

MATHER AIRPORT CONTINUOUS DESCENT APPROACH (CDA)

Noise Analysis Report

Prepared for:
The Sacramento County Airport System

November 2006



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MATHER AIRPORT CONTINUOUS DESCENT APPROACH (CDA)

Noise Analysis Report

Introduction

At the request of the Sacramento County Airport System (SCAS), ESA Airports prepared this report summarizing the results of periodic aircraft noise measurements made over several years at generally the same four locations along the Runway 22L ILS approach corridor to Mather Airport. The noise measurements were made prior to, during, and after the implementation of a Continuous Descent Approach (CDA) into Mather Airport.

Consideration of implementing a CDA into Mather was first discussed at the Mather Airport Aircraft Overflight Noise Working Group in 2002. At that time, the CDA was being tested by UPS at Louisville International Airport in Kentucky. The early noise measurement results at Louisville showed promise by noticeably reducing noise levels on the ground in areas at distances from 7 to 15 nautical miles from the runway end - distances that were similar to some of the noise sensitive areas along the approach to Mather Airport.

In October 2003, the Mather Airport Aircraft Overflight Noise Working Group forwarded 33 measures to the Sacramento County Board of Supervisors for their consideration including the recommendation to implement a CDA at Mather Airport. The Board of Supervisors approved 30 of the 33 measures and directed the SCAS to work with the Federal Aviation Administration (FAA), Airborne Express (ABX), and UPS to investigate the potential for implementing the CDA at Mather Airport.

Over nearly a three-year period, the FAA, ABX, and UPS worked closely with SCAS to design, test, and, ultimately, implement the CDA at Mather Airport. Over that time, the measured single event aircraft noise levels of UPS aircraft have been steadily and significantly reduced. The reduction has been achieved by optimization by the airlines of the CDA procedures, rigorous pilot training, adoption of the CDA as the default procedure for Mather arrivals, assistance by the FAA air traffic controllers, and advocacy for the procedure by SCAS. The initial results for the ABX CDA, which is in its early stages of implementation, are also encouraging. As the ABX CDA is refined and improved, we would expect see lower single event levels.

This report describes the CDA procedure, discusses the noise measurements and operational data, and documents the reduction in single event noise levels that resulted from this work.

Continuous Descent Approach

The Continuous Descent Approach (CDA) involves the management of the aircraft configuration (flaps, speed brakes, landing gear, and throttles) by the pilot or autopilot to use the minimum required thrust on a continuous glide angle into an airport. By using the lowest thrust possible and following a standard 3-degree glide angle into the airport, aircraft will produce lower levels of noise than aircraft using higher thrust settings and a “step down” approach. Figure 1 is a depiction of the 3-degree and step down approaches. Although a step-down approach at Mather Airport had been replaced with a standard 3-degree approach, SCAS believed that the management of drag inducing devices could provide further noise reductions.

For many airports, the opportunity to implement a CDA is limited because of the volume of air traffic on approach and in the vicinity of the airport especially during daytime periods. When approaching traffic is heavy, a pilot may need to adjust throttles, flap settings, and extend landing gear to maintain safe and consistent spacing with other aircraft in the airport environs. Extending flaps, and landing gear makes an aircraft “dirty” (i.e., increases drag), which requires the application of additional thrust to keep the aircraft flying at the same speed.

During the nighttime hours when cargo aircraft are arriving at Mather Airport, arrival traffic is relatively light and there are typically few other aircraft in the airport environs. This affords air traffic controllers and pilots the opportunity to use the CDA approach for those aircraft that are capable of flying them. The UPS Boeing 757 and ABX Boeing 767 aircraft that operate into Mather and the pilots who fly them have the capability to fly a CDA into Mather Airport.

Implementation of the CDA at Mather Airport required a coordinated effort by SCAS, UPS, ABX, and the FAA. SCAS served as the lead agency and assisted in the coordination between ABX, UPS, and the FAA. SCAS also processed selected operational information about each flight from the UPS and ABX provided Flight Data Recorder (FDR) data. SCAS also collected information directly from pilots at the end of each flight and led the noise measurement effort. All of the pre-2006 CDA test flights were flown by UPS with the purpose of developing the optimal CDA approach for Mather Airport.

UPS contributed to the effort by proposing the appropriate procedures for Mather, testing and perfecting those procedures in flight simulators, and testing the procedures in flight during the noise measurement program. ABX also contributed significantly to the process of implementing a CDA at Mather Airport for their Boeing 767 aircraft. This was achieved by coordination between UPS and ABX in order to modify the UPS-developed Boeing 757 CDA procedures for use in the ABX Boeing 767 aircraft. In addition, ABX pilots spent hours in flight simulators learning the CDA on the ABX 767 aircraft.

FAA assisted with the process by working with the air traffic controllers to prepare for and assist in the CDA testing. FAA also made procedural changes to make it easier for aircraft to set up for the CDA about 50 nautical miles from the Airport.

Noise Measurements

Aircraft noise measurements were made at the four locations shown in Figure 2 along the Runway 22L¹ approach corridor into Mather Airport in April-May 2004, February-March 2005, April 2005, and February-March 2006. The February and March 2006 noise measurements were over made over an 18-day period to ensure an adequate sample size for comparison to previous noise measurement efforts.

The noise measurements were made to document aircraft noise levels prior to, during, and after the implementation of the CDA. Although all noise levels were measured during the measurement program, the primary focus of this analysis is the single event noise levels of UPS's Boeing 757 and ABX's Boeing 767 aircraft. Specifically, we analyzed the measured maximum sound levels (L_{max}) and single event noise exposure levels (SENEL) of both aircraft types.

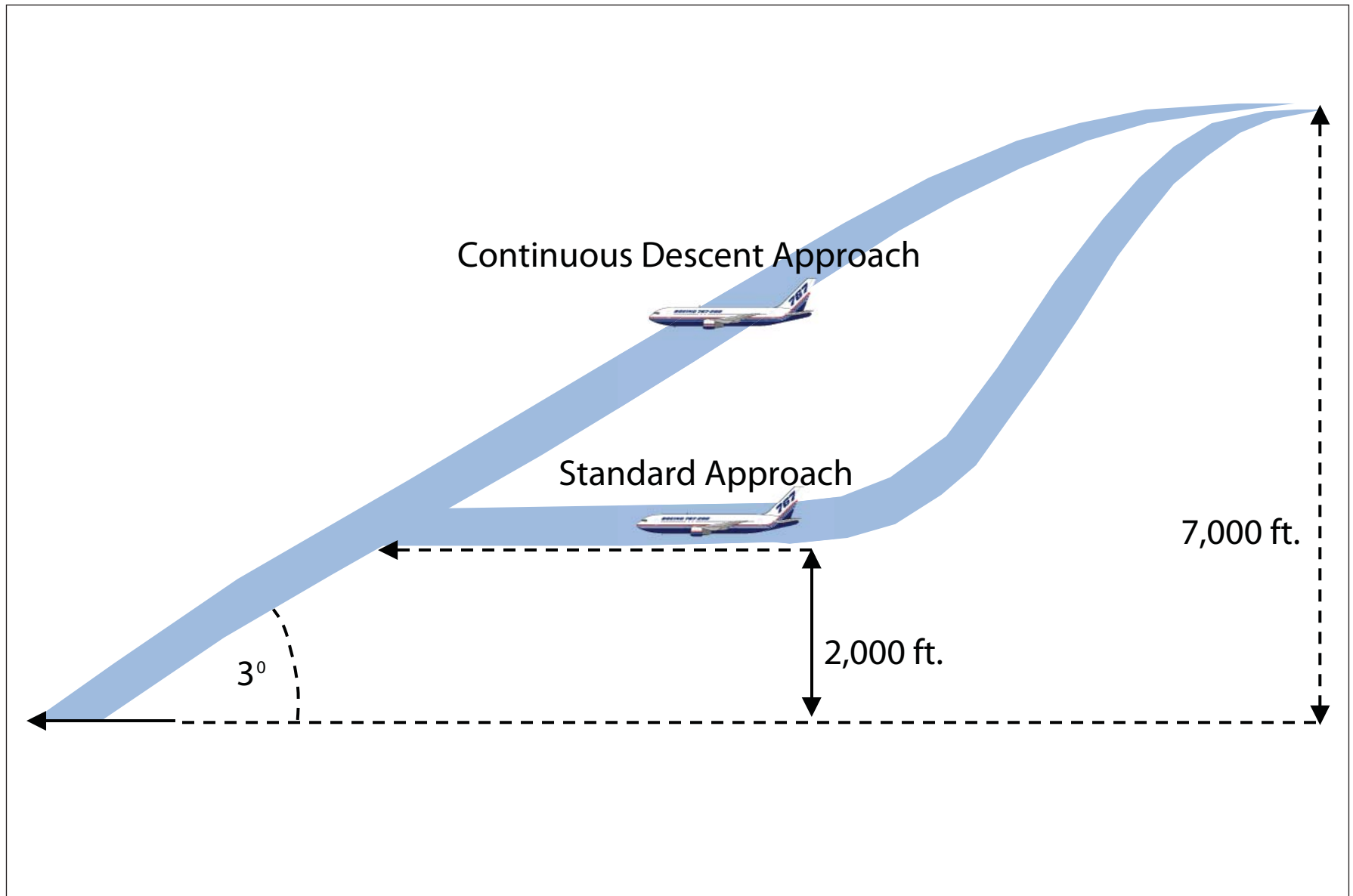
Larson Davis 870 and Larson Davis 820 environmental noise monitors were used during the noise measurement program. One of the locations, Site 1, was moved slightly during the measurements to accommodate the request of a resident. The site was moved approximately 2,200 feet east and approximately 130 feet lower in elevation than its original location. Table 1 provides the longitude and latitude all of the sites. The noise monitors were serviced and calibrated daily. The single-event threshold of the noise monitors was set approximately 10 decibels (dB) above the ambient sound levels at each site.

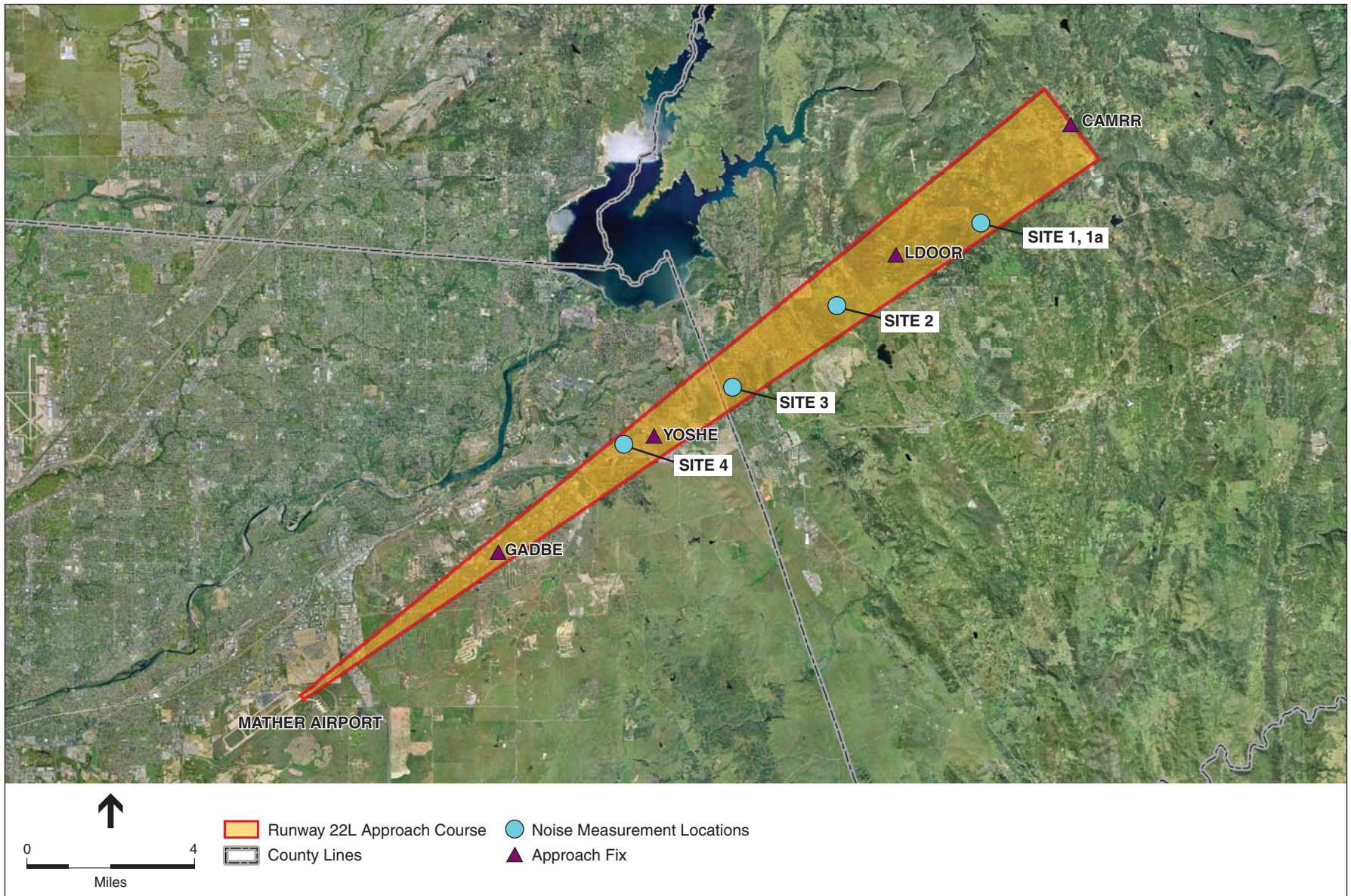
**TABLE 1
MATHER AIRPORT APPROACH CORRIDOR MEASUREMENT SITE DATA**

Site	Address	Approx. Coordinates	Approx. Elevation (MSL)	Approx. Distance to Threshold Rwy 22L (nm)	Approx. 3-Degree Glide Slope Altitude (ft)
1	Bertana Ct/Lazy Knoll Ct Rescue, CA	N38-43.549 W120-58.744	1,510 feet	17.30	5,600
2	2280 Ethel Dr El Dorado County, CA	N38-41.868 W121-02.586	1,260 feet	13.87	4,417
3	354 Glen Ridge Ct El Dorado Hills, CA	N38-40.198 W121-05.381	1,010 feet	11.17	3,557
4	2305 Farndon Ct Folsom, CA	N38-39.016 W121-08.291	336 feet	8.55	2,722

Three detailed technical memoranda concerning the noise measurements are available at SCAS's web site at www.sacairports.org.

¹ Runway 22L is used for arrivals by air carrier-sized cargo aircraft approximately 98 percent of the year.





SOURCE: GlobeXplorer, 2004; HMMH, 2006; and ESA, 2006

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Figure 2
 Noise Measurement Locations along the ILS Approach Corridor

Operational Data

Data from the SCAS's Aircraft Noise and Operations Monitoring System (ANOMS) was used to identify aircraft type, location, altitude, slant distance, and time of closest approach for each measured aircraft event. The aircraft operations data are collected from the FAA's Automated Radar Terminal System (ARTS), the same system that provides position and aircraft identification information to FAA Air Traffic Controllers.

During the testing and implementation of the CDA, UPS and ABX provided SCAS with select data from the FDRs indicating the configuration of each Boeing 757 and 767 aircraft along the approach to Runway 22L. The ANOMS data and FDR data were correlated to identify aircraft that were performing the CDA procedure and aircraft that were not. Post-flight pilot interviews were conducted to assess when a CDA was flown. SCAS also reviewed the ANOMS data for each approach to aid in the determination. Since February 2006 was the first set of measurements during the recently developed ABX CDA, all of the pre-2006 ABX arrivals noise events were presumed to be non-CDA approaches.

Data Analysis

Measured noise events were correlated with aircraft operations on the basis of time. The time of the maximum noise level typically occurs within a few seconds of the time of closest approach. In most cases, aircraft noise events were readily discernible from other sounds due to the low ambient noise levels during the nighttime measurements. As discussed earlier, the nighttime is the only time that flying the CDA is possible due to the relatively low traffic levels in the Mather Airport environs.

Noise events for aircraft operations that were outside of the Runway 22L approach corridor (based on their slant distance from the noise monitoring site) were excluded from the analysis.

The FDR data and/or pilot surveys were used to determine if an aircraft was flying a CDA approach or not. All of the noise measurements made prior to the testing and implementation of the CDA were assumed to be non-CDA approaches. It is important to note that although a flight may not have been an official CDA, their characteristics could be CDA-like simply because aircraft approaching Mather Airport are already flying a 3-degree approach and the aircraft may have been using a low throttle setting and flying in a clean (flaps and landing gear up, speed brakes down) configuration. As a result, some non-CDA noise events have CDA-like noise levels.

The noise events successfully correlated with aircraft operations were grouped into CDA and non-CDA events by site. The high, low, and median values of each category were determined. The data were also compared graphically by site.

UPS Boeing 757 Results

Figure 3 graphically depicts the results for the Lmax values for the UPS Boeing 757 aircraft at all four sites. Figure 4 shows the results for the SENEL values the UPS Boeing 757 aircraft at all four sites. In both cases, the graphs clearly show that the CDAs generally produce lower noise level than the non-CDA approaches. As shown in Figures 5 and 6, the average of the range of Boeing 757 single event levels fell by about four decibels from the non-CDA to the CDA approaches for both the Lmax and SENEL values.

The downward shift in the range and average measured noise levels during the UPS CDA events demonstrated that there is a direct, consistent, and repeatable relationship between the use of the UPS CDA and a reduction in single event noise levels at the noise measurement sites.

Table 2 provides the number of noise events that were correlated to each UPS Boeing 757 aircraft by measurement site number and by CDA versus non-CDA events.

**TABLE 2
NUMBER OF CDA AND NON-CDA UPS
BOEING 757 AIRCRAFT ARRIVAL NOISE EVENTS**

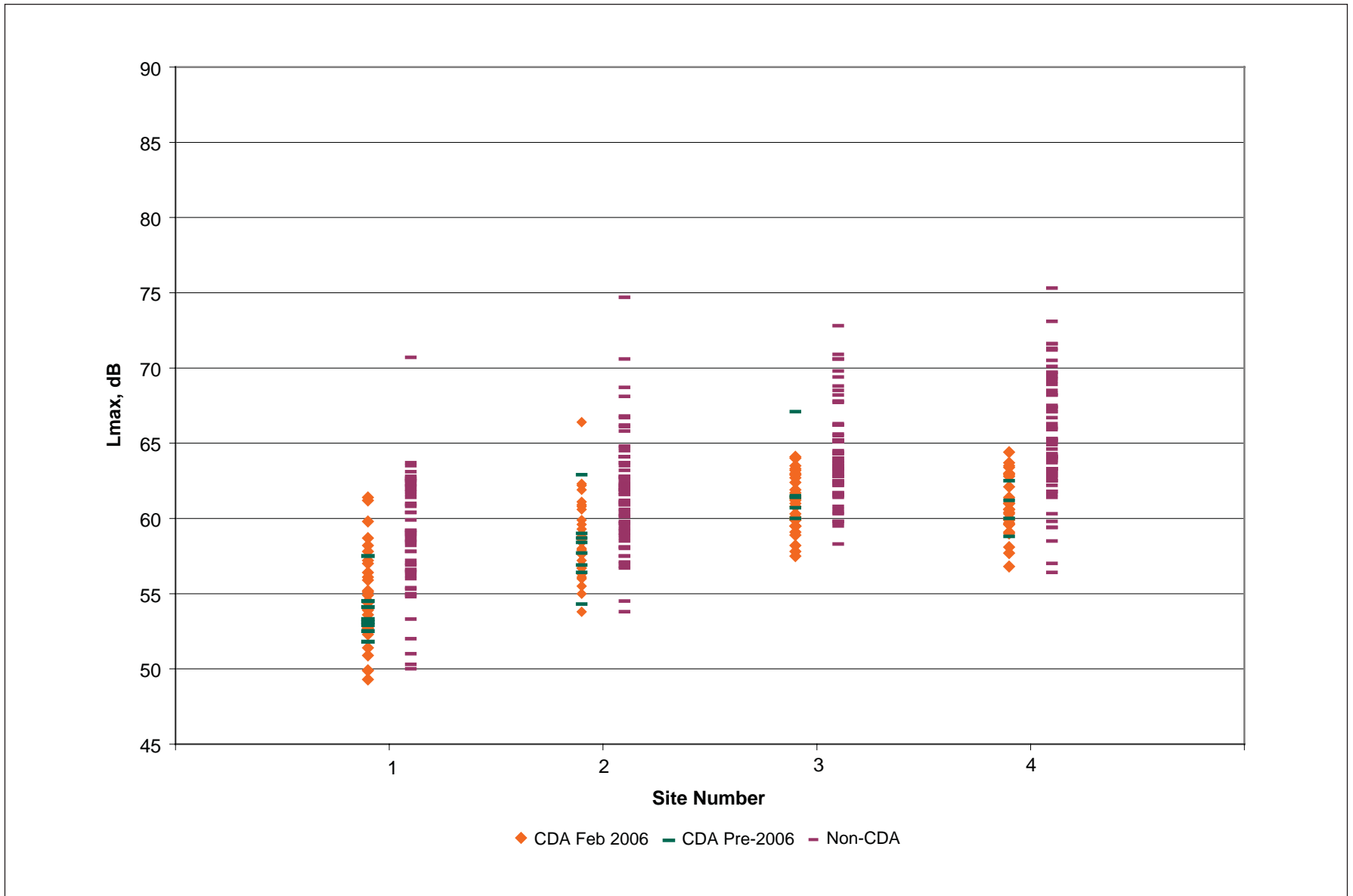
Site No.	Non-CDA	CDA	Total
1	52	38	90
2	70	41	111
3	67	33	100
4	74	34	108

ABX Boeing 767 Results

Figure 7 depicts the results for the Lmax values for the ABX Boeing 767 aircraft at all four sites. Figure 8 shows the results for the SENEL values for the ABX Boeing 767 aircraft at all four sites. Figures 9 and 10 show the range of measured noise levels as well as the average of the measured Lmax and SENEL values, respectively. In all cases, the graphs show that the results for the ABX 767 CDA varied from site-to-site.

At Site 1, the most distant site, the average ABX 767 CDA single event noise levels were slightly higher than non-CDA noise events. At Site 2 the average ABX 767 CDA Lmax values were higher, while the SENEL values were about the same. Sites 3 and 4 experienced about a 2 decibel reduction in the average Lmax and SENEL values as a result of the ABX 767 CDA.

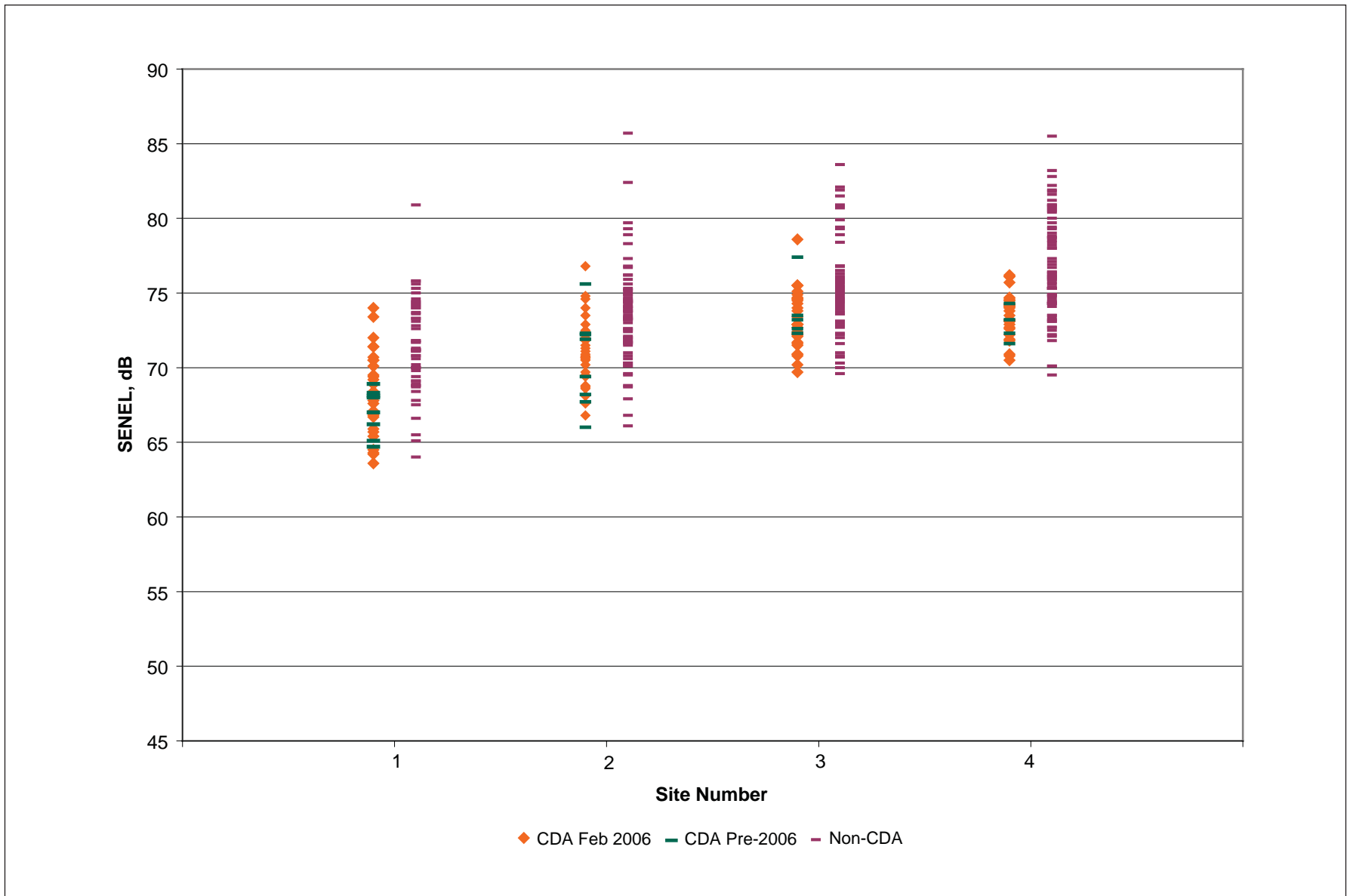
It is important to note the ABX 767 CDA is in the early stages of development and implementation. As was the case with the refinement of the UPS 757 CDA, additional reduction in single event noise levels for the ABX 767 CDA should be expected as the procedure is studied and refined.



SOURCE: HMMH, 2006; and ESA, 2006

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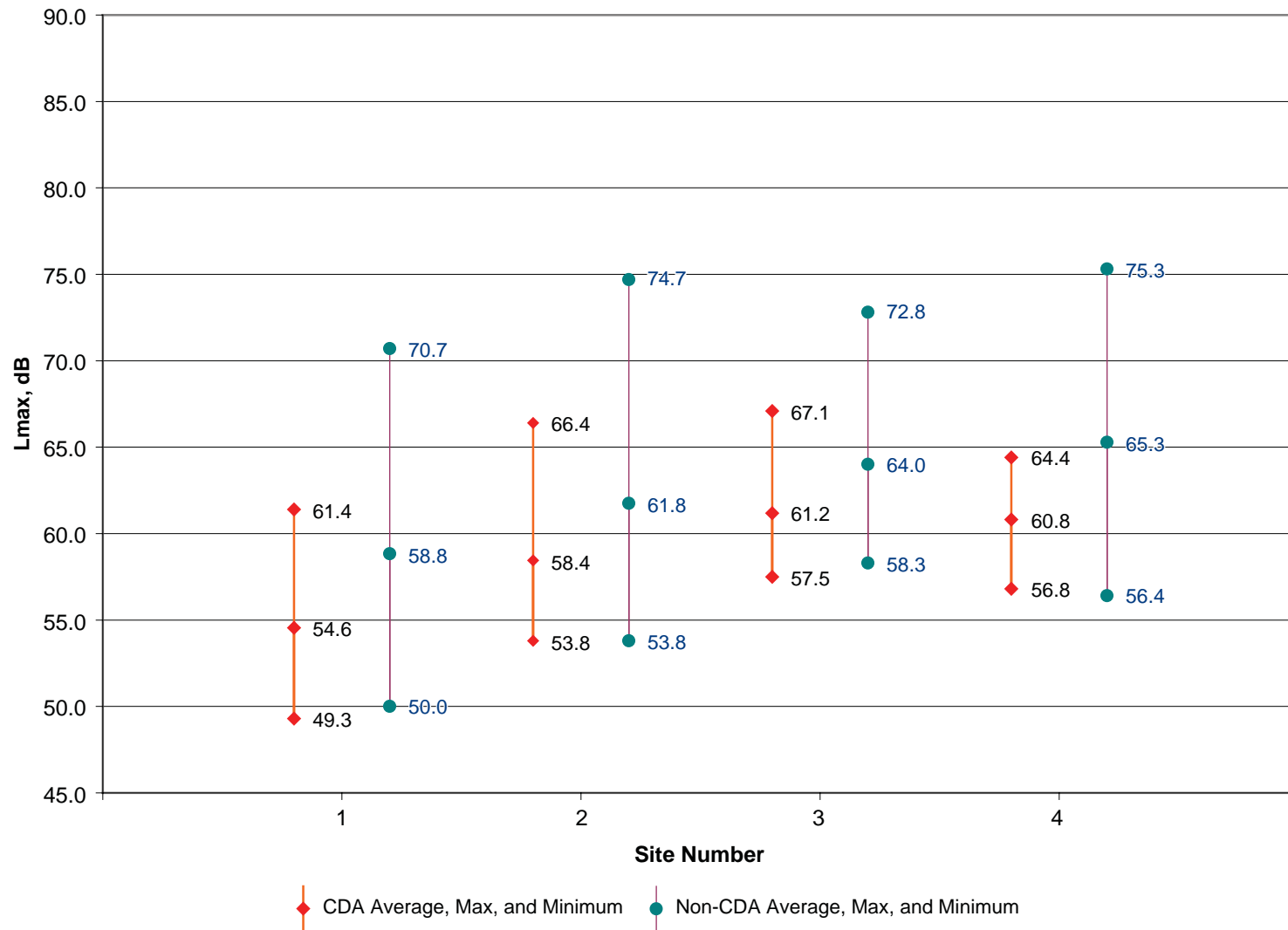
Figure 3
Lmax Comparison for UPS CDA and Non-CDA Flights at the
Noise Measurement Sites



SOURCE: HMMH, 2006; and ESA, 2006

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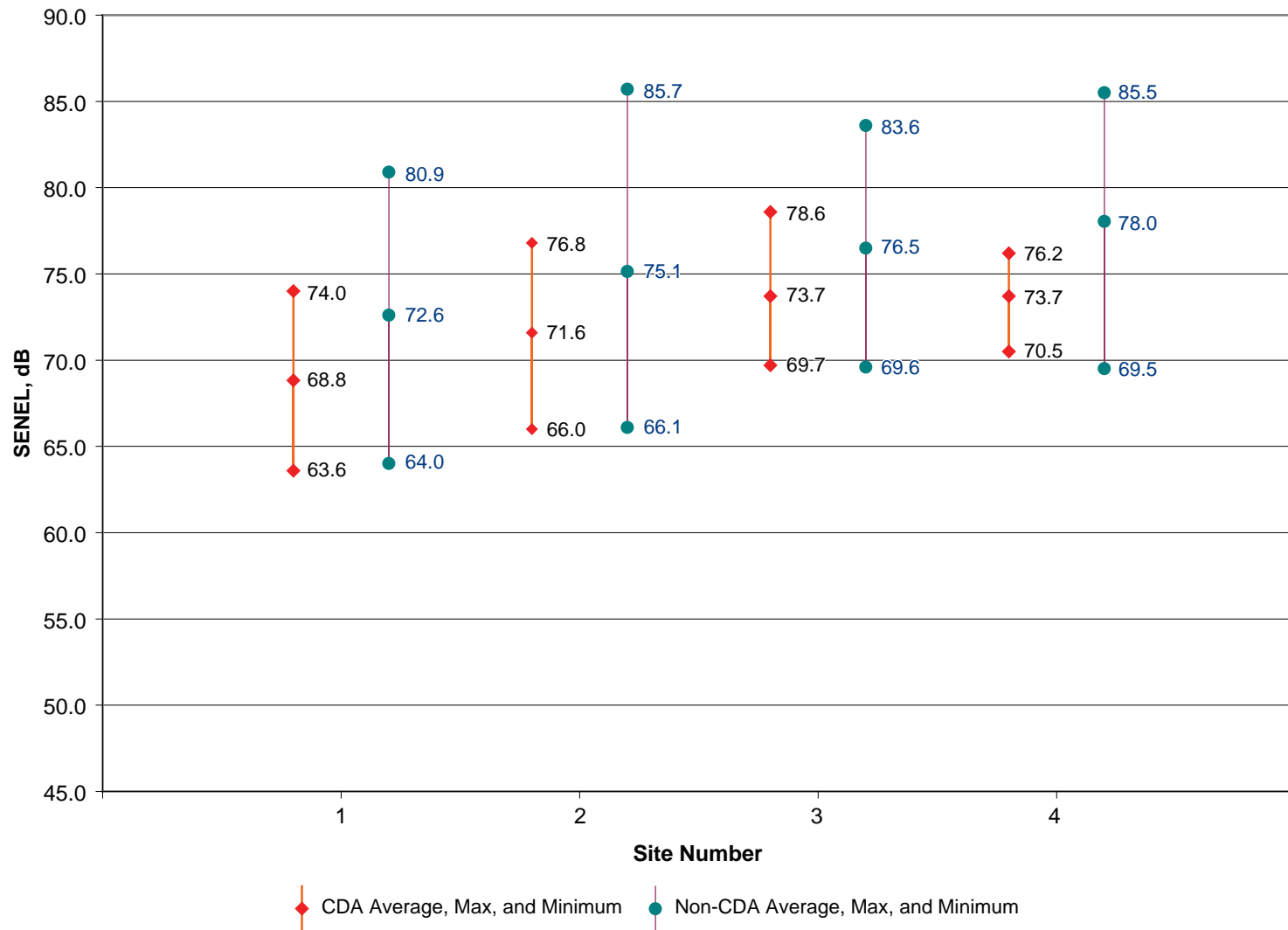
Figure 4
SENEL Comparison for UPS CDA and Non-CDA Flights at the
Noise Measurement Sites



SOURCE: HMMH, 2006; and ESA, 2006

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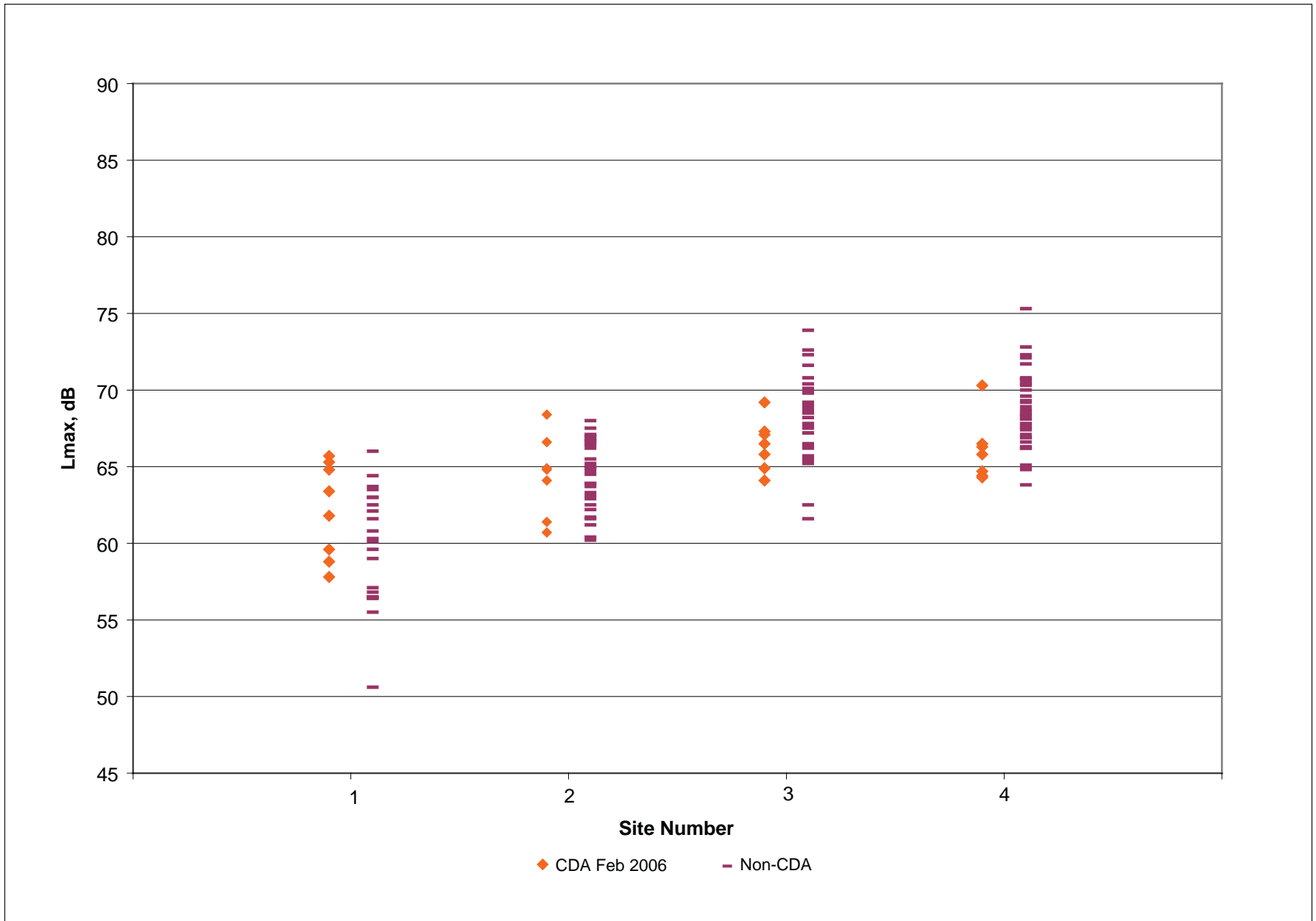
Figure 5
High, Low, and Energy-Average Lmax Comparison for UPS CDA and Non-CDA Flights at the Noise Measurement Sites



SOURCE: HMMH, 2006; and ESA, 2006

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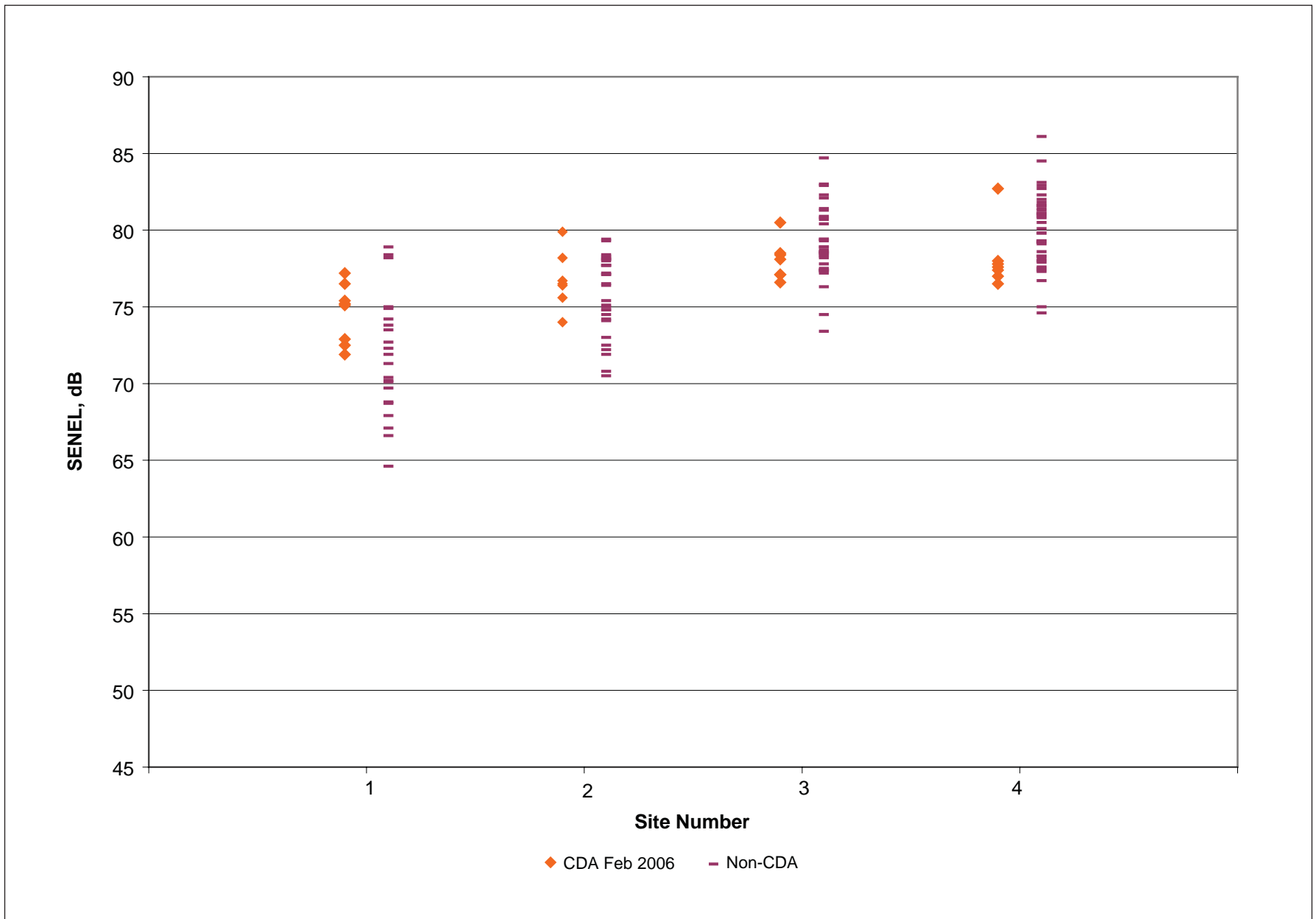
Figure 6
High, Low, and Energy-Average SENEL Comparison for UPS CDA and Non-CDA Flights at the Noise Measurement Sites



SOURCE: HMMH, 2006; and ESA, 2006

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Figure 7
Lmax Comparison for ABX CDA and Non-CDA Flights at the
Noise Measurement Sites



SOURCE: HMMH, 2006; and ESA, 2006

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Figure 8
 SENEL Comparison for ABX CDA and Non-CDA Flights at the
 Noise Measurement Sites

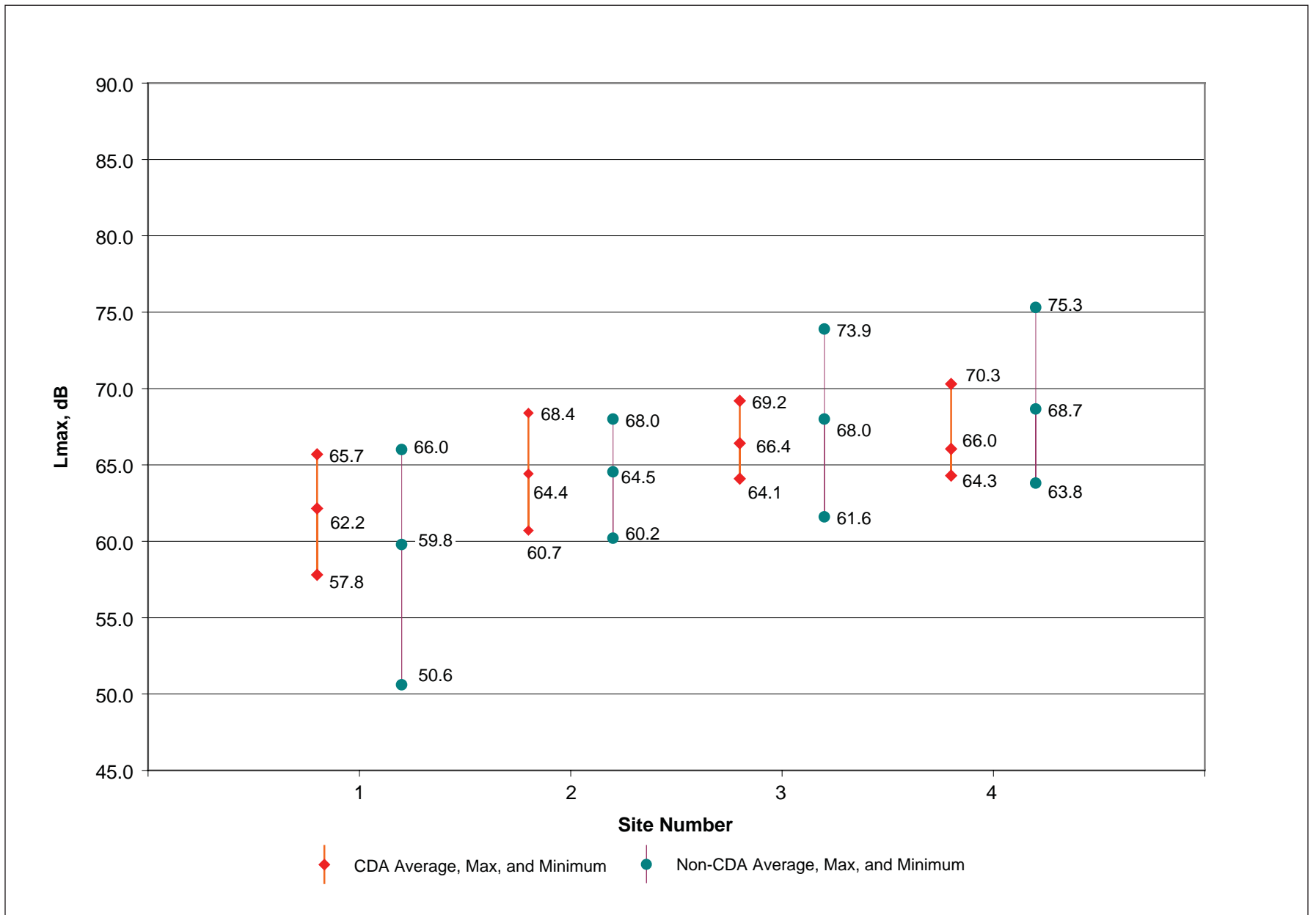


Figure 9
High, Low, and Average Lmax Comparison for ABX CDA and Non-CDA Flights at the Noise Measurement Sites

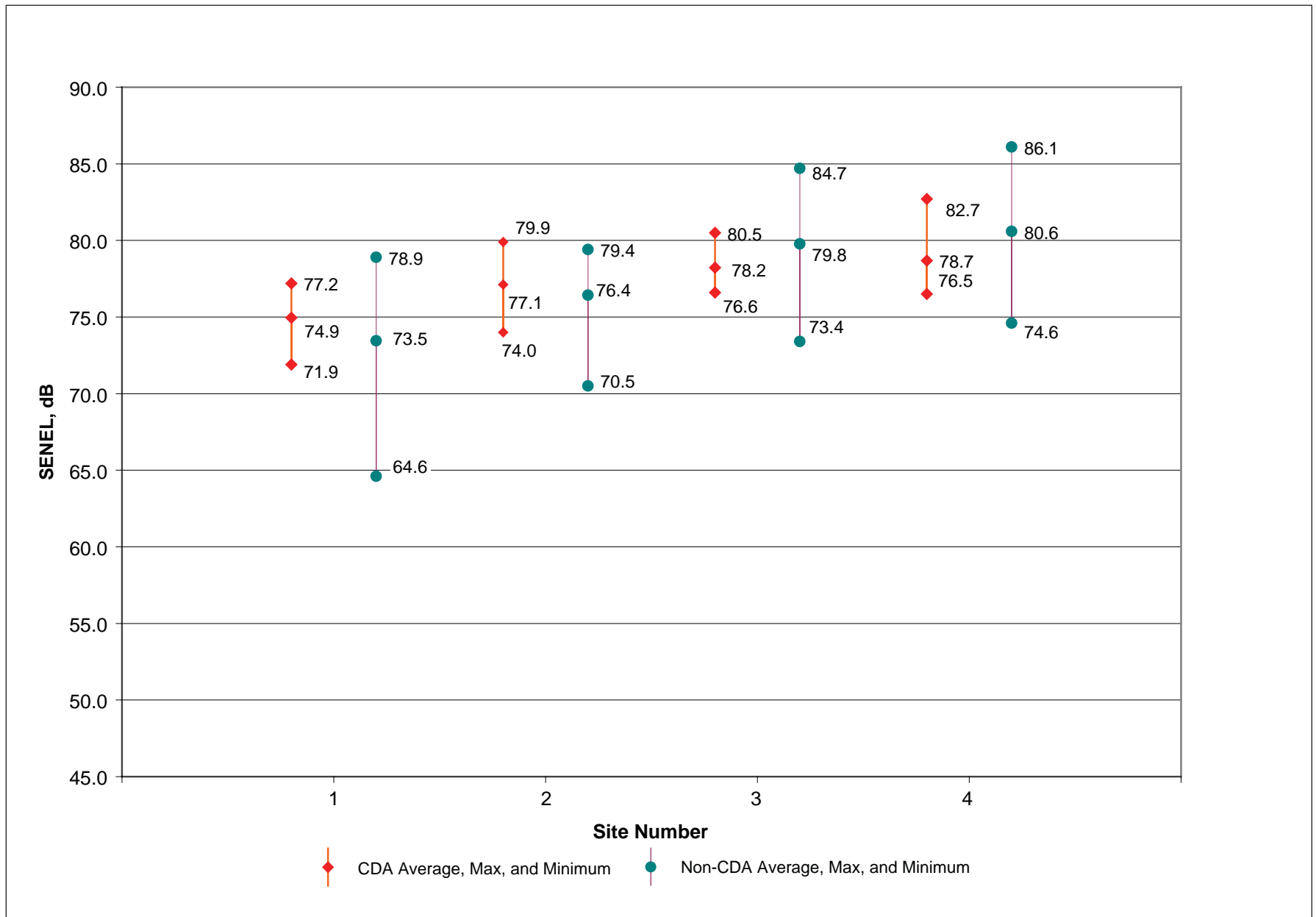


Figure 10
High, Low, and Energy-Average SENEL Comparison for ABX CDA and Non-CDA Flights at the Noise Measurement Sites

Table 3 provides the number of noise events that were correlated to each ABX Boeing 767 aircraft by measurement site number and by CDA versus non-CDA events.

**TABLE 3
NUMBER OF CDA AND NON-CDA ABX
BOEING 767 AIRCRAFT ARRIVAL NOISE EVENTS**

Site No.	Non-CDA	CDA	Total
1	22	8	30
2	30	7	37
3	34	7	41
4	40	7	47

Conclusions

The comparison of the CDA and non-CDA noise events clearly shows that use of the CDA significantly reduced aircraft noise levels on a single-event basis for UPS's Boeing 757 aircraft approaches into Mather Airport. The average reduction at each of the measurement sites was about 4 decibels for both the Lmax and SENEL values. The 4 dB amount would be noticeable to a listener on the ground.

The reduction in single event noise levels for the ABX 767 CDA were not as consistent as the UPS 757 CDA, but that is to be expected as the ABX CDA is in the early stages of development and implementation. Single event levels are expected to be reduced further as the ABX 767 is studied and refined.

By implementing a CDA at Mather single event levels of individual air cargo aircraft flights will be reduced which will result in a reduction in the cumulative aircraft noise exposure levels as well.

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