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At your request, this memorandum summarizes some of the key differences in the sound levels and character of noise produced by turboprop and regional jet aircraft. This memo presents comparisons between the two types of aircraft in the following areas: general physical characteristics, predicted Sound Exposure Levels and climb performance as computed by the Integrated Noise Model, and Measured Noise Levels as reported in FAA Advisory Circulars.

PHYSICAL COMPARISONS

The following table presents some basic characteristics of the range of turboprop and regional aircraft discussed in this analysis.

Aircraft Type	Passengers (typical)	Maximum takeoff weight
Turboprop (Commuter) Aircraft:		
Beechcraft 1900 (B1900)[1]	19	16,950
Jetstream 31[2]	29	24,000
Saab 340ER (SF340)[3]	37	29,000
ATR 42[4]	42	36,800
ATR 72[5]	68	48,500
Turbojet (Regional Jet) Aircraft:		
Canadair Regional Jet (CRJ 100)[6]	50	47,450
Embraer 145 (EMB145)[7]	50	43,350

As shown in the table, although both regional jet types are significantly heavier than the most common turboprop aircraft currently operating at Naples (B1900 and SF340), they also carry significantly more passengers. In terms of weight and passenger load, the two turboprop aircraft types that are most directly comparable to the regional jets are the ATR 42 and ATR 72, which are comparable to the regional jets discussed here.

[1] Data taken from *Jane's All the World's Aircraft*, 2002-2003.
[2] *Jane's All the World's Aircraft*, 1997-1998.
[3] *Jane's All the World's Aircraft*, 1999-2000.
[4] *Jane's All the World's Aircraft*, 2001-2002.
[5] Ibid.
[6] Ibid..
[7] *Jane's All the World's Aircraft*, 2002-2003.

INM COMPARISON OF TURBOPROP AND REGIONAL JETS

We computed Sound Exposure Level (SEL) contours for the typical aircraft types that operate at Naples Municipal Airport, using the FAA's Integrated Noise Model (INM), version 6.0c (the current model). Unfortunately, the INM does not contain a complete data base of either turboprop or regional jet aircraft; to satisfy modeling requirements, the FAA provides a "Substitution List" for users to model aircraft that have similar weight and engine characteristics. Substitutions for those aircraft, as specified by FAA, are presented in the table below.

INM Substitutions for Typical Turboprop and Regional Jet Aircraft

Aircraft Type	INM Substitution
Turboprop (Commuter) Aircraft:	
Beechcraft 1900 (B1900)	DeHavilland DHC-6 (DHC6)
Jetstream 31	DeHavilland DHC-6 (DHC6)
Saab 340ER	Saab 340 (SF340) [no substitution]
ATR 42	DeHavilland DHC-6 (DHC6)
ATR 72	Hawker-Siddely 748 (HS748A)
Turbojet (Regional Jet) Aircraft:	
Canadair Regional Jet (CRJ 100)	Canadair Challenger 601 (CL601)
Embraer 145ER	Embraer 145 (EMB145) [no substitution]

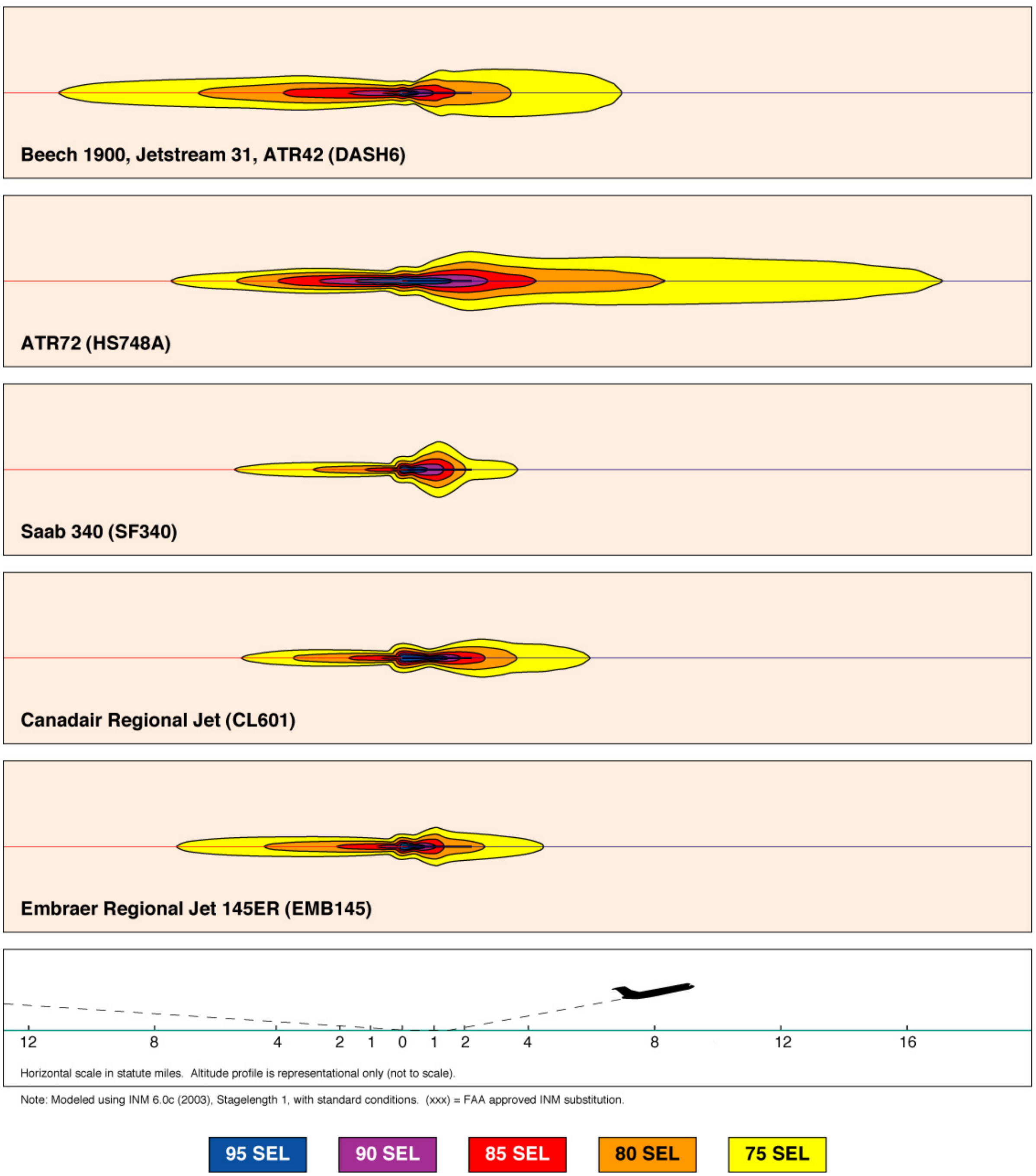
We modeled SEL contours for a takeoff and landing cycle on a straight-in and -out flight path. The figure on the following page presents the results; the aircraft type is labeled as well as its INM substitute. As shown in the figure, the INM's computed overall noise levels, in terms of SEL, are quieter for the regional jets than for the turboprop aircraft.

In particular, the SEL contours for both regional jets are smaller in magnitude than those for the ATR 42 and ATR 72. The following table summarizes these differences.

Computed Sound Exposure Levels from INM

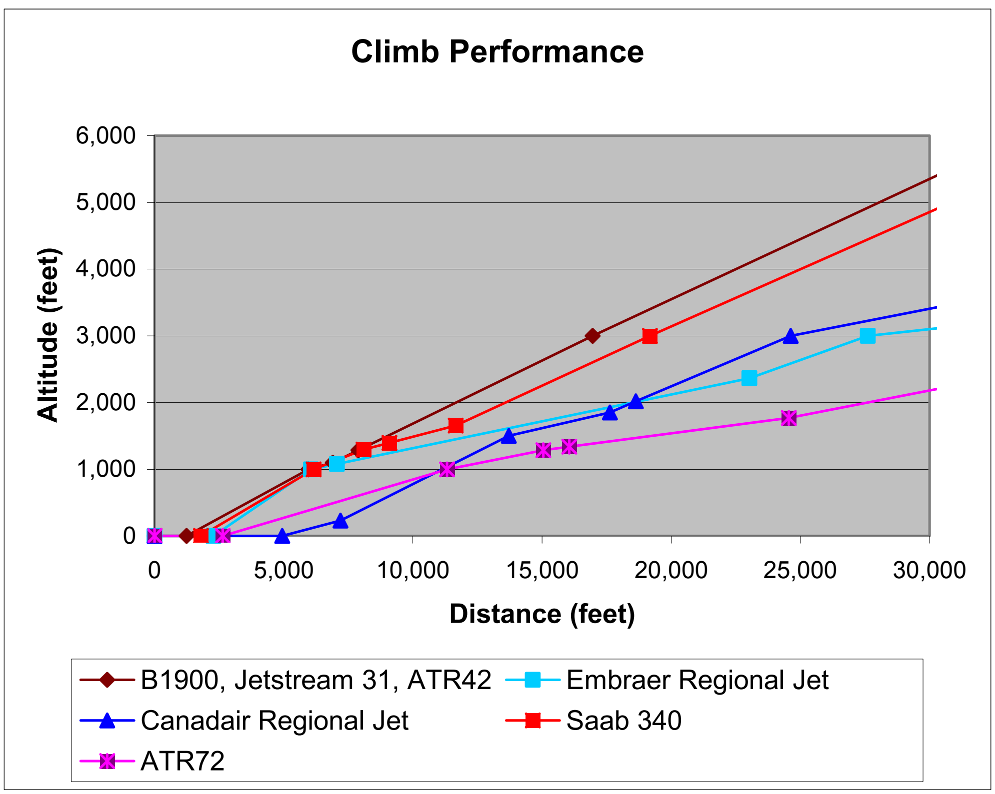
Aircraft Type (INM Type)	Sound Exposure Level (SEL, in dBA) at 2 miles from:		Total area enclosed in SEL 75 dBA contour (square miles)
	Takeoff Roll	Touchdown	
Turboprop (Commuter) Aircraft:			
Beechcraft 1900	84	90	20
Jetstream 31	84	90	20
Saab 340	81	82	6
ATR 42	84	90	20
ATR 72	94	93	30
Turbojet (Regional Jet) Aircraft:			
Canadair Regional Jet	90	84	8
Embraer 145	82	86	8

Comparison of Sound Exposure Level (SEL) Contours for Landing - Takeoff Cycles of Representative Twin-turbopropeller Commuter and Regional Jet Aircraft



Two major reasons for this difference are aircraft speed and engine noise frequency content. Although propeller aircraft may have a higher climb gradient than jet aircraft, their speed is much less. This translates into a longer duration for a typical pass by (i.e., it takes longer to go by the monitor at 100 knots than at 150 knots), and consequently a higher noise event. Another major difference between turboprop and turbojet aircraft noise is the frequency content of the engine noise: small turbojets generate mostly high-frequency noise, which is quickly attenuated through air absorption, whereas turboprops generate significant low-frequency noise, which propagates quite well over long distances. In addition, turboprops often generate discrete "tones" which stand out from the rest of the acoustic signature.

Climb performance affects noise levels on the ground. Because of their propellers, turboprop aircraft actually generate relatively high levels of thrust at low speeds, which can translate into relatively high rates of climb on takeoff, whereas jet aircraft tend to be more efficient at higher speeds and altitudes. However, it is not possible to generalize the differences in climb performance on initial takeoff climb for these two categories of aircraft. The figure below compares the climb profiles for the various INM aircraft types discussed in this memorandum. It shows that most of the turboprops climb relatively quickly on takeoff (i.e., those represented by the DHC-6 and SF340). The EMB145 regional jet climbs at a comparable rate. The HS748A turboprop and CL601 regional jet climb relatively slowly by comparison. The HS748 is an aircraft originally built in the 1950's, with relatively poor performance compared to modern turboprops.



Comparison of INM-Predicted Climb Performance for Turboprops and Regional Jets

COMPARISON OF FAA CERTIFICATION DATA

The FAA publishes noise level data for certificated noise levels (in EPNdB) and estimated Maximum A-weighted noise levels (in dBA) in Advisory Circulars 36-1H and 36-3H, respectively. Certification data are presented as Estimated Perceived Noise Levels (EPNL), measured in EPNdB. One significant difference between EPNL and A-weighted decibels is that frequency content – especially tones – are taken into consideration in the computation of EPNL. These data provide valuable comparisons because they are for the actual aircraft, flown under controlled measurement conditions – unlike INM data, there are no assumptions or substitutions. The table below compares the certificated and estimated noise levels for the aircraft types in question, based on the Advisory Circulars.

FAA Advisory Circular Data

Aircraft Type	Maximum takeoff weight (lbs)	Certificated Noise Level (in EPNdB)[8]			Estimated Noise Level (in dBA)[9]	
		Takeoff	Sideline	Approach	Takeoff	Approach
Beechcraft 1900	16,600	n.a.	n.a.	n.a.	66.5	77.0
Jetstream 31	24,000	86.4	83.4	87.8	72.5	76.3
Saab 340B	28,500	78.0	85.9	91.6	63.4	82.0
ATR 42-320	35,600	82.2	83.9	96.8	66.7	84.8
ATR 72-200	48,500	86.9	84.7	91.1	73.2	82.4
Canadair Regional Jet (CL-600-2B19)	53,000	79.8	82.2	92.1	67.2	81.4
Embraer 145ER	45,410	77.9	84.6	92.6	65.9	82.9

The table shows that the certificated noise levels for the turboprop aircraft are generally higher than those for the regional jet aircraft; again, this is probably due mainly to the low frequency and tonal content in the noise produced by turboprops. The A-weighted decibels, on the other hand, show that the maximum noise levels for the two different types of aircraft are very similar.

SUMMARY

In summary, the total noise levels produced by regional jets are likely to be lower than those produced by the majority of turboprop aircraft currently operating at Naples Municipal Airport. This is due mainly to the character of the noise produced by turboprops (low-frequency) and their slower speeds on departure. The regional jets reviewed in this analysis also typically carry more passengers than those currently operating at Naples, which allows for greater total passenger capacity with less total noise.

[8] FAA Advisory Circular 36-1H.
[9] FAA Advisory Circular 36-3H.