

HMMH

77 South Bedford Street
Burlington, MA 01803
Tel. (781) 229-0707
Fax (781) 229-7939
W www.hmmh.com

MEMORANDUM

To: Councilwoman Kathee Burke-Gonzalez, East Hampton Town Board
Copy: E. Vail, East Hampton Town Attorney
P. Kirsch, C. Van Heuven, and W. E. Pilsch, Kaplan Kirsch & Rockwell
From: Ted Baldwin and Sean Doyle
Date: April 10, 2015
Subject: Documentation of HMMH Noise Analyses
Reference: HMMH Project 307162.002



In response to the East Hampton Town Board's request, HMMH is pleased to provide this memorandum that documents HMMH roles in the process that led to proposed legislation (and associated implementation-related materials) to address disturbance from operations at East Hampton Airport (HTO).

1. BACKGROUND

The study process included three noise-analysis "phases." HMMH assisted on the second and third phases, and provided follow-up assistance related to implementation of the proposed legislation, in a "fourth" step.

1) In an October 30, 2014 Special Meeting, the Town Board heard a joint citizen and consultant presentation of a "Phase 1 Noise Analysis Interim Report," which proposed a "preliminary draft problem definition" and a "list of potential alternatives to address that definition." *HMMH was not involved in this phase.* The Town Board reached consensus to proceed with the next study phase, to recommend: (1) a final problem definition and (2) a refined list of alternatives that offer the best promise for addressing that problem. The Town subsequently retained HMMH to assist with the "Phase 2" effort.

2) On December 2, 2014, Ms. van Heuven of Kaplan Kirsch & Rockwell LLP (KKR) and I presented the "Phase 2 Noise Analysis" results, which culminated in recommendation of: (1) a final problem definition, and (2) a short list of the most promising alternatives for addressing that problem. The Town Board subsequently directed HMMH and KKR to undertake a third study phase to evaluate those alternatives.

3) On February 4, 2014, I assisted Ms. van Heuven and Mr. Kirsch of KKR in presenting the Phase 3 results, titled "Regulations to Address Noise and Disturbance from Operations at East Hampton Airport." The results included estimates of the affected operations and associated noise complaints for a four-element solution to the problem definition, based on a November 1, 2013 – October 31, 2014 analysis year.

The Town Board considered verbal public input made at the February 4 meeting, a subsequent March 3 work session, and a March 12 public hearing; and written input received via mail, and via email through a link on the Town's website. Based on this input, the Board requested that HMMH assist in assessing additional restriction alternatives, again in terms of estimates of the affected operations and associated noise complaints. Those analyses led the Town Board to propose legislation for a revised three-element solution to the problem definition.

4) The Town Board then requested that HMMH provide implementation-related materials.

This memorandum responds to a final request by the Town that we document our technical assistance, including data sources, assumptions, citations, analytical process, etc., to describe the steps we undertook in preparing information the Board took into account in making decisions regarding the proposed legislation. We understand this documentation will be posted on the Town's website¹ or on a project-specific website ("htoplanning.com")² that the Town and KKR have established to present the "administrative record" for the legislative process.

The following three sections address HMMH's assistance related to the Phase 2 analyses (Section 2), the Phase 3 analyses (Section 3), and preparation of implementation materials (Section 4). Supporting materials are either incorporated into this document, provided electronically for posting on the Town or project website (with hypertext links in this document), or already are posted on one of the websites (again, with hypertext links). The relevant location is noted in each case.

¹ <http://ehamptonny.gov/HtmlPages/AirportInterimNoiseAnalysis.html>

² <http://www.htoplanning.com/>

2. HMMH ASSISTANCE WITH PHASE 2

HMMH assistance with Phase 2 addressed four task areas:

- Task 1 – Review Phase 1 Interim Report and Analysis
- Task 2 – Collect and Analyze Most Recent 12 Months of Complaint and Operations Data
- Task 3 – Refine Problem Definition and Identify Most Relevant Alternative(s)
- Task 4 – Prepare for and Participate in December 2, 2014 Town Board Presentation

2.1 Task 1 – Review Phase 1 Interim Report and Analysis

Under this task, HMMH reviewed the summary Phase 1 documentation presented at the October 30, 2014 meeting and related technical background.

2.1.1 Work Product(s)

There is no product for this task; its purpose was assisting HMMH to come up to speed on issues, prior work completed, and other background.

2.1.2 Specific HMMH Activities

HMMH reviewed the summary Phase 1 documentation provided on the Town website under the heading “OCTOBER 30, 2014 PRESENTATIONS,” including:

- Phase I Noise Analysis Interim Report
(<http://ehamptonny.gov/DocumentsPDF/Airport/AirportNoiseInterim/PhaseNoiseAnalysisInterimReportFINAL.pdf>)
- Analysis of 2014 YTD Noise Complaints
(<http://ehamptonny.gov/DocumentsPDF/Airport/AirportNoiseInterim/Analysis2014YTDNoiseComplaintsFINAL.pdf>)
- Update on Disturbance from Operations
(<http://ehamptonny.gov/DocumentsPDF/Airport/AirportNoiseInterim/UpdateDisturbanceOperationsFINAL.pdf>)
- October 30, 2014 Handout
(<http://ehamptonny.gov/DocumentsPDF/Airport/AirportNoiseInterim/October30Handout.pdf>)

Ted Baldwin viewed the online video of the October 30th presentations, via the East Hampton LTV website, <http://www.ltveh.org/>.

HMMH reviewed technical material used in preparing the interim reports. The material is provided on the “<http://www.htoplanning.com/>” website, including:

- <http://www.htoplanning.com/.docs/Town Documents\141105 INM Case Echo Report Annual Average Helicopters 2013.PDF>
- <http://www.htoplanning.com/.docs/Town Documents\141105 INM Case Echo Report Busy Day Fixed Wing Plus Helicopters.PDF>
- <http://www.htoplanning.com/.docs/Town Documents\141105 INM Case Echo Report Busy Day Helicopters 2013.PDF>
- <http://www.htoplanning.com/.docs/Town Documents\141105 INM Case Echo Reports Annual Average 2013.PDF>
- <http://www.htoplanning.com/docs/Town Documents/150105 Young Environmental Sciences Technical Memorandum, INM Noise Contour Development for 2013 Input Data.PDF>

HMMH provided guidance to the Town Board and staff regarding the sufficiency of this documentation.

HMMH reviewed other background materials that were available prior to December 2014. Those materials currently are provided on the “[htoplanning.com](http://www.htoplanning.com/)” website. HMMH did not fully review all of these materials. We focused on the following, and briefly reviewed others:

- Town “Noise Subcommittee” meeting minutes and findings currently presented under the “[Town - Appointed Committee Documents](#)” heading.
- Documentation of noise abatement procedures and aircraft operations, presented under the “[Other](#)” heading.
- Documentation of the “New York North Shore Helicopter Route” under the “[FAA Documents](#)” heading.

2.2 Task 2 – Collect, Analyze, and Compare Most Recent 12 Months of Complaint and Operations Data

Under this task, HMMH obtained and analyzed complaint and operations data for the 12 months from November 1, 2013 through October 30, 2014, in order to evaluate the most current feedback on aircraft operations and compare that feedback to the varying levels of activity at the airport over the same time period.

The complaint data were obtained from the HTO PlaneNoise complaint system. The operations data were obtained from the HTO Vector operations-monitoring system. The information from these two sources provided valuable bases for refining the problem definition in Phase 2 and for estimating the numbers of operations that would have been affected by alternative restrictions considered in Phase 3 (if those restrictions had been in place over that period), and also for estimating the associated numbers of complaints.

The PlaneNoise system is a web-based aircraft noise-complaint-management application that automates and simplifies the labor- and cost-intensive tasks of noise complaint collection, response, database-management, and reporting. The HTO installation accepts complaints submitted via webform, telephone, and email.

The PlaneNoise complaint database has many advantages, including:

- It is highly statistically significant, since it represents a complete set of the noise complaints registered with the Town over the time period of interest, in this case covering an 12 months of airport operations.
- It contains a broad range of data regarding complaint time, location, source, etc.
- It was current, in that it covered the most recent 12 months of information at the start of HMMH's assistance.

The Town installed the Vector operations-monitoring system to serve the primary purpose of automatically collecting the most accurate and complete information feasible on aircraft landings, in order to assess landing fees. In practice it has been determined that the installation also captures a majority of departures.

The system uses cameras placed at strategic locations on the airfield to detect and photograph aircraft operations. The system then "reads" aircraft registration numbers and Vector uses that information to identify the aircraft, owner/operator, aircraft type, etc., as feasible. Since any automatic data-collection system has limitations compared to human observers, Vector staff manually review difficult images to improve accuracy. When possible, HTO staff members also monitor operations visually and manually log them. Those manual logs are provided to Vector for cross-referencing with the automatically collected data in order to fill in manually logged operations that the automatic system may have missed.

The Vector operations database has many advantages, including:

- It represents the best available source of information on actual operations at the airport.
- It contains a broad range of data regarding operation type, time, aircraft type, powerplant type, etc.
- It was current, in that it covered the most recent 12 months of information at the start of HMMH's assistance.
- It represents a large, statistically significant data sample.

2.2.1 Work Products

Under this task, HMMH analyzed complaint data to seek out patterns that reveal issues of greatest concern to the greatest numbers of residents. We looked for patterns related to combinations of factors (such as geographic distribution, season, day of week, time of day, aircraft-type category, etc.) that elicited the greatest community reaction. We used the citizen-provided information on the operations of concern; i.e., the aircraft-type category about which they were registering a complaint. The PlaneNoise options include: jet, helicopter, prop, seaplane, unknown, and multiple.

The primary work products of this task were:

- Elements of the December 2, 2014 PowerPoint presentation titled "East Hampton Airport Phase II Noise Analysis." That presentation is available on the "htoplanning.com" website, at <http://www.htoplanning.com/docs/Town Documents\141202 Phase II Noise Analysis Presentation, HMMH.PPTX>. Sections 2.2.2 through 2.2.7 discuss the development of the specific elements of that presentation related to this task.
- The PlaneNoise data file used in preparing elements of the December 2, 2014 presentation, with HMMH addition of geographic information. Section 2.2.2 discusses the development of the file. It is available at: <http://www.htoplanning.com/docs/Town Documents\150410 PLANE NOISE COMPLAINTS DATA names and addresses redacted.xlsx>.

- The Vector operations data file used in elements of the December 2, 2014 presentation, with HMMH addition of geographic information. Section 2.2.3 discusses the development of the file. It is available at: <http://www.htoplanning.com/.docs/TownDocuments\150410 VECTOR OPERATIONS data reg num redacted.xlsx>
- A spreadsheet used to prepare to prepare the fifth page of the December 2, 2014 PowerPoint presentation cited above, at: http://www.htoplanning.com/.docs/Town Documents\150410 1_HTO_complaint_distribution.xlsx. Section 2.2.4 discusses the file.
- A spreadsheet used to prepare the 14th – 18th pages of the December 2, 2014 PowerPoint presentation, at: http://www.htoplanning.com/.docs/Town Documents\150410 2_HTO_daily_operations_statistics.xlsx. Section 2.2.6 discusses the file.
- A spreadsheet used to prepare the 20th, 21st, and 24th pages of the December 2, 2014 PowerPoint presentation, at: http://www.htoplanning.com/.docs/TownDocuments\150410 3_HTO_operations_complaints_comparison.xlsx. Section 2.2.7 discusses the file.



2.2.2 Specific HMMH Activities – PlaneNoise Complaints Data File

With HTO staff assistance, HMMH downloaded the 12 months of PlaneNoise records in “CSV” (comma- or character-separated variable) data-file format.

HMMH edited this file in three ways:

- It was saved in Microsoft Excel “.xlsx” format.
- The PlaneNoise data included complainant address information. To plot those locations on a map and look for geographic patterns, HMMH “geocoded” each address to obtain its latitude and longitude, through the use of the “GPS Visualizer’s Address Locator” utility available at <http://www.gpsvisualizer.com/geocoder/>. The PlaneNoise CSV file was opened in the utility and the data were processed using the option of Bing Maps to be the source of latitude and longitude data.³
- Annotation was added at the top of the file (to the right of the first rows of data) to describe the contents of each column. That annotation is reproduced below:

PLANE_NOISE_COMPLAINTS_data.xlsx Column Descriptions	
ID:	Discrete complaint identification number assigned by PlaneNoise.
Address:	Complainant-reported street address.
Aircraft_Type:	Complainant-chosen aircraft-type description (of aircraft responsible for complaint).
City:	Complainant-reported jurisdiction.
Email_Body:	Complainant-provided comments. PlaneNoise automatic voice-to-text transcription from voicemails. "NULL" if none provided.
Filing_Method:	Method via which complainant entered submitted complaint. “Hotline” & “Webform” submitted automatically; “Email” & “Manual” entered by PlaneNoise.
First_Name:	Complainant-provided first name.
Hamlet:	Complainant’s hamlet; identified from address by PlaneNoise.
Last_Name:	Complainant-provided last name.
State:	Complainant’s state; identified from address by PlaneNoise.
Town:	Complainant’s town; identified from address by PlaneNoise.
ZipCode:	Complainant-identified zip code
EVENTDATETIME:	Date and time complaint received via Hotline; Complainant-identified on Webform.
Latitude:	Complainant address’s latitude derived through geocoding by HMMH
Longitude:	Complainant address’s longitude derived through geocoding by HMMH

As noted previously, a redacted version of this file, with complainants’ first and last names, street addresses, and latitude/longitude removed for privacy purposes, is posted on the “htoplanning.com” website, at:

http://www.htoplanning.com/.docs/TownDocuments\150410 PLANE_NOISE_COMPLAINTS_DATA_names_and_addresses_redacted.xlsx.

³ Other choices were Google Maps and MapQuest. Address geocoding processes of this type are a readily available commodity-type service at this time. There is no reason to believe any of the three data sources is more or less accurate.

2.2.3 Specific HMMH Activities – Vector Operations Data File

With HTO staff assistance, HMMH downloaded the 12 months of Vector operations records, also in CSV data file format. HMMH edited this file in four ways:

- It was saved in Microsoft Excel “.xlsx” format.
- Seaplane-configured Cessna 208 aircraft operating at the airport were identified through online research into their registration numbers.
- Twelve operations were removed. Nine of these were aircraft identified as large airline-type aircraft that do not operate at the airport, and in several cases further research indicated the aircraft type was inconsistent with the registration number. Three were identified as helicopters, without models identified, so no noise classification was possible. This small number of removed operations was statistically insignificant, given that it represents less than 0.05% of the remaining 25,823 operations.
- Annotation was added at the top of the file (to the right of the first rows of data) to describe the contents of each column. That annotation is reproduced below:



VECTOR_OPERATIONS_data.xlsx Column Descriptions	
Airport	Airport Code For associated operations
DateTime	Date and Time of the aircraft operation
Registration	Aircraft registration number of
CallSign	Flight number call sign for scheduled operations
Activity_Type	Notes whether the operation was an Arrival (A) or Departure (D)
ModelType	ICAO aircraft type identified by system
MaxLandingWeight	Maximum registered landing weight for the identified model type in lbs
Runway	Recorded runway the aircraft is operating from
AcftType	Aircraft Category Jet (J), Turboprop (T), Turboprop Seaplane* ⁴ (TS), Piston Prop (P), Helicopter (H)
EngType	Aircraft Engine Type Jet, Turboprop, Piston
EngNum	Count of the number of engines on identified aircraft.

A redacted version of this file is posted on the “htoplanning.com” website under “Town Documents,” at: <http://www.htoplanning.com/docs/TownDocuments\150410 VECTOR OPERATIONS data registration redacted.xlsx>. The redactions remove the aircraft registration numbers (and occasionally reported any call signs), for privacy purposes.

2.2.4 Specific HMMH Activities – Complaint Statistics

HMMH used the data from the PlaneNoise complaints data file to prepare the fifth page of the December 2, 2014 PowerPoint presentation cited above. That slide is labelled “Some overall complaint statistics (11/1/13 – 10/31/14).” In order to prepare that slide, HMMH imported data from the PlaneNoise data file into a spreadsheet posted on the “htoplanning.com” website, at:

<http://www.htoplanning.com/docs/Town Documents\150410 1 HTO complaint distribution.xlsx>.

The spreadsheet contains the data extracted from the PlaneNoise data file and the figure that was imported into the PowerPoint.

2.2.5 Specific HMMH Activities – Complaint Density Plots

HMMH’s geographic information system specialist imported the location data from the PlaneNoise complaints data file into ESRI ArcGIS Version 10.1 to produce plots of “complaint density,” in terms of complaints per square mile, as presented in pages 6-11 of the December 2, 2014 PowerPoint presentation cited above, titled:

- Complaint Density - Helicopters (11/1/13 – 10/31/14)
- Complaint Density – Jets
- Complaint Density – Seaplanes
- Complaint Density - Non-Seaplane Propeller
- Complaint Density - Multiple Aircraft
- Complaint Density - Unknown Aircraft

⁴ TS designation made by HMMH from additional evaluation of through online research into C208 registration numbers.

2.2.6 Specific HMMH Activities – Daily Operations Statistics

HMMH used the data from the PlaneNoise complaints data file to prepare pages 14-18 of the December 2, 2014 PowerPoint presentation cited above, titled:

- When do operations occur? All Aircraft Operations by Day, 11/1/2013 - 10/31/2014
- When do operations occur? Helicopter Operations by Day, 11/1/2013 - 10/31/2014
- When do operations occur? Jet Operations by Day, 11/1/2013 - 10/31/2014
- When do operations occur? Turbopropeller Operations by Day, 11/1/2013 - 10/31/2014
- When do operations occur? Piston Prop Operations by Day, 11/1/2013 - 10/31/2014

In order to prepare those slides, HMMH imported data from the PlaneNoise data file into a spreadsheet posted on the “htoplanning.com” website, at:

<http://www.htoplanning.com/.docs\Town Documents\150410 2 HTO daily operations statistics.xlsx>.



The spreadsheet contains the data extracted from the PlaneNoise data file and the figures that were imported into the PowerPoint.

2.2.7 Specific HMMH Activities – Complaints versus Operations Plots

HMMH used the data from the PlaneNoise complaints data file to prepare the 20th, 21st, and 24th pages of the December 2, 2014 PowerPoint presentation cited above, titled:

- Annual complaints versus operations 11/1/13 - 10/31/14
- Seasonal complaints versus operations 5/1 - 10/31/14
- Complaints per operation (all aircraft types) versus activity across the average annual week, 11/1/13-10/31/14

In order to prepare those slides, HMMH imported data from the PlaneNoise data file into a spreadsheet posted on the “htoplanning.com” website, at:

<http://www.htoplanning.com/.docs\Town Documents\150410 3 HTO operations complaints comparison.xlsx>.

The spreadsheet contains the data extracted from the PlaneNoise complaint data file the Vector and the figures that were imported into the PowerPoint.

2.3 Task 3 – Refine Problem Definition and Identify Most Relevant Alternative(s)

Under this task, HMMH collaborated with KKR in preparing:

- The refined problem definition presented on page 26 of the December 2, 2014 PowerPoint presentation.
- The list of possible alternatives presented on page 27 of the December 2, 2014 PowerPoint presentation, and further reviewed on pages 28-34.
- The conclusion and recommendation presented on page 35 of the December 2, 2014 PowerPoint presentation.

2.4 Task 4 – Prepare for and Participate in December 2, 2014 Town Board Presentation

Under this task, HMMH collaborated with KKR in finalizing and making the December 2 PowerPoint presentation.

3. HMMH ASSISTANCE WITH PHASE 3

HMMH assistance with Phase 3 addressed six task areas:

- Task 1 – Summarize Research into Helicopter Noise Characteristics and Effects
- Task 2 – Research Whether Other Categories Elicit Strong Complaint Response
- Task 3 – Further Refine Temporal Dimensions of the Problem Definition
- Task 4 – Estimate Reductions in Noise Complaints from Abatement Alternatives
- Task 5 – Coordinate with Helicopter Operators to Assess Voluntary Approaches
- Task 6 – Prepare for and Participate in February 3, 2015 Town Board Presentation

3.1 Task 1 – Summarize Research into Helicopter Noise Characteristics and Effects

The Phase 2 analysis of HTO complaint and operations data revealed that helicopters elicit much stronger response from residents than fixed-wing aircraft types. To assist the Town in understanding this response, HMMH identified and summarized research that has been conducted into: (1) the extent to which response to helicopter noise differs from that due to fixed-wing aircraft, (2) the aspects of helicopter noise that make it more disturbing, (3) possible means for quantifying the differences, and (4) other available results that might assist the Town in understanding the issue and crafting the most appropriate noise-abatement approach.

The HMMH report titled “Review of Studies that Address Effects of Helicopter Noise” describes the research conducted under this task and the associated results and conclusions. The report is provided on the “www.htoplanning.com” website at: [/docs/Town Documents/150203 HMMH Memorandum re Review of Studies that Address Effects of Helicopter Noise.PDF](#).

These results were summarized and presented on page 16 of the February 4 and 10, 2015 PowerPoint presentations, discussed in Sections 3.4.1 and 3.4.2.



3.2 Task 2 – Research Whether Other Categories Elicit Strong Complaint Response

Under this task, HMMH undertook two primary activities.

- Refine Activity Categories that Fall under Problem Definition
- Review and Comment on Proposed Noisy Aircraft Definitions

Sections 3.2.1 and 3.2.2 discuss these two activities.

3.2.1 Refine Activity Categories that Fall under Problem Definition

HMMH conducted additional research into the available HTO complaint and operations data to identify specific categories of aircraft that fit within the problem definition of “frequent” and “disturbing” operations. The primary focus was on seaplane models. HMMH used the online research discussed in Section 2.2.3 to distinguish which operations were undertaken in seaplane-configured Cessna 208 aircraft. The research did not reveal a stronger response to seaplane-configured aircraft compared to aircraft with conventional landing gear.

The Vector data indicate that the Cessna 208 Caravan with floats was the only recognizable seaplane model operating at HTO in the analysis year in any substantial numbers. For example, page 13 of the December 2, 2014 “Phase II Noise Analysis” presentation referenced in Section 2.2.1 notes that approximately 25% of all annual operations were conducted by 25 specific aircraft, of which five were turbopropeller seaplanes. All five of those seaplanes were Cessna 208s. Review of aircraft certification data presented in the European Aviation Safety Agency (EASA) “Noise Type Certificates - Approved Noise Levels” data files discussed in Section 4.2.1, show that Cessna 208 variants with floats can be quieter than variants with conventional landing gear.

To supplement this information, HMMH analyzed FAA noise-modeling estimates of the noise levels produced by land and seaplane (“float”) variants of the Cessna 182 (the only such land and seaplane comparison available in the model) to assess differences in noise level. The analysis was conducted using the FAA’s Integrated Noise Model (INM) version 7.0d. HMMH calculated the average arrival and departure noise levels for straight-in and out arrivals and departures of each aircraft type, at two locations. The locations were one runway length off of each end of Runway 10/28, on centerline, as shown on the following figure:

Analysis Locations for Comparing INM-Based Estimates of Relative Aircraft Noisiness

Source: HMMH



The following table presents the average arrival and departure levels for each aircraft at the two locations, and also the overall arrival/departure average. The float-equipped aircraft is quieter on departure and overall, although noisier on arrival.⁵

Comparison of INM-Based SEL Values for Cessna 182 Conventional and Float-Equipped Variants
Source: HMMH

Operation / Aircraft Type	Average SEL Calculated at the Two Analysis Locations for Each Aircraft Type:		Difference (Negative means Float Plane is Quieter)
	CNA182 Land	CNA182FLT Sea	
Arrival	79.5	89.7	10.2
Departure	94.6	90.6	-4.0
Arrival / Departure Average	91.7	90.2	-1.5



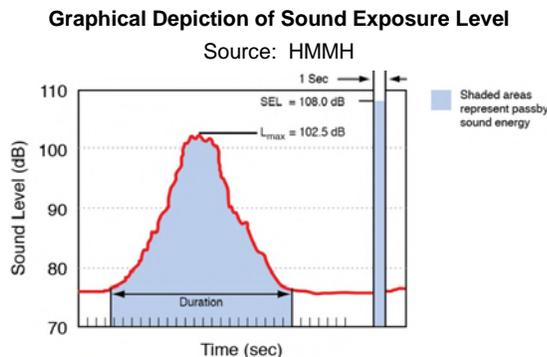
3.2.2 Review and Comment on Proposed Noisy Aircraft Definitions

HMMH reviewed the draft aircraft noise-rating approach proposed by the HTO Airport Planning Committee, Noise Subcommittee in its October 28, 2014 memorandum to Councilwoman Kathee Burke-Gonzalez titled “Eighth Preliminary Findings and Recommendations – Alternatives for Noise Control for Town Board Considerations.” That report is available at: <http://www.htoplanning.com/docs/Town - Appointed Committee Documents/141028 Noise sub-committee 8th Findings - Alternatives for Noise Control.PDF>.

That report recommended establishing noise ratings based on FAA-published “Part 36” aircraft noise-certification levels. Appendix A of this report provides an introduction to Part 36. That appendix notes that noise limits and metrics, and measurement locations and procedures vary according to aircraft classifications. Specifically, some Part 36 ratings are in terms of SEL and some are Lmax, both of which are in terms of the A-weighted decibel.⁶ Others are in terms of Effective Perceived Noise Level (“EPNL” or “EPNdB”).⁷

In somewhat more detailed terms, noise metrics used in certification are as follow:

⁵ HMMH undertook this analysis in terms of Sound Exposure Level (“SEL”), the metric the INM uses to take into account the total noise energy over the course of an entire noise event. By summing the sound energy over the entire event, SEL generally matches our impression of the relative overall “noisiness” of individual events, including the effects of both duration and level. In simple terms, SEL “compresses” the energy for the noise event into a single second. The following figure depicts this compression, for a hypothetical noise event.



The compression of energy into one second means that a given noise event’s SEL will almost always will be a higher value than its Lmax, as shown on the figure. For most aircraft flyovers, SEL is roughly five to 12 dB higher than Lmax. Adjustment for duration means that relatively slow and quiet helicopter or propeller aircraft can have the same or higher SEL than faster, louder jets, which produce shorter-duration events.

⁶ An important characteristic of sound is its frequency, or “pitch.” Most people respond to sound most readily when the predominant frequency is in the range of normal conversation. The acoustical community has defined “filters” to approximate our response to sounds made up of many different frequencies. The “A weighting” filter generally does the best job of matching human response to environmental noise sources, including common transportation sources. “A-weighted decibels” are abbreviated “dBA.” The U. S. Environmental Protection Agency (EPA) and nearly every other federal, state, and international agency have adopted A-weighting for use in describing environmental and transportation noise.

⁷ EPNL is a measure of noise dose similar to SEL. It includes a frequency weighting correction similar to – but not exactly the same as – dBA. It also includes a correction for distinct “pure tones,” which are most often significant in aircraft noise sources in the form of high-pitched “whines.”

- Light propeller-driven aircraft (12,500 pounds or less maximum gross takeoff weight, MGTOW) are certificated in terms of overflight maximum A-weighted decibels (i.e., Lmax dBA).
- Heavy propeller-driven aircraft (over 12,500 lbs. MGTOW) and all jets are certificated in terms of approach, departure, and sideline EPNdB measurements.
- Heavy helicopters (7,000 lbs. or less MGTOW) are certificated in terms of approach, departure, and overflight (not sideline) EPNdB measurements.
- Light helicopters (under 7,000 lbs. MGTOW) may be certificated the same as heavy helicopters or in terms of overflight SEL measurements alone.

On pages 11 and 12 of their report, the Noise Subcommittee recommended using FAA-published EPNdB and dBA (including both SEL and Lmax) levels to identify multiple aircraft noise classifications:

Most aircraft are classified by the FAA based on the noise they produce, either with a dBA rating or an EPNdB rating in decibels. The dBA rating is approximately equivalent to EPNdB less 13 decibels. However, EPNdB has three separate ratings, approach (AP), take-off (TO), and flyover (FO). For EPNdB, it is proposed that the highest of the three ratings, AP, TO, and FO be used, converted to its dBA equivalent.

Subject to more specific professional advice, the committee preliminarily proposes that aircraft rated at 80 dBA (or EPNdB equivalent) be classified as “most noisy,” (most helicopters and many jets), aircraft rated below 75 dBA be classified as “least noisy,” (most light aircraft and some very quiet jets), and aircraft rated at 75 dBA and above but less than 80 dBA be classified as “noisy” (a few helicopters, some quieter jets, and noisier piston aircraft). The most noisy aircraft class should be subject to the most stringent regulation or to outright prohibition. Least noisy aircraft should be accorded the greatest freedom and least regulation. Noisy aircraft can either be treated separately, with regulation less stringent than for the noisiest class, or grouped with either least noisy or most noisy aircraft for regulatory purposes, depending on the regulation. Alternatively, a level between 75 dBA and 80 dBA could be established as the dividing line for a given regulation, effectively creating only two noise classes for that purpose.

The Noise Subcommittee provided the following summary proposal on page 13 of their report:

We propose that all noise control measures considered by the Town Board ... be evaluated by application to each of three separate noise classes by aircraft type: noisiest, noisy, and least noisy, to be defined by FAA dBA rating or equivalent maximum EPNdB rating with the aid of professional assistance. We tentatively propose the classes be defined by FAA noise ratings of 80 dBA (or EPNdB equivalent) and above for the noisiest, 75 dBA up to but less than 80 dBA for the noisy, and below 75 dBA for the least noisy.

This proposal raised several concerns:

- Multiple noise classifications would require regulations that would be difficult to evaluate, explain, and administer.
- Using the same decibel-level cutoff for aircraft certified using Lmax, SEL, and EPNL could lead to inconsistent ratings, since the same Lmax, SEL, and EPNL decibel levels would reflect different perceived noisiness, and the relative order of the noisiness could vary from operation to operation.
- There is no precise method of translating or equating Lmax, SEL, and EPNL values, nor even any industry-recognized “rules of thumb” for making rough approximations.
- FAA publishes Lmax, SEL, and EPNL certification values for a variety of locations relative to distance from start-of-takeoff roll, distance from landing threshold, and perpendicular offset from the runway sideline. In addition, some data are for level flyover, rather than approach, departure or sideline.

After reviewing the Noise Subcommittee recommendation in light of the Phase 2 noise analysis results and the final problem definition, HMMH recommended that the Town consider ranking aircraft based on published EPNL approach data, which the FAA and the International Civil Aviation Organization (ICAO) use to regulate the allowable noise levels of the aircraft types of primary concern at HTO; i.e., jets, larger propeller-driven aircraft, and heavier helicopters. In addition, FAA and ICAO use a consistent altitude – 394’ – for setting approach noise limits for these three aircraft categories, providing a consistent distance reference.⁸

⁸ ICAO noise certification standards are set forth in Annex 16 to the Convention on International Civil Aviation, “Environmental Protection,” Volume II, “Aircraft Engine Emissions.” FAA regularly amends Part 36 to “harmonize” U.S. regulations with any revisions made to ICAO Annex 16.

The Noise Subcommittee’s January 20, 2015 memorandum to the Town Board titled “Final Report and Recommendations,” recommended a three-part definition of “noisiest” aircraft:⁹

- For aircraft with published EPNL values, “noisiest” would be those with published levels of 91 EPNdB or greater.
- For aircraft without published EPNL values, but with published SEL values, “noisiest” would be those with published SEL values of 84 dBA or greater.
- For aircraft with only published Lmax values, “noisiest” would be those with published levels of 80 dBA Lmax or greater.

After considering this input, the Town Board requested that HMMH evaluate alternatives that considered two categories of “noisy” aircraft:

- If EPNL ratings are published by U.S. or international regulatory bodies, noisy aircraft are those with approach levels ≥ 91.0 EPNdB (consistent with the subcommittee’s proposal).
- For aircraft with no published EPNL rating, noisy aircraft are those with published flyover levels ≥ 81.0 SEL or Lmax (a simplification of the subcommittee’s proposal for separate 84 dB SEL and 80 dB Lmax cutoffs).

Section 3.4 presents analysis results for alternatives that applied: (1) both of these definitions and (2) only the EPNL definition.



3.3 Task 3 – Further Refine Temporal Dimensions of the Problem Definition

Under this task, HMMH and Town representatives reviewed the temporal distributions and relationships of noise and complaints prepared in the Phase 2 analyses, as discussed in Section 2.2 (in particular the Section 2.2.7 plots of complaints versus operations).

To assist in their deliberations related to definition of nighttime restrictions, the Town Board requested that HMMH provide additional detail on operations and noise complaints in the October 1, 2014 – September 30, 2015 analysis period that occurred under a number of specific time intervals, as shown in the following table:

Operations and Noise Complaints October 1, 2014 – September 30, 2015 for Various Time Intervals
Source: HMMH

Time Interval	Affected Operations			Associated Complaints		
	All Helos	All Fixed	All Aircraft	All Helos	All Fixed	All Aircraft
8 - 9 pm	257	452	709	703	167	870
9 - 10 pm	134	260	394	433	93	526
10 - 11 pm	90	145	235	289	52	341
Existing voluntary curfew (11 pm – 7 am)	199	382	581	747	141	888
7 - 8 am	241	579	820	867	217	1,084
8 - 9 am	330	856	1,186	946	294	1,240
9- 10 am	316	1,173	1,489	809	386	1,195
8 pm – 8 am	1,567	3,847	5,414	4,794	1,350	6,144
24-Hour Total	7,047	18,670	25,717	16,152	6,316	22,468

Based on the review of the Phase 2 results and this supplemental information, the Town Board made the following policy determinations associated to time-related definitions for consideration in the evaluation of potential access restrictions:

- Season: *May 1 – September 30*
- Weekend: *Thursday noon – Monday noon*
- Holidays: *Memorial Day, Independence Day and Labor Day, also including the days before and after*
- Basic curfew hours: *11 p.m. – 7 a.m.*
- Extended curfew hours: *8 – 11 p.m. and 7 – 9 a.m.*

⁹ That report is available at: <http://www.htoplanning.com/docs/Town - Appointed Committee Documents/150120 Final Report and Recommendations of the Noise Subcommittee.PDF>. Pages 40-41 present these three “noisy aircraft” definitions.

3.4 Task 4 – Estimate Reductions in Noise Complaints from Abatement Alternatives

Under this task, HMMH evaluated the numbers of operations that would have been affected and the associated noise complaints in the October 1, 2014 – September 30, 2015 analysis period for a range of potential use restrictions, including:

1. Prohibit all aircraft operations year-round from 11 pm – 7 am
2. Prohibit noisy aircraft year-round during 8 pm – 9 am evening, night, and early morning hours (extends curfew into “shoulder hours”)
3. Prohibit all helicopter operations on weekends and holidays in the summer season (May 1 – September 30)
4. Prohibit all noisy aircraft from conducting more than one take-off and one landing in any calendar week in the summer season
- 5a. Prohibit noisy helicopters from conducting more than two take-offs and two landings in any calendar week in the summer season
- 5b. Prohibit noisy helicopters from conducting more than one take-off and one landing in any calendar week in the summer season



HMMH analyses addressed various combinations of these alternatives and “noisy aircraft” definitions, as discussed in Section 3.2.2. The following five overall combinations were considered:

3.4.1 Evaluation of Alternative Restrictions 1 – 4, including EPNL, Lmax, and SEL Definitions of “Noisy Aircraft”

This assessment evaluated alternatives 1 – 4 listed above, with a noisy aircraft definition that generally followed the Noise Subcommittee’s recommendation (discussed in Section 3.2.2) for considering noisy aircraft cutoffs based on EPNL, Lmax, and SEL, using the following cutoffs:

- If EPNL ratings are published by U.S. or international regulatory bodies, noisy aircraft are those with approach levels ≥ 91.0 EPNdB.
- For aircraft with no published EPNdB rating, noisy aircraft are those with published flyover levels ≥ 81.0 SEL or Lmax (a simplification of the subcommittee’s proposal for separate 84 dB SEL and 80 dB Lmax cutoffs).

The results are presented in the February 4, 2015 PowerPoint titled “Regulations to Address Noise and Disturbance from Operations at East Hampton Airport,” which is available on the “htoplanning.com” website, at <http://www.htoplanning.com/docs/Town Documents/150204 HMMH and KKR presentation on Regulations to Address Noise and Disturbance from Operations at East Hampton Airport.PDF>.

3.4.2 Evaluation of Alternative Restrictions 1 – 4, including only an EPNL Definition of “Noisy Aircraft”

This assessment evaluated alternatives 1 – 4 listed above, with a noisy aircraft definition based solely on EPNL:

- If EPNL ratings are published by U.S. or international regulatory bodies, noisy aircraft are those with approach levels ≥ 91.0 EPNdB

The results are presented in the February 10, 2015 PowerPoint titled “Regulations to Address Noise and Disturbance from Operations at East Hampton Airport,” which is available on the “htoplanning.com” website, at [http://www.htoplanning.com/docs/Town Documents/150210 Regulations to Address Noise and Disturbance from Operations at East Hampton Airport \(Updated PowerPoint\).PDF](http://www.htoplanning.com/docs/Town Documents/150210 Regulations to Address Noise and Disturbance from Operations at East Hampton Airport (Updated PowerPoint).PDF).

3.4.3 Evaluation of Alternative Restrictions 1, 2, and 4, including only an EPNL Definition of “Noisy Aircraft”

This assessment evaluated alternatives 1, 2, and 4 listed above, with a noisy aircraft definition based solely on EPNL; i.e., if EPNL ratings are published by U.S. or international regulatory bodies, noisy aircraft are those with approach levels ≥ 91.0 EPNdB. The results are presented in the April 7, 2015 PowerPoint titled “Regulations to Address Noise and Disturbance from Operations at East Hampton Airport,” which is available on the “htoplanning.com” website, at <http://www.htoplanning.com/docs/Town Documents/150407 HMMH Powerpoint Presentation, Regulations to Address Noise and Disturbance from Operations at East Hampton Airport.PDF>.

3.4.4 Evaluation of Alternative Restrictions 1, 2, and 5a, including only an EPNL Definition of “Noisy Aircraft”

This assessment evaluated alternatives 1, 2, and 5a listed above, with a noisy aircraft definition based solely on the EPNL; i.e., if EPNL ratings are published by U.S. or international regulatory bodies, noisy aircraft are those with approach levels ≥ 91.0 EPNdB. No PowerPoint presentation was prepared for this combination of alternatives. The results were shared with the Town Board for internal deliberative purposes. The following table summarizes the cumulative results.

Combined Outcomes of Restrictions 1 (Prohibit all aircraft operations year-round from 11 pm – 7 am), 2 (Prohibit noisy aircraft year-round during 8 pm – 9 am), and 3 (Prohibit noisy helicopters from conducting more than two take-offs and two landings in any calendar week in the summer season)

Source: HMMH



	May 1 – September 30, 2015			October 1, 2014 – September 30, 2015		
	Helicopters	Fixed-Wing	All Aircraft	Helicopters	Fixed-Wing	All Aircraft
Estimated Number of Operations Affected	3,597	552	4,149	3,756	652	4,408
Total Existing Operations in Category	5,855	14,004	19,859	7,044	18,670	25,714
% Total Operations Affected by Restrictions 1, 2, and 5a	61.4%	3.9%	20.9%	53.3%	3.5%	17.1%
Estimated Associated Complaints	9,588	704	10,291	9,782	740	10,523
Total Existing Complaints in Category	14,935	5,999	20,934	16,152	6,316	22,468
% Total Complaints Associated with Restrictions 1, 2, and 5a	64.2%	11.7%	49.2%	60.6%	11.7%	46.8%

3.4.5 Evaluation of Alternative Restrictions 1, 2, and 5b, including only an EPNL Definition of “Noisy Aircraft”

This assessment evaluated alternatives 1, 2, and 5b listed above, with a noisy aircraft definition based solely on the EPNL; i.e., if EPNL ratings are published by U.S. or international regulatory bodies, noisy aircraft are those with approach levels ≥ 91.0 EPNdB. No PowerPoint presentation was prepared for this combination of alternatives. The results were shared with the Town Board for internal deliberative purposes. The following table summarizes the cumulative results.

Combined Outcomes of Restrictions 1 (Prohibit all aircraft operations year-round from 11 pm – 7 am), 2 (Prohibit noisy aircraft year-round during 8 pm – 9 am), and 3 (Prohibit noisy helicopters from conducting more than one take-off and one landing in any calendar week in the summer season)

Source: HMMH

	May 1 – September 30, 2015			October 1, 2014 – September 30, 2015		
	Helicopters	Fixed-Wing	All Aircraft	Helicopters	Fixed-Wing	All Aircraft
Estimated Number of Operations Affected	4,728	552	5,280	4,887	652	5,539
Total Existing Operations in Category	5,855	14,004	19,859	7,044	18,670	25,714
% Total Operations Affected by Restrictions 1, 2, and 5b	80.8%	3.9%	26.6%	69.4%	3.5%	21.5%
Estimated Associated Complaints	12,230	704	12,934	12,425	740	13,166
Total Existing Complaints in Category	14,935	5,999	20,934	16,152	6,316	22,468
% Total Complaints Associated with Restrictions 1, 2, and 5b	81.9%	11.7%	61.8%	76.9%	11.7%	58.6%

3.5 Details of Analyses

The HMMH analyses of affected operations and associated noise complaints were performed using Excel spreadsheets that incorporated operations and complaint data assembled, analyzed, and enhanced through the steps discussed in Section 2.2.

The HMMH analyses are embodied in three spreadsheets:

- **4_HTO_preliminary_restriction_analyses.xlsx:** This spreadsheet provided the results discussed in Section 3.3. It is available at http://www.htoplanning.com/#Town_Documents/150410_4_HTO_preliminary_restriction_analyses.xlsx.
- **5_HTO_feb04_restriction_analyses.xlsx:** This spreadsheet provided the results discussed in Section 3.4.1. It is available at http://www.htoplanning.com/#Town_Documents/150410_5_HTO_feb04_restriction_analyses.xlsx.
- **6_HTO_post_feb04_restriction_analyses.xlsx:** This spreadsheet provided the results discussed in Sections 3.4.2, 3.4.3, 3.4.4, and 3.4.5. It is available at http://www.htoplanning.com/#Town_Documents/150410_6_HTO_post_feb04_restriction_analyses.xlsx.

3.6 Task 5 – Coordinate with Helicopter Operators to Assess Voluntary Approaches

Under this task, HMMH, Town Board, and airport staff representatives consulted and met with representatives of major helicopter and fixed-wing operator constituencies, and fixed-base operator, fuel provider, ground-support businesses. The group met on January 21, 2015. The meeting addressed the Town’s interest in feedback on:



- Voluntary abatement procedures pursued in the 2014 summer season, including mid-season adjustments.
- Approaches taken to monitor, assess, and report on compliance.
- Special circumstances meriting consideration in assessing compliance, such as weather, traffic levels, etc.
- The most effective means for communicating with operators and pilots to promote compliance.
- The most valuable feedback to provide operators and pilots to enhance compliance.
- Ideas for building on “lessons learned” in the 2014 season.

At the conclusion of the meeting and in a follow-up email, the Town representatives followed up with a request for feedback on these topics.

3.7 Task 6 – Prepare for and Participate in February 3, 2015 Town Board Presentation

Under this task, HMMH prepared the presentations discussed in Sections 3.4.1, 3.4.2, and 3.4.3, and participated in making the Section 3.4.1 presentation (delayed due to weather until February 4, 2015).

4. DOCUMENTATION ASSISTANCE

At the conclusion of Phase 3, the Town Board requested HMMH assistance in two additional tasks:

- Documentation of the assistance we provided Phases 2 and 3, to recount the data sources, analytical steps, and other actions HMMH undertook in preparing information the Board took into account in making decisions regarding the proposed legislation.
- Preparation of information for aircraft owners/operators and other interested parties to use to determine the status of specific aircraft vis-à-vis the defined criterion for being categorized as a “noisy.”

4.1 Complete Documentation of Phase 2 and 3 Noise-Related Elements

This memorandum and the referenced material posted on the Town and “htoplanning” websites represent the product of this task.

4.2 Guidance and Information on Noisy Aircraft Identification

HMMH prepared information for aircraft owners/operators and other interested parties to use to determine the status of specific aircraft vis-à-vis the defined criterion for being categorized as a “noisy” aircraft under two of the proposed laws. The information includes:

4.2.1 Expanded list of potentially noisy aircraft

HMMH identified aircraft classified as “noisy” types in the legislation, using the final 91.0 and higher EPNdB definition, using data from twelve (12) online FAA and European Aviation Safety Agency (EASA) data files, all of which are available at http://www.htoplanning.com/#Town_Documents:

- Eight (8) FAA Advisory Circular 36-1H (Change 1), “Noise Levels for U.S. Certificated and Foreign Aircraft,” 05/25/2012 data files, downloaded February 23, 2015:
 1. http://www.htoplanning.com/#Town_Documents/150410_uscert_appendix_01_20120424.xls
 2. http://www.htoplanning.com/#Town_Documents/150410_nonuscert_appendix_02.xls
 3. http://www.htoplanning.com/#Town_Documents/150410_uscert_appendix_06.xls
 4. http://www.htoplanning.com/#Town_Documents/150410_uscert_appendix_07.xls
 5. http://www.htoplanning.com/#Town_Documents/150410_uscert_appendix_08_20120424.xls
 6. http://www.htoplanning.com/#Town_Documents/150410_nonuscert_appendix_09.xls
 7. http://www.htoplanning.com/#Town_Documents/150410_helicopter_appendix_10.xls
 8. http://www.htoplanning.com/#Town_Documents/150410_helicopter_appendix_11.xls
- Four (4) EASA “Noise Type Certificates - Approved noise levels” data files, downloaded February 18, 2015:
 9. [http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Jets_\(141203\).xlsx](http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Jets_(141203).xlsx)
 10. [http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Heavy_Props_\(141203\).xlsx](http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Heavy_Props_(141203).xlsx)
 11. [http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Light_Props_\(141203\).xlsx](http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Light_Props_(141203).xlsx)
 12. [http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Helicopters_\(141203\).xlsx](http://www.htoplanning.com/#Town_Documents/150410_TCDSN_Helicopters_(141203).xlsx)



HMMH provided a list of “noisy aircraft types” that is available at: [http://www.htoplanning.com/docs/Town Documents/150303 List of Noisy Aircraft Types.PDF](http://www.htoplanning.com/docs/Town_Documents/150303_List_of_Noisy_Aircraft_Types.PDF).

4.2.2 Summary of steps that individual aircraft owners/operators can use to investigate their specific aircraft

HMMH prepared concise guidance of the steps that individual owners/operators, the Town, or other interested parties can use to conduct further research into the status of a specific aircraft vis-à-vis the definition of a “noisy” aircraft. It is available at: [http://www.htoplanning.com/docs/Town Documents/150224 How Do I Tell if an Aircraft is Noisy.PDF](http://www.htoplanning.com/docs/Town_Documents/150224_How_Do_I_Tell_if_an_Aircraft_is_Noisy.PDF).

APPENDIX A: OVERVIEW OF PART 36 AIRCRAFT CERTIFICATION

The Federal Aviation Administration (FAA) has set limits on allowable aircraft noise levels under Title 14, Part 36, of the Code of Federal Regulations, “Noise Standards: Aircraft Type and Airworthiness Certification.” Aircraft designs must meet these standards to receive new or revised “type certificates” for production of aircraft to operate in the U.S. (The final section of this overview summarizes a separate regulation related to the phaseout of older, noisier types.)

Part 36 noise limits, noise metrics, measurement locations, and measurement procedures vary according to aircraft classifications established under other FAA regulations, including, but not limited to:

- Subsonic versus supersonic speed capabilities
- Type of propulsion (e.g. turbojet- or propeller-driven)
- Type of lifting mechanism (e.g., fixed-wing, helicopter, and tilt-rotor)
- Weight (e.g., different criteria for “small” versus “large” fixed-wing aircraft with maximum gross takeoff weights less than 12,500 pounds versus 12,500 pounds or more; and different criteria for helicopters up to and equal to 7,000 pounds versus over 7,000 pounds.
- Operating category (e.g., “acrobatic,” “agricultural,” “commuter,” “normal,” “restricted,” “transport,” and “utility”) and use (e.g., “firefighting” or “carrying external loads”)
- Date of initial flight or of application for type certificate
- Engine manufacturer and model

Because Part 36 “stage classifications” (e.g., “Stage 1” or “Stage 2”) vary with these characteristics, references to a specific stage should be used with care. This ambiguity largely relates to the manner in which Part 36 (and the term “stage”) evolved and became more complex over time, as summarized in the following timeline:

Initial Rule: 1969 - Establishment of Initial Noise Certification Standards

When first promulgated in 1969, Part 36 only applied to transport-category large and turbojet-powered airplanes. The transport category includes jets with takeoff weights over 12,500 pounds, and propeller-driven airplanes over 19,000 pounds. The rule sets separate measurement requirements and limits for takeoff, sideline, and approach locations, in terms of “Effective Perceived Noise Level” (“EPNL”), which is a metric that takes noise level, duration, and pure tones into account. The original regulation simply categorized aircraft as “certificated” or “uncertificated,” with no reference to the term stage.

1974 Amendment: Part 36 Application to Propeller-Driven Small Aircraft

The FAA added noise standards for “propeller-driven small aircraft” and “propeller-driven commuter category aircraft” in 1974, prior to the creation of the stage terminology. They continue to be termed certificated or uncertificated, with no reference to stage. The noise standards for these aircraft are in terms of “A-weighted decibel” (“dBA”) limits for level flyovers 1,000’ above ground level.

1977 Amendment: Introduction of Stage Classifications

In 1977, the FAA amended Part 36 to define more stringent noise limits for transport-category large and turbojet-powered aircraft, and introduced the concept of certification stages, to differentiate between the original and revised standards. For these categories, the amendment created three stages:

- “Stage 1” aircraft have never been shown to meet any noise standards, either because they have never been tested, or because they have been tested and failed.
- “Stage 2” aircraft meet original noise limits, set in 1969.
- “Stage 3” aircraft meet more stringent limits, established in 1977.

1978 Amendment: Extension of Part 36 to Civil Supersonic Aircraft

The FAA amended Part 36 to apply the same noise standards to civil supersonic jets as to civil subsonic jets. Concorde with flight time before 1980 were exempted – 16 aircraft in 1978; these aircraft comprised the entire fleet, since no further aircraft were produced.



1988 Amendment: Addition of Stage 1 and 2 Standards for Helicopters

The FAA amended Part 36 to incorporate helicopter standards after the creation of stage terminology. As a result, helicopter noise standards are similar in some aspects to those for propeller-driven small aircraft and in other aspects to those for transport-category large and turbojet-powered airplanes. The helicopter standards involve a particularly complex array of noise certification characteristics, including multiple noise metrics, measurement locations, weight classes, aircraft operating categories, etc.

The 1988 amendment established two helicopter certification classes. Stage 1 helicopters are uncertificated. Stage 2 helicopters are certificated under the original noise standards, which were the most stringent until 2014, when a Stage 3 helicopter class was added (see 2014 amendment discussion).

Helicopter measurement locations and other testing requirements differ significantly from fixed-wing airplane categories. Most helicopter noise standards are in terms of EPNL for three measurement locations, which include takeoff and approach, like transport-category large and turbojet airplanes (but not sideline as for those types), and level-flyover, like propeller-driven small airplanes.

For some helicopter categories with maximum gross takeoff weights not over 7,000 pounds, alternate certification standards may be used that are based on the “Sound Exposure Level” (“SEL”), which is a noise metric based on the A-weighted decibel that takes level and duration into account, but does not include a tone correction as in EPNL. These alternate standards only consider the level-flyover measurement location

2005 Amendment: Addition of Stage 4 Fixed-Wing Certification Standards

In 2005, FAA amended Part 36 to adopt a Stage 4 classification. The Stage 4 noise limits are a cumulative 10 EPNL less than those for Stage 3. All subsonic turbojet-powered and transport-category airplanes with maximum gross takeoff weights of 12,500 pounds or more for which application of a new type design is submitted on or after January 1, 2006, must meet new noise certification levels.

It should be noted that the Stage 4 standard applies only to application for type certification on and after January 1, 2006.

2013 Amendment: Addition of Tiltrotor Certification Standards

In 2013, FAA amended Part 36 to set tiltrotor standards in EPNL for takeoff, approach, and flyover measurement locations, like the basic helicopter standards. Tiltrotors are either certificated or uncertificated; the term “stage” is not used.

2014 Amendment: Addition of Stage 3 Helicopter Certification Standards

In 2014, FAA amended Part 36 to adopt a Stage 3 helicopter classification, which established more stringent noise limits for helicopters for type certification in the U.S., so as to “harmonize” the U.S. regulations with international standards.

Other Amendments to Part 36

The preceding timeline focuses only on evolution of noise classifications and use of the term stage. It should be noted that the regulation has been amended over 20 times to address a broad range of certification-related matters, such as revisions to noise limits, measurement procedures, measurement locations, meteorological reference conditions, data corrections, flight procedures, applicability to specific aircraft, and more.

Phaseout of Older, Noisier Aircraft Classes

Another federal regulation – “Part 91” (Subpart I) – prohibits regular operation of Stage 1 and 2 civil subsonic jet airplanes over 75,000 pounds, and extends that prohibition to all Stage 1 and 2 civil subsonic jets on January 1, 2016. It should be noted that most, if not all, jet airplanes in production today meet Stage 4 standards. Part 91 does not set phaseout dates for non-jet airplanes or Stage 3 jets.

