# Flightseeing Noise Assessment Study

Public Meeting



July 27, 2000

### **Presentation Outline**

Goals of study
Background on noise
Noise Measurement methodology
Mitigation options

## Goals of the Study

- Quantify flightseeing noise using a variety of noise measures
- Quantify other sources of noise
- Identify factors that are important
- Develop Model to allow prediction of noise from future actions
- Identify potential mitigation options

## Background on Noise

Characteristics of noise
Noise weighting scales
Noise metrics
Effects of noise
Community response criteria

## **Characteristics of Sound**

#### Sound Level

Sound Level (how loud) is measured in decibels, which are abbreviated as dB. Decibel are calculated on the logarithmic scale and can not be added or subtracted as with normal numbers.

### □ Frequency

Frequency (pitch) is measured in bands called Hertz. What we generally call high or low pitch is frequency.

### Duration

Duration (how long the noise lasts) is another important feature in measuring the total impact of a noise event.

### **Characteristics of Sound**

### Propagation of Sound

Propagation (how sound travels) depends on several environmental characteristics;

- Frequency, temperature and humidity
- Temperature gradients
- Wind gradients
- Shielding by structures
- Excess ground attenuation

Because many of these factors change daily and sometimes hourly, aircraft producing the same noise level at the source are experienced differently on the ground.

# **Frequency Weighting Scales**

#### Loudness Curves

The human ear cannot hear all frequencies of sound, so special "weighted scales" have been developed to reflect what we actually hear. The scale most closely related to human perception is Aweighting, written as dBA.

The dBA Scale has become the most prominent of these scales and is widely used in community noise analysis It's advantages are that it has shown good correlation with community response and is easily measured

# Hearing Curves



## **Noise Metrics**

### Single Event Metrics

- Maximum Noise Level (Lmax)
- Sound Exposure Level (SEL)

### Cumulative Noise Metrics

- LEQ Noise Level
- Time Above Noise Level
- Cumulative Daily Noise Metrics
  - DNL Noise Level

## Single Event Noise Metrics



## LEQ Noise Level



### Time Above Noise Level



## **DNL Noise Level**



## Effects of Noise on People

Hearing Loss
Communication Interference
Sleep Interference
Physiological Response
Annoyance

## **Communication Interference**



## **Sleep Interference**



## Annoyance and Community Response



### Park Service Visitor Response



# Noise Monitoring Methodology

- Measurement methodology
- Noise Measurement locations
- Measurement Data to be collected
- Examples of data results

# Measurement Data

#### Acoustic Data

- Continuous 1-second dBA noise data
- Sample periods of frequency-weighted data

#### Aircraft Flight Information

- Aircraft Flight Information
- Aircraft Flight Paths
- Noise Complaint Data
  - Time and Location of Complaint
  - Nature of Complaint
- Weather Data
  - Hourly Weather Reports
    - Wind, Temp, Humidity, Press, Cover
- Correlate Data

## **Measurement Sites**

#### Longer-term Sites

- 15 sites
- Continuous measurement of all noise
- Computer DNL, LEQ Single Event and Time Above

### □ Short-term and Background Sites

- 15 sites
- Continuous measurement of all noise for short-term periods
- Computer LEQ, Single Event and Time Above

### Indoor Sites

- 4 sites
- Outdoor to indoor noise reduction

# Site Selection Criteria

- Exposed to aircraft activity and/or other sources of noise
- Representative of the potential exposure of residences
- Representative of the noise environment in the environs study area
- Not in close proximity to localized noise sources
- Not in locations exposed to excessive higher wind speeds
- Not in locations that are severely shielded from the aircraft activity
- □ Variety of exposure
- □ Spatialy Distributed
- Security and access for noise monitor

## **Noise Monitoring Locations**



### **Continuous Measurement of Noise**



### Sequence of Noise Measurement



## Time History Plot of Noise Event



Time history plot of noise event

## **Daily Noise Events**

Hour Of The Day																							
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	99.6			77.6	67.9	75.8	86.7	77.2	67.9	79.1	81.3	74.7	90.0	74.7	68.2	76.9	84.4	74.9	82.7	83.2	76.1	73.4	80.5
2				86.3	67.3	77.8		77.4	72.4	68.8	81.0	71.1	71.8	85.1		80.5	82.1	76.5	75.4	74.8	77.1		80.5
3								68.4	75.9	80.6	72.3	69.0	69.6	79.2		87.8	72.8	73.4	75.0	80.1			86.7
4								76.2	90.6	68.1	76.5	77.3	83.9	78.6		73.7		75.8	71.5	77.4			79.2
5								80.6	84.5	79.0	105.4	73.5	90.8	77.6		80.9		70.7	69.0	73.2			78.9
6								80.1	71.7	76.5	67.8	91.1	81.7	77.2		79.4		80.8	82.0	75.1			79.1
7								75.9	72.8	70.9	83.0	72.4	72.1			84.9		86.1	83.5	76.8			
8								71.4		73.3	71.8		76.6					72.2	65.9	81.6			
9								75.6		63.7	75.0		80.0						72.5				
10								80.5		65.8	74.1								76.7				
11										75.0	72.6												
12										80.0	80.7												
13										98.2													
13										64.0													
10										66.0													
17										73.9 91.5													
18										72.0													
19																							
20																							

# Single Event Noise by Aircraft

Aircraft		FAR 36 Stage	Event Count	Energy Average SEL	Graph of Energy Average SEL
	B73A	2	56	94.8	
	B73B		806	84.6	
	B747	3	55	95.9	
	B757	3	226	81.8	
	B767	3	43	87.1	
	DC10	3	140	90.7	
	DC8S	2	34	97.6	
	EA30	3	10	83.5	
	EA32	3	85	84.5	
	F28	2	181	93.2	
	MD11	3	29	93.6	
	MD80	3	851	91.2	
Other Aircraft			854	91.2	
				1	

### **Frequency Measurements**



### **Outdoor to Indoor Noise Levels**

![](_page_29_Figure_1.jpeg)

## Aircraft and Other Noise Levels

![](_page_30_Figure_1.jpeg)

## **Ambient Noise Levels**

![](_page_31_Figure_1.jpeg)

### Weather vs. Noise

![](_page_32_Figure_1.jpeg)

## Flight Path Modeling

![](_page_33_Picture_1.jpeg)

## **Noise Contours**

![](_page_34_Figure_1.jpeg)

![](_page_35_Figure_0.jpeg)

## Factors that Affect Annoyance

- Number of flight events
- Loudness of the flight events
- Duration of each flight event
- Total time each day that flight noise is heard
- Hour of the day
- Pitch of frequency of the noise
- Belief that not all is being done

## Activity Interference

- Outdoor speech and communication
- Outdoor activities
- Business activities
- □ Sleep and/or relaxation
- Indoor speech and communication
- Sense of natural quiet

## **Example Noise Metrics**

Number of SEL events per day
 Daytime Time duration that aircraft are audible
 Daytime LEQ above the ambient
 Daily DNL noise level

## **Mitigation Options**

- Flight Paths and Procedures
- New Technology
- Regulations
- Fly Quiet Programs