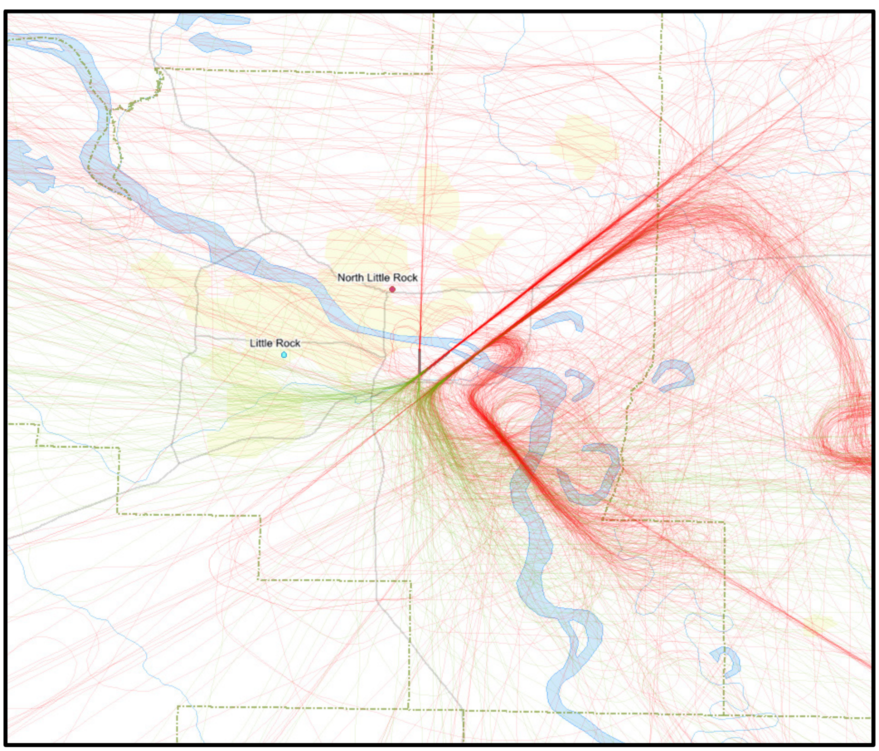
*Excludes C130 tracks and helicopters

F.14.5 Representative Radar Flight Tracks

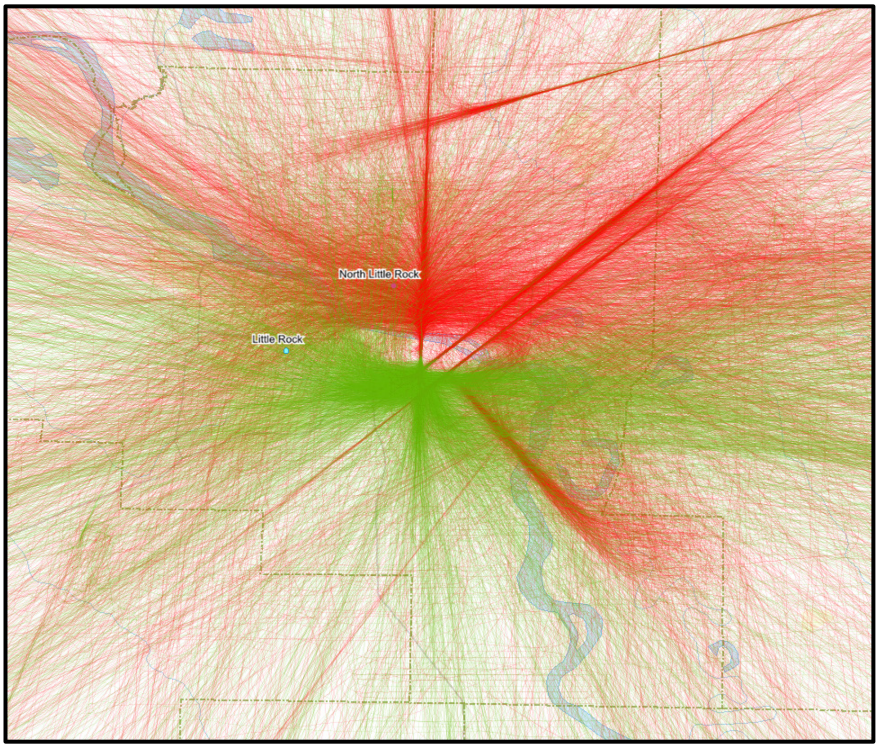
South Flow, Civil Jets – 33% Sample



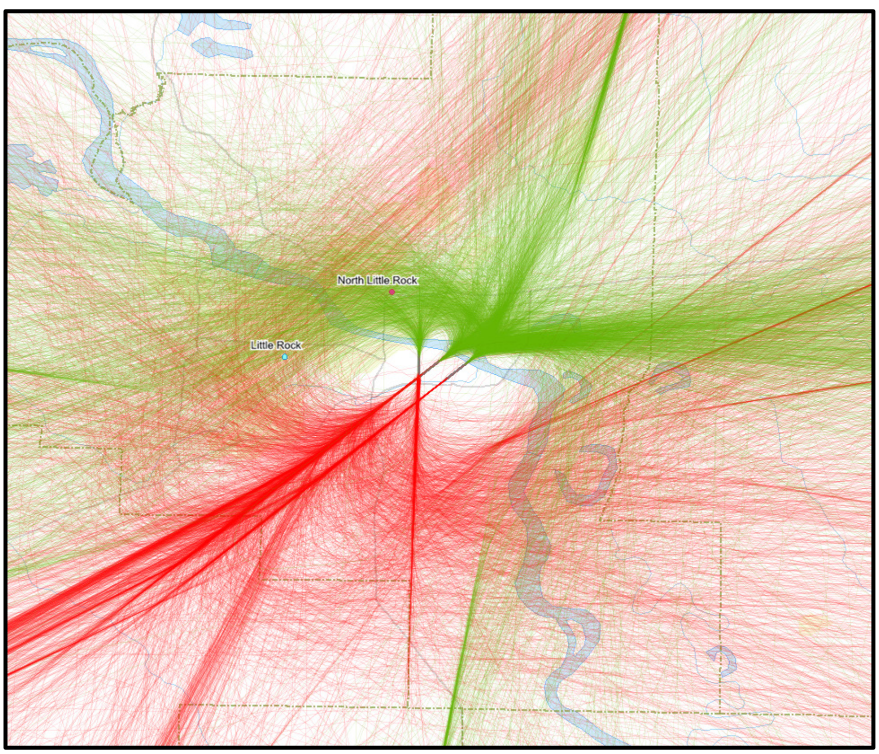
Military Jets – 100% Sample



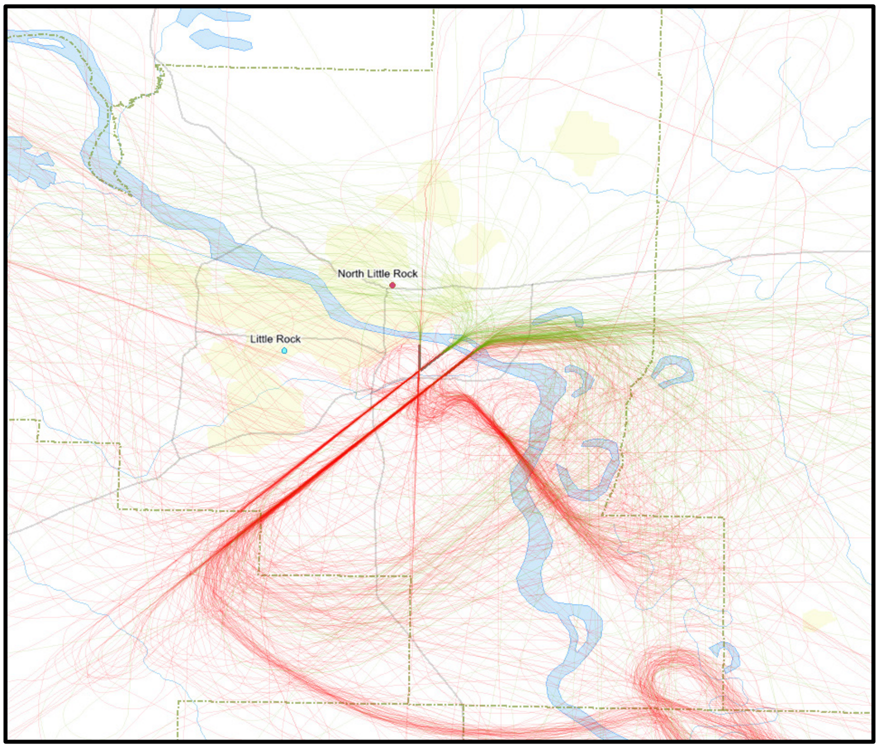
South Flow, Non-Jets – 50% Sample



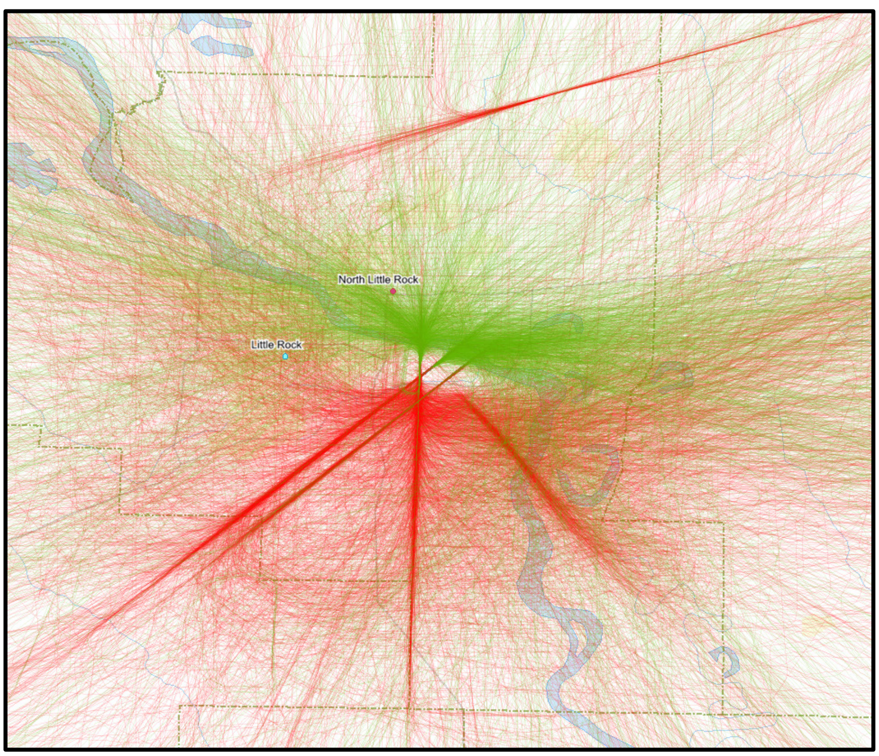
North Flow, Civil Jets – 33% Sample



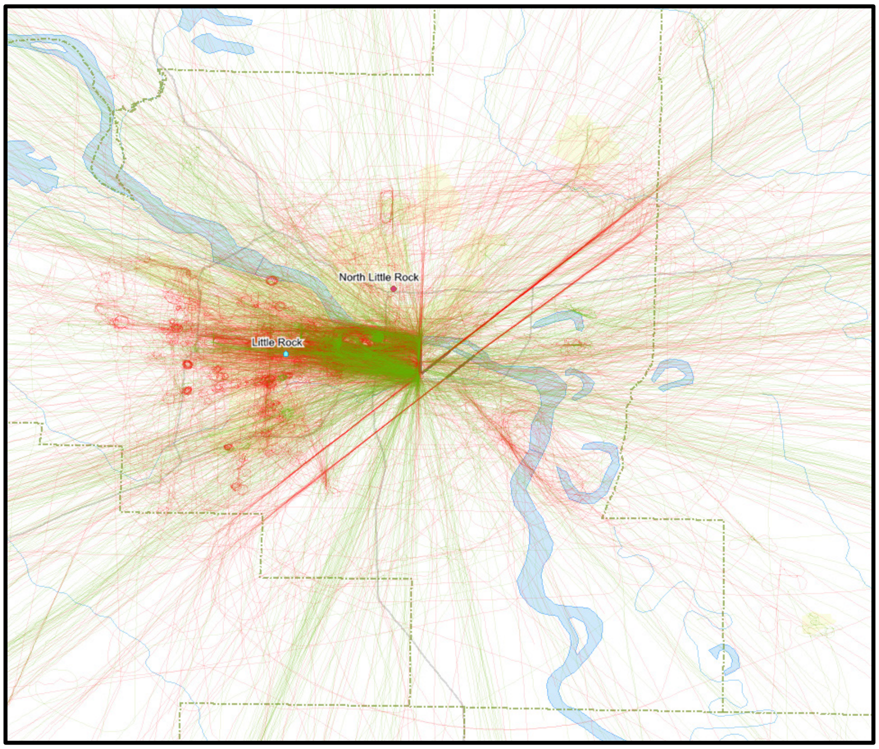
Military Jets – 100% Sample



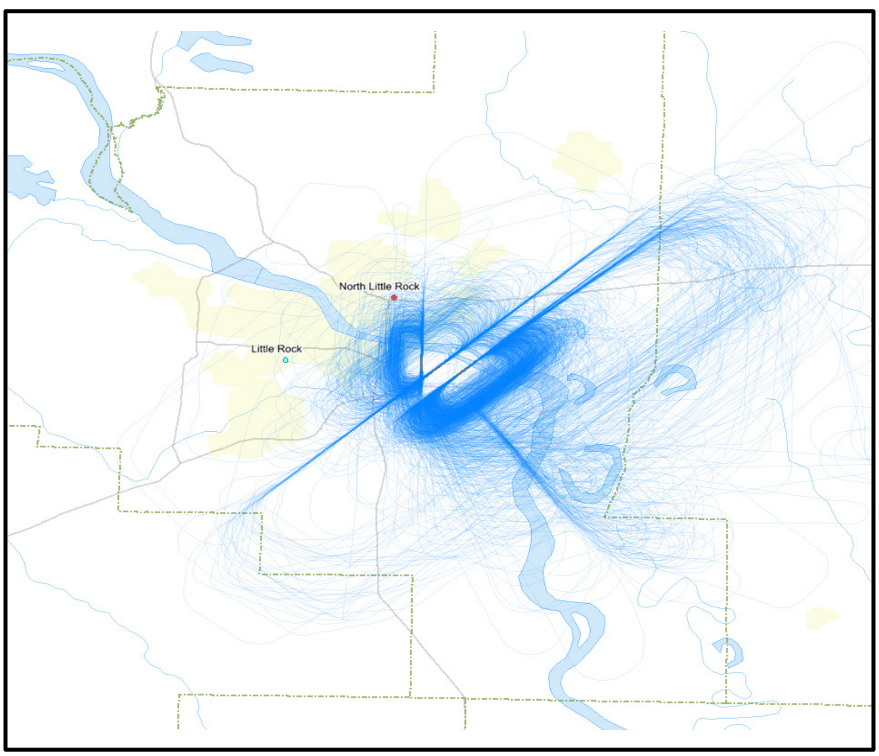
North Flow, Non-Jets – 50% Sample



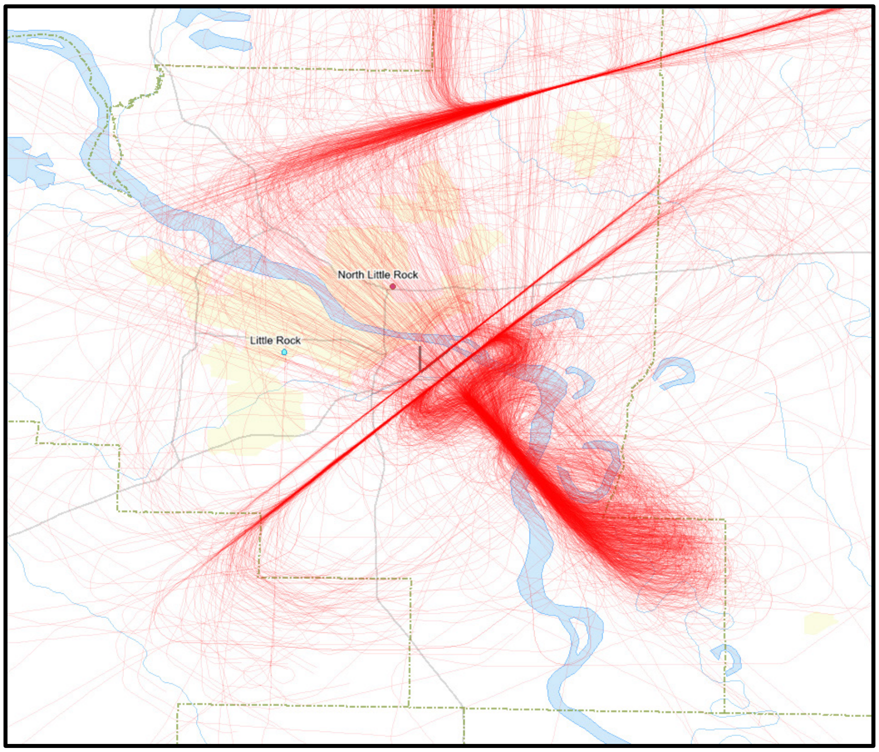
Helicopters – 100% Sample



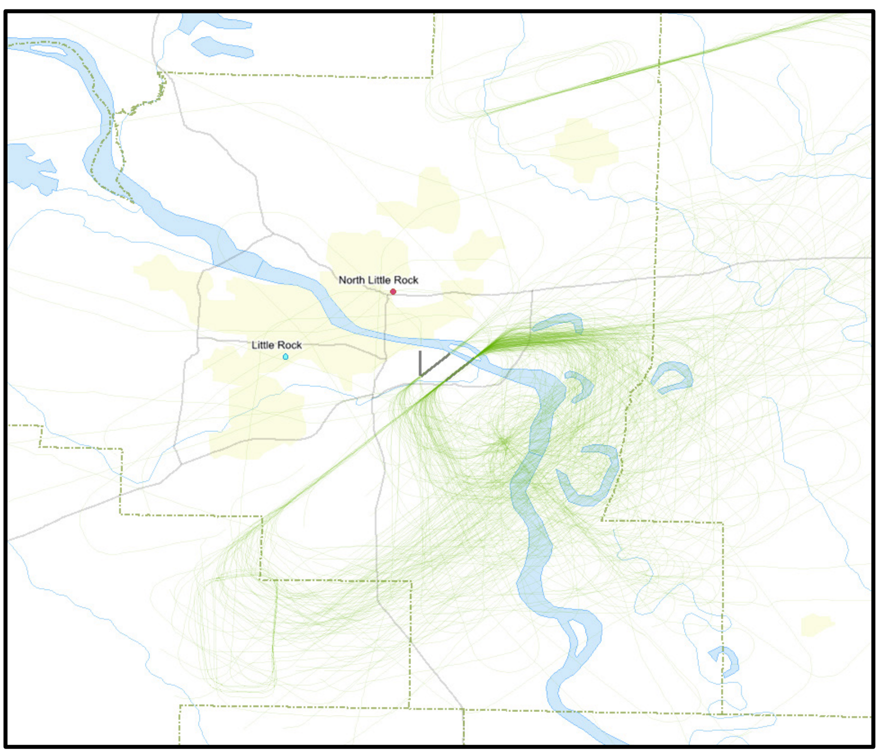
Local Operations – 100% Sample



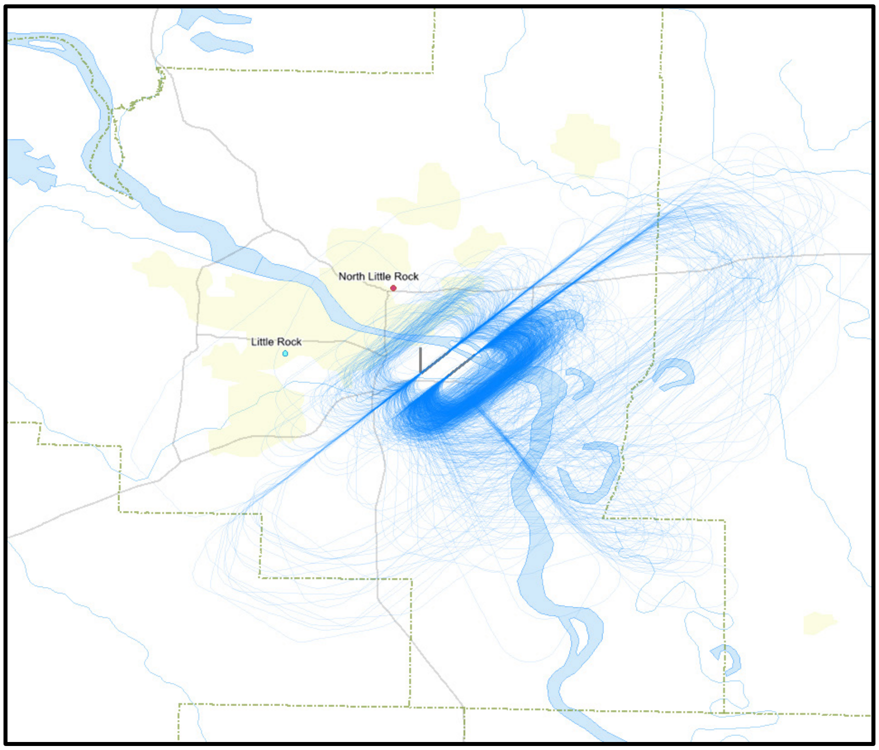
C130 Arrival Operations – 100%



C130 Departure Operations – 100%



C130 Local Operations – 100%



F.15 Memphis Intl, MEM

Airport: Memphis International Airport
City: Memphis, TN
Runways: 4
Helipads: 0
Elevation: 341 feet MSL

Local Operation Notes: No local operations modeled.

Helicopter Notes: No Helicopter operations modeled.

Other Notes: Mostly commercial operations.

F.15.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
09	35.058623	-89.985731	253	150	8,946	0	3
18C	35.054594	-89.976171	271	150	11,120	0	3
18L	35.048816	-89.972951	278	150	9,000	0	3
18R	35.049489	-89.987443	288	150	9,320	0	3
27	35.057781	-89.955856	292	150	8,946	0	3
36C	35.024050	-89.975526	341	150	11,120	0	3
36L	35.023885	-89.986893	321	150	9,320	0	3
36R	35.024094	-89.972432	335	150	9,000	0	3

F.15.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.15.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	167,944	64,899	19,183	1,323	73	42	253,464	365
ATADS (Data Days)	167,944	64,899	19,219	1,344	0	0	253,406	365
Database	165,603	63,561	18,279	686	0	0	248,129	365
Scale Factor	101.4%	102.1%	105.1%	195.9%	0	0	102.1%	n/a

Notes:

- Local Civil added to General Aviation due to the low number of Local Civil tracks in the database.
- Local Military added to Military due to low number of Local Military tracks in the database.

F.15.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	168,545	26,922	21,151 (1)	2,163 (2)	176 (1)	214 (2)	219,171	365
Database	165,603	63,561	18,279	686	0	0	248,129	365
Scale Factor	101.8%	42.4%	116.7%	346.5%	0	0	88.3%	n/a

Notes:

1) Local Civil added to General Aviation due to the low number of Local Civil tracks in the database.
2) Local Military added to Military due to the low number of Local Military tracks in the database.

F.15.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.15.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	196.45	110.78	307.23	199.95	107.27	307.22	-	-	-	396.40	218.05	614.45
Civilian Jet, Other	14.53	1.13	15.66	14.24	1.42	15.66	-	-	-	28.77	2.55	31.32
Civilian Prop	16.53	5.93	22.46	15.42	7.04	22.46	-	-	-	31.95	12.97	44.92
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.41	<0.01	0.41	0.42	-	0.42	-	-	-	0.83	-	0.83
Military Jet, Other	0.63	0.05	0.68	0.67	0.01	0.68	-	-	-	1.30	0.06	1.36
Military Prop	0.75	0.02	0.77	0.75	0.02	0.77	-	-	-	1.50	0.04	1.54
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**229.30**	**117.91**	**347.21**	**231.45**	**115.76**	**347.21**	**-**	**-**	**-**	**460.75**	**233.67**	**694.42**

Note: Each circuit operation counted as two operations in Total Operations

F.15.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	153.36	108.74	262.10	156.86	105.24	262.10	-	-	-	310.22	213.98	524.20
Civilian Jet, Other	16.10	1.25	17.35	15.77	1.57	17.34	-	-	-	31.87	2.82	34.69
Civilian Prop	13.93	3.60	17.53	13.21	4.32	17.53	-	-	-	27.14	7.92	35.06
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	0.72	0.01	0.73	0.73	-	0.73	-	-	-	1.45	0.01	1.46
Military Jet, Other	1.10	0.08	1.18	1.18	0.01	1.19	-	-	-	2.28	0.09	2.37
Military Prop	1.30	0.04	1.34	1.30	0.04	1.34	-	-	-	2.60	0.08	2.68
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**186.51**	**113.72**	**300.23**	**189.05**	**111.18**	**300.23**	**-**	**-**	**-**	**375.56**	**224.90**	**600.46**

Note: Each circuit operation counted as two operations in Total Operations

F.15.4 Modeled Tracks

RNAV procedures:

- 7 STAR (Arrival) RNAV procedures
- 5 RNAV RNP procedures (runway 08L, 08C, and 08R)
- 8 RNAV GPS procedures (all runways)
- 18 RNAV SID (Departure) procedures

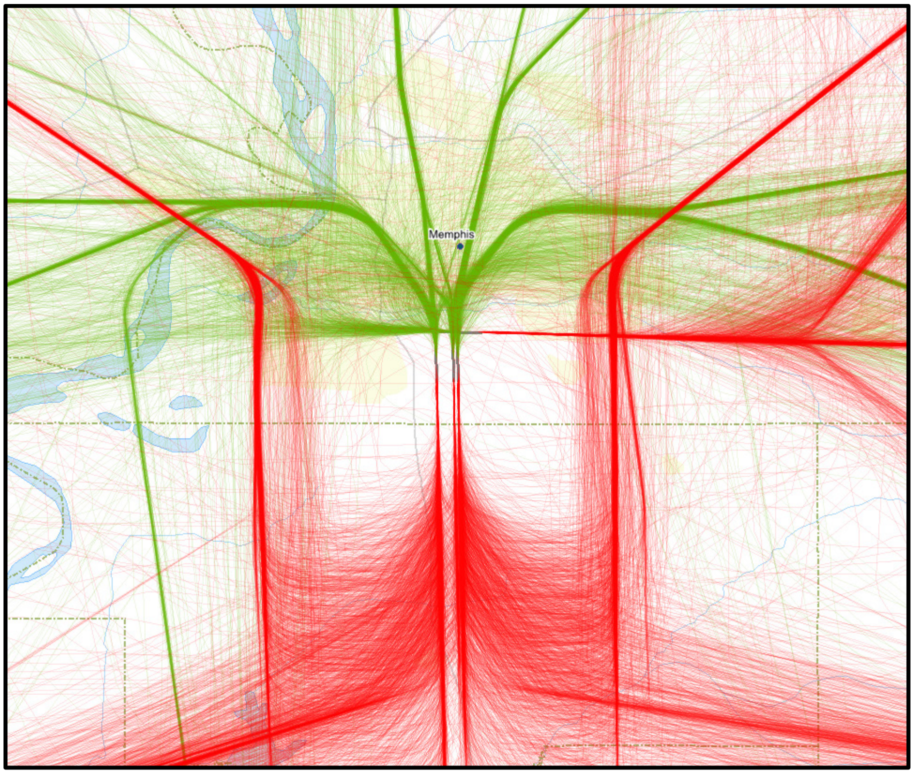
Total Tracks:

Aircraft Category	Arrivals		Departures		Locals	
	South	North	South	North	South	North
Jets	62,468	54,419	39,311	76,100	-	-
Non-Jets, fixed-wing	3,100	5,000	1,918	5,813	-	-
Total	65,568	59,419	41,229	81,913	-	-

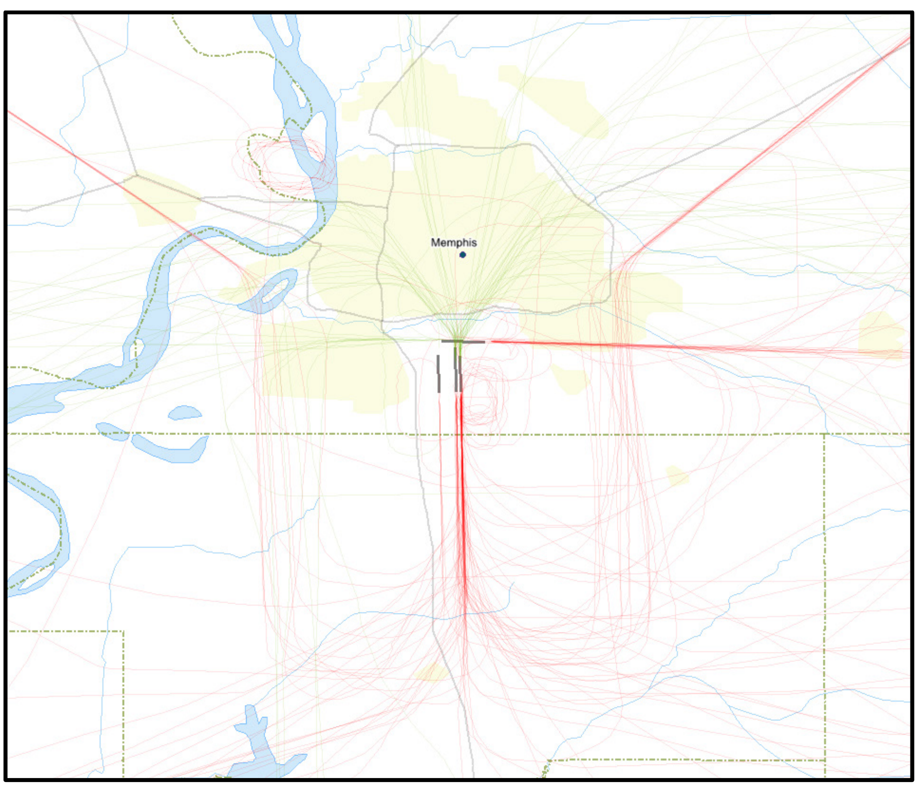
Aircraft Category	Total			Percent	
	South	North	Total	South	North
Jets	101,779	130,519	232,298	44%	56%
Non-Jets, fixed-wing	5,018	10,813	15,831	32%	68%
Helicopters	n/a	n/a	-	n/a	n/a
Total	106,797	141,332	248,129	43%	57%

F.15.5 Representative Radar Flight Tracks

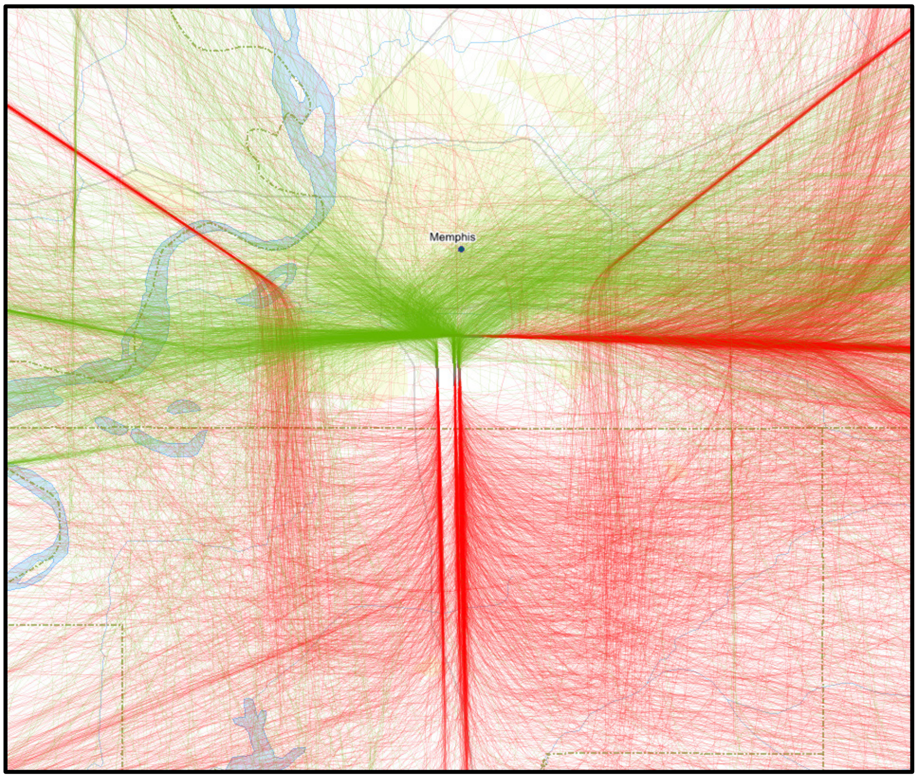
North Flow, Non-military Jets – 7% Sample



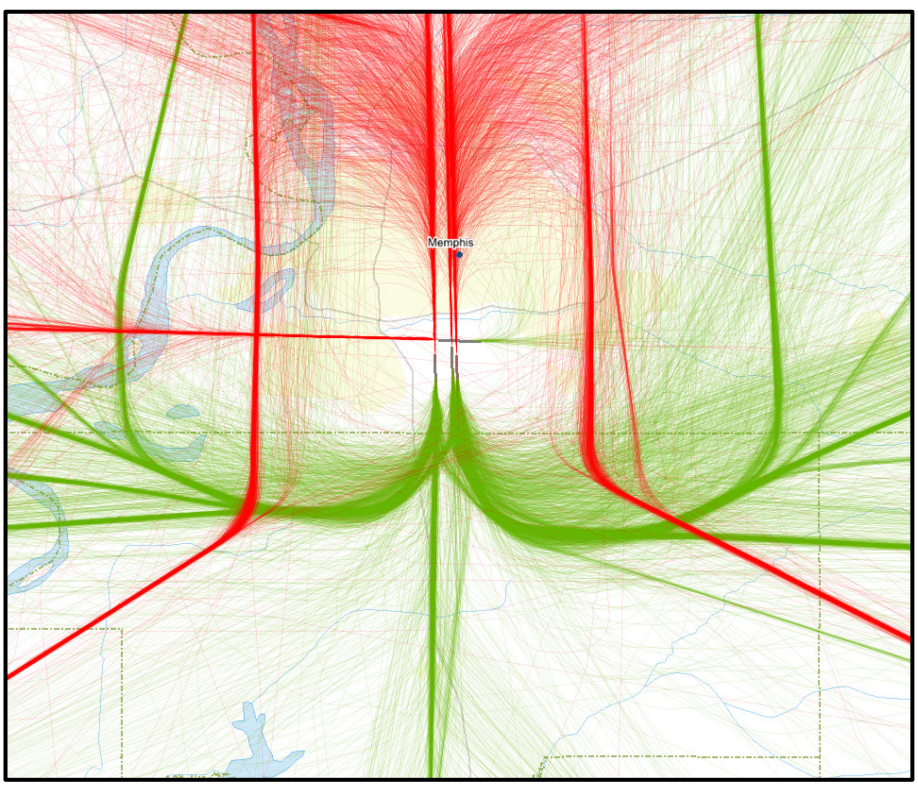
Military Jets – 100% Sample



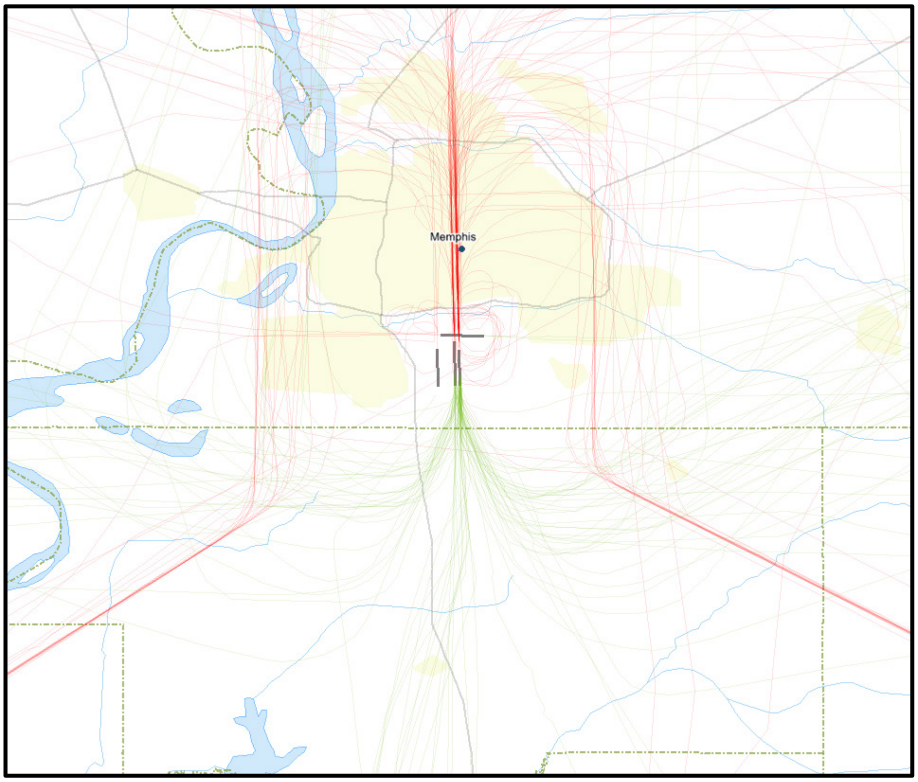
North Flow, Non-Jets – 50% Sample



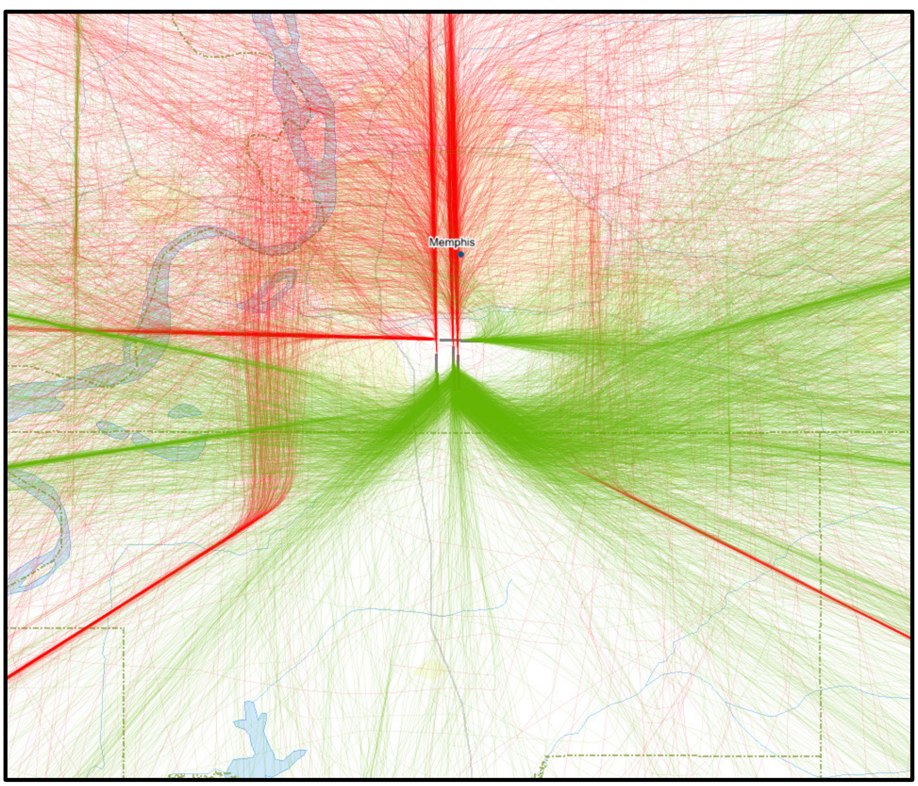
South Flow, Non-military Jets – 7% Sample



Military Jets – 100% Sample



South Flow, Non-Jets – 50% Sample



F.16 Miami Intl, MIA

Airport: Miami International Airport
City: Miami, FL
Runways: 4
Helipads: 0
Elevation: 8 feet MSL

Local Operation Notes: No local operations modeled.

Helicopter Notes: No helicopter operations modeled.

Other Notes: Mostly commercial operations. One 2015 operation (412,915 total operations) was not modeled due to a processing error. This omission has no effect within the precision of the model.

F.16.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
08L	25.802898	-80.301542	8	150	8,600	0	3
08R	25.800699	-80.301434	8	200	10,506	0	3
09	25.786095	-80.314838	7	150	13,016	1,358	3
12	25.799285	-80.302290	8	150	9,355	0	3
26L	25.802019	-80.269536	8	200	10,506	0	3
26R	25.803978	-80.275430	8	150	8,600	0	3
27	25.787731	-80.275326	8	150	1,3016	261	3
30	25.786625	-80.277537	8	150	9,355	940	3

F.16.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.16.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	309,780	63,546	18,616	952	0	0	392,894	365
ATADS for Data Days	309,780	63,546	18,616	952	0	0	392,894	365
Database	305,654	61,543	18,670	687	0	0	386,554	365
Scale Factor	101.3%	103.3%	99.7%	138.6%	0	0	101.6%	n/a

F.16.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	359,554*	33,914	18,224	1,223	0	0	412,915	365
Database	305,654	61,543	18,670	687	0	0	386,554	365
Scale Factor	117.6%	55.1%	97.6%	178.0%	0	0	106.8%	n/a

* One fewer air carrier operation modeled due to processing error.

F.16.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.16.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	413.80	71.64	485.44	420.35	65.08	485.43	-	-	-	834.15	136.72	970.87
Civilian Jet, Other	16.59	2.80	19.39	17.08	2.32	19.40	-	-	-	33.67	5.12	38.79
Civilian Prop	30.65	1.42	32.07	30.66	1.42	32.08	-	-	-	61.31	2.84	64.15
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	<0.01	-	-	<0.01	-	-	-	-	-	-	-	-
Military Jet, Other	0.59	0.05	0.64	0.55	0.09	0.64	-	-	-	1.14	0.14	1.28
Military Prop	0.63	0.02	0.65	0.63	0.02	0.65	-	-	-	1.26	0.04	1.30
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**462.26**	**75.93**	**538.19**	**469.27**	**68.93**	**538.20**	**-**	**-**	**-**	**931.53**	**144.86**	**1,076.39**

Note: Each circuit operation counted as two operations in Total Operations

F.16.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	437.86	81.55	519.41	446.64	72.77	519.41	-	-	-	884.50	154.32	1,038.82
Civilian Jet, Other	16.24	2.75	18.99	16.72	2.27	18.99	-	-	-	32.96	5.02	37.98
Civilian Prop	24.40	1.16	25.56	24.33	1.23	25.56	-	-	-	48.73	2.39	51.12
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	<0.01	-	-	<0.01	-	-	-	-	-	-	-	-
Military Jet, Other	0.76	0.07	0.83	0.71	0.12	0.83	-	-	-	1.47	0.19	1.66
Military Prop	0.82	0.02	0.84	0.81	0.03	0.84	-	-	-	1.63	0.05	1.68
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**480.08**	**85.55**	**565.63**	**489.21**	**76.42**	**565.63**	**-**	**-**	**-**	**969.29**	**161.97**	**1,131.26**

Note: Each circuit operation counted as two operations in Total Operations

F.16.4 Modeled Tracks

RNAV procedures:

- 4 STAR (Arrival) RNAV procedures
- 5 RNAV RNP procedures (runway 08R, 12, 26L, 27, 30)
- 8 RNAV GPS procedures (All runways)
- 11 RNAV SID (Departure) procedures

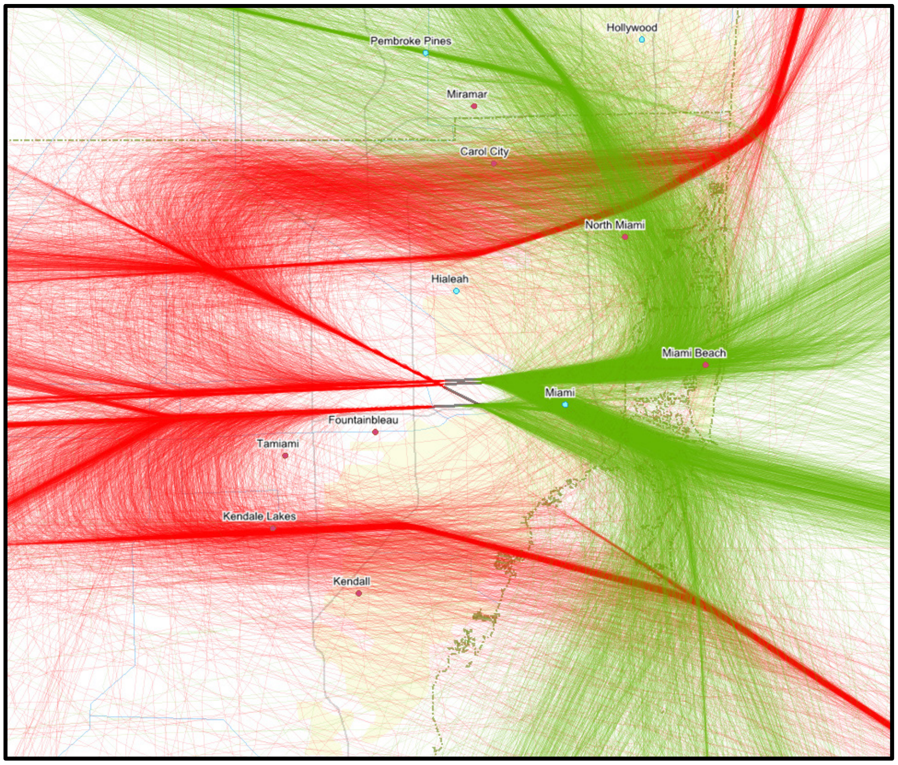
Total Tracks:

Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	136,114	46,234	136,115	45,196	-	-
Non-Jets, fixed-wing	8,885	2,899	8,291	2,820	-	-
Total	144,999	49,133	144,406	48,016	-	-

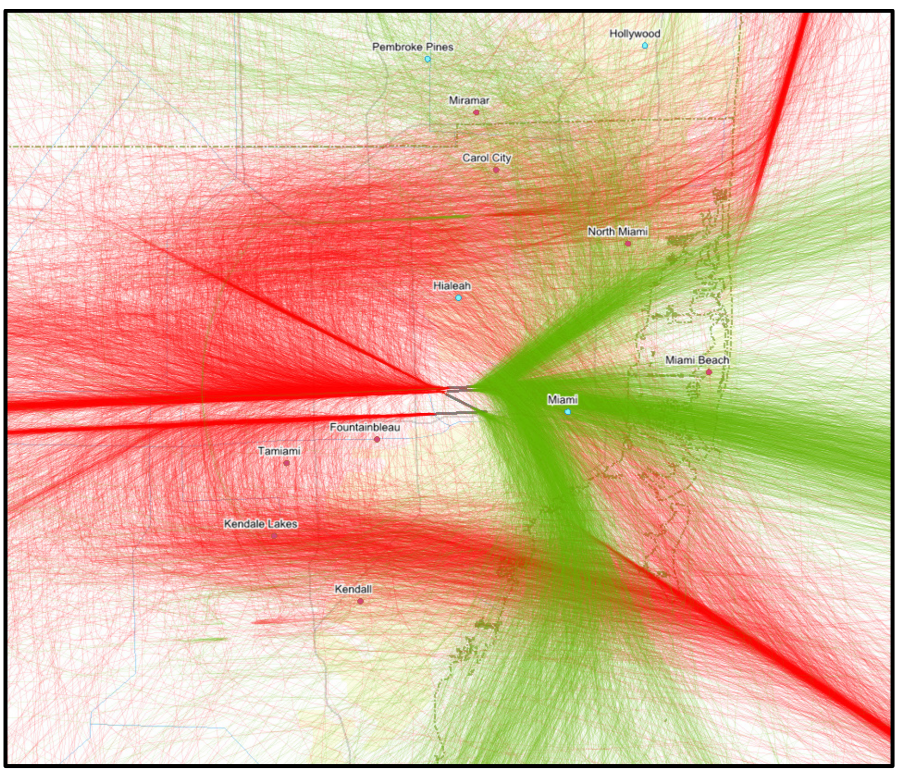
Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	136,114	46,234	136,115	45,196	-	-
Non-Jets, fixed-wing	8,885	2,899	8,291	2,820	-	-
Helicopters	n/a	n/a	n/a	n/a	n/a	n/a
Total	144,999	49,133	144,406	48,016	-	-

F.16.5 Representative Radar Flight Tracks

East Flow, Jets – 4% Sample

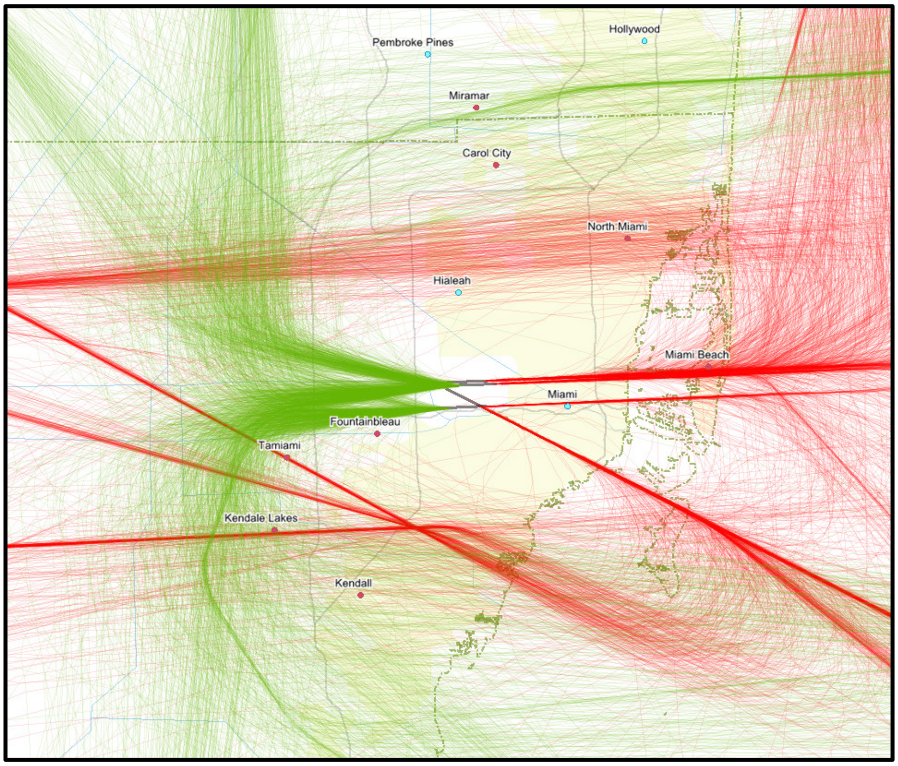


Non-Jets – 50% Sample

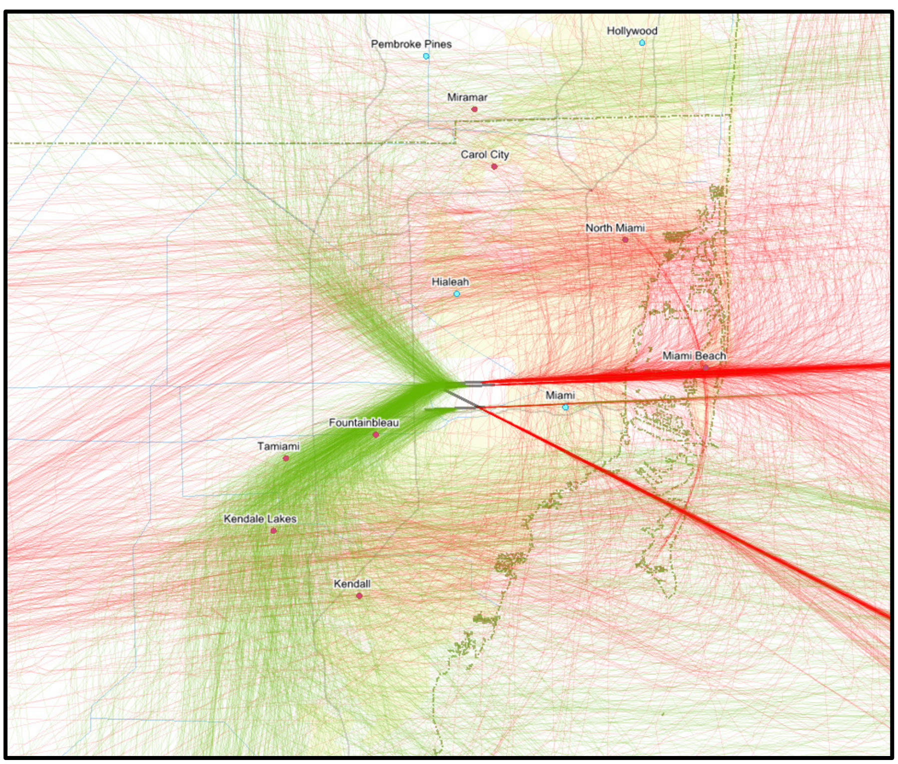


West Flow

Jets – 4% Sample



Non-Jets – 50% Sample



F.17 Chicago O'Hare Intl, ORD

Airport: Chicago O'Hare International Airport
City: Chicago, IL
Runways: 8
Helipads: 1
Elevation: 668 feet MSL

Local Operation Notes: No local operations modeled.

Helicopter Notes: No helicopter operations were modeled.

Other Notes: Very busy commercial airport.

F.17.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
04L	41.981655	-87.913918	656	150	7,500	0	3
04R	41.953327	-87.899418	661	150	8,075	0	3
09L	42.002832	-87.926676	668	150	7,500	0	3
09R	41.983898	-87.918352	660	150	7,967	0	3
10C	41.965701	-87.931522	669	200	10,801	0	3
10L	41.968995	-87.931532	672	150	13,001	0	3
14L	42.002435	-87.915368	653	150	10,005	1,998	3
14R	41.990435	-87.933140	666	200	9,685	0	3
22L	41.969922	-87.879743	654	150	8,075	0	3
22R	41.997537	-87.896371	648	150	7,500	0	3
27L	41.983900	-87.889051	650	150	7,967	0	3
27R	42.002831	-87.899084	664	150	7,500	0	3
28R	41.969070	-87.883729	651	150	13,001	0	3
28C	41.965766	-87.891810	650	200	10,801	0	3
32L	41.970083	-87.910233	654	200	9,685	0	3
32R	41.981405	-87.891713	648	150	10,005	0	3

F.17.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.17.2.1 2013-2014

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	539,542	331,524	7,302	193	0	0	878,561	365
ATADS for Data Days	533,913	327,945	7,243	193	0	0	869,294	361
Database	515,374	317,902	5,754	43	0	0	839,073	361
Scale Factor	103.6%	103.2%	125.9%	448.8%	0	0	103.6%	n/a

F.17.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	597,750	270,110	7,141	135	0	0	875,136	365
Database	515,374	317,902	5,754	43	0	0	839,073	361
Scale Factor	116.0%	85.0%	124.1%	314.0%	0	0	104.3%	n/a

F.17.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.17.3.1 2013-2014

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	1,063.03	125.53	1,188.56	1,077.37	111.20	1,188.57	-	-	-	2,140.40	236.73	2,377.13
Civilian Jet, Other	7.19	0.40	7.59	7.12	0.47	7.59	-	-	-	14.31	0.87	15.18
Civilian Prop	6.97	0.62	7.59	7.20	0.40	7.60	-	-	-	14.17	1.02	15.19
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	0.23	0.01	0.24	0.22	0.03	0.25	-	-	-	0.45	0.04	0.49
Military Prop	0.02	-	0.02	0.02	-	0.02	-	-	-	0.04	-	0.04
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**1,077.44**	**126.56**	**1,204.00**	**1,091.93**	**112.10**	**1,204.03**	**-**	**-**	**-**	**2,169.37**	**238.66**	**2,408.03**

Note: Each circuit operation counted as two operations in Total Operations

F.17.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	1,080.47	117.31	1,197.78	1,081.63	116.15	1,197.78	-	-	-	2,162.10	233.46	2,395.56
Civilian Jet, Other	6.75	0.72	7.47	6.79	0.68	7.47	-	-	-	13.54	1.40	14.94
Civilian Prop	5.99	0.67	6.66	6.01	0.65	6.66	-	-	-	12.00	1.32	13.32
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	0.17	0.01	0.18	0.16	0.02	0.18	-	-	-	0.33	0.03	0.36
Military Prop	0.01	-	0.01	0.01	-	0.01	-	-	-	0.02	-	0.02
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**1,093.39**	**118.71**	**1,212.10**	**1,094.60**	**117.50**	**1,212.10**	**-**	**-**	**-**	**2,187.99**	**236.21**	**2,424.20**

Note: Each circuit operation counted as two operations in Total Operations

F.17.4 Modeled Tracks

RNAV procedures:

- 5 STAR (Arrival) RNAV procedures
- 0 RNAV RNP procedures
- 13 RNAV GPS procedures (All runways except 32L)
- 6 RNAV SID (Departure) procedures

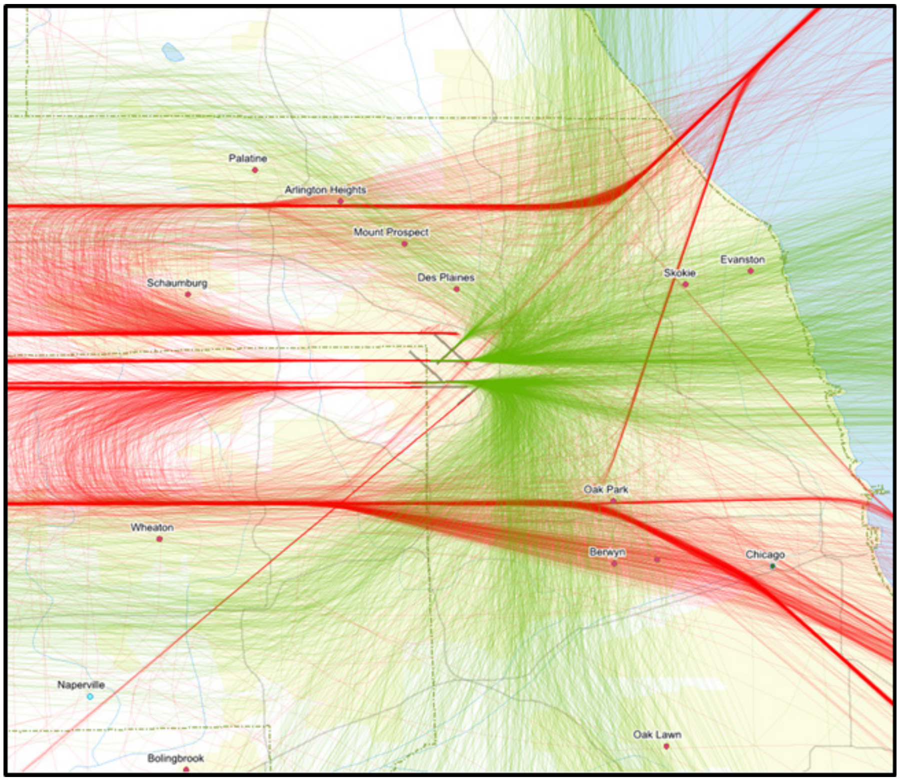
Total Tracks:

Aircraft Category	Arrivals East	Arrivals West	Departures East	Departures West	Locals East	Locals West
Jets	102,371	315,870	94,806	321,027	-	-
Non-Jets, fixed-wing	534	1,960	527	1,978	-	-
Total	102,905	317,830	95,333	323,005	-	-

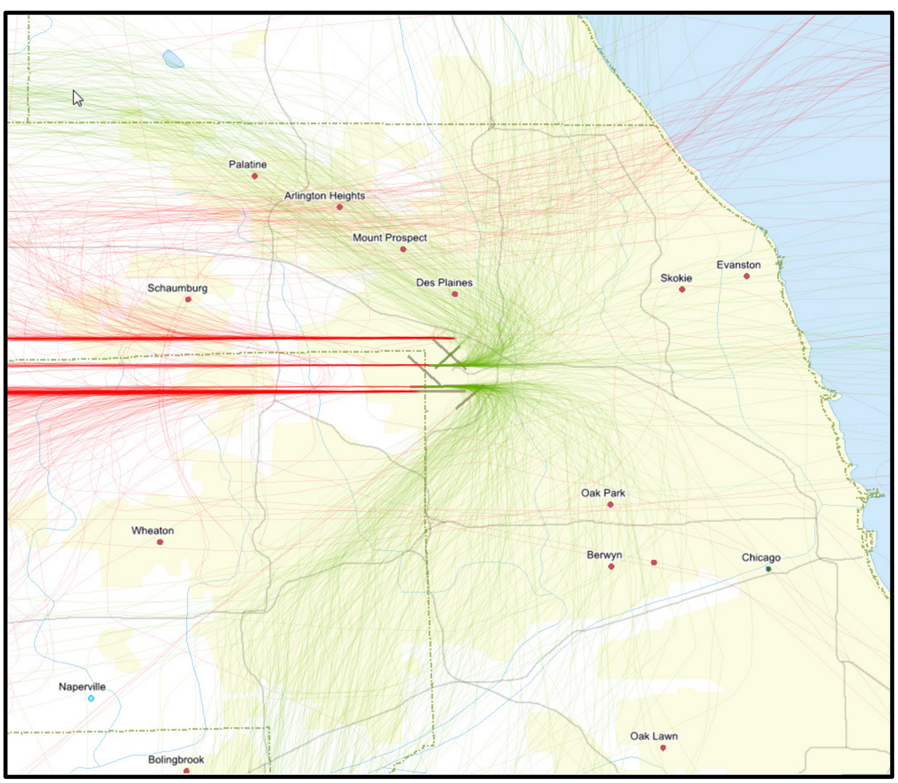
Aircraft Category	Total East	Total West	Total Total	Percent East	Percent West
Jets	197,177	636,897	834,074	24%	76%
Non-Jets, fixed-wing	1,061	3,938	4,999	21%	79%
Helicopters	n/a	n/a	-	n/a	n/a
Total	198,238	640,835	839,073	24%	76%

F.17.5 Representative Radar Flight Tracks

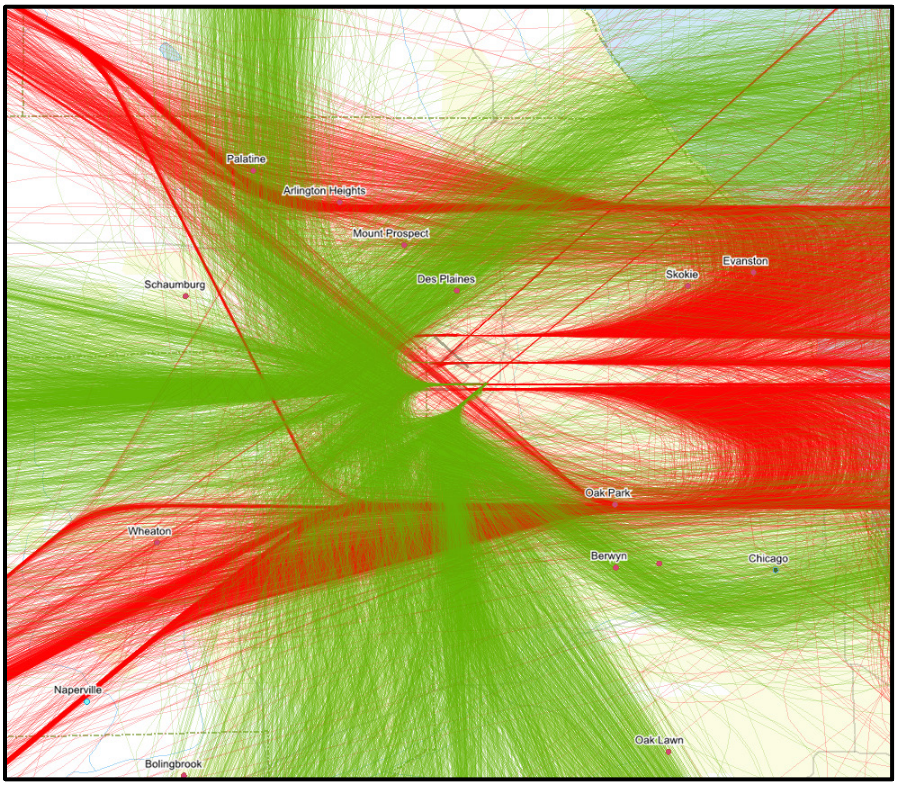
East Flow, Jets – 3% Sample



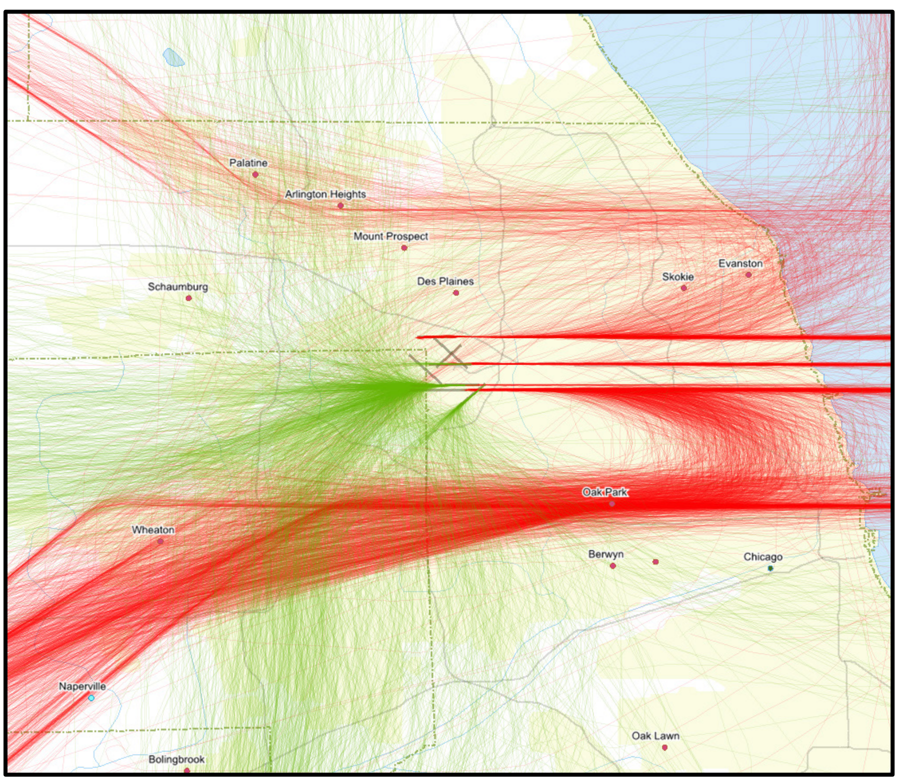
Non-Jets – 100% Sample



West Flow, Jets – 3% Sample



Non-Jets – 100% Sample



F.18 Savannah/Hilton Head Intl, SAV

Airport: Savannah/Hilton Head International Airport
City: Savannah, GA
Runways: 2
Helipads: 3
Elevation: 50 feet MSL

Local Operation Notes: Circuits modeled at 2,000 feet AFE. Split tracks counted as local operations and make up the majority of the local operations. Local tracks were not removed from modeling based on maximum range or maximum altitude.

Helicopter Notes: A moderate number of operations, about 3 percent of total daily operations. Variety of INM types. Split tracks counted as local operations. MD600N not modeled (26 annual operations).

Other Notes: Relatively large number of military jet operations and C-130 aircraft operations.

F.18.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
01	32.116571	-81.199991	29	150	7,002	0	3
10	32.128754	-81.218792	17	150	9,351	0	3
19	32.135816	-81.200138	42	150	7,002	0	3
28	32.128475	-81.188589	46	150	9,351	0	3
H1	32.116622	-81.197215	25	n/a	n/a	n/a	n/a
H2	32.122858	-81.197436	33	n/a	n/a	n/a	n/a
H3	32.125799	-81.205562	18	n/a	n/a	n/a	n/a

F.18.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.18.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	14,728	21,477	30,734	6,460	13,952	1,691	89,042	365
ATADS for Data Days	14,654	21,397	30,545	6,404	13,898	1,669	88,567	363
Database	14,624	19,409	24,388	3,283	5,418	980	68,102	363
Scale Factor	100.2%	110.2%	125.2%	195.1%	256.5%	170.3%	130.1%	n/a

F.18.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	20,094	19,151	31,895	7,535	8,701	1,556	88,932	365
Database	14,624	19,409	24,388	3,283	5,418	980	68,102	363
Scale Factor	137.4%	98.7%	130.8%	229.5%	160.6%	158.8%	130.6%	n/a

F.18.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.18.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	38.36	5.88	44.24	40.08	4.16	44.24	-	-	-	78.44	10.04	88.48
Civilian Jet, Other	13.25	0.70	13.95	13.34	0.62	13.96	7.58	0.06	7.64	41.75	1.44	43.19
Civilian Prop	30.46	1.66	32.12	30.06	2.06	32.12	9.94	0.07	10.01	80.40	3.86	84.26
Civilian Rotorcraft	1.36	0.06	1.42	1.35	0.08	1.43	1.31	0.18	1.49	5.33	0.50	5.83
Military Jet, Fighter	3.07	0.02	3.09	3.04	0.04	3.08	1.53	0.01	1.54	9.17	0.08	9.25
Military Jet, Other	1.31	0.03	1.34	1.31	0.03	1.34	0.15	0.01	0.16	2.92	0.08	3.00
Military Prop	3.42	0.08	3.50	3.49	0.02	3.51	0.57	0.01	0.58	8.05	0.12	8.17
Military Rotorcraft	0.88	0.02	0.90	0.90	-	0.90	0.02	-	0.02	1.82	0.02	1.84
TOTAL	**92.11**	**8.45**	**100.56**	**93.57**	**7.01**	**100.58**	**21.10**	**0.34**	**21.44**	**227.88**	**16.14**	**244.02**

Note: Each circuit operation counted as two operations in Total Operations

F.18.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	42.42	6.79	49.21	44.43	4.78	49.21	-	-	-	86.85	11.57	98.42
Civilian Jet, Other	13.84	0.73	14.57	13.92	0.64	14.56	4.75	0.04	4.79	32.51	1.41	33.92
Civilian Prop	31.21	1.58	32.79	30.80	1.99	32.79	6.22	0.05	6.27	68.23	3.62	71.85
Civilian Rotorcraft	1.36	0.06	1.42	1.34	0.08	1.42	0.82	0.11	0.93	3.52	0.25	3.77
Military Jet, Fighter	3.61	0.02	3.63	3.58	0.05	3.63	1.42	0.01	1.43	8.61	0.08	8.69
Military Jet, Other	1.54	0.03	1.57	1.54	0.04	1.58	0.14	0.01	0.15	3.22	0.08	3.30
Military Prop	4.03	0.10	4.13	4.10	0.02	4.12	0.54	0.01	0.55	8.67	0.13	8.80
Military Rotorcraft	1.03	0.02	1.05	1.06	-	1.06	0.02	-	0.02	2.11	0.02	2.13
TOTAL	**99.04**	**9.33**	**108.37**	**100.77**	**7.60**	**108.37**	**13.91**	**0.23**	**14.14**	**213.72**	**17.16**	**230.88**

Note: Each circuit operation counted as two operations in Total Operations

F.18.4 Modeled Tracks

RNAV procedures:

- 0 STAR (Arrival) RNAV procedures
- 1 RNAV RNP procedures (runway 28)
- 4 RNAV GPS procedures (one for each runway)
- 0 RNAV SID (Departure) procedures

Total Tracks:

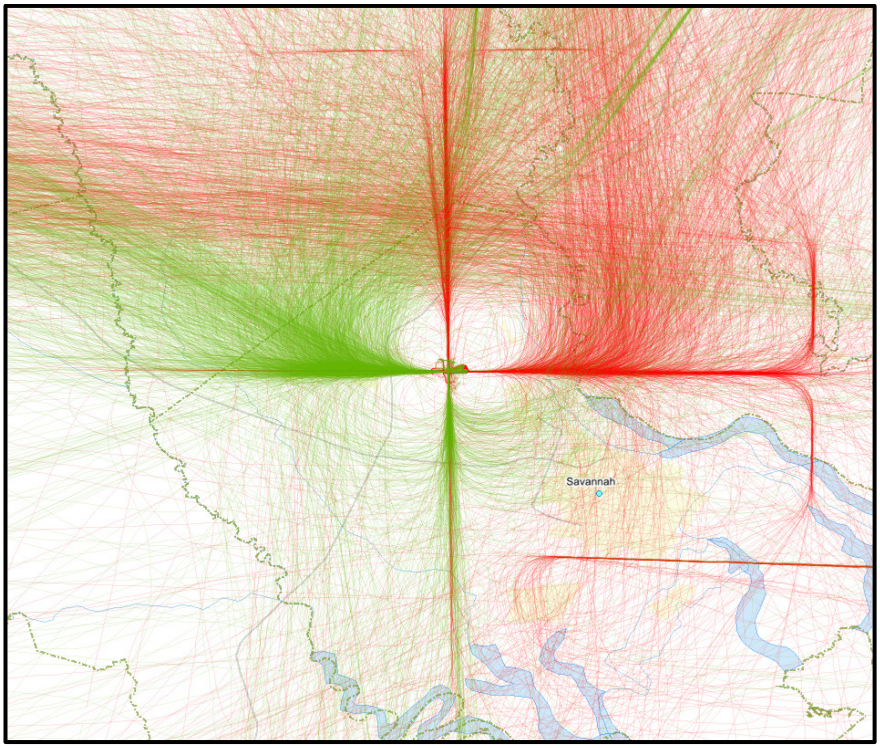
Aircraft Category	Arrivals		Departures		Locals	
	North	South	North	South	North	South
Jets	7,558	14,107	9,163	11,987	71	59
Non-Jets, fixed-wing	4,801	6,634	7,463	3,984	274	36
Total	12,359	20,741	16,626	15,971	345	95

Aircraft Category	Arrivals	Departures	Locals
Helicopters	803	722	-

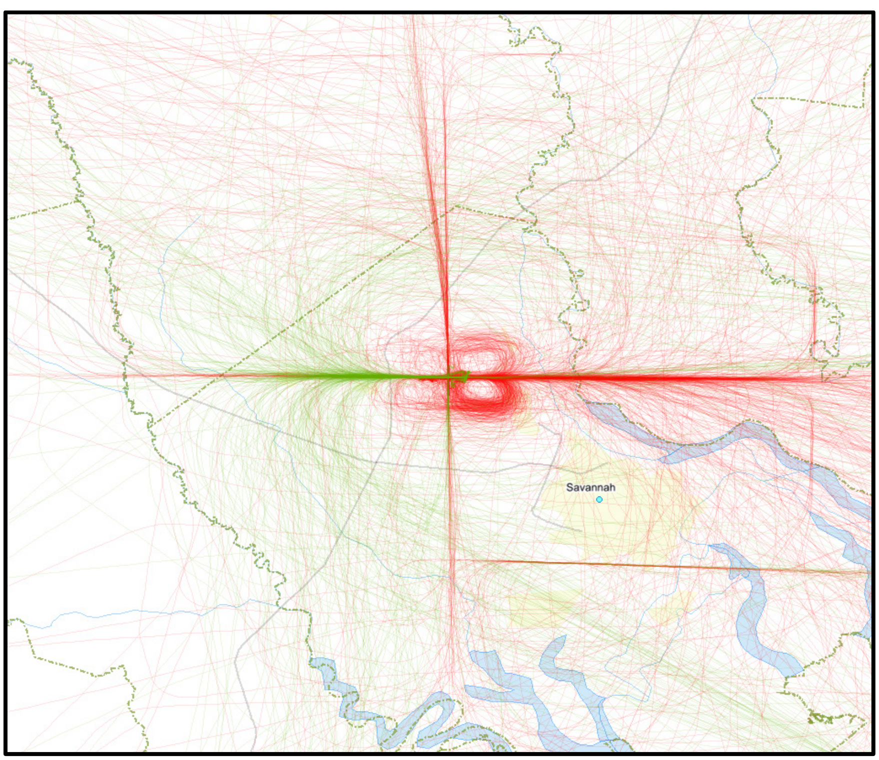
Aircraft Category	Total			Percent	
	North	South	Total	North	South
Jets	16,792	26,153	42,945	39%	61%
Non-Jets, fixed-wing	12,538	10,654	23,192	54%	46%
Helicopters	n/a	n/a	1,525	n/a	n/a
Total	29,330	36,807	67,662	44%	56%

F.18.5 Representative Radar Flight Tracks

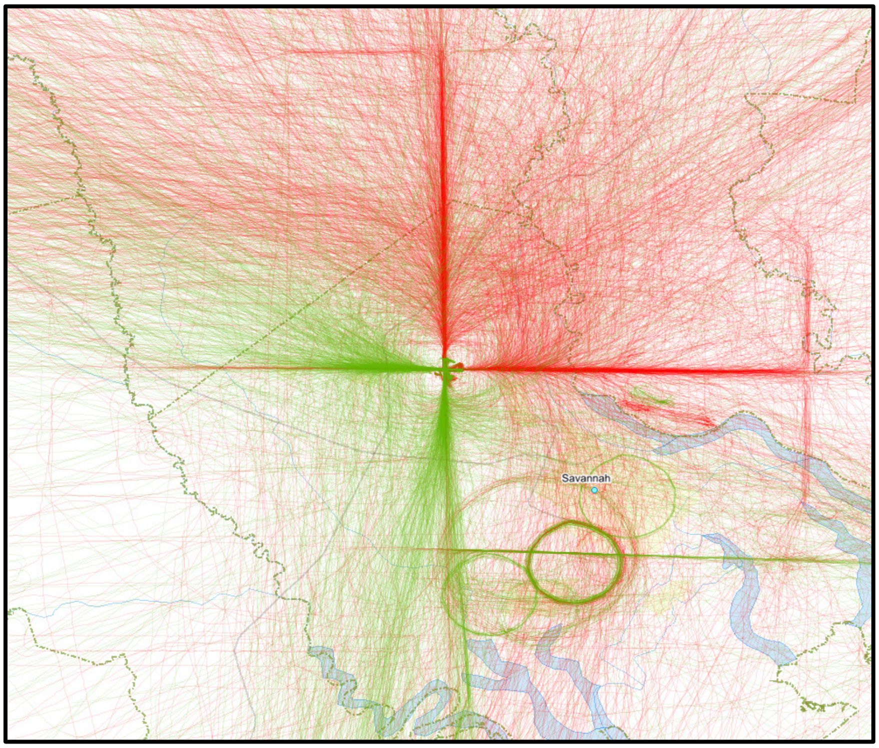
South Flow, Non-Military Jets – 33% Sample



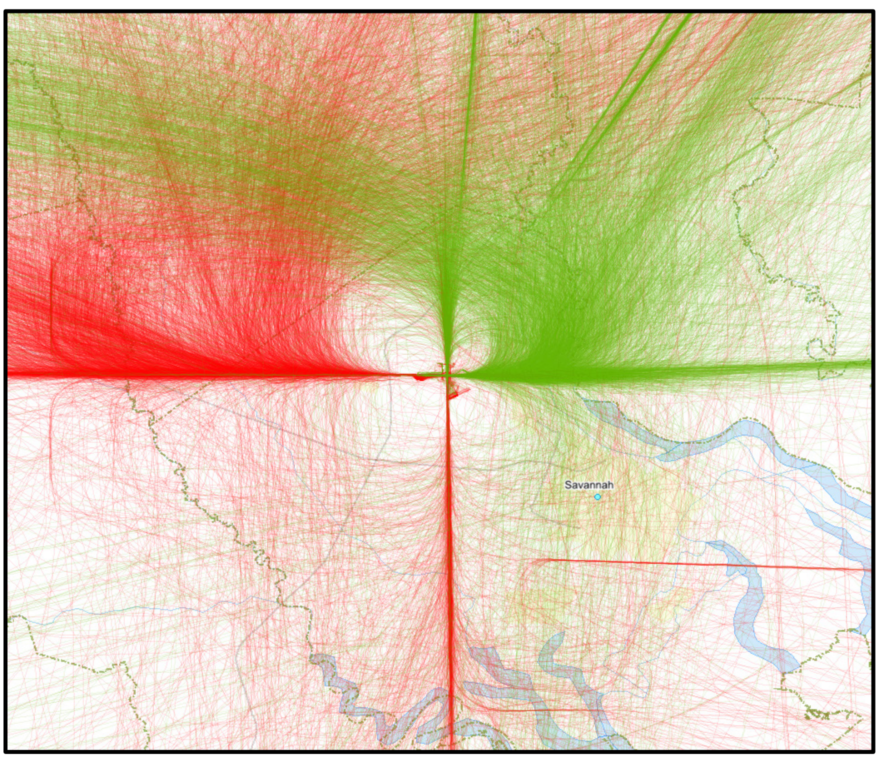
Military Jets – 100% Sample



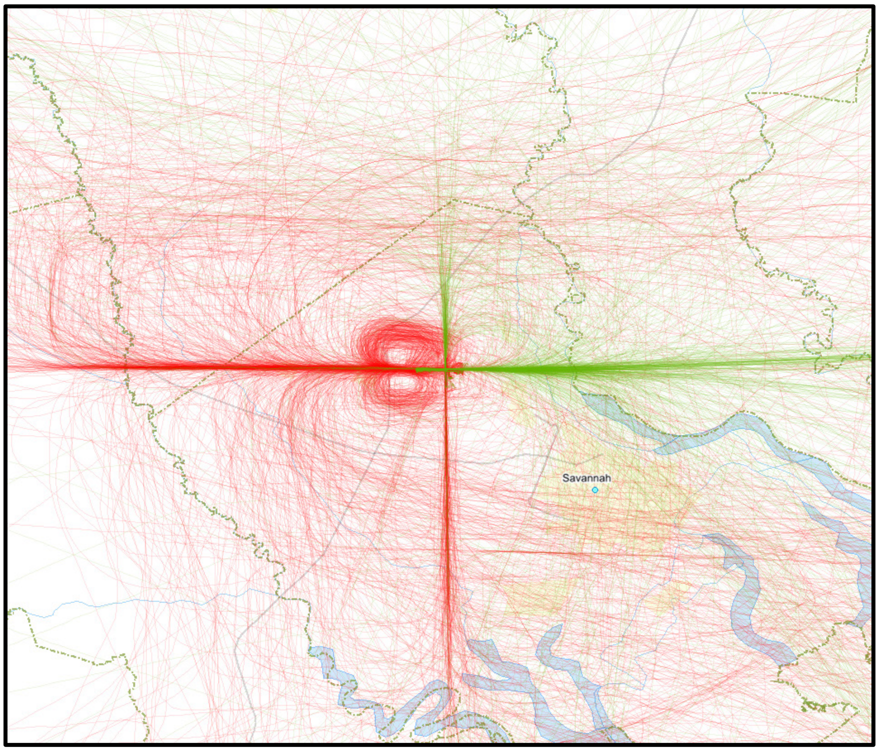
South Flow, Non-Jets – 50% Sample



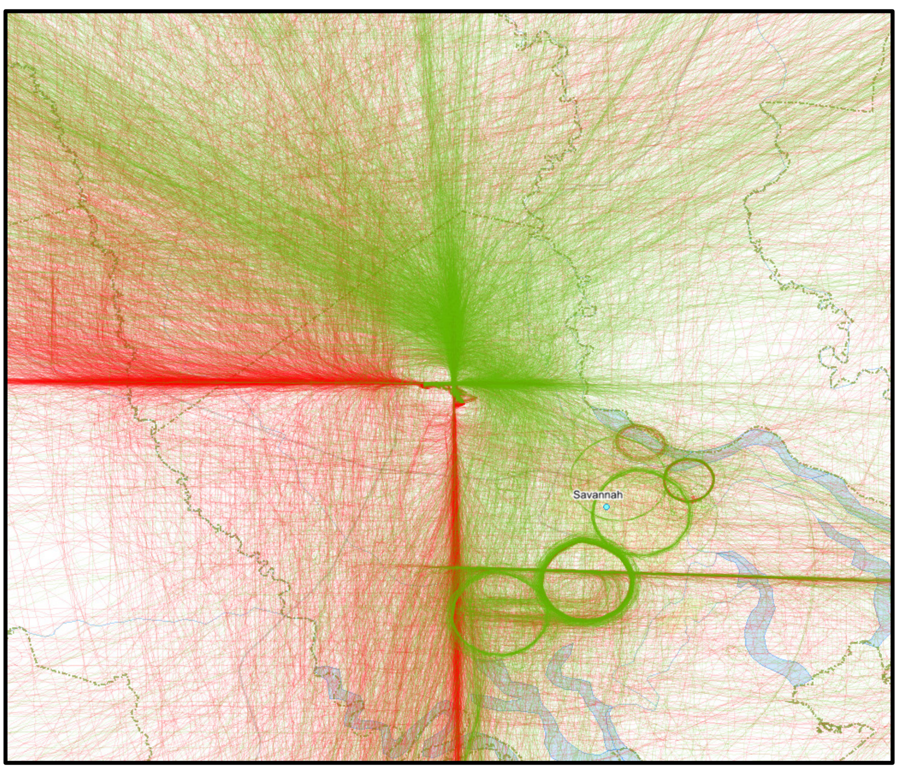
North Flow, Non-Military Jets – 33% Sample



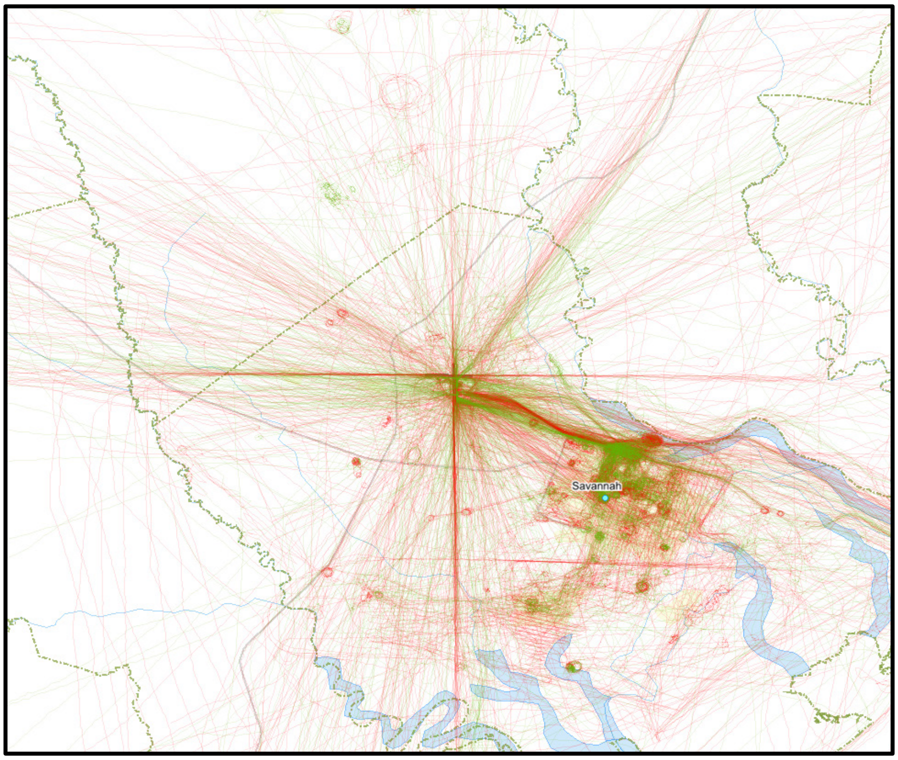
Military Jets – 100% Sample



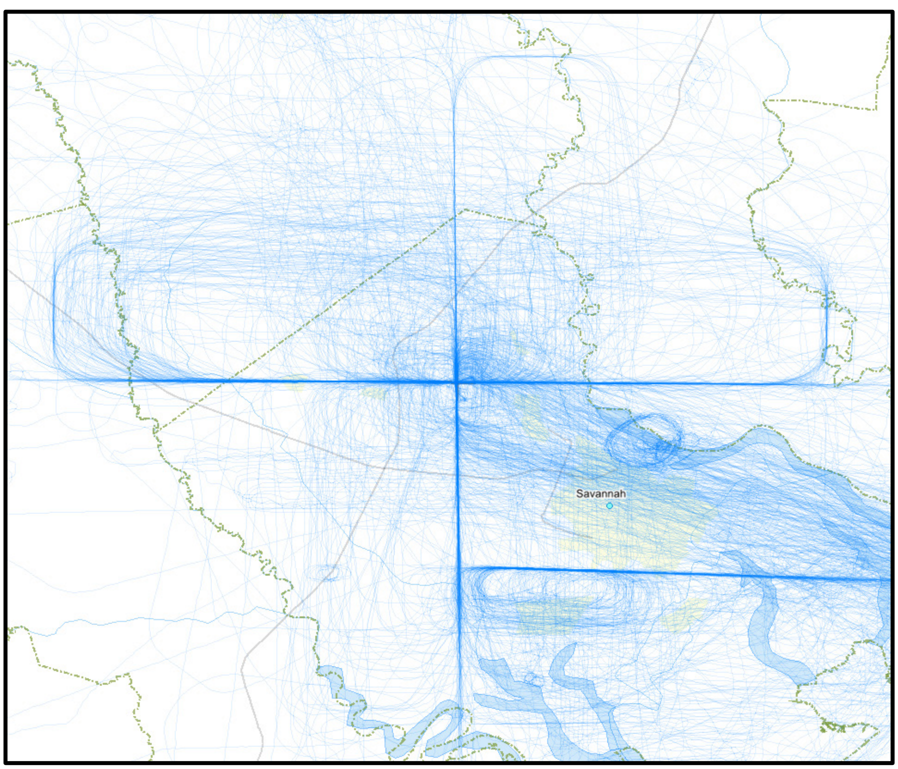
North Flow, Non-Jets – 50% Sample



Helicopters 100% Sample



Local 100% Sample



F.19 Norman Y. Mineta San Jose Intl, SJC

Airport: Norman Y. Mineta San Jose International Airport
City: San Jose, CA
Runways: 3
Helipads: 0
Elevation: 62 feet MSL

Local Operation Notes: Circuits modeled at 1,442 feet AFE. There were no split tracks. Circuit tracks that had a maximum altitude greater than 2,200 feet MSL were removed from modeling.

Helicopter Notes: No helicopter operations modeled.

Other Notes: Mostly commercial jet operations. One 2015 operation (148,669 total operations) was not modeled due to a processing error. This omission has no effect within the precision of the model.

F.19.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
11	37.365892	-121.93660	42	100	4,599	0	3
12L	37.374993	-121.94018	38	150	11,000	1,307	3
12R	37.373728	-121.94199	38	150	1,1000	1,297	3
29	37.356391	-121.92618	52	100	4,599	0	3.6
30L	37.350992	-121.91707	62	150	11,000	2,537	3
30R	37.352257	-121.91525	61	150	11,000	2,537	3

F.19.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.19.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	82,280	20,445	27,034	217	4,863	114	134,953	365
ATADS for Data Days	82,280	20,445	27,034	217	4,863	114	134,953	365
Database	81,750	19,849	26,200	188	2,906	56	130,949	365
Scale Factor	100.6%	103.0%	103.2%	115.4%	167.3%	203.6%	103.1%	n/a

F.19.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	91,134	23,183	29,715	237	4,338	62	148,669	365
Database	81,750	19,849	26,200	188	2,906	56	130,949*	365
Scale Factor	111.5%	116.8%	113.4%	126.1%	149.3%	110.7%	113.5%	n/a

* 1 fewer civilian propeller operation modeled due to processing error; Affected overall DNL by less than 0.1 dB (estimated).

F.19.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.19.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	118.67	12.03	130.70	115.14	15.56	130.70	-	-	-	233.81	27.59	261.40
Civilian Jet, Other	20.68	1.47	22.15	20.64	1.51	22.15	0.17	0.02	0.19	41.66	3.02	44.68
Civilian Prop	21.84	3.07	24.91	22.19	2.72	24.91	6.02	0.46	6.48	56.07	6.71	62.78
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	0.05	-	0.05	0.05	-	0.05	0.02	-	0.02	0.14	-	0.14
Military Prop	0.25	<0.01	0.25	0.25	<0.01	0.25	0.12	0.02	0.14	0.74	0.04	0.78
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**161.49**	**16.57**	**178.06**	**158.27**	**19.79**	**178.06**	**6.33**	**0.50**	**6.83**	**332.42**	**37.36**	**369.78**

Note: Each circuit operation counted as two operations in Total Operations

F.19.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	132.10	13.37	145.47	128.19	17.28	145.47	-	-	-	260.29	30.65	290.94
Civilian Jet, Other	22.73	1.61	24.34	22.68	1.66	24.34	0.16	0.02	0.18	45.57	3.29	48.86
Civilian Prop	24.10	3.39	27.49	24.48	3.00	27.48	5.36	0.41	5.77	53.94	6.80	60.74
Civilian Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Fighter	-	-	-	-	-	-	-	-	-	-	-	-
Military Jet, Other	0.05	-	0.05	0.05	-	0.05	0.01	-	0.01	0.11	-	0.11
Military Prop	0.27	<0.01	0.27	0.27	<0.01	0.27	0.07	0.01	0.08	0.61	0.01	0.62
Military Rotorcraft	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**179.25**	**18.37**	**197.62**	**175.67**	**21.94**	**197.61**	**5.60**	**0.44**	**6.04**	**360.52**	**40.75**	**401.27**

Note: Each circuit operation counted as two operations in Total Operations

F.19.4 Modeled Tracks

RNAV procedures:

- 0 STAR (Arrival) RNAV procedures
- 4 RNAV RNP procedures (runways 12L, 12R, 30L, and 30R)
- 6 RNAV GPS procedures (All runways)
- 0 RNAV SID (Departure) procedures

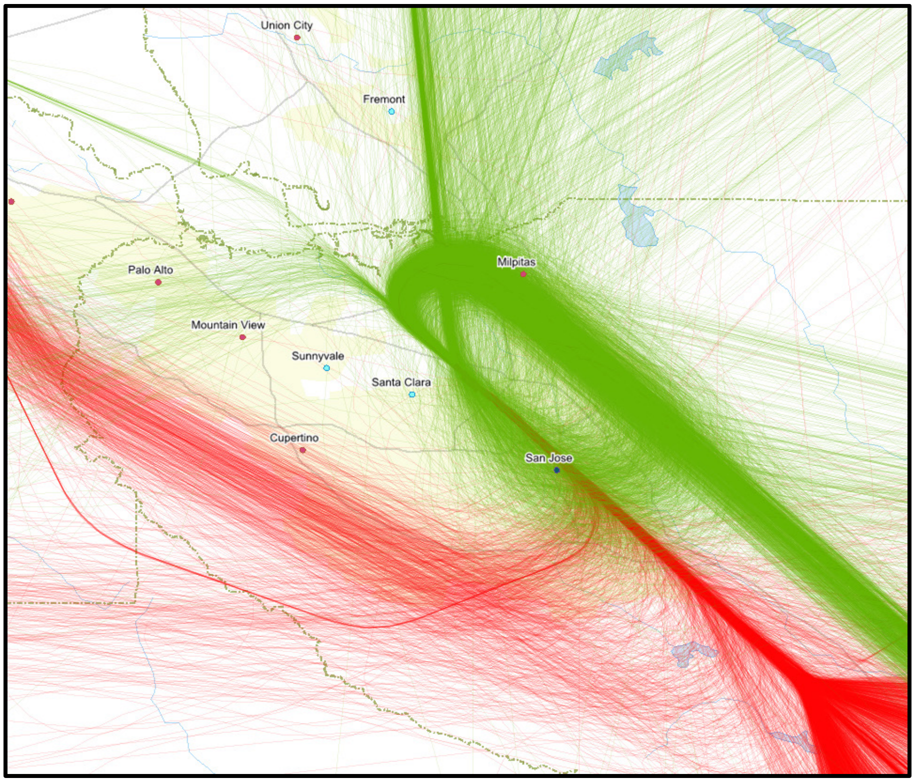
Total Tracks:

	Arrivals		Departures		Locals	
Aircraft Category	**East**	**West**	**East**	**West**	**East**	**West**
Jets	5,926	49,577	6,369	48,393	8	38
Non-Jets, fixed-wing	897	7,881	814	8,130	172	1,262
Total	6,823	57,458	7,183	56,523	180	1,300

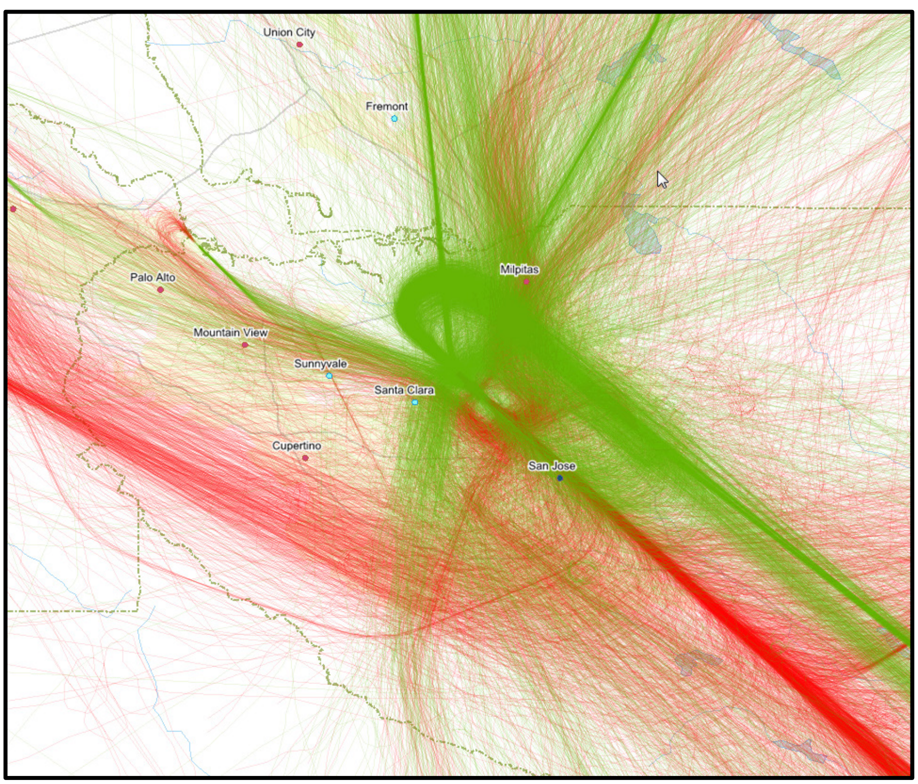
	Total			Percent	
Aircraft Category	**East**	**West**	**Total**	**East**	**West**
Jets	12,303	98,008	110,311	11%	89%
Non-Jets, fixed-wing	1,883	17,273	19,156	10%	90%
Helicopters	n/a	n/a	-	n/a	n/a
Total	14,186	115,281	129,467	11%	89%

F.19.5 Representative Radar Flight Tracks

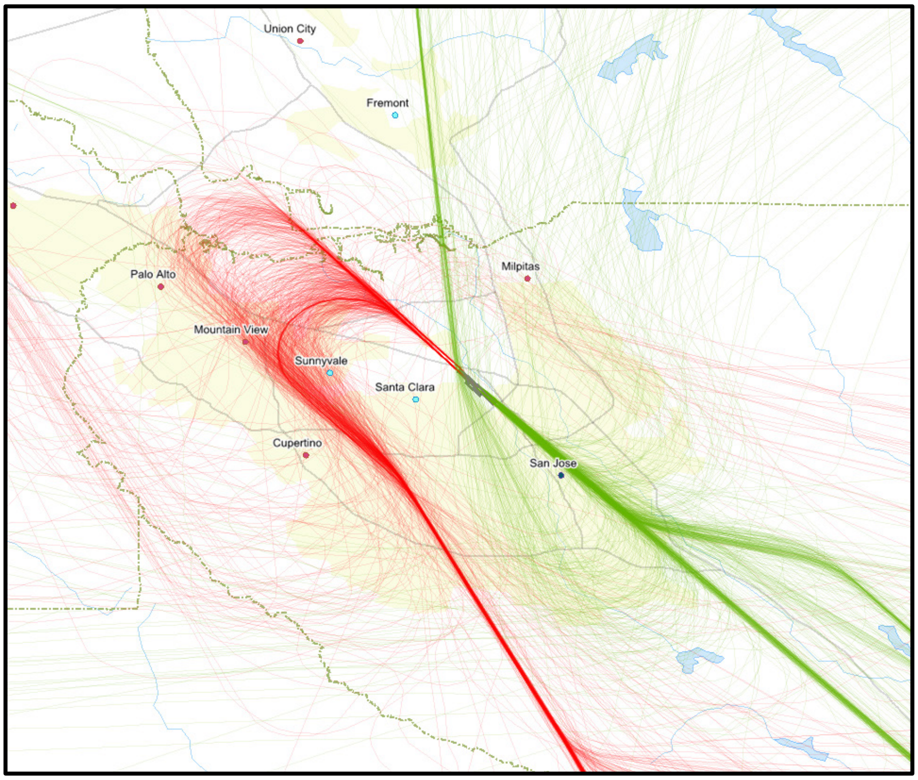
West Flow, Jets – 10% Sample



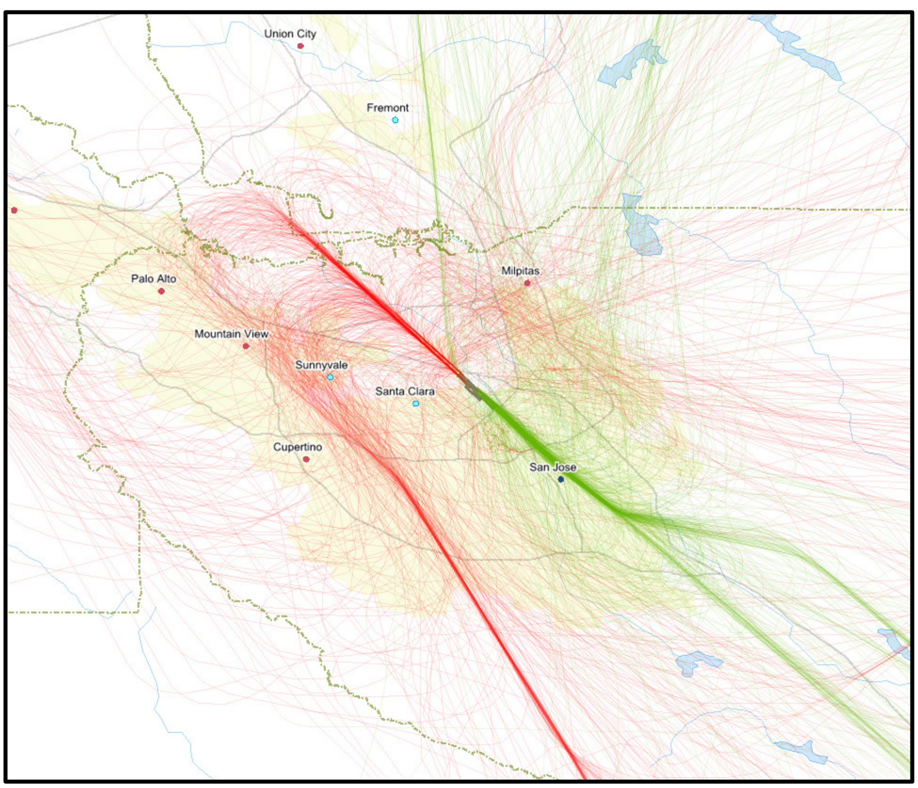
Non-Jets – 60% Sample



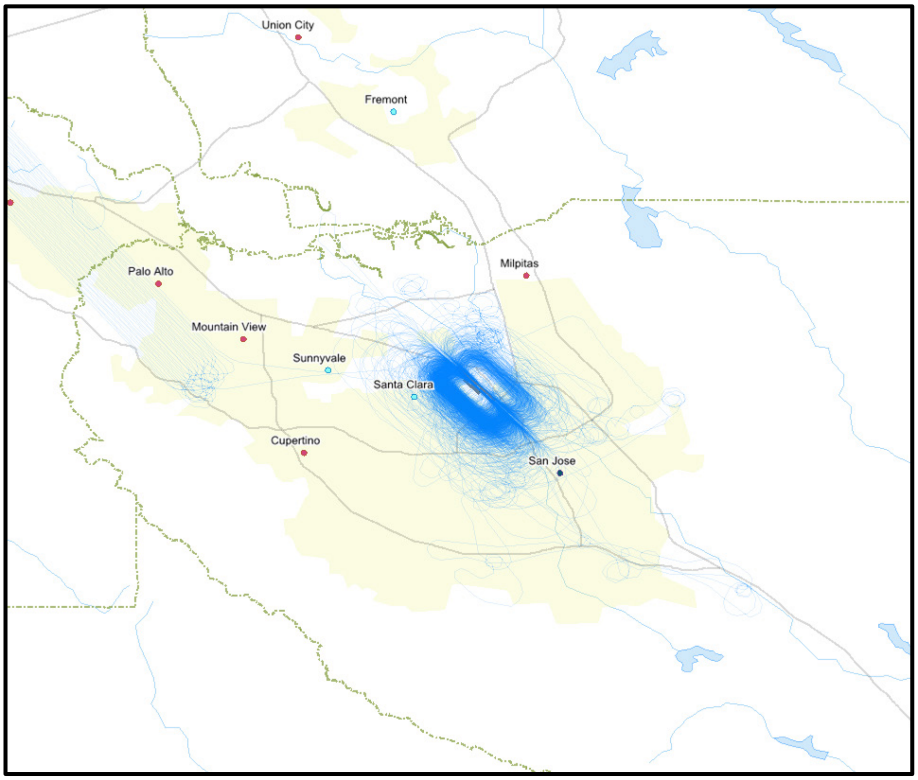
East Flow, Jets – 10% Sample



Non-Jets – 60% Sample



Local operations – 100% Sample



F.20 Syracuse Hancock Intl, SYR

Airport: Syracuse Hancock International Airport
City: Syracuse, NY
Runways: 2
Helipads: 1
Elevation: 421 feet MSL

Local Operation Notes: Circuits modeled at 1,000 feet AFE and 2,600 feet AFE. Split tracks were mostly helicopters and counted as non-local operations. Local tracks with their longest level segment at 2,100 feet MSL or below used the 1,000 feet AFE profile. All other circuit operations used the 2,600 feet AFE profile. Circuit tracks with a maximum range of greater than 25 nautical miles or a maximum altitude greater than 4,200 feet MSL were removed from modeling.

Helicopter Notes: A moderate number of operations, about 3 percent of total daily operations. Mostly general aviation or air taxi. Variety of INM types. None counted as local operations.

Other Notes: Mostly commercial jet operations.

F.20.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
10	43.108200	-76.126153	419	150	9,003	0	3
15	43.121227	-76.112834	415	150	7,500	0	3
28	43.109308	-76.092475	400	150	9,003	0	3
33	43.106975	-76.092577	402	150	7,500	0	3
H1	43.107803	-76.111619	414	n/a	n/a	n/a	n/a

F.20.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.20.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	18,605	27,762	12,989	1,039	5,532	322	66,249	365
ATADS for Data Days	18,513	27,646	12,938	1,034	5,532	322	65,985	363
Database	17,696	26,875	9,673	294	966	252	55,756	363
Scale Factor	104.6%	102.9%	133.8%	351.7%	572.7%	127.8%	118.3%	n/a

F.20.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	20,635	22,464	13,239	1,061	3,487	341	61,227	365
Database	17,696	26,875	9,673	294	966	252	55,756	363
Scale Factor	116.6%	83.6%	136.9%	360.9%	361.0%	135.3%	109.8%	n/a

F.20.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.20.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	34.13	10.94	45.07	37.51	7.56	45.07	0.06	-	0.06	71.76	18.50	90.26
Civilian Jet, Other	3.66	0.34	4.00	3.73	0.28	4.01	0.25	-	0.25	7.89	0.62	8.51
Civilian Prop	25.68	4.61	30.29	26.46	3.83	30.29	6.88	0.43	7.31	65.90	9.30	75.20
Civilian Rotorcraft	1.86	0.18	2.04	1.89	0.15	2.04	-	-	-	3.75	0.33	4.08
Military Jet, Fighter	0.03	0.01	0.04	0.04	-	0.04	-	-	-	0.07	0.01	0.08
Military Jet, Other	0.24	-	0.24	0.21	0.03	0.24	0.25	0.07	0.32	0.95	0.17	1.12
Military Prop	0.59	0.02	0.61	0.60	0.01	0.61	0.12	0.01	0.13	1.43	0.05	1.48
Military Rotorcraft	0.53	0.02	0.55	0.49	0.05	0.54	-	-	-	1.02	0.07	1.09
TOTAL	**66.72**	**16.12**	**82.84**	**70.93**	**11.91**	**82.84**	**7.56**	**0.51**	**8.07**	**152.77**	**29.05**	**181.82**

Note: Each circuit operation counted as two operations in Total Operations

F.20.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	32.44	11.57	44.01	36.18	7.82	44.00	0.07	-	0.07	68.69	19.39	88.08
Civilian Jet, Other	3.75	0.35	4.10	3.81	0.29	4.10	0.10	-	0.10	7.66	0.64	8.30
Civilian Prop	23.63	3.91	27.54	24.24	3.30	27.54	4.37	0.27	4.64	52.24	7.48	59.72
Civilian Rotorcraft	1.78	0.17	1.95	1.80	0.15	1.95	-	-	-	3.58	0.32	3.90
Military Jet, Fighter	0.03	0.01	0.04	0.04	-	0.04	-	-	-	0.07	0.01	0.08
Military Jet, Other	0.24	-	0.24	0.21	0.03	0.24	0.09	0.03	0.12	0.54	0.06	0.60
Military Prop	0.60	0.02	0.62	0.61	0.01	0.62	0.30	0.05	0.35	1.51	0.08	1.59
Military Rotorcraft	0.54	0.02	0.56	0.51	0.05	0.56	-	-	-	1.05	0.07	1.12
TOTAL	**63.01**	**16.05**	**79.06**	**67.40**	**11.65**	**79.05**	**4.93**	**0.35**	**5.28**	**135.34**	**28.05**	**163.39**

Note: Each circuit operation counted as two operations in Total Operations

F.20.4 Modeled Tracks

RNAV procedures:

- 0 STAR (Arrival) RNAV procedure
- 0 RNAV RNP procedures
- 4 RNAV GPS procedures (one for each runway)
- 0 RNAV SID (Departure) procedures

Total Tracks:

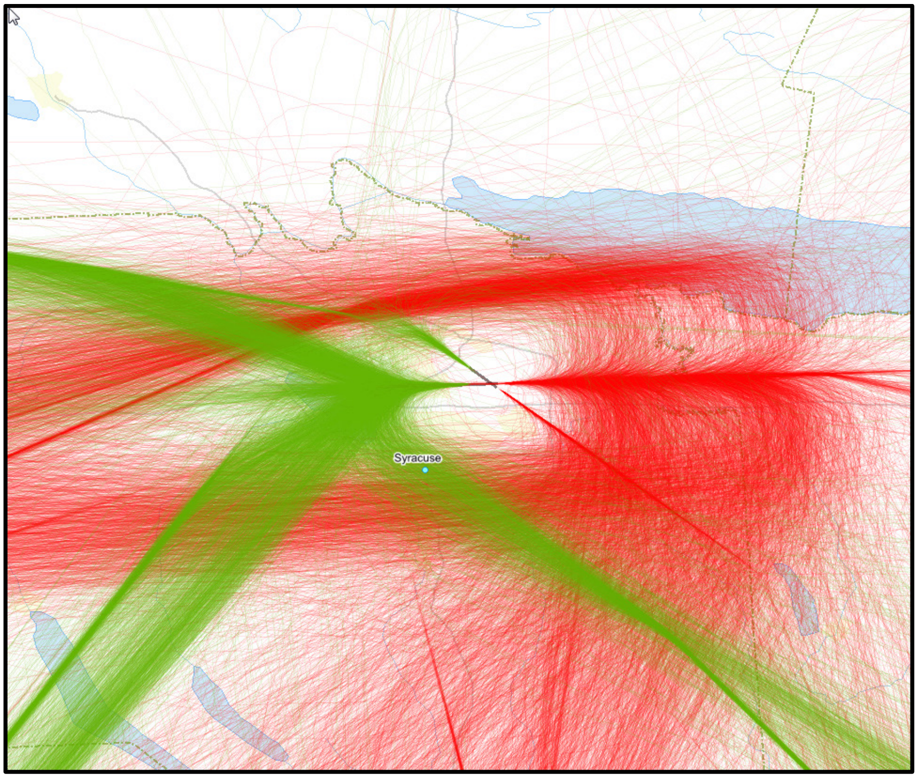
Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	6,519	10,530	6,666	10,228	23	88
Non-Jets, fixed-wing	3,523	6,222	3,916	5,742	170	329
Total	10,042	16,752	10,582	15,970	193	417

Aircraft Category	Arrivals	Departures	Locals
Helicopters	609	583	-

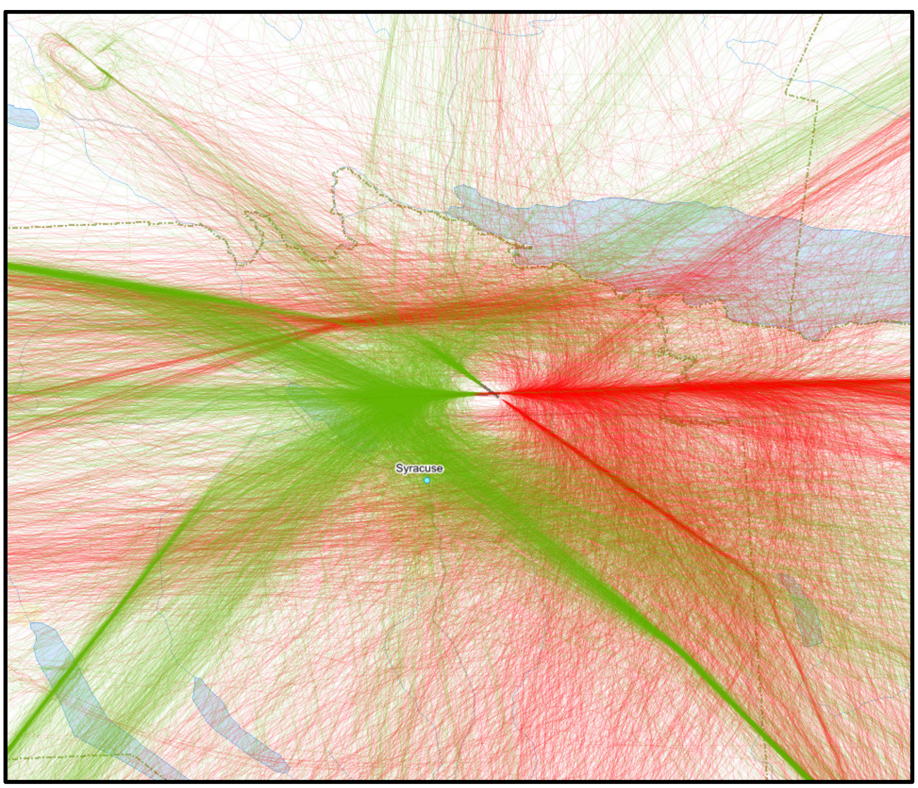
Aircraft Category	Total			Percent	
	East	West	Total	East	West
Jets	13,208	20,846	34,054	39%	61%
Non-Jets, fixed-wing	7,609	12,293	19,902	38%	62%
Helicopters	n/a	n/a	1,192	n/a	n/a
Total	20,817	33,139	55,148	39%	61%

F.20.5 Representative Radar Flight Tracks

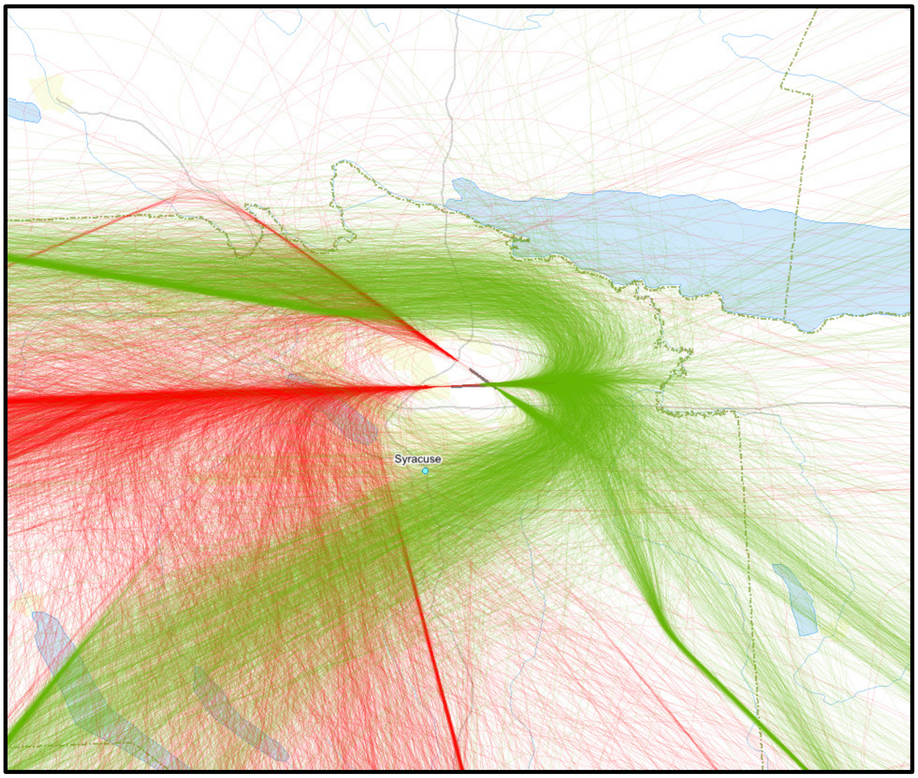
West Flow, Jets – 50% Sample



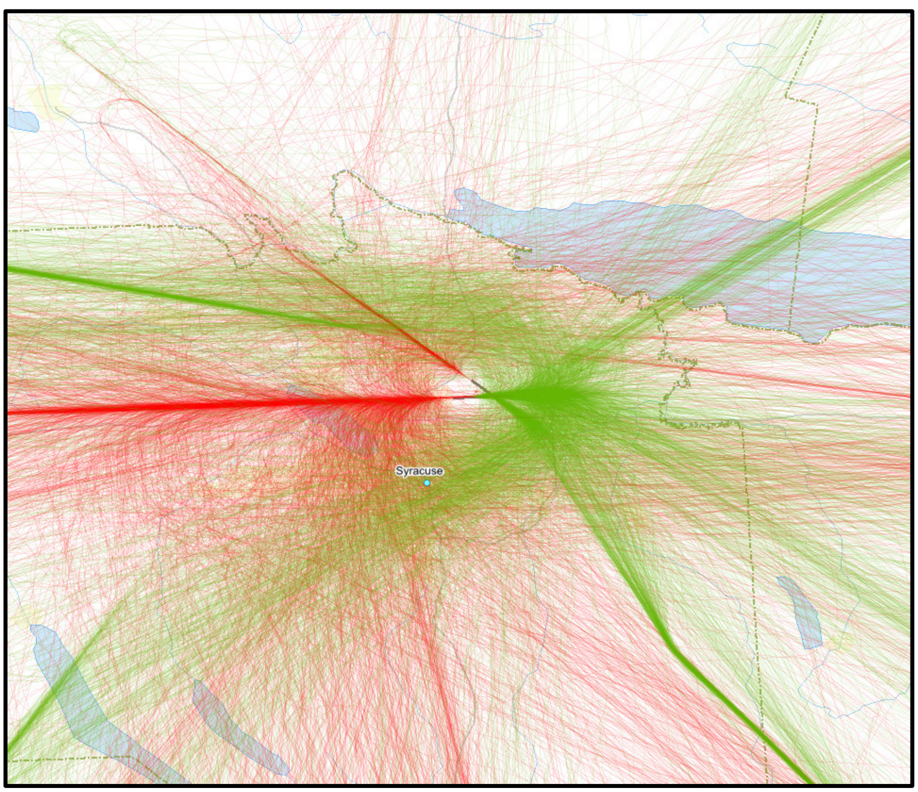
Non-Jets – 75% Sample



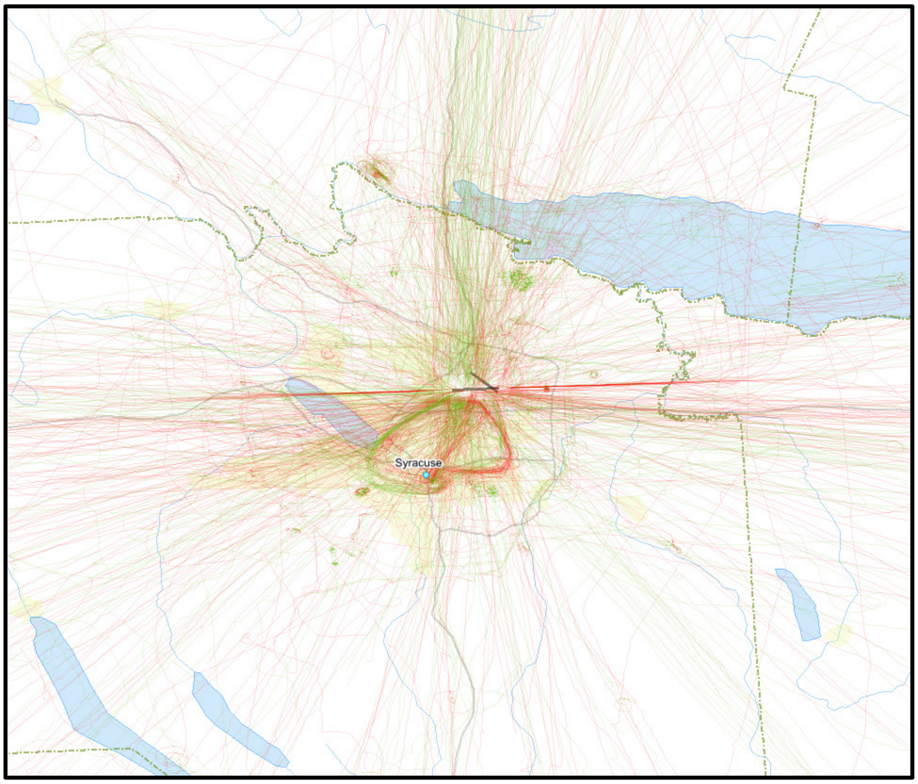
East Flow, Jets – 50% Sample



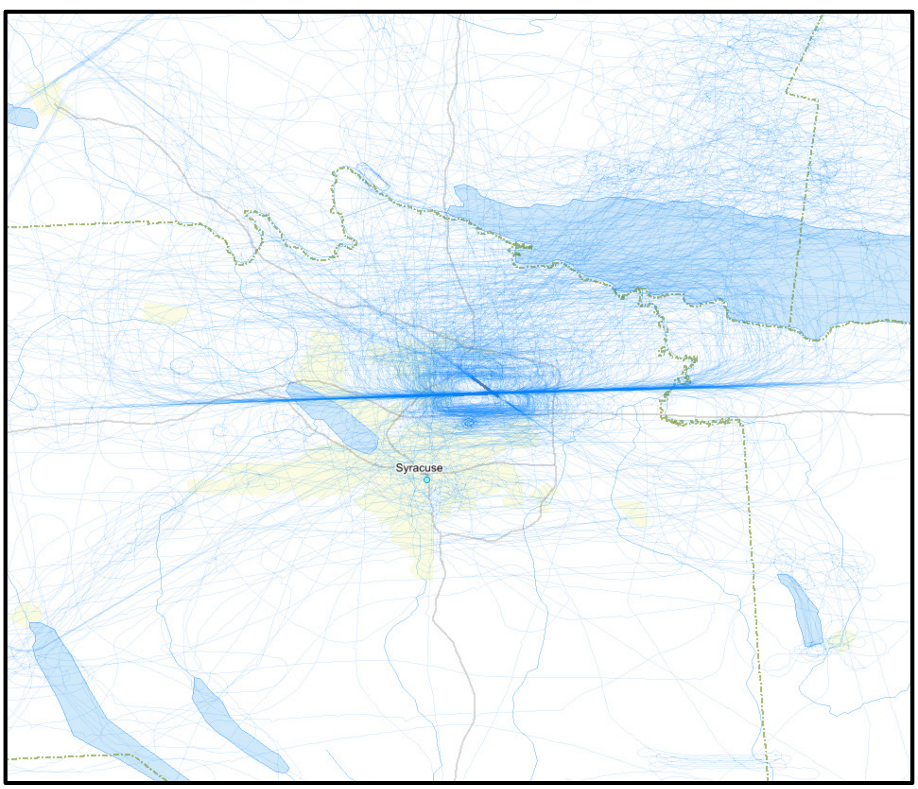
Non-Jets – 33% Sample



Helicopters 100% Sample



Local 100% Sample



F.21 Tucson Intl, TUS

Airport: Tucson International Airport
City: Tucson, AZ
Runways: 3
Helipads: 1
Elevation: 2,643 feet MSL

Local Operation Notes: Circuits modeled at 1,400 feet AFE. Local tracks with their longest level segment at or above 5,000 feet MSL were removed from the modeling. Split military tracks counted as local operations. Other split tracks counted as itinerant operations as long as their maximum range was at least 7 nautical miles from the airport center. There were a large number of military fighters split tracks counted as local.

Helicopter Notes: A large number of operations, about 5 percent of total daily operations. Mostly small non-military operations. None counted as local operations.

Other Notes: Relatively high number of non-jet operations. Very high number of military fighter operations.

F.21.1 Runway Coordinates

Runway Or Pad	Latitude (Degrees)	Longitude (Degrees)	Elevation (feet MSL)	Width (feet)	Length (feet)	Displaced Threshold (feet)	Glide Slope (degrees)
03	32.117167	-110.95904	2561	150	7,000	850	3
11L	32.123370	-110.94791	2578	150	10,996	0	3
11R	32.122103	-110.94965	2574	75	8,408	1,410	3
21	32.130761	-110.94304	2569	150	7,000	0	3
29L	32.105756	-110.93046	2629	75	8,408	0	3
29R	32.101990	-110.92282	2643	150	10,996	0	3
H1	32.130655	-110.94074	2571	n/a	n/a	n/a	n/a

F.21.2 ATADS and Radar Flight Track Data Operations (Annual) Summary

F.21.2.1 2012-2013

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	32,219	20,314	40,820	14,928	22,861	9,514	140,656	365
ATADS for Data Days	31,814	20,079	40,233	14,867	22,507	9,508	139,008	360
Database	31,278	20,148	26,335	9,407	9,900	1,253	98,321	360
Scale Factor	101.7%	99.7%	152.8%	158.0%	227.3%	758.8%	141.4%	n/a

F.21.2.2 2015

Data Parameter	Air Carrier	Air Taxi	General Aviation	Military	Local Civil	Local Military	Total Ops	Days of Data
ATADS	28,979	19,936	39,282	18,552	26,926	9,760	143,435	365
Database	31,278	20,148	26,335	9,407	9,900	1,253	98,321*	360
Scale Factor	92.6%	98.9%	149.2%	197.2%	272.0%	778.9%	145.9%	n/a

* 7 fewer military jet (non-fighter) operations modeled due to processing error; Affected overall DNL by less than 0.0005 dB (estimated).

F.21.3 Modeled Annual Average Daily Number of Flight Events and Operations

F.21.3.1 2012-2013

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	51.76	9.49	61.25	51.57	9.68	61.25	0.08	0.01	0.09	103.49	19.19	122.68
Civilian Jet, Other	13.60	0.68	14.28	13.49	0.79	14.28	0.21	0.01	0.22	27.51	1.49	29.00
Civilian Prop	40.98	1.97	42.95	39.82	3.12	42.94	28.24	2.72	30.96	137.28	10.53	147.81
Civilian Rotorcraft	6.58	2.90	9.48	6.66	2.82	9.48	-	-	-	13.24	5.72	18.96
Military Jet, Fighter	18.12	0.07	18.19	18.18	-	18.18	9.92	-	9.92	56.14	0.07	56.21
Military Jet, Other	0.52	<0.01	0.52	0.53	-	0.53	2.38	-	2.38	5.81	-	5.81
Military Prop	1.18	0.20	1.38	1.15	0.23	1.38	0.76	0.15	0.91	3.85	0.73	4.58
Military Rotorcraft	0.51	0.05	0.56	0.56	0.01	0.57	-	-	-	1.07	0.06	1.13
TOTAL	**133.25**	**15.36**	**148.61**	**131.96**	**16.65**	**148.61**	**41.59**	**2.89**	**44.48**	**348.39**	**37.79**	**386.18**

Note: Each circuit operation counted as two operations in Total Operations

F.21.3.2 2015

Aircraft Group	Arrivals			Departures			Circuits			Total Operations		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Commercial Jet	48.42	8.77	57.19	48.18	9.02	57.20	0.09	0.01	0.10	96.69	17.80	114.49
Civilian Jet, Other	13.28	0.66	13.94	13.17	0.77	13.94	0.25	0.02	0.27	26.70	1.45	28.15
Civilian Prop	40.06	1.93	41.99	38.93	3.05	41.98	33.77	3.26	37.03	112.76	8.24	121.00
Civilian Rotorcraft	6.50	2.88	9.38	6.58	2.80	9.38	-	-	-	13.08	5.68	18.76
Military Jet, Fighter	22.61	0.08	22.69	22.69	-	22.69	10.18	-	10.18	55.48	0.08	55.56
Military Jet, Other	0.65	<0.01	0.65	0.66	-	0.66	2.45	-	2.45	3.76	-	3.76
Military Prop	1.47	0.24	1.71	1.43	0.28	1.71	0.78	0.15	0.93	3.68	0.67	4.35
Military Rotorcraft	0.64	0.06	0.70	0.69	0.01	0.70	-	-	-	1.33	0.07	1.40
TOTAL	**133.63**	**14.62**	**148.25**	**132.33**	**15.93**	**148.26**	**47.52**	**3.44**	**50.96**	**313.48**	**33.99**	**347.47**

Note: Each circuit operation counted as two operations in Total Operations

F.21.4 Special KC135 Considerations

In INM, the KC135R has only one takeoff weight and it causes the aircraft to overrun TUS's runway by thousands of feet. To avoid the overrun, the weight was reduced. As a KC135R is a derivative of a Boeing 707, the reduction in weight was based on INM's 707320 profile weights:

707320 - Max Take-off Weight= 334000

Stage 1 weight – 214000 (64.1% of Max TOW)
Stage 2 weight – 228000 (68.3% of Max TOW)
Stage 3 weight – 240000 (71.9% of Max TOW)
Stage 4 weight – 260000 (77.8% of Max TOW)

(There are stages 5, 6, and 7 but not needed for ABQ)

KC135R- Max Take-off Weight= 324000

Stage 1 weight – 208000 (64.2% of Max TOW)
Stage 2 weight – 221000 (68.2% of Max TOW)
Stage 3 weight – 233000 (71.9% of Max TOW)
Stage 4 weight – 252000 (77.8% of Max TOW)

Stage 1 weight was also used for circuit profile.

F.21.5 Modeled Tracks

RNAV procedures:

- 1 STAR (Arrival) RNAV procedure
- 2 RNAV RNP procedures (runways 11L and 29R)
- 6 RNAV GPS procedures (all runways)
- 2 RNAV SID (Departure) procedures

Total Tracks:

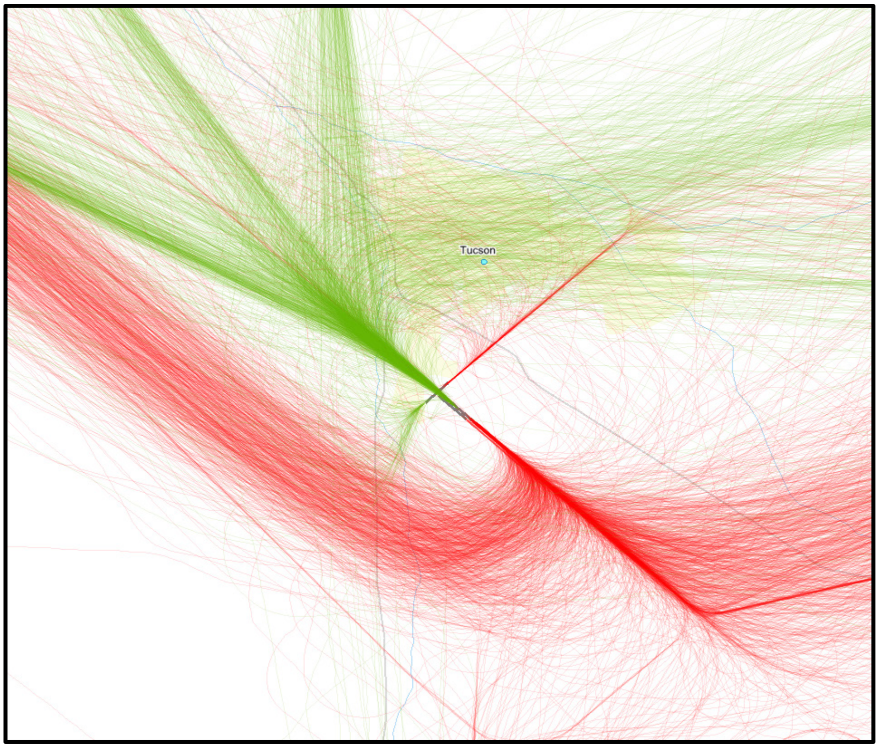
Aircraft Category	Arrivals		Departures		Locals	
	East	West	East	West	East	West
Jets	22,385	8,503	23,087	6,583	58	16
Non-Jets, fixed-wing	7,943	3,823	6,283	4,266	3,818	615
Total	30,328	12,326	29,370	10,849	3,876	631

Aircraft Category	Arrivals	Departures	Locals
Helicopters	3,138	3,256	-

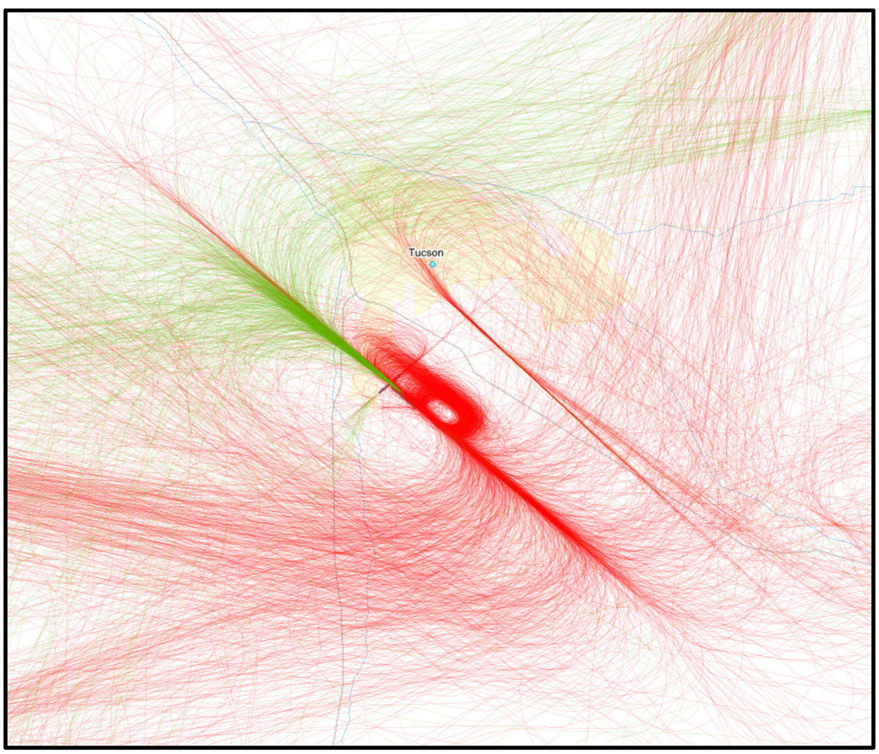
Aircraft Category	Total			Percent	
	East	West	Total	East	West
Jets	45,530	15,102	60,632	75%	25%
Non-Jets, fixed-wing	18,044	8,704	26,748	67%	33%
Helicopters	n/a	n/a	6,394	n/a	n/a
Total	63,574	23,806	93,774	73%	27%

F.21.6 Representative Radar Flight Tracks

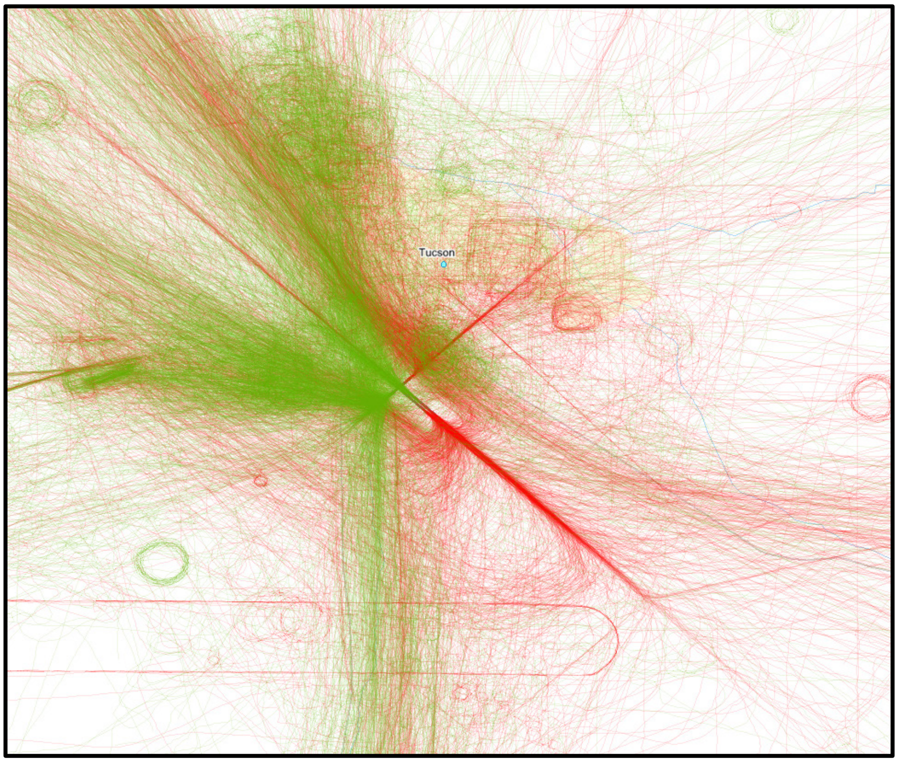
West Flow, Non-Military Jets – 25% Sample



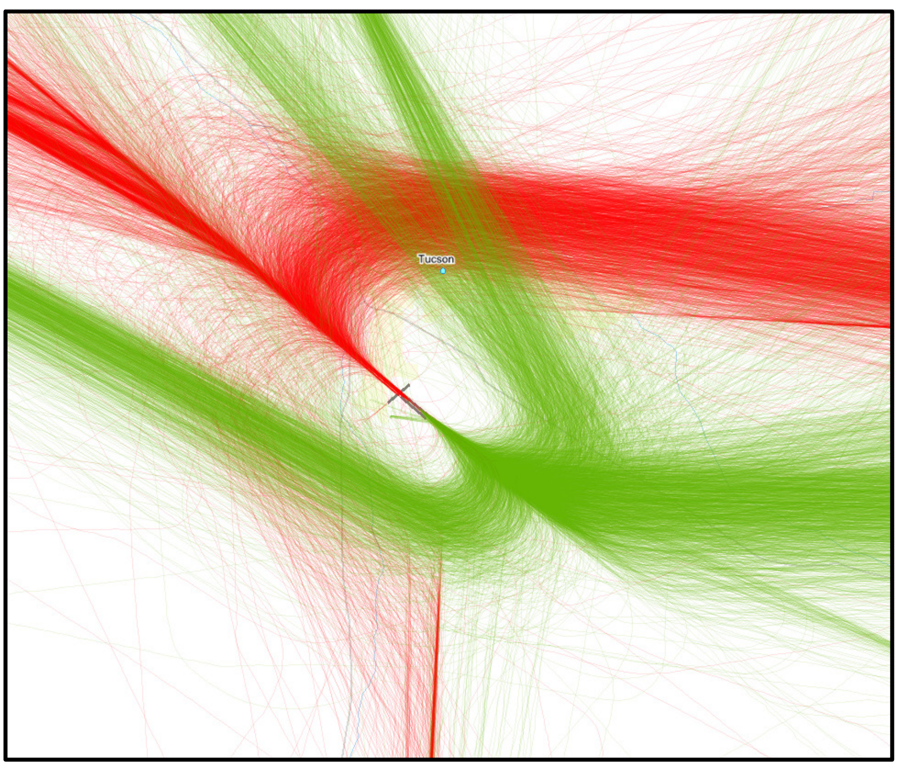
Military Jets – 100% Sample



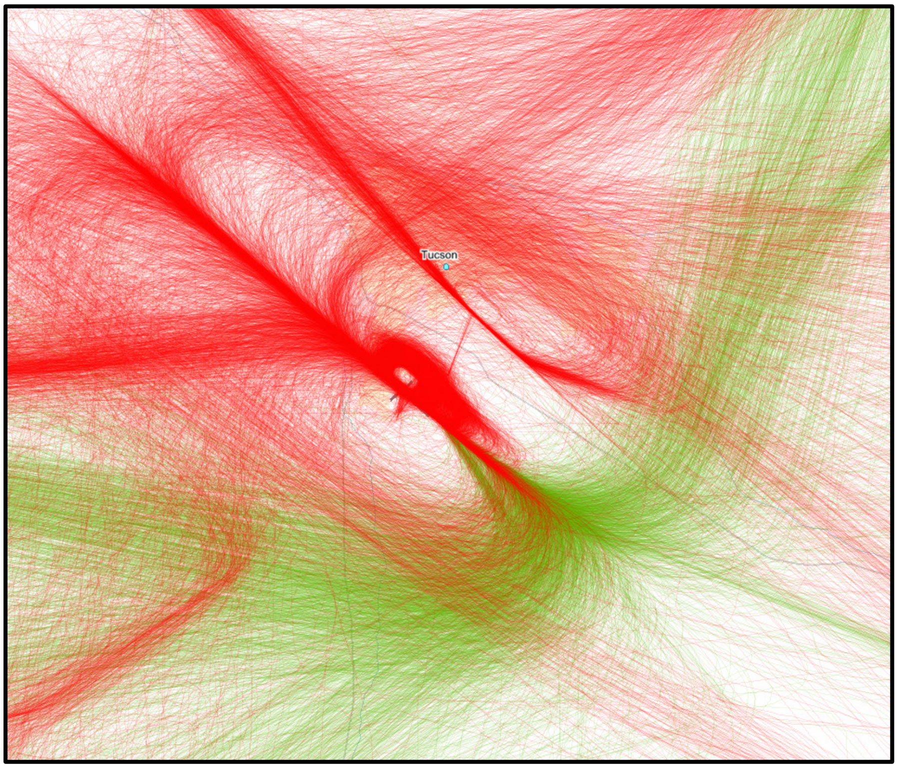
West Flow, Non-Jets – 50% Sample



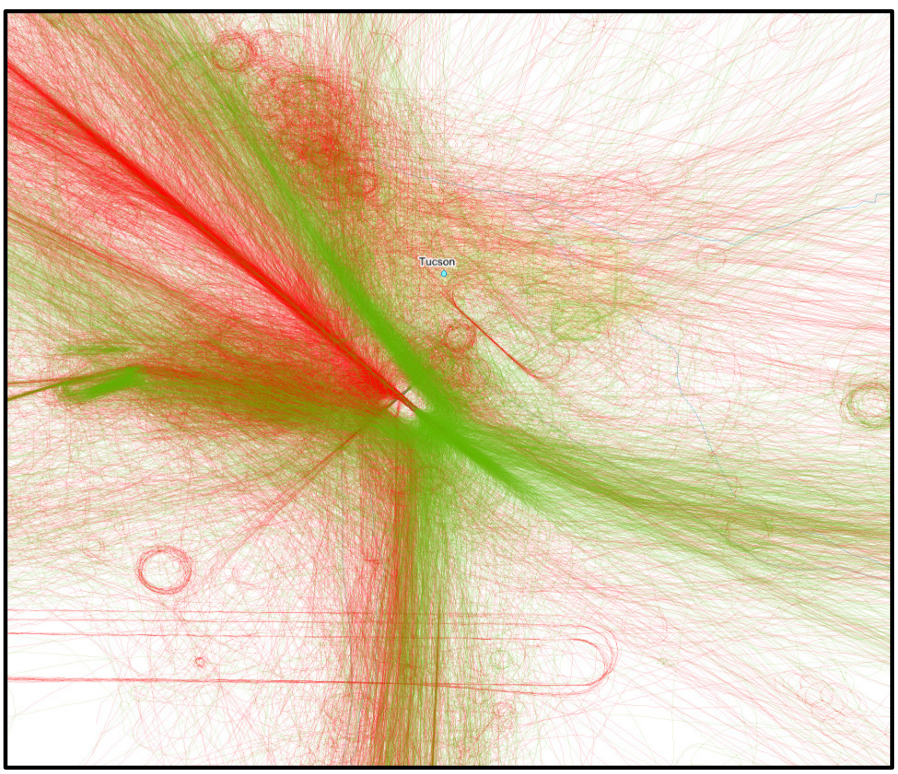
East Flow, Non-Military Jets – 25% Sample



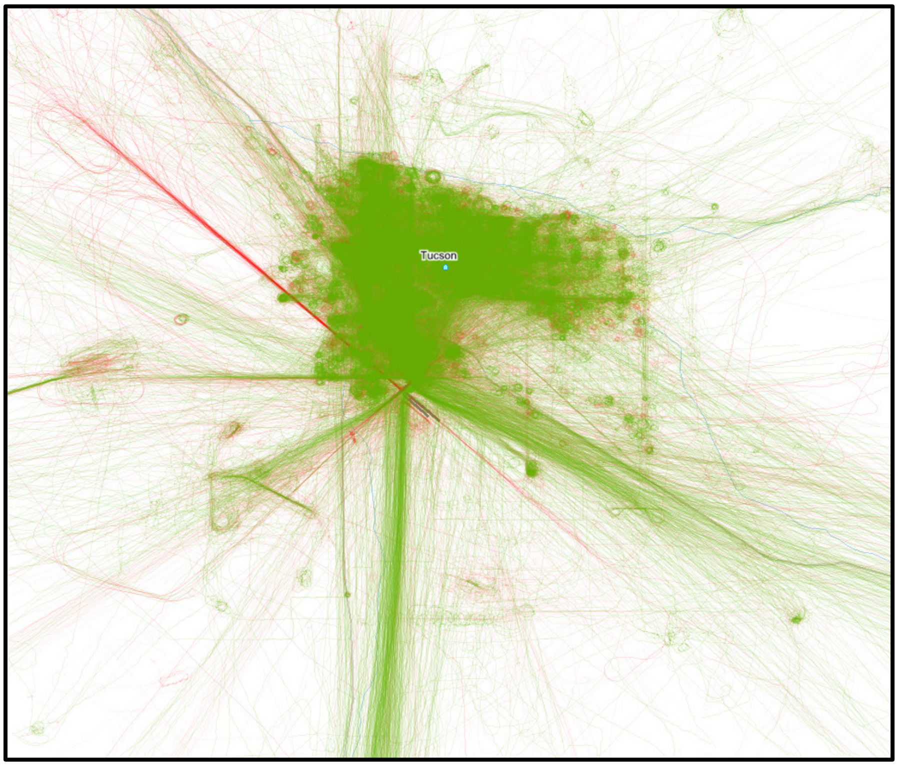
Military Jets – 100% Sample



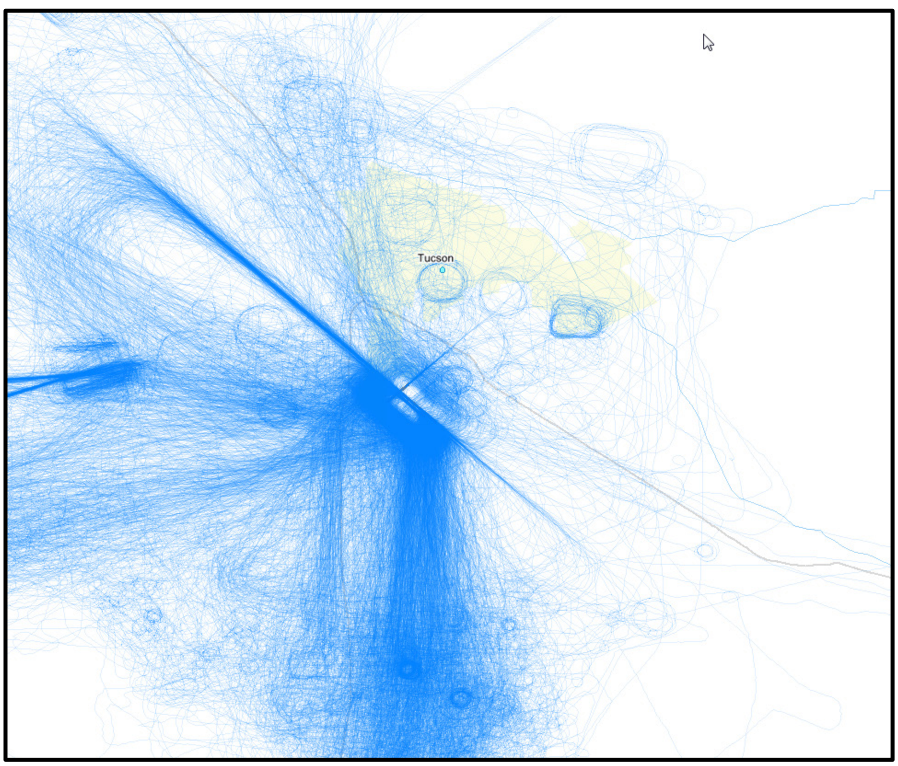
East Flow, Non-Jets – 50% Sample



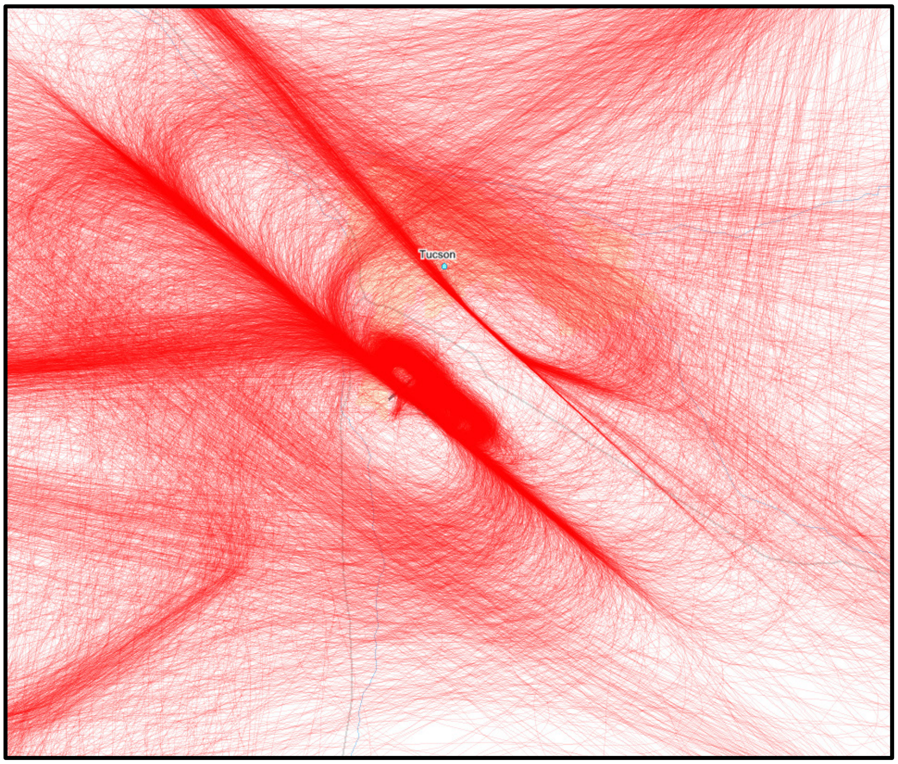
Helicopters 100% Sample



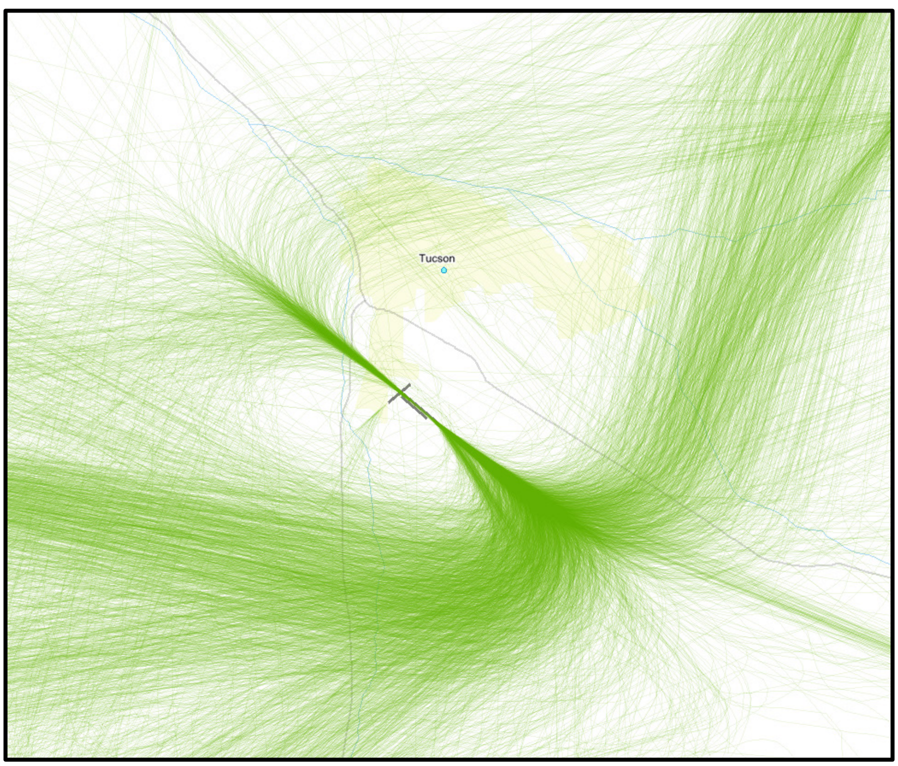
Local 100% Sample



F16 Aircraft – 100% Sample - Arrivals



F16 Aircraft – 100% Sample - Departures



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Analysis of the Neighborhood Environmental Survey

Volume 4 of 4: Appendices G through J

Contracts DTFACT-15-D-00008 and DTFACT-15-D-00007

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Appendix G Sensitivity Analyses for Regression Models

The confidence bands for each dose-response curve are computed from the estimated covariance matrix of the estimated slope and intercept, under the following assumptions:

A. The form of the two-parameter logistic model described in Equation (8.1) and Appendix H accurately describes the relationship between DNL and the probability of being highly annoyed. The model in Equation (8.1), with a positive slope, forces the predicted percent HA to increase as DNL increases. This assumption would be violated if the actual curve had a different form, for example, if the percent HA increased with DNL up to DNL 65 dB and decreased thereafter.

B. The curve and variability measures are calculated using the respondents to the survey. The confidence bands are computed under the assumption that respondents and nonrespondents have the same relationship between noise exposure and annoyance, and do not account for possible differences between respondents and nonrespondents to the survey.

C. Observations within the same airport are sampled independently. This assumption is met through the sampling design.

D. The values of HA and DNL for each respondent are accurate measures. These assumptions require external validation and cannot be assessed from the survey data alone. The validity of the questionnaire for determining the annoyance of the respondent was established through in the ACRP pilot study 02-35 (Miller, et al. 2014a), as discussed in Chapter 2. The validity of the DNL values depend on the quality procedures for the noise calculations and could be assessed by an independent confirmation of the DNL values at the geolocations of the survey respondents.

This appendix contains the results of the sensitivity analyses that were performed to assess assumptions (A) and (B). The first two sections fit expanded models that include the model in Equation (8.1) as a special case in order to assess the appropriateness of the model in Equation (8.1). Appendix E presents the results of a nonresponse bias analysis; Section G.3 repeats the model-fitting using a set of nonresponse-adjusted weights, and it is found that these nonresponse adjustments do not change the national curve. Finally, Section G.4 fits an alternative model from Fidell et al. (2011) to the data, as requested by the FAA.

G.1 Assessing Model Fit for the Individual Airport Dose-Response Curves

The sensitivity analyses for assessing the fit of the two-parameter logistic regression curve to individual airports included fitting expanded models that contained the model in Equation (8.1) as a special case and conducting hypothesis tests for lack of fit. The sensitivity analyses showed that the model in Equation (8.1) fits most of the individual airports well, although there are indications that BFI, LAS, LIT, and ORD may have some features in specific noise exposure ranges that deviate from the sigmoidal shape of the logistic regression function. As with the national curve, there were few, if any, observations for most airports above DNL 70 dB, and caution should be used when predicting percent HA from the curves in higher noise ranges.

One standard statistical approach for assessing the fit of a model is to embed it in a larger model and then perform a statistical test of whether the additional terms in the larger model equal zero. The logistic regression model in Equations (H.1) and (H.2) assumes that annoyance always increases with higher noise exposures. It is possible, however, that in an individual airport annoyance might be lower in the 70-75 dB range of DNL than in the 65-70 dB range: A larger model that allows assessment of whether the two-parameter logistic model adequately describes the relationship between DNL and HA includes additional quadratic and cubic terms[1] in the regression model. The cubic polynomial model is expressed using the form of the model in Equation (H.2):

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 DNL + \beta_2 DNL^2 + \beta_3 DNL^3, \quad \text{(G.1)}$$

When the coefficients β_2 and β_3 equal zero, the model in Equation (G.1) reduces to that in Equation (H.2).

Table G-1 presents the Wald chi-squared test statistic and p-value for the test of the null hypothesis that $\beta_2 = \beta_3 = 0$. For this test, a small p-value (less than 0.05) means that at least one of the coefficients β_2 or β_3 is statistically significantly different from zero. A large p-value means that there is no reason to doubt the adequacy of the two-parameter model in Equation (8.1). Table G-1 also presents the Hosmer-Lemeshow (2000) goodness-of-fit test statistic and p-value for each airport. For the Hosmer-Lemeshow test, a small p-value indicates statistically significant lack of fit; a large p-value gives no reason to doubt the adequacy of the model in Equation (8.1).

Table G-1. Statistical tests for quadratic and cubic terms, and for lack of fit, in individual airport models.

Airport Identifier	Wald Chi-squared Test Statistic	Wald Test p-value	Hosmer-Lemeshow Test Statistic	Hosmer-Lemeshow p-value
ABQ	0.1397	0.9325	4.5655	0.8028
ALB	0.7226	0.6968	10.9874	0.2024
ATL	1.6731	0.4332	8.8591	0.3543
AUS	0.1038	0.9494	2.6546	0.9541
BDL	3.5830	0.1667	11.2858	0.1860
BFI	9.0648	0.0108	8.4722	0.3888
BIL	0.0286	0.9858	3.2748	0.9159
DSM	3.6523	0.1610	9.3598	0.3129
DTW	2.3961	0.3018	4.5570	0.8037
LAS	12.6859	0.0018	10.5022	0.2315
LAX	1.6698	0.4339	6.8362	0.5544
LGA	1.1608	0.5597	9.6040	0.2939
LIT	6.3360	0.0421	6.2035	0.6245
MEM	4.0553	0.1316	8.8276	0.3570
MIA	0.9185	0.6318	8.3593	0.3992
ORD	10.2131	0.0061	25.9661	0.0011
SAV	4.4465	0.1083	10.1340	0.2557
SJC	2.0093	0.3662	17.5246	0.0251
SYR	5.2414	0.0728	9.6472	0.2907
TUS	3.1695	0.2050	13.0720	0.1094

Four airports (BFI, LAS, LIT, and ORD) had values for the quadratic and/or cubic terms in Equation (G.1) that were statistically significantly different from zero.[2] These results are consistent with the data plots in Appendix I.1, in which the scatter from the data points indicated that there may be a downturn in percent HA for those airports at higher noise exposures. In addition, ORD and SJC exhibited statistically significant lack of fit from the Hosmer-Lemeshow test. For SJC, note the data points in Figure I-18 are evenly scattered but not as tightly clustered about the line as for the other airports, giving rise to the large Hosmer-Lemeshow test statistic for that airport.

[1] The Stone-Weierstrass theorem (Rudin 1964, p. 150) states that any smooth curve can be well approximated by a polynomial of sufficiently large degree. Higher-order polynomial terms (beyond cubic) did not improve the model fit.

[2] Note that no adjustments for multiple testing were performed for the statistical tests presented in this section. In general, if all 20 null hypotheses for the individual airports were true, one would expect one of the tests to be declared statistically significant by chance. A Bonferroni adjustment can be performed for the tests in Table J.1, if desired, by multiplying each p-value by 20.

G.2 Assessing Model Fit for the National Dose-Response Curve

To assess assumption (A), models that were generalizations of the model in Equation (8.1) were fit to the data. The first alternative model included extra quadratic and cubic terms in the model, and fit the model from Equation (G.1) to the data from all airports combined. The jackknife (see Appendix H, Section H.3) was used to compute the covariance matrix and standard errors of the coefficients. Table G-2 gives the estimated coefficients for the cubic polynomial model.

Table G-2. Coefficients for cubic polynomial model, all airports

Coefficient	Estimate	Standard Error	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Intercept, β_0	-4.2752	23.8340	-54.1717	45.6213
DNL, β_1	-0.2964	1.1835	-2.7735	2.1807
DNL^2, β_2	0.01125	0.0195	-0.0295	0.0520
DNL^3, β_3	-0.00009	0.0001	-0.0003	0.0001

Note that the coefficients of the intercept and slope differ greatly from those in Table 8-2 because of the multicollinearity of the variables; the multicollinearity also results in much larger standard errors for all coefficients. This is a common occurrence when the independent variables in a regression model are highly correlated. The Wald test statistic for the null hypothesis H_0: $\beta_2 = \beta_3 = 0$ is Q = 27 with p-value < 0.001, indicating that the quadratic and cubic terms improve the fit of the model. This significance of the quadratic and cubic terms occurs largely because of the observations above DNL 70 dB.

An additional check of model adequacy was run by fitting a cubic spline model to the data (Eilers and Marx 1996; Breidt, Claeskens and Opsomer 2005; Breidt and Opsomer 2009; SAS Institute 2014, p. 8077). A cubic spline model divides the horizontal axis into segments, and fits a cubic regression model as in Equation (G.1) to each segment. It thus allows the data to determine the shape of the curve in each segment, and provides a method of checking assumptions about model form. When the data set is sufficiently large for the model to be fit, a cubic spline model provides a more accurate picture of the underlying curve than a cubic polynomial because the spline model is completely data-driven while the cubic polynomial model must follow that functional form. The spline model can be thought of as a smoothed method of "connecting the dots" of the data points. A cubic spline model was fit with 3 internal knots (leading to 5 segments) at equal percentiles of DNL.

Figure G-1 shows the national curve with coefficients in Table 8-2 along with the 95 percent confidence bands for that curve. It is displayed alongside the curve from Equation (G.1) with quadratic and cubic terms in DNL, and the spline model. Although the higher-order polynomial terms in the cubic polynomial model are statistically significant, for values of DNL between 50 and 70 dB, the curves fit using the two expanded models produced predictions of percent HA that were close to the predictions from the model from Equation (8.1); the curves were entirely contained within the confidence bands shown for the national curve in Figure 8-2. Above 70 dB, the two expanded models produced predictions of percent HA that were lower than the curve using the model from Equation (8.1). We recommend caution when using the national curve to predict percent HA for values of DNL above 70 dB.

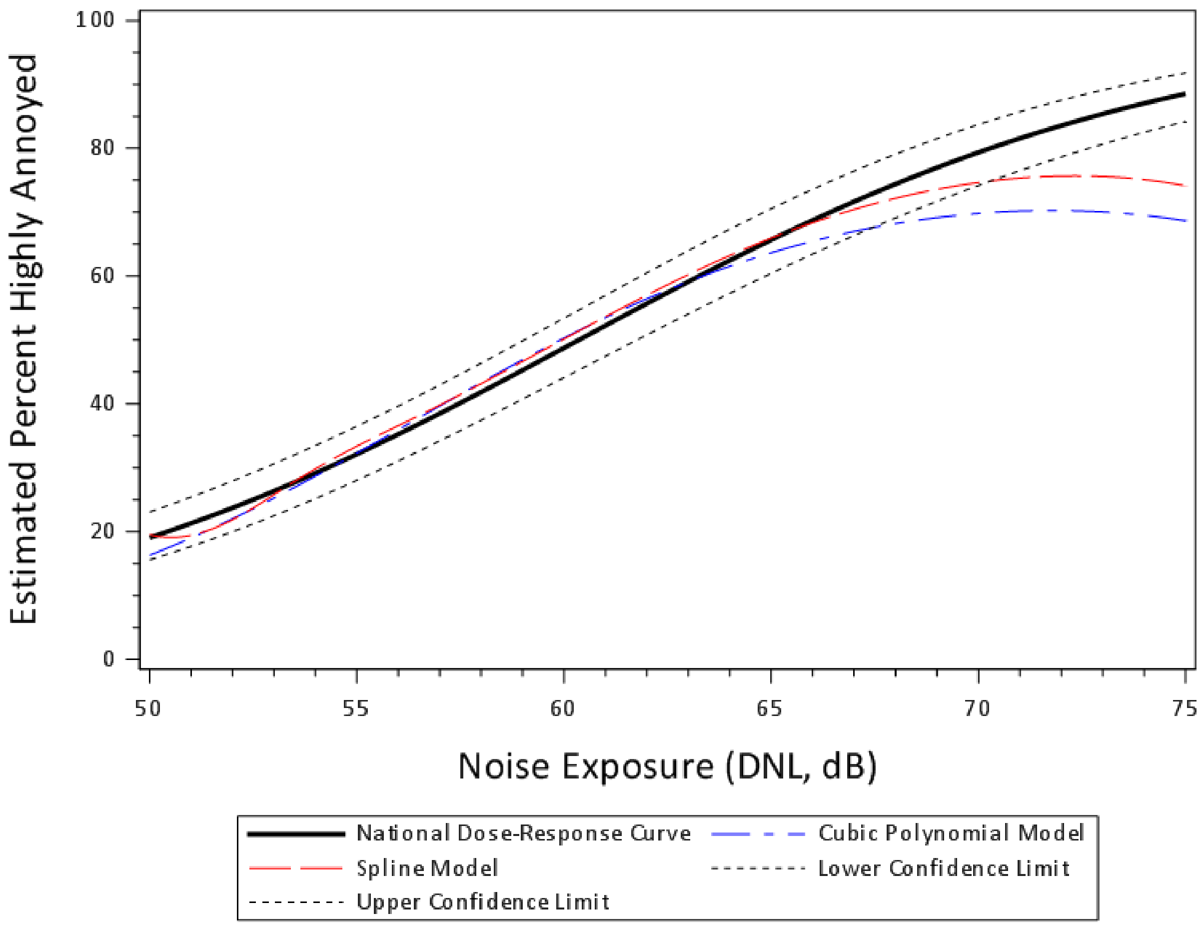

Figure G-1. Alternative Models Fit to All Airports

G.3 Fitting the Curves using Nonresponse-Adjusted Weights

For the NES, the overall response rate for the mail questionnaire was 40.3 percent. Nonresponse bias would occur if respondents and nonrespondents at the same noise exposure have different levels of annoyance. Appendix E contains the results of nonresponse bias analyses that evaluated whether the response propensity differed by characteristics known for all sampled units.

As argued in Appendix H.1, a weight of one can be used for each respondent when fitting the dose-response curves. However, there is nonresponse to the survey and it is possible that the nonresponse is related to the outcome variable (annoyance to aircraft noise). It is therefore desired to explore the effect of nonresponse-adjusted weights on the estimated dose-response.

To do an additional check on Assumption (B), weights were constructed that adjust for nonresponse (Brick 2013). Computation of nonresponse-adjusted weights started with an initial weight of one for each respondent. Separately for each airport, regression tree models (Hothorn, Hornik & Zeilus 2006; Lohr, Hsu & Montaquila 2015; Earp, Toth & Oslund 2016) were fit to the observations in the selected sample. The models predicted whether each eligible sampled address was a respondent based on information known for both respondents and nonrespondents, using the variables in Table D-1. The predicted probability of responding to the survey was calculated from the model for each respondent and the nonresponse-adjusted weight for each respondent was the reciprocal of its predicted probability to respond to the survey. In this way, the weights of respondents were increased so they also represented nonrespondents with similar characteristics. The weights were scaled to sum to 500 for each airport.

Both the individual airport curves and the national curve were refit using the nonresponse-adjusted weights. Table G-3 shows the model coefficients without and with the weights for the individual airport curves. The first two columns of the table repeat the coefficients given in Table 8-1 for the twenty airports. The weights had no meaningful impact on the predicted percent highly annoyed. For all airports except BFI, BIL, and ORD, the maximum difference between predicted percent highly annoyed from the model with weights and the model without weights was less than 2.5 percentage points (and for most airports, the differences were smaller than that). For BFI, BIL, and ORD, the maximum difference was less than 4 percentage points.

Table G-3. Coefficients of Model in Equation (8.1), unweighted and weighted

Airport Identifier	β_0, no weights	β_1, no weights	β_0, nonresponse-adjusted weights	β_1, nonresponse-adjusted weights
ABQ	-6.1563	0.1093	-6.3547	0.1115
ALB	-8.2847	0.1355	-8.2697	0.1355
ATL	-8.3554	0.1379	-8.3852	0.1369
AUS	-11.4847	0.1903	-12.0232	0.1998
BDL	-6.9470	0.1124	-6.9953	0.1131
BFI	-6.5752	0.1031	-6.0274	0.0935
BIL	-13.8302	0.2395	-14.1638	0.2473
DSM	-8.6299	0.1387	-8.2164	0.1315
DTW	-5.9880	0.1059	-5.6359	0.0995
LAS	-6.6325	0.1025	-6.7051	0.1033
LAX	-5.7330	0.0930	-6.1811	0.1002
LGA	-13.1473	0.2125	-13.2178	0.2127
LIT	-8.0593	0.1395	-7.8990	0.1365
MEM	-8.9629	0.1388	-8.7980	0.1354
MIA	-12.6290	0.2005	-12.3167	0.1953
ORD	-10.5999	0.1840	-10.4877	0.1793
SAV	-9.1981	0.1566	-9.5121	0.1627
SJC	-10.7487	0.1782	-11.3460	0.1877
SYR	-3.4425	0.0489	-3.5687	0.0505
TUS	-7.3388	0.1399	-7.3821	0.1409
National curve	-8.4304	0.1397	-8.4459	0.1396

The last row in Table G-3 shows the coefficients of the national curve without weights (columns 1 and 2) and with weights (columns 3 and 4). The two curves, with and without weights, are shown in Figure G-2 and are virtually identical at all values of DNL between 50 and 75. The maximum difference between the predicted percent HA for the curve without weights and the curve fit with nonresponse-adjusted weights is less than one-half of one percentage point.

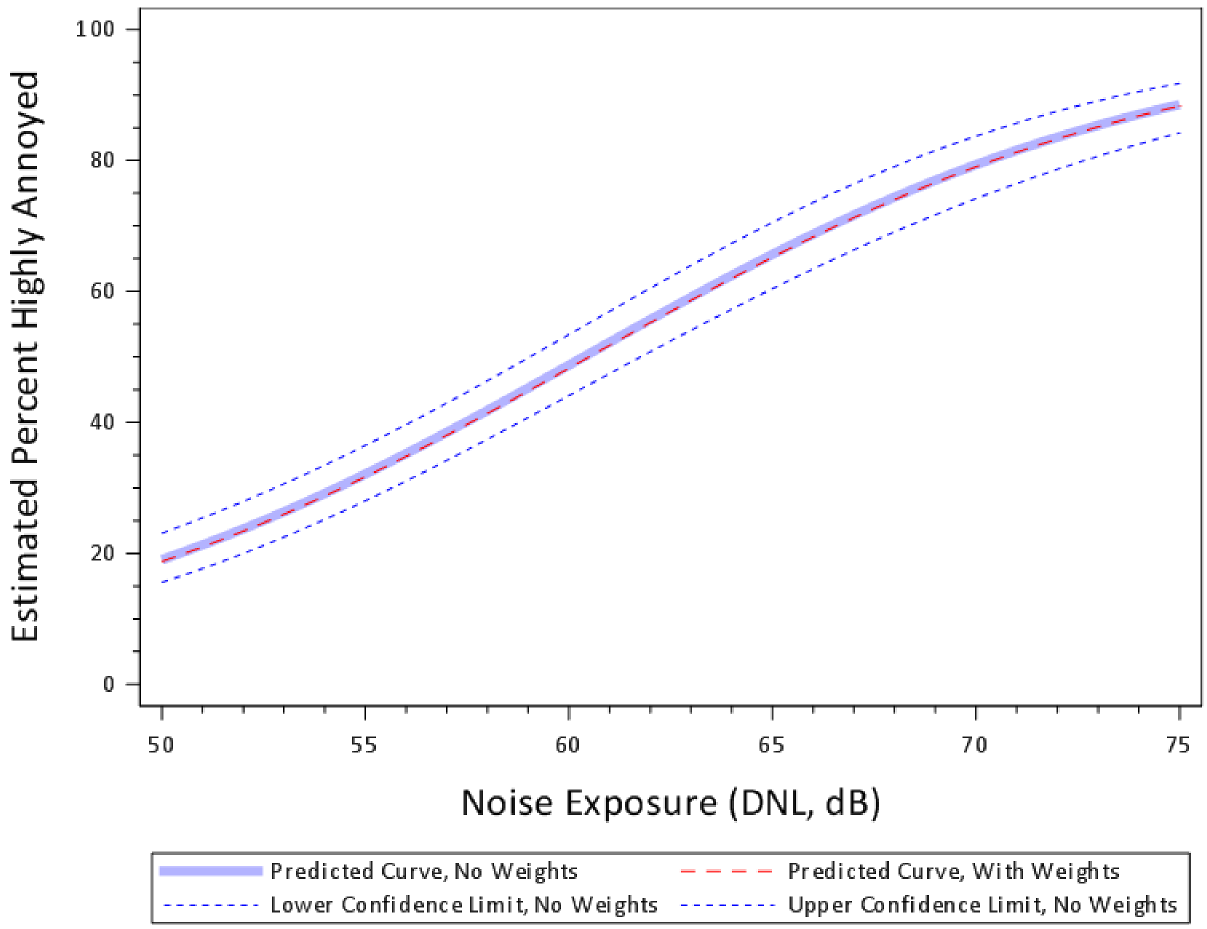

Figure G-2. National Curve and Curve Fit with Nonresponse-Adjusted Weights

The analyses in this section were conducted to provide a further investigation of potential nonresponse bias. Evidence of potential nonresponse bias potentially correctable by using the weights would exist, if the curves fit with nonresponse-adjusted weights differed greatly from the curves fit without weights. The results of these analyses show that the individual airport curves and national curve are little changed when nonresponse-adjusted weights are used, and therefore, the simpler unweighted models are used. This analysis detected no nonresponse bias in the national curve reported in Chapter 8 using the information available on the sampling frame.

G.4 Fitting the Community Tolerance Level Curve from Fidell et al. (2011)

Fidell et al. (2011) proposed an alternative model for the relationship between noise exposure and annoyance. This model hypothesized that the annoyance with noise “should increase at the same rate as the duration-adjusted loudness of exposure” (Fidell et al. 2011, p. 793). The estimated noise dose is given by $m = \left[10^{DNL/10}\right]^{0.3}$. The model predicts the probability of being highly annoyed, P(HA), as

$$P(HA) = p = \exp\left(-\frac{A}{m}\right), \tag{G.2}$$

where A is the parameter to be estimated.

For fitting the model in Equation (G.2), it is convenient to express it in a form that is structurally similar to the logistic regression model used in Chapter 8. By substituting $\left[10^{DNL/10}\right]^{0.3}$ for *m*, taking the natural logarithm of both sides of the equation, and performing some algebra, the model in Equation (G.2) can be written in an algebraically equivalent form as:

$$-ln[-ln(p)] = -\ln(A) + [0.03][\ln(10)](DNL). \tag{G.3}$$

Equation (G.3) is of the form

$$-ln[-ln(p)] = \beta_0 + \beta_1\,(DNL), \tag{G.4}$$

and thus has similar structure to the FICON (1992) model in Equation (H.2), with an intercept β_0 and slope β_1.

The difference between Equation (H.2) and Equation (G.4) is that Equation (H.2) uses a logit link function, $\ln\left(\frac{p}{1-p}\right)$, while Equation (G.4) uses a log-log link function, $-ln[-ln(p)]$. The relationships specified by the two functions (logit and log-log) are slightly different, but both transform *p*, which is between 0 and 1, to a number in the range $(-\infty, +\infty)$. Both models specify that the predicted P(HA) increases with DNL. The logit function is symmetric about $p = 0.5$, because $\ln\left(\frac{p}{1-p}\right) = -\ln\left(\frac{1-p}{p}\right)$. That is, with logistic regression one could model P(not highly annoyed) instead of modeling P(highly annoyed) and obtain the same results. The log-log link function is not symmetric; it approaches a probability of 0 more steeply and approaches a probability of 1 more slowly than the logistic function, although the differences in fit are usually small for the middle of the probability range.

The specific formulation of the model in Fidell et al. (2011), in Equation (G.3), sets the intercept in Equation (G.4) equal to $-\ln(A)$, and this parameter is estimated from the data. The model fixes the slope in Equation (G.4) to be $[0.03][\ln(10)] \approx 0.069$. The slope in the Fidell et al. (2011) model is forced to equal 0.069 for all airports and is not estimated from the data.

The model in Equation (G.3) was fit to the individual airports from the NES, and to all airports together. Table G-4 gives the coefficients and standard errors for the individual airport curves and the national curve using this model, as well as the estimate of the parameter A from Equation (G.2) and the estimated value of the Community Tolerance Level (CTL) arising from this model. The CTL is defined to be the value of DNL for which half of the community is predicted to be highly annoyed, according to the model in Equation (G.2). These values are calculated as:

$$A = \exp(-\beta_0) \tag{G.5}$$

and

$$CTL = \{-ln[-ln(0.5)] - \beta_0\}/\{[0.03][\ln(10)]\}. \tag{G.6}$$

Table G-4. Estimated Coefficients for Model in Equation (G.3), with Lower and Upper Confidence Limits (CLs)

Airport Identifier	β_0			A			CTL		
	Estimate	Lower CL	Upper CL	Estimate	Lower CL	Upper CL	Estimate	Lower CL	Upper CL
ABQ	-3.54	-3.66	-3.42	34.51	30.69	38.81	56.57	54.87	58.27
ALB	-3.95	-4.07	-3.84	52.06	46.47	58.32	62.52	60.88	64.17
ATL	-3.84	-3.96	-3.71	46.50	41.04	52.67	60.89	59.08	62.69
AUS	-4.04	-4.15	-3.92	56.60	50.60	63.31	63.73	62.11	65.36
BDL	-3.92	-4.04	-3.81	50.62	45.17	56.72	62.12	60.47	63.76
BFI	-4.03	-4.14	-3.91	56.14	50.00	63.04	63.62	61.94	65.29
BIL	-3.90	-4.01	-3.79	49.49	44.23	55.38	61.79	60.16	63.42
DSM	-4.04	-4.15	-3.92	56.58	50.61	63.26	63.73	62.11	65.34
DTW	-3.53	-3.66	-3.40	34.06	29.97	38.71	56.38	54.53	58.23
LAS	-4.08	-4.19	-3.96	59.01	52.61	66.19	64.34	62.67	66.00
LAX	-3.86	-3.99	-3.73	47.52	41.74	54.10	61.20	59.32	63.08
LGA	-4.06	-4.18	-3.94	57.93	51.54	65.10	64.07	62.38	65.76
LIT	-3.69	-3.81	-3.58	40.10	35.74	44.99	58.74	57.08	60.41
MEM	-4.14	-4.26	-4.02	62.91	55.76	70.98	65.26	63.52	67.01
MIA	-4.11	-4.22	-3.99	60.72	54.01	68.27	64.75	63.05	66.45
ORD	-3.48	-3.63	-3.34	32.61	28.21	37.69	55.75	53.65	57.85
SAV	-3.82	-3.93	-3.71	45.68	40.83	51.10	60.63	59.01	62.25
SJC	-3.94	-4.05	-3.82	51.20	45.52	57.60	62.28	60.58	63.99
SYR	-3.95	-4.07	-3.84	52.17	46.63	58.37	62.55	60.93	64.18
TUS	-3.09	-3.24	-2.95	22.05	19.01	25.56	50.08	47.94	52.22
National Curve	-3.85	-3.97	-3.73	47.05	41.79	52.97	61.06	59.34	62.77

The last row of Table G-4 shows the estimated coefficient from the model in Equation (G.3) for all airports together. This was calculated using a random intercept regression model.

The model in Equation (G.4), in which the slope as well as the intercept is estimated from the data, allows one to check the implicit assumption in Fidell et al. (2011) that the slope is 0.069, which is equivalent to assuming that the exponent α in the function $m = \left[10^{DNL/10}\right]^{\alpha}$ is $\alpha = 0.3$. This is done by fitting the two-parameter model in Equation (G.4) and then testing the null hypothesis H_0: $\beta_1 = 0.069$. Table G-5 gives the estimated slope and intercept for the model in Equation (G.4) for each airport. The value of the exponent in Table G-5 is calculated as $\alpha = 10\ \beta_1/\ln(10)$. The test for whether the slope β_1 is equal to (0.03) ln(10) ≈ 0.069 was carried out by forming the test statistic

$$T = [\text{estimate of } \beta_1 - (0.03)\ln(10)]/(\text{Standard error of estimate of } \beta_1) \qquad \text{(G.7)}$$

and comparing the value of T to a t distribution with (number of observations – 2) degrees of freedom. This also serves as a statistical test for the null hypothesis that the exponent α equals 0.3.

Table G-5. Estimated Slopes and Intercepts from Model in Equation (G.4) for Each Airport

Airport Identifier	β_0			β_1			Estimate of exponent, α	Test statistic for $H_0: \beta_1 = 0.069$	p-value for $H_0: \beta_1 = 0.069$
	Estimate	Lower CL	Upper CL	Estimate	Lower CL	Upper CL			
ABQ	-3.682	-6.432	-0.933	0.072	0.020	0.124	0.312	0.101	0.920
ALB	-4.541	-6.334	-2.747	0.080	0.047	0.112	0.346	0.645	0.519
ATL	-5.382	-6.768	-3.995	0.095	0.072	0.119	0.415	2.183	0.029
AUS	-6.439	-8.339	-4.539	0.112	0.078	0.147	0.488	2.482	0.013
BDL	-4.230	-5.908	-2.552	0.075	0.045	0.104	0.324	0.358	0.720
BFI	-4.073	-5.545	-2.600	0.070	0.045	0.095	0.303	0.060	0.952
BIL	-7.694	-10.134	-5.254	0.139	0.094	0.184	0.604	3.048	0.002
DSM	-5.094	-6.865	-3.324	0.088	0.057	0.119	0.381	1.175	0.241
DTW	-3.991	-5.885	-2.097	0.077	0.044	0.111	0.336	0.481	0.631
LAS	-3.945	-5.169	-2.721	0.067	0.046	0.088	0.290	-0.214	0.830
LAX	-3.823	-4.997	-2.648	0.068	0.049	0.088	0.297	-0.065	0.948
LGA	-7.702	-9.121	-6.283	0.131	0.107	0.156	0.570	5.018	0.000
LIT	-5.127	-7.055	-3.199	0.095	0.060	0.131	0.414	1.462	0.144
MEM	-5.469	-6.654	-4.283	0.091	0.071	0.111	0.395	2.200	0.028
MIA	-7.261	-8.617	-5.905	0.122	0.099	0.145	0.530	4.548	0.000
ORD	-7.924	-9.471	-6.376	0.145	0.118	0.172	0.629	5.558	0.000
SAV	-5.561	-7.943	-3.178	0.101	0.057	0.144	0.438	1.433	0.152
SJC	-6.397	-8.043	-4.751	0.112	0.083	0.142	0.488	2.931	0.004
SYR	-1.849	-3.471	-0.227	0.031	0.002	0.060	0.136	-2.566	0.011
TUS	-5.456	-7.565	-3.347	0.111	0.073	0.149	0.482	2.194	0.029
National	-5.225	-5.971	-4.478	0.093	0.080	0.106	0.405	3.817	0.001

From Table G-5, 10 of the 20 airports have slopes that are statistically significantly different from the hypothesized value of 0.069 (i.e., the exponents α are statistically significantly different from 0.3).

The last row of Table G-5 shows the estimated coefficients for the national curve for the model in Equation (G.4). This was fit using a random coefficients regression model, where each airport had its own intercept β_{0i} and slope β_{1i} for the model

$$-ln[-ln(P[HA, \text{airport } i])] = \beta_{0i} + \beta_{1i}\,(DNL),$$

and the different intercepts and slopes are related through the model in Equation (H.4). The one-parameter model in Fidell et al. (2011), reported in Table G-4, exhibits statistically significant lack of fit for the data for the national curve. The maximum likelihood estimate of the exponent α, from the two-parameter model reported in Table G-5, is 0.405, which is significantly higher than the assumed value of 0.3.

Figure G-3 displays the national curve from Table 8-2, the curve fit using the model in Fidell et al. (2011), and a curve fit using the two-parameter log-log link model in Equation (G.4). The two-parameter log-log link model fits the data well, and may in fact provide a better fit above DNL 70 dB than the logistic model that was requested for the national curve. The one-parameter model from Fidell et al. (2011), however, does not fit the data well. It overestimates the annoyance at low noise exposures and underestimates the annoyance at higher noise exposure by fixing the slope at 0.069.

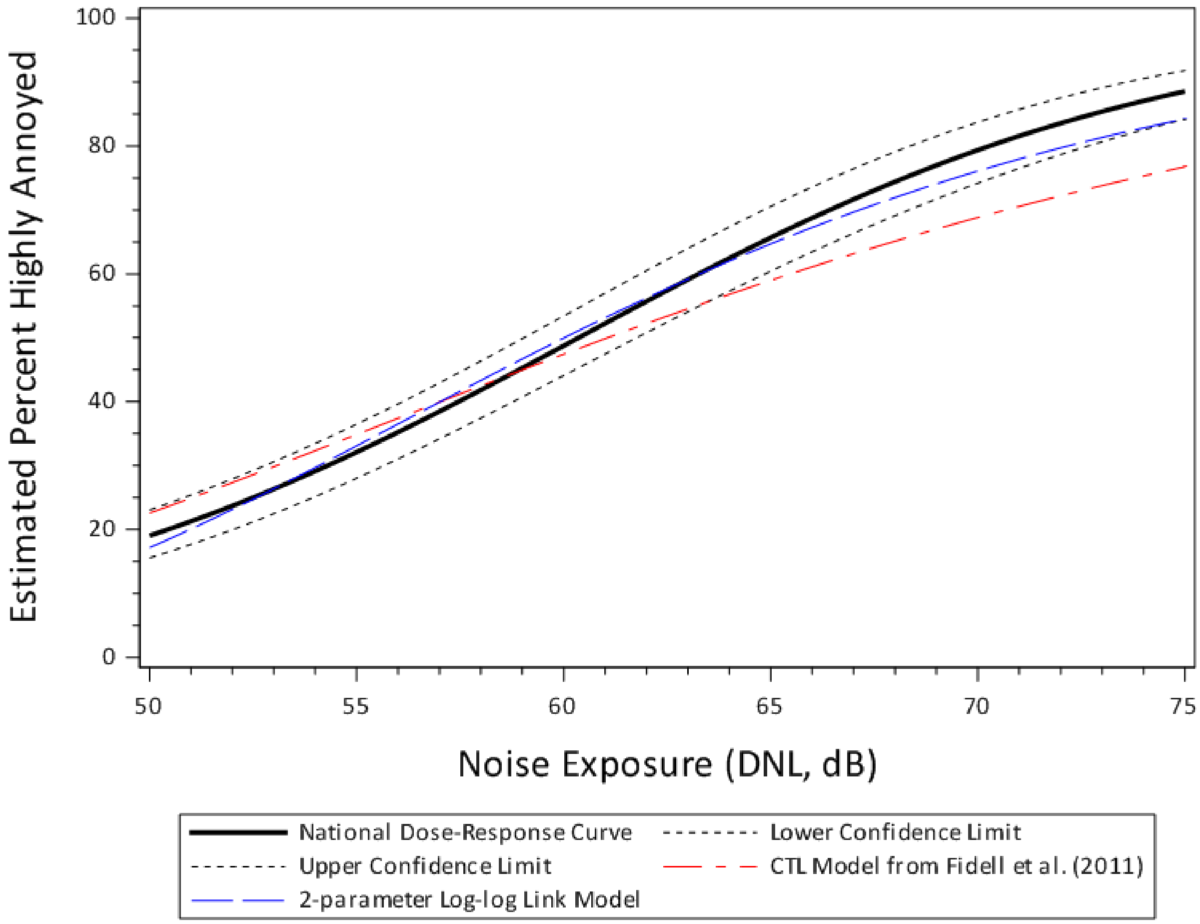

Figure G-3. National Curve, along with Curves Fit using Fidell et al. (2011) Model and Two-parameter Log-log Link Model

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Appendix H Regression Model Formulas and Computations

H.1 Model for Individual Airport Dose-Response Curves

Equations (8.1) and (H.1) give the logistic regression model, from FICON (1992), used to fit dose-response curves for the individual airports. It is:

$$\text{Percent } HA = \frac{100 \ \exp(\beta_0 + \beta_1 DNL)}{1 + \exp(\beta_0 + \beta_1 DNL)}. \tag{H.1}$$

This logistic regression model can be expressed in algebraically equivalent form as:

$$\ln\left(\frac{p}{1-p}\right) = \text{logit}(p) = \beta_0 + \beta_1 DNL, \tag{H.2}$$

where $p = P(HA)$ is the probability of being highly annoyed if exposed to noise at the DNL value in the right-hand side of the equation. The slope β_1 in the logistic regression model may be interpreted as the expected change in the log odds ratio $\ln\left(\frac{p}{1-p}\right)$ associated with a change of one dB in DNL. Alternatively, the exponentiated value of the coefficient gives the change in the odds ratio $p/(1-p)$ associated with a one-dB change in DNL. Thus, the parameters in the FICON (1992) curve ($\beta_0 = -11.13$ and $\beta_1 = 0.141$) can be interpreted as follows: if address A has a value of DNL that is one dB greater than the DNL value for address B, then the log odds ratio for being highly annoyed is expected to be 0.141 higher for address A than for address B, and the odds ratio is expected to be exp(0.141) = 1.15 greater for address A than for address B. The difference in P(HA) at values of DNL that differ by one dB depends on the particular values of DNL because of the nonlinear relationship between P(HA) and DNL in the logistic regression.

The LOGISTIC procedure of SAS® software (SAS Institute, Inc., 2014), version 9.4, was used to fit the model predicting HA from DNL for each airport. The profile likelihood method was used to construct confidence intervals.

Sampling weights were not used when fitting the dose-response curves. The NES was designed for estimating the logistic regression function in Equation (8.1) with high statistical efficiency. The sampling design specified higher inclusion probabilities for addresses in higher noise strata than in lower noise strata to obtain sufficiently high numbers of respondents with higher noise exposure — this ensured that the sample from each airport would include respondents with a large range of noise exposures. The noise exposure was the only variable used in the stratification at each airport. Because regression analyses are performed conditionally on the independent (x) variable (here, DNL), weights are not needed for the analysis. Pfeffermann and Sverchkov (1999) and Pfeffermann (2011) provide a theoretical justification for conditioning on the weights in the analysis of the data. In their approach, modified “q weights” are calculated that divide the design weight (the inverse of the inclusion probability) by the conditional expected value of the design weight given x. Because the inclusion probabilities in the NES are functions of x, the “q weight” for each unit is one. Therefore, the national curve can be estimated using a logistic regression with each observation having weight one.[3]

[3] It would be possible to fit a regression model using the sampling weights, but the model would have low precision for estimating the dose-response curve. Because the sampling fractions were so much higher in the high noise exposure strata, the sampling weights are low for high noise exposure households and high for low noise exposure households. An airport curve fit using the weights would be determined almost exclusively by the sampled households with DNL between 50 and 55 dB, with almost no influence from households with higher DNL.

H.2 Model for National Dose-Response Curve

The national curve was fit using a random coefficients logistic regression model, which includes individual airport intercepts and slopes as random effects (McCulloch and Neuhaus 2001; Demidenko 2004; Allison 2012). The full model is expressed in two stages. First, the model for percent HA at each airport is assumed to have its own intercept β_{0i} and slope β_{1i}, according to the model in Equation (H.1):

$$\%\ HA, airport\ i = \frac{100\ \exp(\beta_{0\mathrm{i}} + \ \beta_{1\mathrm{i}} DNL)}{1 + \exp(\beta_{0\mathrm{i}} + \ \beta_{1\mathrm{i}} DNL)}. \tag{H.3}$$

The coefficients for the individual airports are assumed to be related through a multivariate normal model, where

$$\begin{bmatrix} \beta_{0\mathrm{i}} \\ \beta_{1\mathrm{i}} \end{bmatrix} \sim N\left(\begin{bmatrix} \beta_0 \\ \beta_1 \end{bmatrix}, \begin{bmatrix} V_{11} & V_{12} \\ V_{12} & V_{22} \end{bmatrix}\right). \tag{H.4}$$

In essence, the model given by Equations (H.3) and (H.4) fits separate dose-response curves for each individual airport and then combines them to produce the national curve. It allows each airport to have its own intercept, as in the probit model of Groothuis-Oodshourn and Miedema (2006). The model also allows each airport to have its own slope, as suggested by Groothuis-Oodshourn and Miedema (2006) as an extension of their model. The random slope term allows the confidence interval bands about the dose-response curve to account for airport-to-airport variability of the slopes.

The estimated dose-response curve resulting from this model is virtually identical to the curve that results from fitting the individual airport logistic regression curves using the model in Section H.1 and then computing the slope as the average of the 20 airport model slopes and the intercept as the average of the 20 airport model intercepts.[4] The advantage of using the form of the model in Equations (H.3) and (H.4) is that it creates a single model that includes all of the airport information, and allows the calculation of the standard errors of the parameter estimates and the confidence bands about the curve. This structure also facilitates the investigation of other factors that might be associated with annoyance to aircraft noise, as discussed in Section H.3.

The precision for the estimated national dose-response curve depends on:

1. The slope and intercept of the "true" population curve,
2. The variability in the dose-response relationship among different airports in the sample,
3. The number of airports in the sample,
4. The number of households sampled per airport, and
5. The distribution of noise exposure among the sampled households.

The variability among airports (item 2) and the number of airports in the sample (item 3) are typically the main factors determining the precision of the estimated slope and intercept in a random coefficient regression model. If different airports have vastly different curves, then more sampled airports are needed to be able to estimate the national relationship with high precision. Item (4) contributes to the precision of the national curve, but the main purpose of sampling 500 addresses per airport was to obtain high precision for the individual airport dose-response curves; the national curve was expected to have almost as much precision if 300 addresses were sampled per airport as if 500 addresses were sampled, because the primary determinant of the precision of the national curve is the variability among airports (Lohr 2014). The sampling

[4] The average of the 20 airport intercepts is -8.64; the average of the 20 airport slopes is 0.143. These values are similar to the coefficients in Table 8.2.

design specified taking a high fraction of high-noise-exposure addresses to increase the precision associated with item (5).

The confidence bands presented for the national curve reflect the sampling error for estimating the national curve, including both the variability among the dose-response curves at different airports and the variability from fitting each individual airport dose-response curve. The confidence bands in Figure 8-2 reflect the uncertainty about the mean of the slopes and intercepts of the individual airport curves. These are distinguished from other types of error bands that might describe the uncertainty about the expected dose-response relationship of a randomly selected new airport, or the uncertainty about the probability that a randomly selected individual at an airport would report being highly annoyed at a specific value of DNL (Groothuis-Oodshourn and Miedema, 2006).

The GLIMMIX procedure of SAS® software (SAS Institute, Inc., 2016), version 9.4, was used to fit the model in Equations (H.3) and (H.4). Adaptive Gauss-Hermite quadrature was used to calculate the maximum likelihood estimates of the slope and intercept.

H.3 Models Used for Additional Analyses in Chapter 9

The goal of the analyses in Chapter 9 was to determine the extent to which the factors listed in Table 9-1 contribute to the prediction of the probability of being highly annoyed, after accounting for the effects of DNL.

For all factors in Table 9-1 except for DEGREEDAYS, two sets of analyses were performed. The first fit a logistic regression model separately for each airport. The form of this model, where FACTOR represents each of the factors in Table 9-1 except for DEGREEDAYS, is

$$\ln\left(\frac{p}{1-p}\right) = \mathrm{logit}(p) = \beta_0 + \beta_1 DNL + \beta_2 FACTOR + \beta_3 DNL \times FACTOR. \tag{H.5}$$

The extra coefficients β_2 and β_3, relative to the model in Equation (H.2), provide information about how the relationship between DNL and P(HA) is modified when FACTOR is included in the model. The coefficient β_2 describes the change in the intercept when the value of FACTOR is increased by one, and the coefficient β_3 describes the change in the slope for DNL when the value of FACTOR is increased by one, assuming that the value of DNL is held constant. The model in Equation (H.5) contains the model in Equation (H.2) as a special case that occurs if the coefficients β_2 and β_3 are equal to zero. If the additional terms β_2 and β_3 are both zero, then, after controlling for DNL, FACTOR is not related to the overall level of annoyance and it does not moderate the relationship between P(HA) and DNL.

To assess the role of FACTOR in the individual airports, a hypothesis test was performed for the compound null hypothesis $H_0\colon \beta_2 = \beta_3 = 0$. The compound test is needed, rather than simply examining the significance of the separate coefficients, because the estimates of β_2 and β_3 may be correlated. This test examines whether FACTOR and the FACTOR-by-DNL interaction explain any additional variability in HA after accounting for the effect of DNL by itself. A Wald test statistic was used, calculated with the TEST statement in PROC LOGISTIC. Under the null hypothesis, the test statistic asymptotically follows a chi-squared distribution with 2 degrees of freedom.

For testing the significance of the additional factors with the national curve, however, a different approach was needed because the values of FACTOR may be correlated within airports.[5] To account for that dependence, the jackknife method was used (Shao and Tu 1995). Twenty analyses were performed using the model in Equation (H.5), where each analysis omitted one of the airports. The variability among the coefficients among the 20 analyses was used to find the standard errors of the regression coefficients and to test the null hypothesis $H_0\colon \beta_2 = \beta_3 = 0$.

The test of the compound null hypothesis $H_0\colon \beta_2 = \beta_3 = 0$ was carried out by calculating the estimated covariance matrix, V, of the vector of estimated coefficients $[\hat{\beta}_2, \hat{\beta}_3]'$. Then the test statistic

$$Q = [\hat{\beta}_2, \hat{\beta}_3]\, \mathrm{V}^{-1}\, [\hat{\beta}_2, \hat{\beta}_3]' \tag{H.6}$$

was compared to a chi-squared distribution with 2 degrees of freedom.[6]

The factor DEGREEDAYS is an airport-level characteristic, having the same value for all respondents at an individual airport. It therefore was analyzed using a different model than the other factors in Table 9-1. The

[5] For the national airport curve, that correlation was accounted for by allowing both intercept and slope to be random effects.

[6] The Wald test statistic Q asymptotically follows a chi-squared distribution if the variance matrix is known rather than estimated. Thomas and Rao (1987) found in empirical studies that for studies with a small number of clusters, an alternative test compares F = Q/2 to an F distribution with appropriate degrees of freedom.

interest was in determining whether airports with different values of DEGREEDAYS had different predicted values of P(HA) at fixed values of DNL. For DEGREEDAYS, the model fit was:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 DNL + \beta_2 DEGREEDAYS. \tag{H.7}$$

A test of the null hypothesis H_0: $\beta_2 = 0$ was performed by comparing the test statistic $T = \hat{\beta}_2 / SE(\hat{\beta}_2)$ to a t distribution with 19 degrees of freedom.

Care must be taken when interpreting statistical tests. Because of the large sample size of the NES, a very small difference between curves at different levels of the FACTOR variable can be deemed to be statistically significant. The decision whether a statistically significant difference is practically important depends on scientific considerations.

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Appendix I Dose-Response Analyses for Individual Airports

Figure 8-1 displayed the individual dose-response curves for all 20 airports on the same plot. In this appendix, the curves are graphed separately for each airport, along with 95 percent confidence bands for the estimated curves. In each graph, the solid line represents the dose-response curve for the airport and the dashed lines represent the 95 percent confidence bands. The data points displayed on the plots were computed using grouped data from each airport, as described in footnote 43 of Chapter 8. To protect the confidentiality of the respondents, the curves for each airport are displayed to the end of the largest noise exposure stratum that has at least 20 respondents, as described in footnote 42 of Chapter 8.

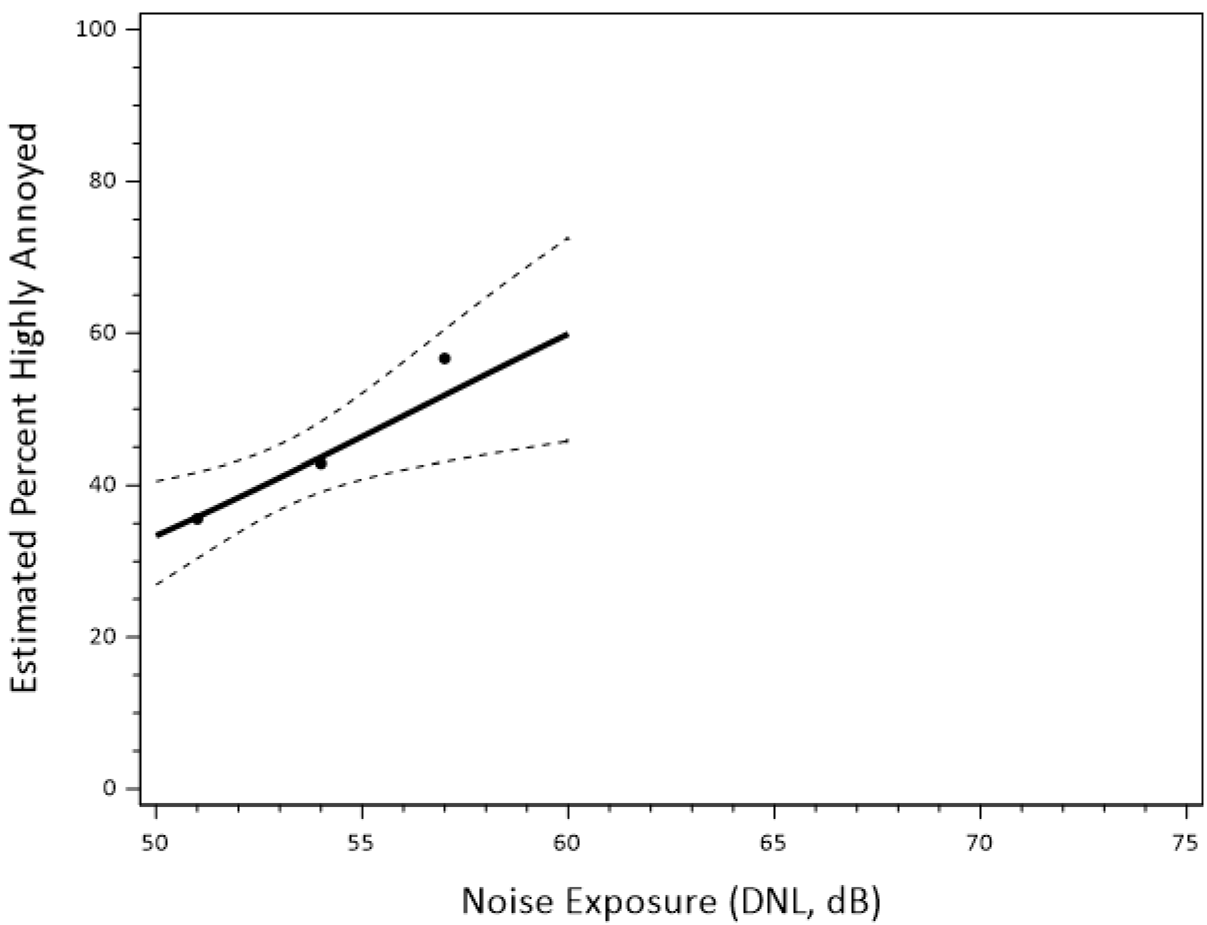

Figure I-1. Dose-Response Curve for ABQ

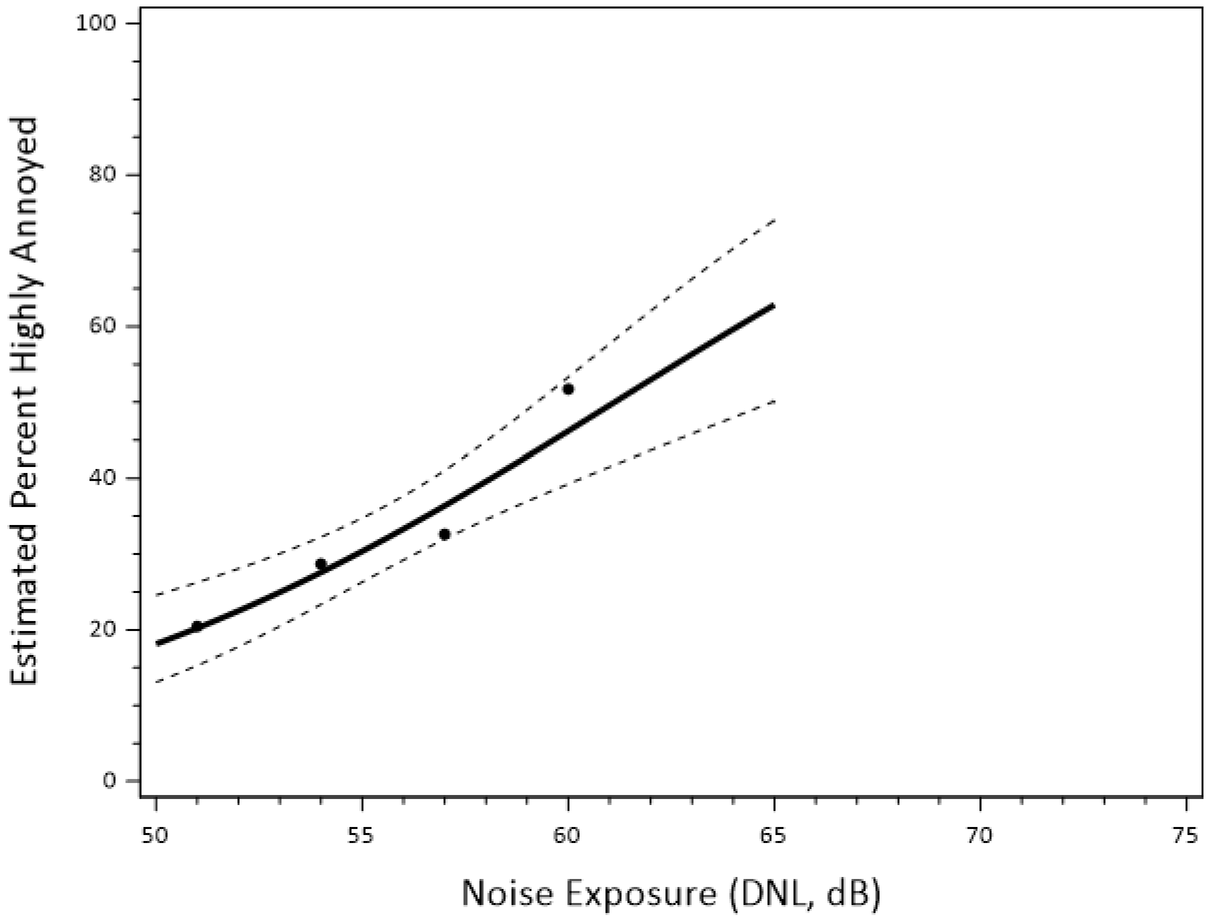

Figure I-2. Dose-Response Curve for ALB

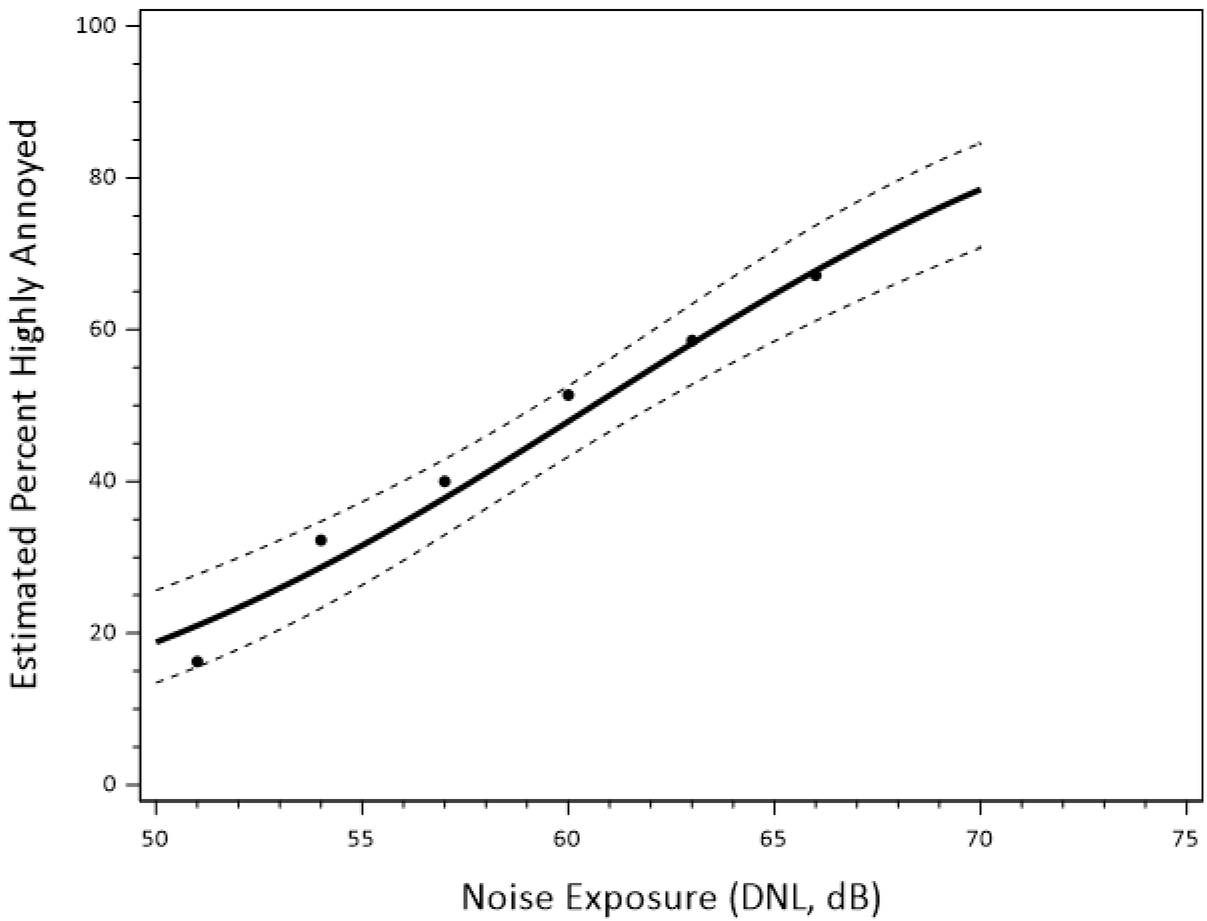

Figure I-3. Dose-Response Curve for ATL

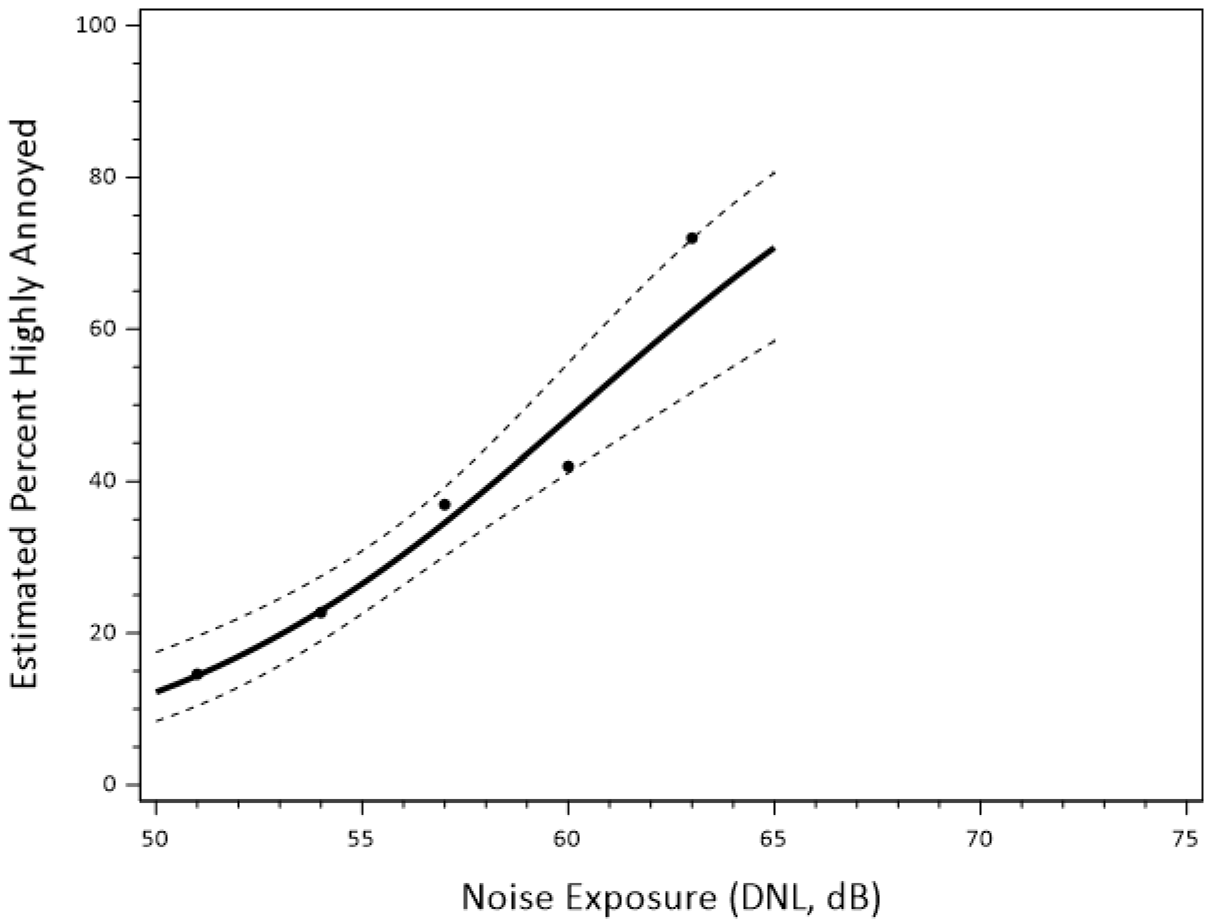

Figure I-4. Dose-Response Curve for AUS

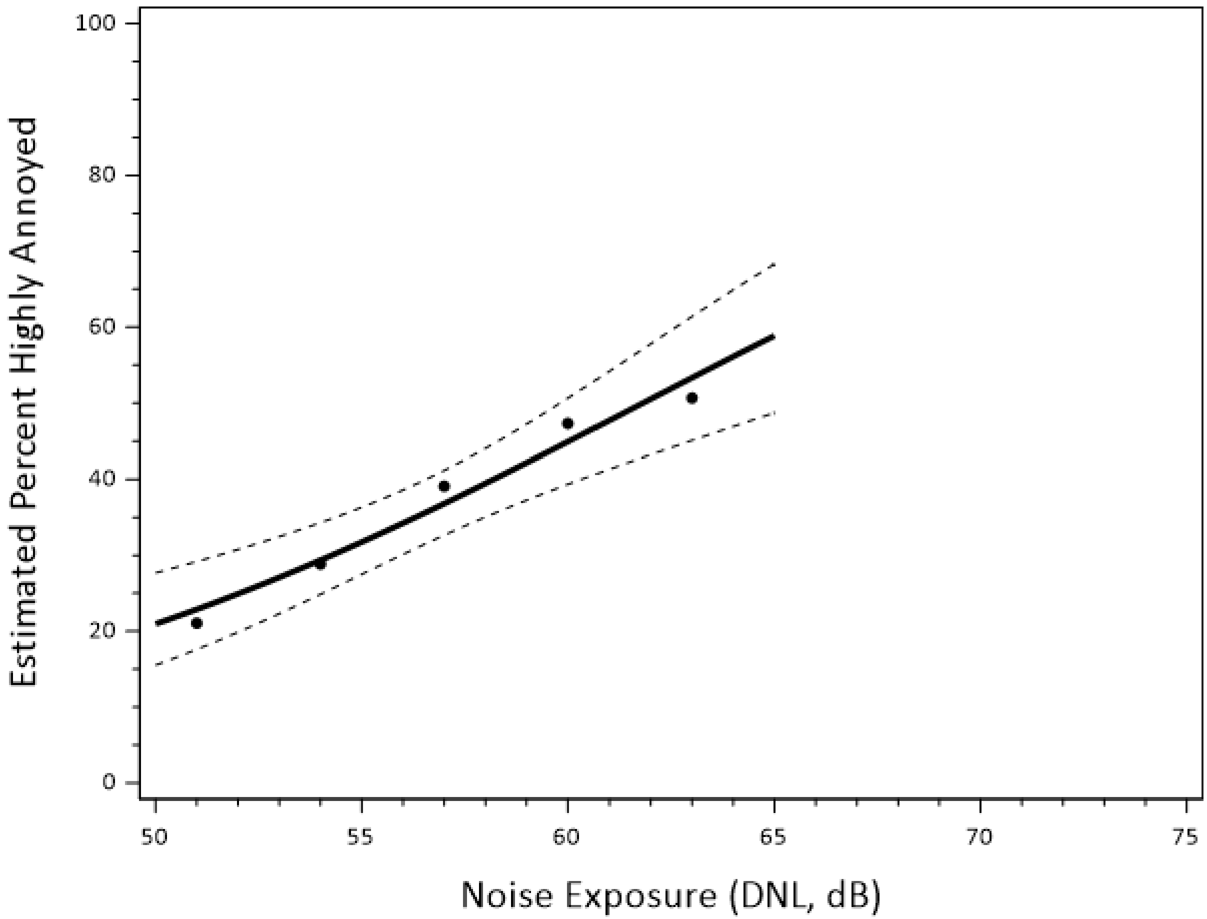

Figure I-5. Dose-Response Curve for BDL

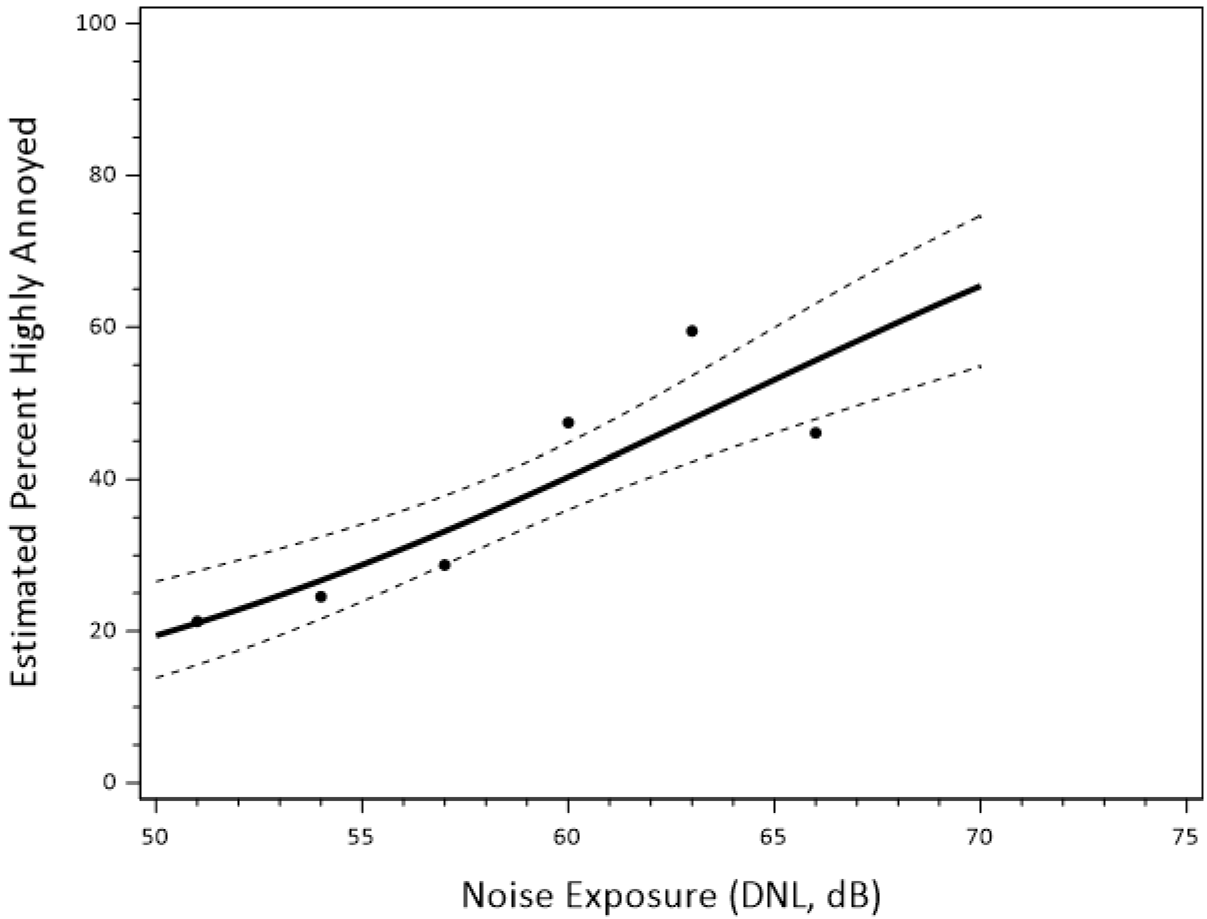

Figure I-6. Dose-Response Curve for BFI

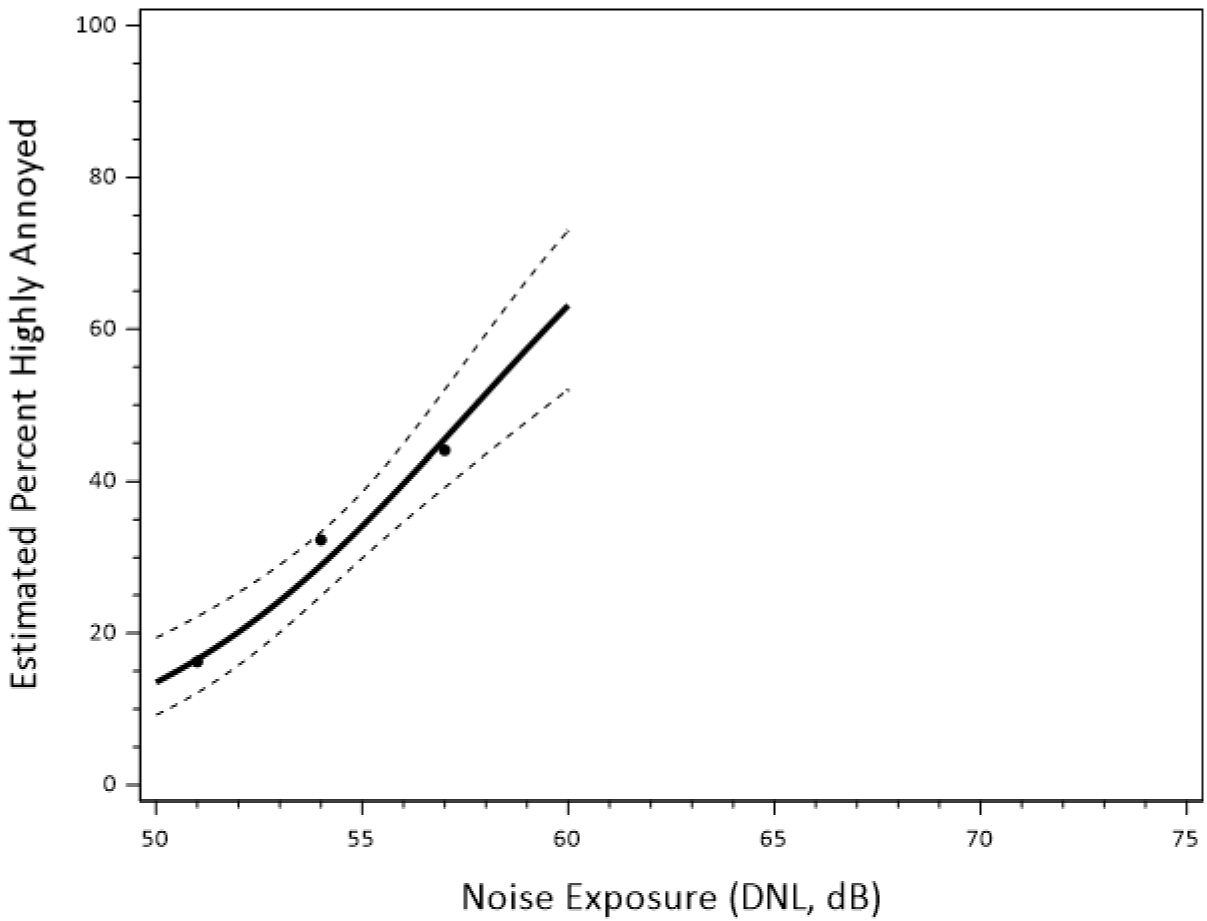

Figure I-7. Dose-Response Curve for BIL

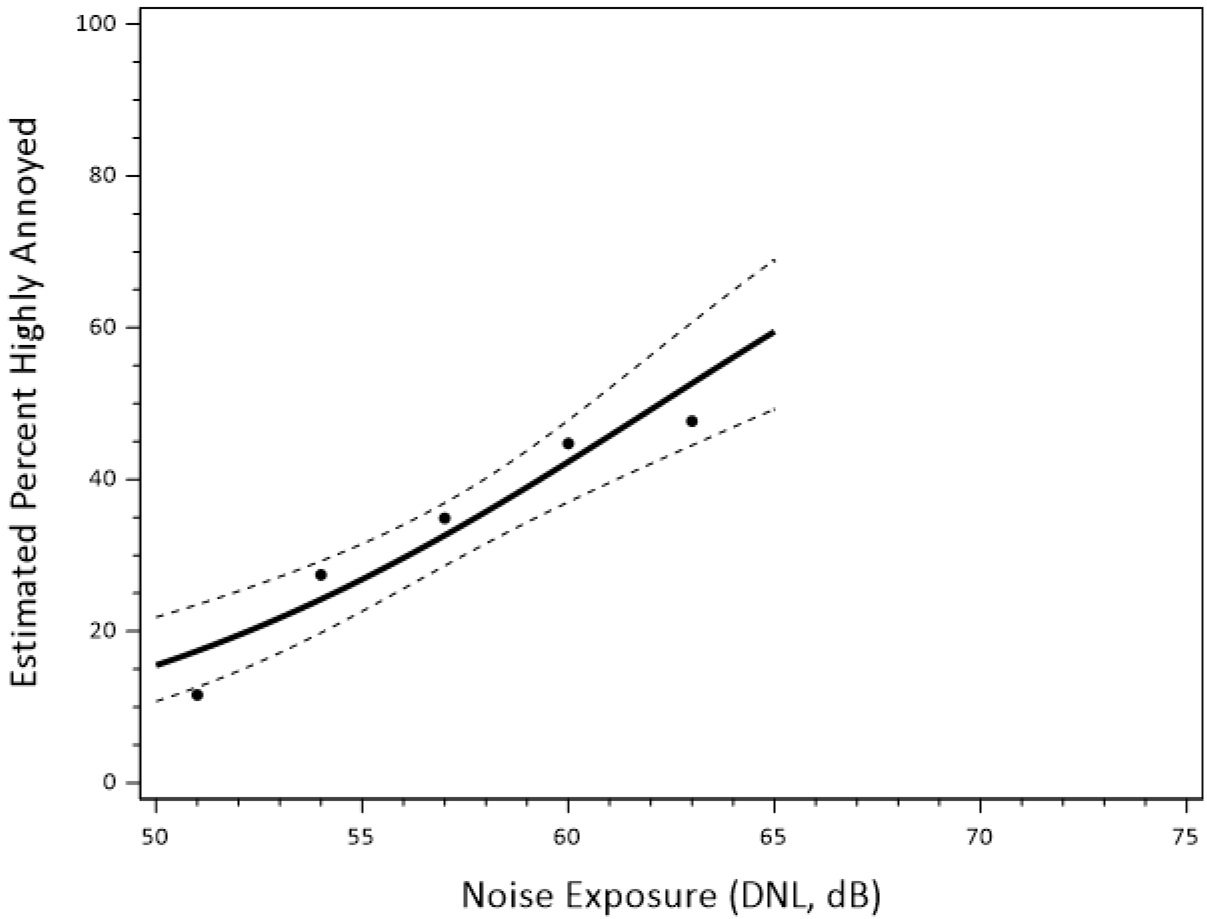

Figure I-8. Dose-Response Curve for DSM

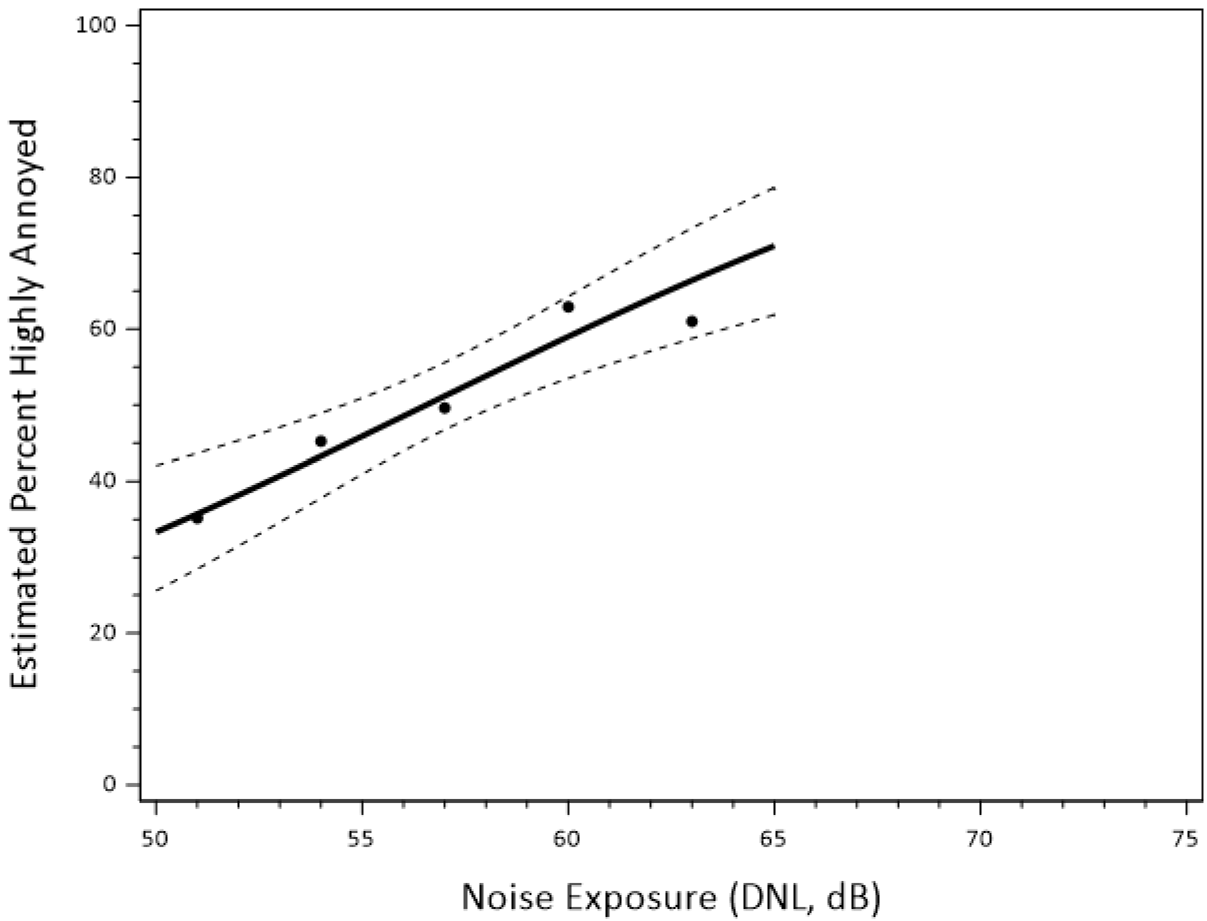

Figure I-9. Dose-Response Curve for DTW

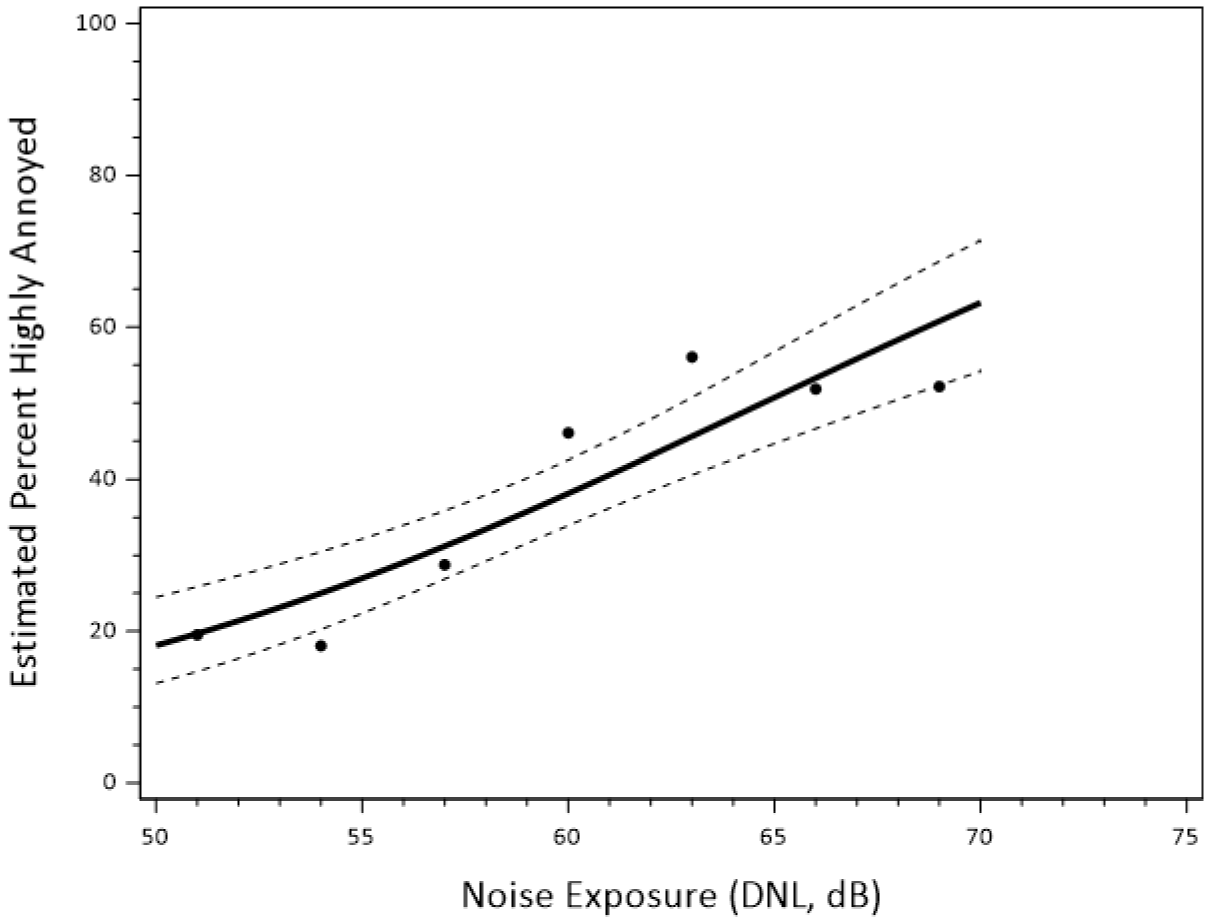

Figure I-10. Dose-Response Curve for LAS

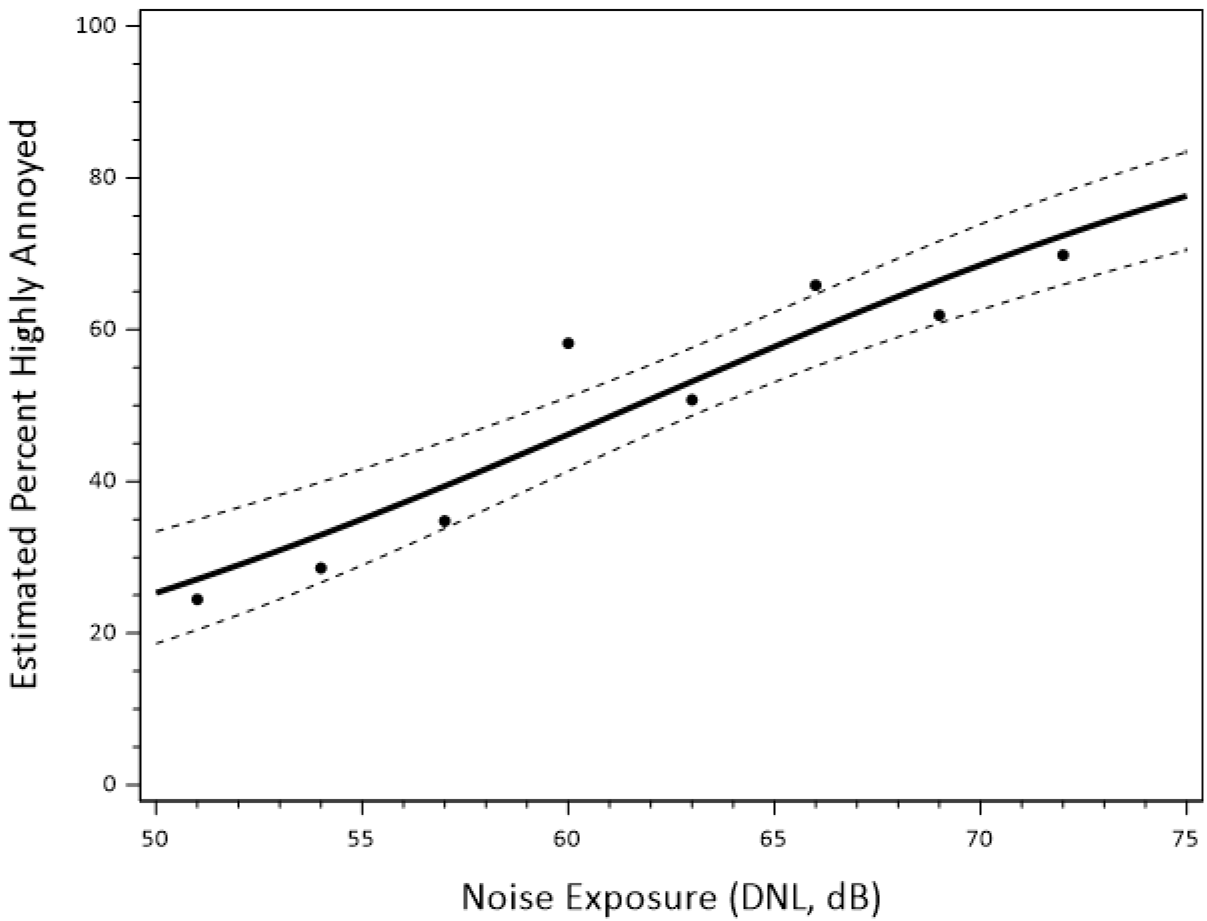

Figure I-11. Dose-Response Curve for LAX

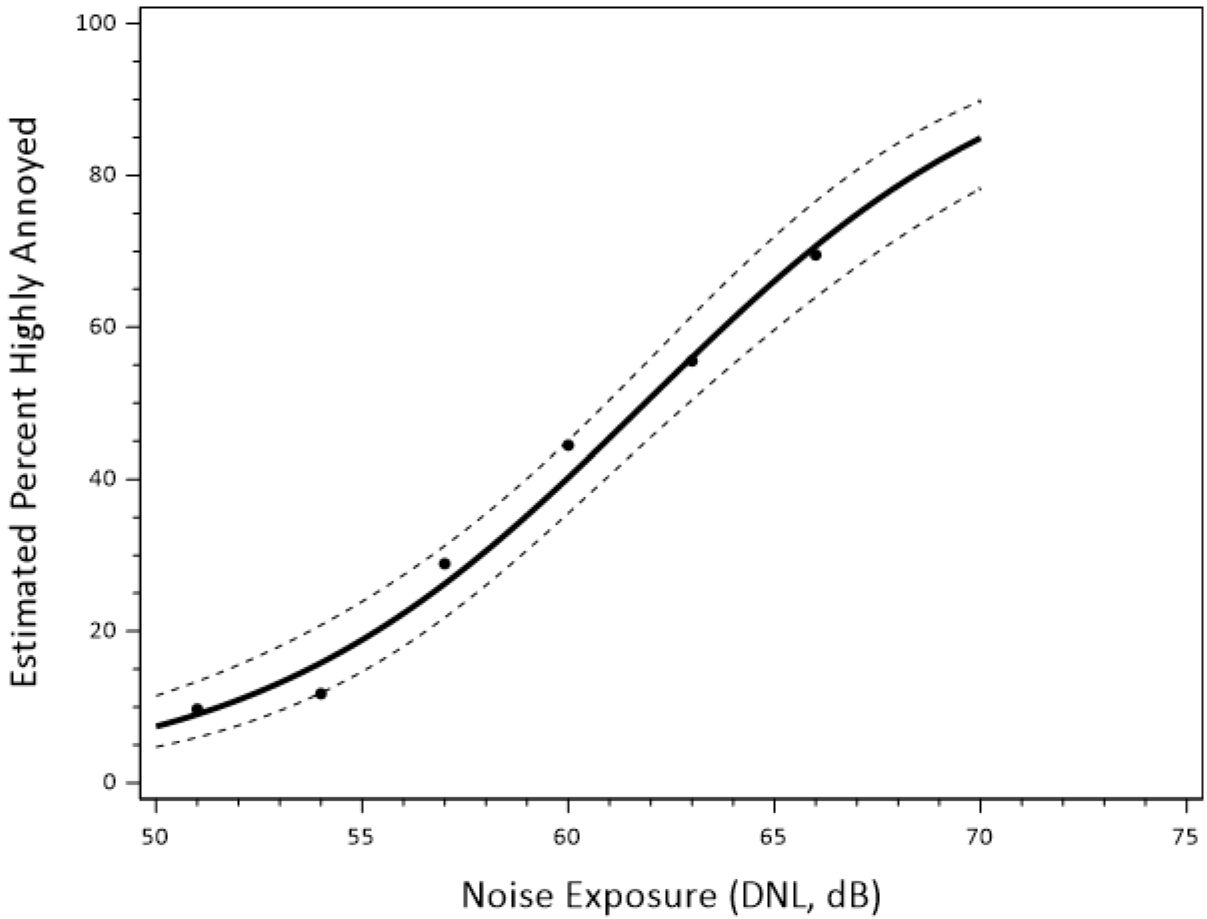

Figure I-12. Dose-Response Curve for LGA

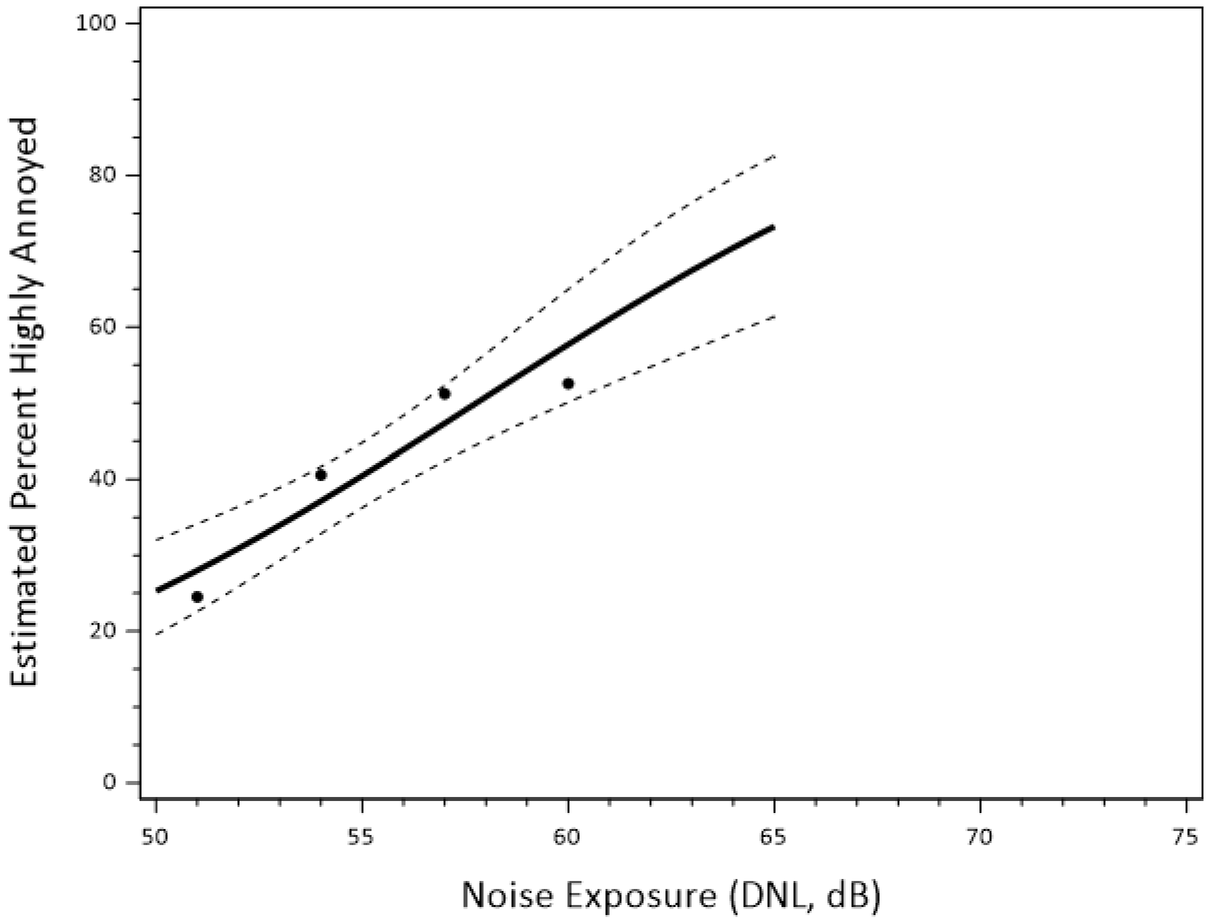

Figure I-13. Dose-Response Curve for LIT

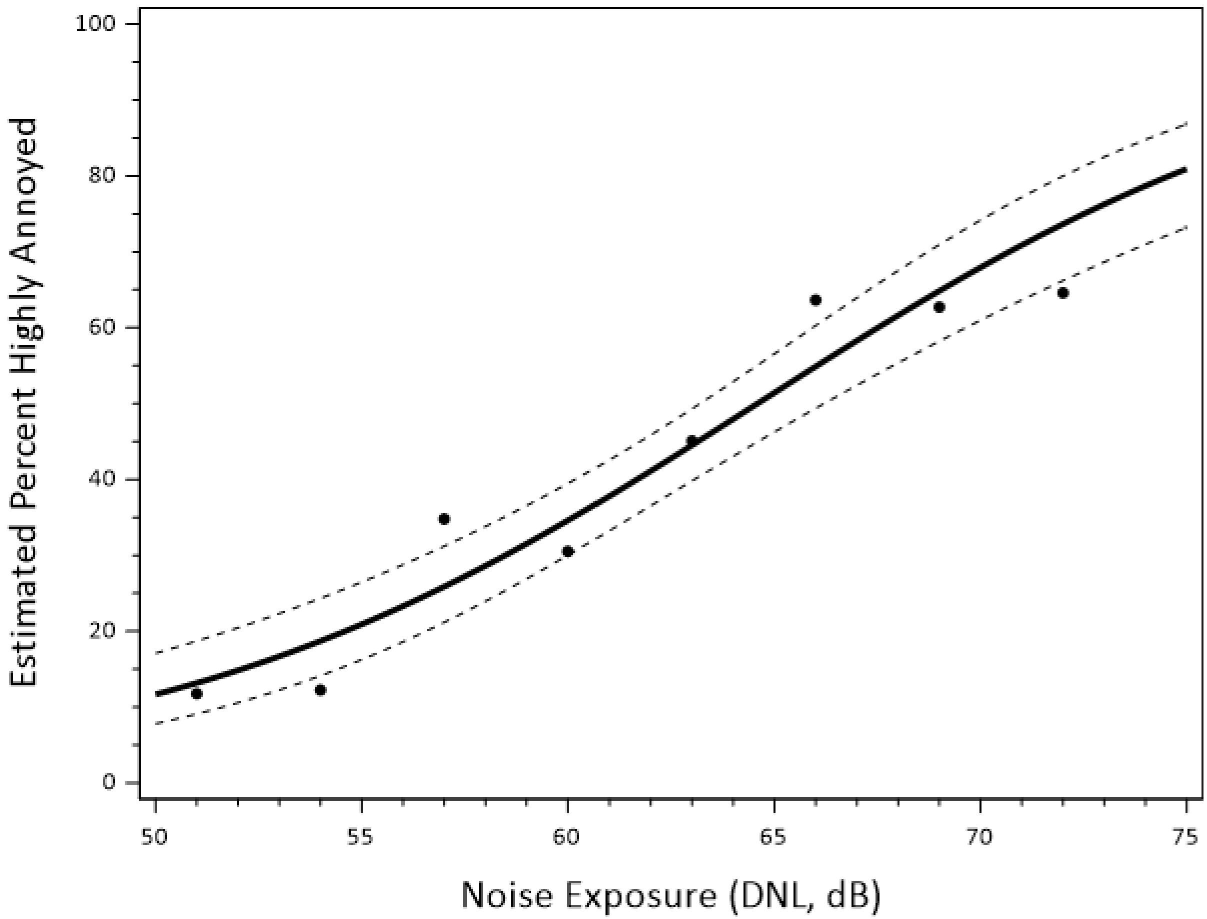

Figure I-14. Dose-Response Curve for MEM

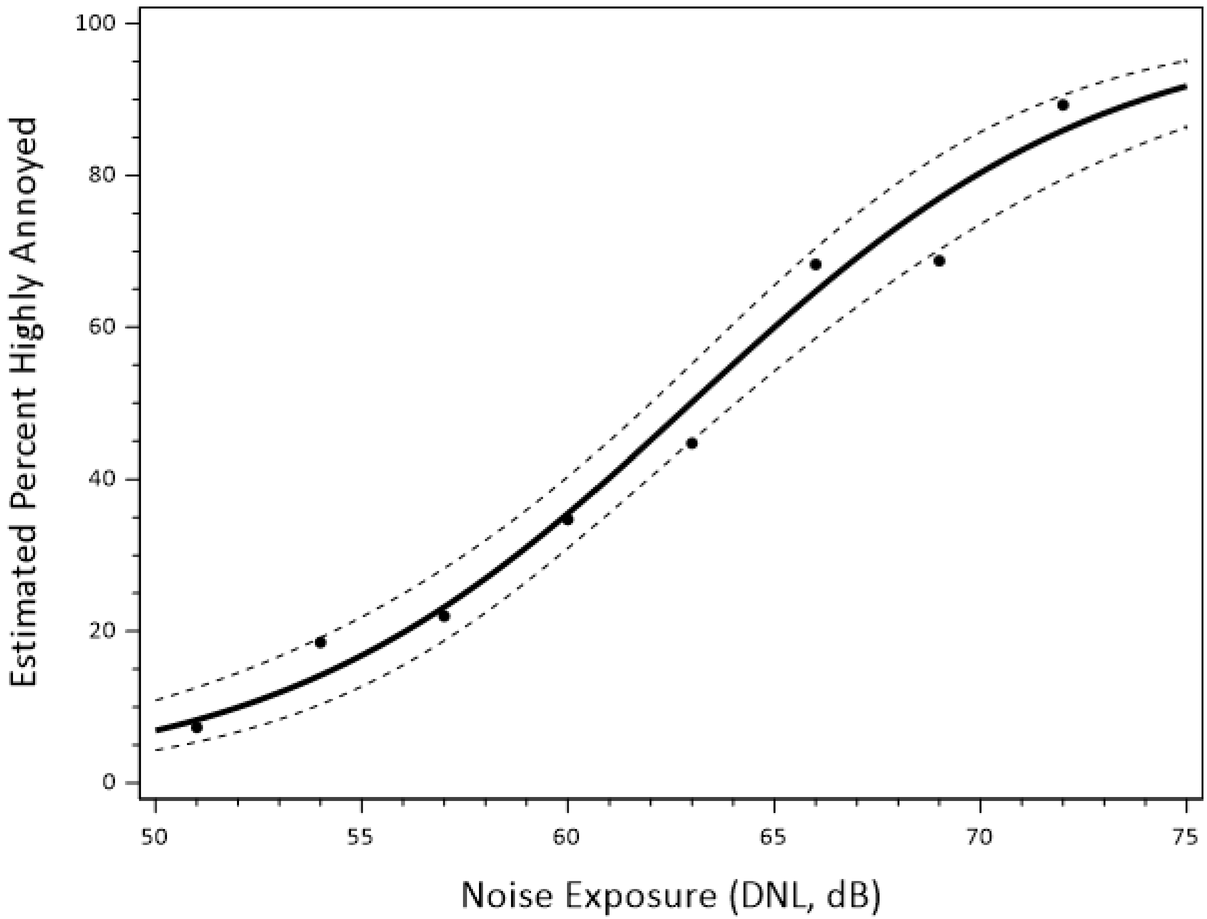

Figure I-15. Dose-Response Curve for MIA

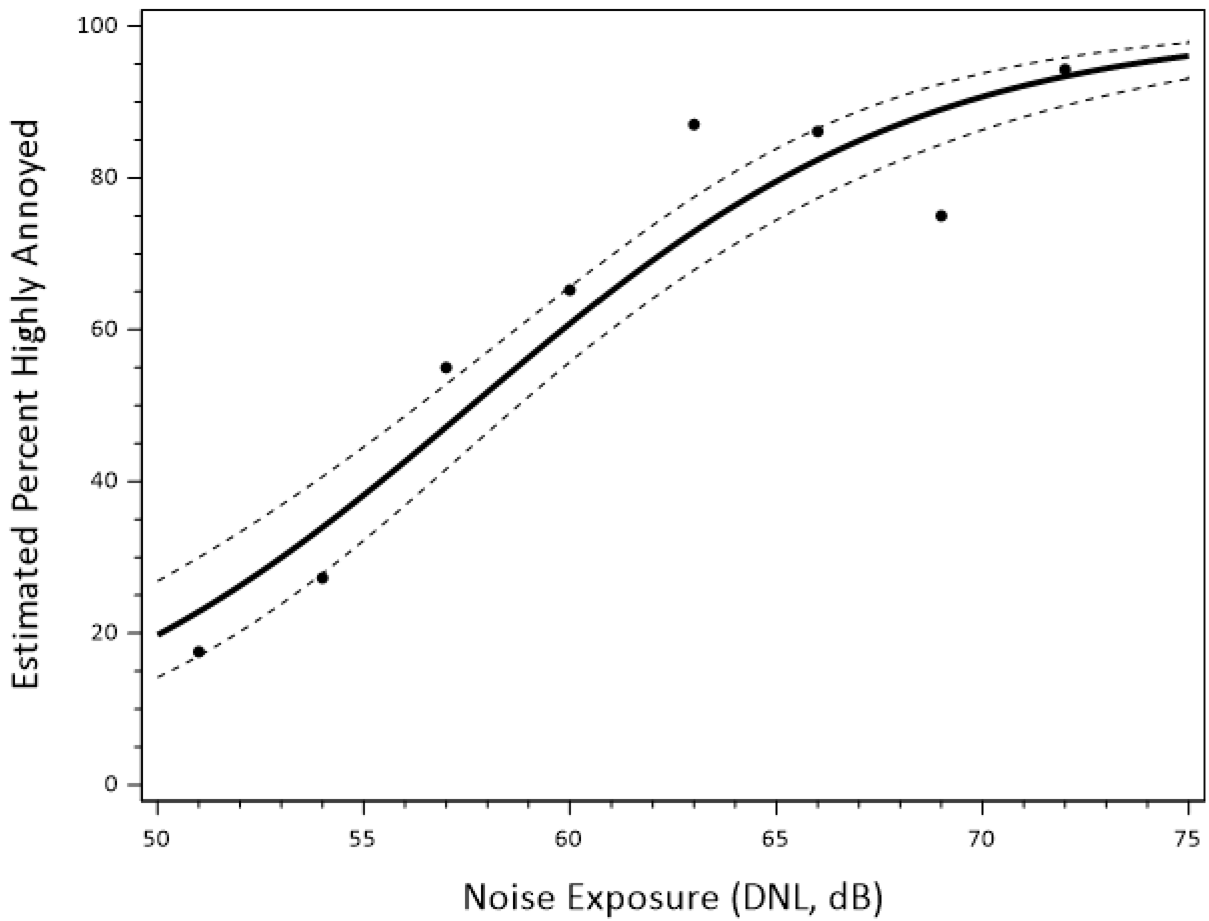

Figure I-16. Dose-Response Curve for ORD

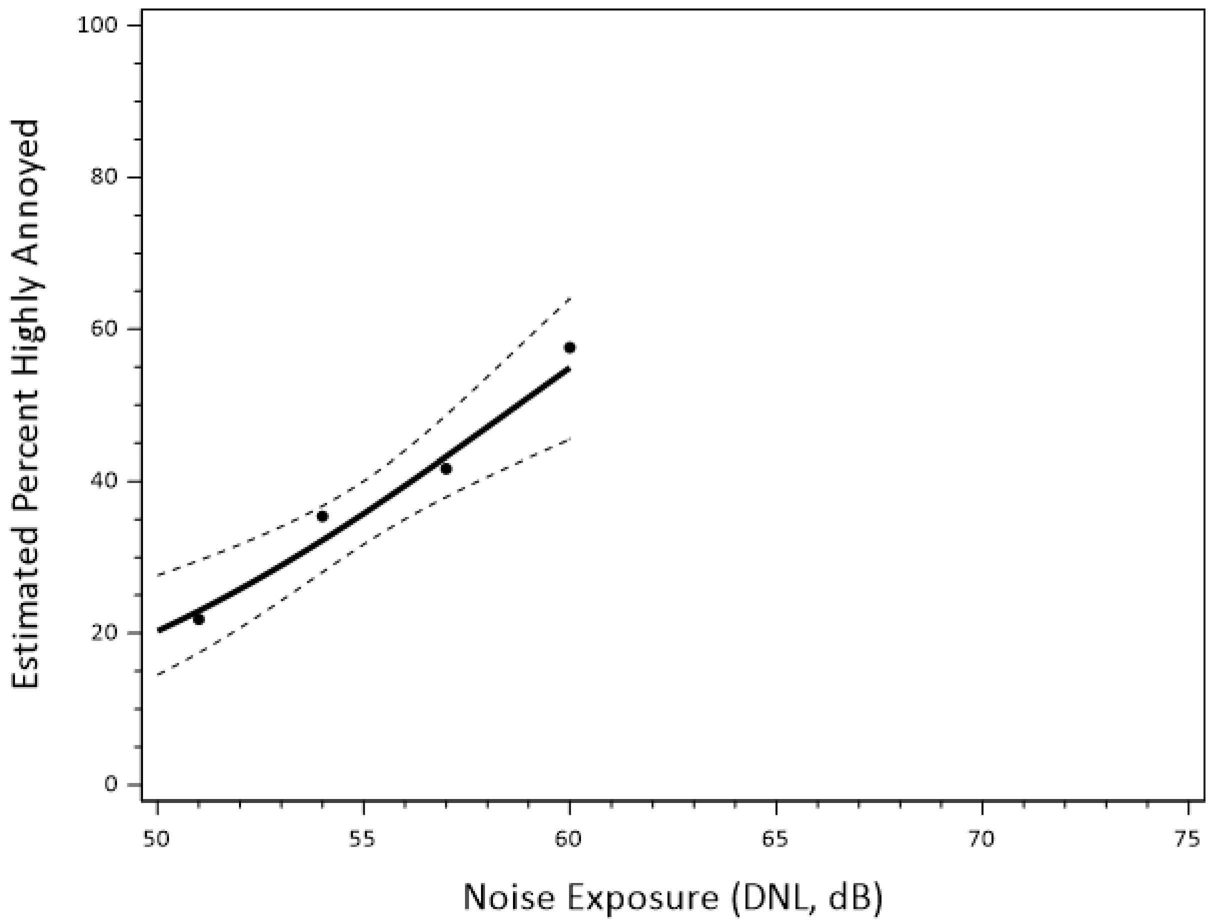

Figure I-17. Dose-Response Curve for SAV

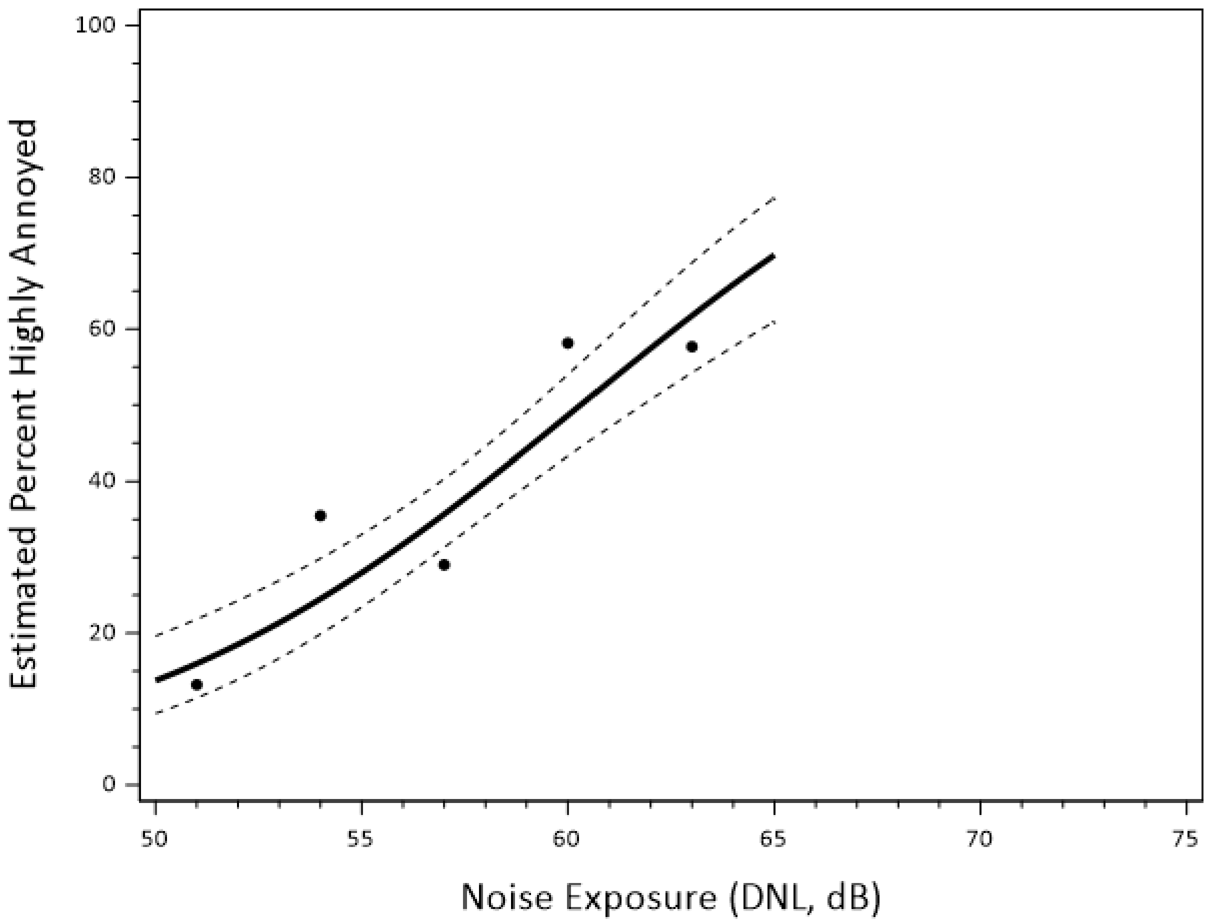

Figure I-18. Dose-Response Curve for SJC

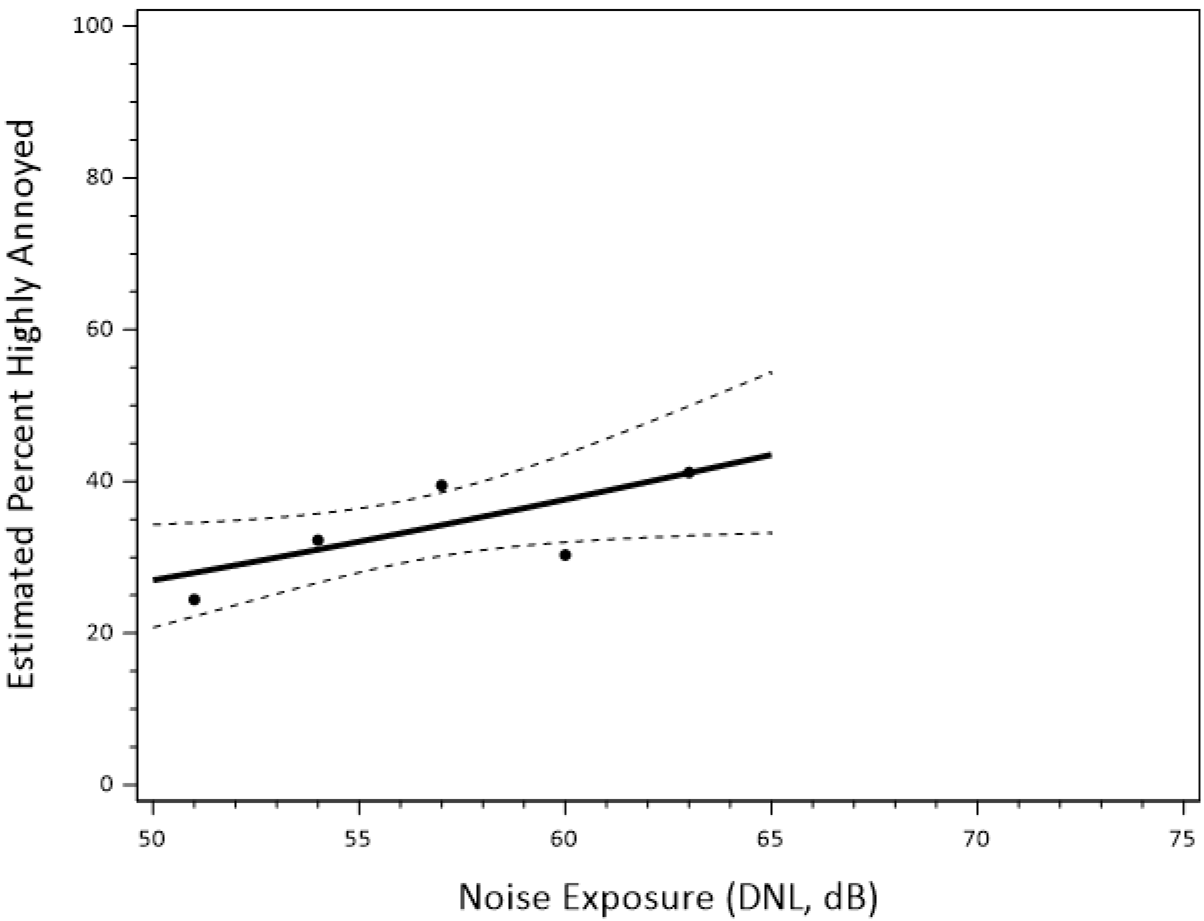

Figure I-19. Dose-Response Curve for SYR

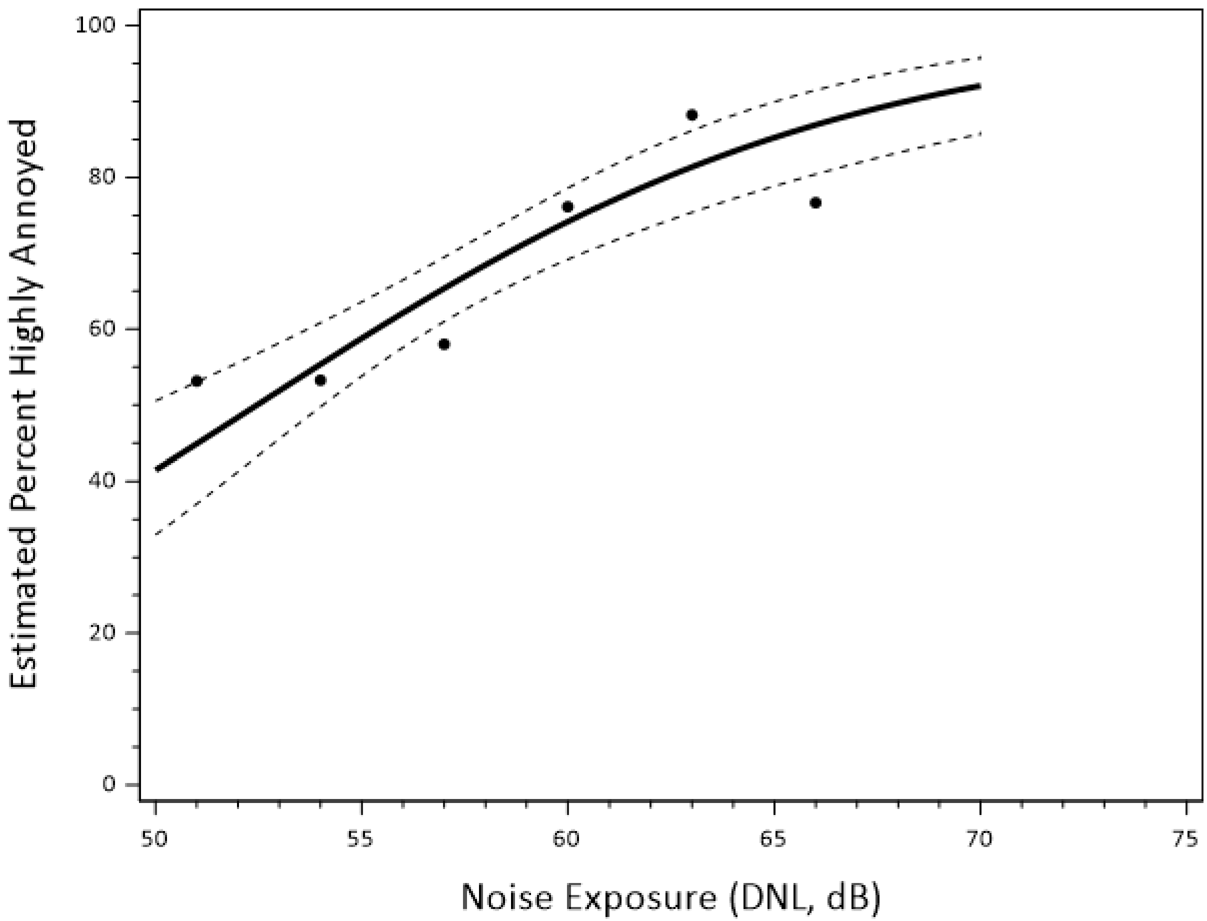

Figure I-20. Dose-Response Curve for TUS

Appendix J Methodology and Rationale for Additional Factors Analyzed

J.1 Introduction

The following six subsections describe the rationale and methodology for six factors identified by the FAA (HMMH 2016) which may aid in understanding differences in dose-response curves between airports. These factors are analyzed in Chapter 9.

1. Climate
2. "Visible" Flight Events
3. "Noticeable" Flight Events
4. "Relatively Important" Flight Events
5. Race/Ethnicity
6. Income

Each factor is analyzed to determine if it modifies the location or shape an airport-specific or the national dose-response curve. The analysis of each factor was undertaken by including extra terms in the basic regression model in Equation (1.1) that describe how the factor values modify the intercept (β_0) and slope (β_1) of the curve. The details of the statistical methods used for the analysis are described in Appendix H (Section H.3).

Factors 1 through 4 use data from calendar year 2015. The following subsections address each of the six factors.

For Factors 5 and 6 (race/ethnicity and income), analyses of whether annoyance differed meaningfully among minority populations (Section J.6) and low-income populations (Section J.7) were undertaken for consistency with the responsibilities under Executive Order (EO) 12898 and US Department of Transportation Order 5610.2(a). These require the FAA to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health environmental effects of its programs, policies, and activities on minority populations and low-income populations" (EO 12898).

J.2 Climate

Climate has been found to be associated with reports of aircraft noise annoyance (Miller et al. 2014a). In considering what climate factors would most likely encourage open windows and/or outside activity, and hence increased exposure to higher aircraft sound levels, the sum of annual cooling degree days (CDD) and heating degree days (HDD) was thought to best overall indicate a climate of moderate temperatures. The smaller the sum, the more moderate and less variable the temperatures would be.

The primary reference used for degree day data was the website of the National Centers for Environmental Information, a part of the National Oceanic and Atmospheric Administration (NOAA). NOAA provides definitions of CDD and HDD (NOAA 2017) as follows:

Cooling Degree Days:

A form of Degree Day used to estimate energy requirements for air conditioning or refrigeration. Typically, cooling degree days are calculated as how much warmer the mean temperature at a location is than 65 °F on a given day. For example, if a location experiences a mean temperature of 75 °F on a certain day, its CDD is 10 because 75 - 65 = 10.

Heating Degree Days:

A form of degree day used to estimate energy requirements for heating. Typically, heating degree days are calculated as how much colder the mean temperature at a location is than 65 °F on a given day. For example, if a location experiences a mean temperature of 55 °F on a certain day, its HDD is 10 because 65 - 55 = 10.

Detailed daily data from calendar year 2015 were used to compute annual total degree days for each airport (NOAA 2015). For a few airports, degree data were not found in the NOAA database, and a similar database derived from historical Weather Underground data was used (Weather Company 2016). A comparison of the NOAA data and Weather Underground showed virtually identical degree day data. Table J-1 shows the annual total degree days for each airport in the sample.

Table J-1. Annual Total Degree Days for the Sampled Airports, 2015

Airport Identifier	Annual Total Degree Days
ABQ	5,296
ALB	7,299
ATL	4,355
AUS	4,644
BDL	6,844
BFI	4,274
BIL	6,635
DSM	6,567
DTW	6,822
LAS	5,560
LAX	2,150
LGA	6,029
LIT	5,192
MEM	5,123
MIA	5,370
ORD	6,912
SAV	4,218
SJC	2,644
SYR	7,417
TUS	4,565

J.3 "Visible" Flight Events

The hypothesis is that the possibility of seeing aircraft increases the degree of annoyance beyond that produced by hearing aircraft.

The concept of passing over or nearly over may be quantified by the elevation angle α of the flight track above the horizon at the track point of closest approach. Figure J-1 depicts the important variables associated with the position of an aircraft relative to a receiver on the ground. The elevation angle, α, ranging from 0 degrees to 90 degrees, can specify how much "over" an aircraft flies. The slant distance determines how close the flight is to the receiver. FAA's decision was to define VISIBLE as the number of flights for which the point of closest approach has a value of α equal to or greater than 45 degrees above the horizon, and with a slant distance less than 12,000 feet. At a slant range of 12,000 feet (approximately 2 nautical miles), a Boeing 737-900 (approximately 140 feet in length) subtends slightly more than 0.5 degrees. Coupling this slant range with a field of view of 180 degrees, the aircraft would consume less than 1 percent of the field of view. With the secondary criteria of the aircraft being at least 45 degrees above the horizon, the field of view would be no more than 90 degrees and the aircraft would consume much less than 1 percent of the field of view. The secondary criteria was chosen because at angles less than 45 degrees from the horizon, it is unlikely aircraft flyovers would be visible to urban or suburban respondents due to intervening trees, buildings, etc.

With its 'detailed grid' output for each respondent, the INM was used to determine the spatial relationship of aircraft flights with respect to a given location on the ground.

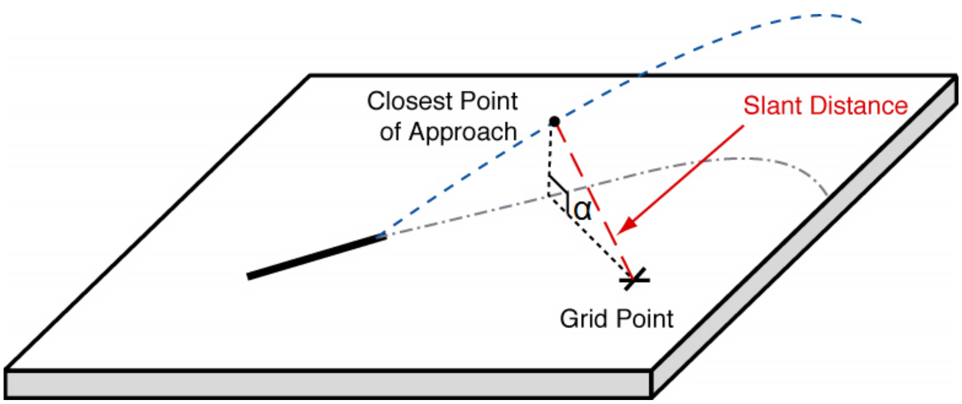

Figure J-1. Concept of Point of Closest Approach, Slant Distance, and Elevation Angle, α

J.4 "Noticeable" Flight Events

The concept of "noticeability" here means that some aspect of aircraft flights, possibly in addition to their sound level, may raise awareness of the planes and hence increase the annoyance. A flight event was deemed 'noticeable' if it had a Maximum (A-weighted) Sound Level (L_{max}) of at least 50 dB at the respondent's location. INM's computation of DNL includes every modeled flight track, and many of those events may have low sound level, making them unlikely to be noticed or even detected by the respondent. The number of noticeable flight events gives an alternative view of noise exposure that concentrates on the events thought to be most likely to annoy a respondent.

Aircraft events must exceed some sound level if residents are to notice them. Various research efforts have addressed noticeability from the perspective of whether such variables as background noise or task accomplishment affect when a test subject becomes conscious of an intruding sound. One study (Potter et al. 1977) found that "test subjects required [audible warning device] signals about 6 to 12 dB above those that an ideal [completely attentive] observer would require to detect essentially all warning signals with a negligible false alarm rate." The test subjects were required to accomplish tasks to steer the test vehicle and to maintain a constant speed and to brake when they heard the signal.

Another study (Sternfeld et al. 1972) divided subjects into two groups, one to do work tasks, the other to do leisure activities. The study reported "during leisure activities there were more occasions when the VTOL aircraft sounds were not noticed than during work activities."

For testing of whether "noticing" more events results in more annoyance, it was assumed the event noise needs to be noticed because subjects are usually engaged in some task while at home. In other words, it was not expected the respondents would normally be sitting outside, waiting to hear an aircraft (detection). From Potter (1977), it is estimated that noticing during a task occurs when the event's noise level is approximately 10 dB above detection. For typically shaped background levels (sloping downward from low frequency levels to high frequency levels at about 4 to 6 dB per octave), jet aircraft can be detected when their A-weighted level is about 7 dB lower than the background noise (Miller 1997). For noticeability, the jet aircraft noise must be about equal to the background noise. For the survey areas, it is assumed that the non-aircraft outdoor background levels generally are below 50 dBA for at least 50 percent of the day. Hence, using a threshold of 50 dBA for counting "noticeable" aircraft seems reasonable.

Using INM's detailed grid point output, the Number of Events (at or) Above a L_{max} of 50 dBA (or NA50 L_{max}), NUMBERABOVE50, was computed for each respondent location.

J.5 "Relatively Important" Flight Events

An alternative description of the objective of this analysis is: At a given exposure in terms of DNL, are people who experience many lower level events more likely to be annoyed than people who experience fewer high level events?

The DNL at any particular location is composed of the contributions from many different aircraft operations. Some of these aircraft operations make a large contribution to the total DNL because the aircraft was a relatively loud aircraft type, the aircraft flight path was very close to the location, or the aircraft operations occurred at night. Typically, a large number of operations at the airport contribute little to nothing at a particular location because they do not fly near the site.

The variable, IMPORTANT, reports the number of important aircraft operations at a particular location by quantifying the number of aircraft operations on an average annual day necessary to produce a DNL one decibel lower than the total DNL. The contributors to the total DNL at each location were ordered from highest to lowest partial DNL (most important to least important). Starting with the highest partial DNL and progressing toward the lowest, the partial DNLs were added until the sum reached a value one decibel lower than the total DNL. As these noise values were added, the number of aircraft operations represented by each contributor was also summed to produce the total number of important operations.

J.6 Race/Ethnicity

The NES asked each mail respondent two questions about race/ethnicity. Question 9 asked: “Are you Spanish, Hispanic, or Latino?” Question 10 asked: “What is your race? One or more categories may be selected” with response options White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander. These questions are consistent with the US OMB’s requirements for race and ethnicity classification (OMB 1997). The minority population is defined as the population that does not report ethnicity and race as “non-Hispanic white alone” (US Census Bureau 2011).

In accordance with the guidelines in FAA (2016), a variable MINORITY was created for each respondent based on the responses to questions 9 and 10. This variable had a value of 1 if the respondent reported being Hispanic on Question 9 or marked at least one of the last four response options (Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander) on Question 10. The variable had a value of 0 if the respondent reported being non-Hispanic in Question 9 and marked only category White in Question 10.

Across all airports, 4,849 respondents (43.4 percent) were classified as minority and 5,136 were classified as non-minority. The 343 respondents to the survey (3.3 percent) who had missing data for MINORITY were omitted from the analysis of this variable.

Table J-2 shows the percentage of respondents at each airport with MINORITY value of 1. The percentages range from 7.4 percent at SYR to 90.7 percent at MIA.

Table J-2. Percentage of Respondents with MINORITY = 1 at Each Airport

Airport Identifier	NES Percent Minority Among Respondents
ABQ	65.7
ALB	14.3
ATL	85.7
AUS	63.3
BDL	11.0
BFI	51.2
BIL	9.9
DSM	9.2
DTW	42.5
LAS	42.2
LAX	71.2
LGA	75.3
LIT	73.3
MEM	66.3
MIA	90.7
ORD	23.7
SAV	21.4
SJC	64.9
SYR	7.4
TUS	81.5

J.7 Income

FAA guidelines (FAA 2016) specify obtaining information on low-income populations from the most recent 5-year estimates from the American Community Survey (ACS). Footnote 4 of the FAA document defines low-income populations as “those that are below the Census one times poverty level.”

The NES did not ask mail respondents about income or other information that could be used to determine poverty status. Consequently, the 2010-2014 ACS 5-year estimates were used to find the percentage below the poverty level (PCTBELOWPOVERTY) in the Census block group corresponding to the address of each respondent. The variable PCTBELOWPOVERTY is a characteristic of the block group in which the respondent resides. A respondent with PCTBELOWPOVERTY = 14.4 lives in a block group in which 14.4 percent of the population resides in households that are below the Census poverty level. The poverty status of the respondent’s household, however, is unknown; therefore, possible modifying effects of individual respondents' poverty status on the dose-response curve could not be assessed.