Committee Secretary
Parliamentary Standing Committee on Public Works
PO Box 6021
Parliament House
Canberra ACT 2600

Sent by Email to: pwc@aph.gov.au

RAAF BASE WILLIAMTOWN REDEVELOPMENT STAGE 2

Attached is my submission to the Parliamentary Standing Committee on Public Works (PWC) on the above referred matter.

Yours faithfully

John Donahoo FIE(Aust)

15 July 2015

Attachment: Submission by John Donahoo

RAAF BASE WILLIAMTOWN REDEVELOPMENT STAGE 2

SUBMISSION BY JOHN DONAHOO

Drainage

Paragraph 91 of the Defence evidence essentially states that:

'The stormwater drainage design for each project element maintains existing base stormwater design discharge as required by Port Stephens Shire Council and Defence.'

Several landowners adjacent to the Base have expressed concern about increased local flooding which they consider may be a result of development at the Base that has occurred over the last 30 years. Further proposed development of the Base has only increased their concerns. The Base is the major contributor for water runoff to both Dawson's Drain to the South, and to the two drains to the East that converge into one drain that then proceeds to Tilligerry Creek. Anecdotal evidence is that flooding began to occur to several rural properties adjacent to the Tilligerry Creek drain circa 1990, which was after the major Base development in the mid 1980s. Defence should consult with the local affected residents and the Port Stephens Council to address this local flooding issue. **Defence may need to provide extra detention ponds, upgrade existing ponds and contribute to the cleaning of drains to prevent flooding to adjacent properties from Base runoff which has steadily increased since the establishment of the Base in the early 1940s.**

Electromagnetic Pulse (EMP)

If two low yield nuclear devices were detonated in space at about 500 km above the earth's surface over international waters, one to the east, and one to the west of Australia at about 150 km distant from each coastline, high-altitude electromagnetic pulses (HEMP) would be created that could cause the functional collapse of the electrical power grid and damage to most electronic equipment in the whole of Australia. As a result, major infrastructure such as communications, transportation, financial services, emergency services, energy distribution, food and water could also be disrupted or extremely impaired. **If such a non-lethal catastrophic event did occur, the Australian people would reasonably expect that their Defence Force would be able to continue to operate.** Consequently, Defence should consider the installation of EMP protection to inter alia, data storage, circuit board storage, all essential airfield operational facilities including airfield lighting, navigation aids, air traffic control equipment, high voltage circuit breaker protection circuits and emergency power generation equipment at Williamtown and for appropriate equipment at other Defence establishments. Moreover, retrofitting of such protection in the future may be difficult, and in some cases impossible, and require major equipment replacement. Furthermore, non-nuclear EMP devices or 'E-bombs' have also been developed which can be used to inflict local area damage.

Aviation Fuel

The Defence proposal does not allow for an increase in aviation fuel storage at Williamtown. Government policy since the late 1970s has prescribed 90 days of fuel storage for the whole of Australia. Defence responded to this policy by prescribing 90 days storage at peacetime rates of effort. In the 1980s, fuel storages at major RAAF airfields were increased to about 45 days usage, except for RAAF Base Edinburgh where storage was increased to about 100 days usage. As the F-35A is about 40% thirstier that the Hornet, and as AEW&C aircraft are now based at Williamtown, the existing 8 Megalitres of storage would need to be augmented by about 12 Megalitres to meet the government policy. There may need to be a similar increase at RAAF Base Amberley. The Defence practice has been to store no more than 4 Megalitres at one storage site at southern airfields and for no tank to be larger than 2 Megalitres. For northern airfields, the practice has been to store two Megalitres in an above ground buried configuration at each site. Storage sites at all airfields are located at least 400 metres apart.

Electrical Reticulation

Reliability of mains electrical supply could be enhanced if the two incoming overhead 11kV feeders to the Base Intake Substation were separately routed underground to the existing Williamtown Supply Authority Zone Substation that is located on Nelson Bay Road south of McDonalds.

Gun/Missile Barricades

Defence should assure the public that they intend to provide Gun/Missile Barricades at the Eastern Operational Readiness Aprons as required by the NATO Explosive Ordnance Safety Principles. Aircraft using these proposed aprons will face towards the civil aviation area.

Aircraft Noise

Much of the proposed Defence Development costing hundreds of millions of dollars moves the existing working accommodation to the north away from future F-35A aircraft noise. However, Defence seems not prepared to spend any money to reduce noise to local residents. This is hypocritical. There are some actions they can take and these are listed at Annex A. That information is of necessity very technical and the Committee may care to consider obtaining independent advice on the content. An issue of great concern is the increase of noise levels **inside** many hundreds of Port Stephens houses of 8 to 12 dBA, a fact not mentioned in the draft EIS. **East Medowie will be particularly hard hit by noise increases from planned F-35A activities at Salt Ash Air Weapons Range.**

Despite requests to Defence via the EIS process and through the Aircraft Noise Ombudsman (ANO), they appear most reluctant to provide basic noise information detailed at Annex A. This is Australia, and people who are going to be subjected to aircraft noise have a right to be provided with all available information. If Defence do not provide this information, then their reluctance creates suspicion that they are hiding something.

Conclusion

While some matters raised in this submission are not directly related to the PWC Terms of Reference, they are allied issues. I hope the foregoing information is of some assistance to the Committee in their deliberations of the referenced works.

Annex:

A. Proposed Actions to Reduce Aircraft Noise in Port Stephens

ANNEX A

PROPOSED ACTIONS TO REDUCE AIRCRAFT NOISE IN PORT STEPHENS

1. Provide a precision approach system to Runway 30 (approach from the sea) to reduce the Instrument Landing System (ILS) noise events over Raymond Terrace by about 60%. Three options for this system have been advised to Defence for their consideration. (Includes ILS, GBAS and RNP 0.3) Recent advice from Minister Andrews that there would be little benefit from such a system is inconsistent with published proposed runway usage for the F-35A which is split 52% / 48% in favour of Runway 12. Currently, 100% of aircraft requiring a precision approach system use Runway 12, as it is the only one available. If a precision approach system was in place on Runway 30and nominated for preferred usage, and for F-35A aircraft operating at tailwinds as prescribed by the aircraft manual, then the precision approach runway usage split could change from 0% / 100% to 60% / 40% in favour of Runway 30. **The foregoing proposal would reduce the incidence, but not the intensity of noise over Raymond Terrace, and in particular at Riverview Ridge and Lakeside.**

2.. **The intensity of noise over Raymond Terrace can be reduced by about 2.5 dBA** if Defence increases the Glide Path angle for the ILS from 3 to 3.5 degrees as allowed by ICAO, and maintains the existing Glide Slope apparatus location. **Defence have provided no adequate reasons for not adopting these measures.**

3. The aircraft noise over houses at Fullerton Cove, Salt Ash, East Medowie, Campvale and other locations will increase with the advent of the F-35A to the extent that land acquisition may have to be considered. **Information from the Defence advice to the Port Stephens Council attached at Appendix 1 shows that noise inside houses of typical construction will increase by about 8 to12 dBA when the Hornet is replaced by the F-35A. This represents a doubling of loudness to the human ear**. About half of the increase is due to higher external F-35A noise, and the other half is due to typical construction components being less able to attenuate F-35A noise compared with Hornet noise. The Port Stephens Council has recently formally advised that Appendix 1 is the latest information they have received from Defence.

4. Defence should provide basic noise information including inter alia, three dimensional flight path data with corresponding power settings and average day/night movements, Noise Power Distance measurements for the Hornet and F-35A for noise metrics for both LAmax (Maximum noise level of a single aircraft noise event in dBA) and EPNL (Effective Perceived Noise Level in EPNdB). The latter information is required to check if their ANEF information is correct as ANEF data is derived in part from EPNL data. This check can be easily achieved at Riverview Ridge where there is only one flight path and F-35A noise is dominant. All calculations are of limited value if they are not validated. Errors can easily occur. By way of example, the attached Word and XL files at Appendices 2 and 3 respectively which are to be read in conjunction with Appendix 1, seem to indicate that Defence ‘normalised’ F-35A spectral data in the third table in that document is incorrect. Moreover, AS 2021 essentially dictates that spectral data is to be used for noise attenuation calculations for houses where external noise exceeds 80 dBA. Appendix 3 shows that F-35A After Burner noise requires a distance of 11,000 feet or 3.4 km to reduce to an overall LAmax of 85 dBA. Therefore, the 80dBA noise level will occur and be exceeded in large areas of Port Stephens, particularly within the 20-25 ANEF zone, and it is therefore important that F-35A spectral data be correct.

5. The Aircraft Noise Level (ANL) in dBA is the noise metric that AS 2021 specifies as the external noise level that is to be used for the design of aircraft noise attenuation for buildings. Defence have provided via the ANO, the ANL Tables for the Hornet but they have not yet provided the ANL Tables for the F-35A. Air Services Australia have met their responsibilities in providing ANL Tables for civil aircraft as required by and included in AS 2021. **However, Defence have not met their responsibilities under that standard.**

6. **Defence should also prepare an Aircraft Noise Level (ANL) contour map in 5 dBA increments overlaid with ANEF lines for the Port Stephens area. The provision of a single map would show residential land developers and prospective purchasers of residential land, the ANL to be used for the design of house noise attenuation in 20 to 25 ANEF zones.** It would also show the high ANL levels outside of the 20 ANEF lines. Typical house construction with doors and windows closed provides noise attenuation of about 20 dBA. The cost to achieve noise attenuation above this level is about $3500 per dBA. Therefore, where a total noise attenuation of 40 dBA is required, the extra building cost is about $70,000. At 45 dBA and above, the cost spirals upwards as a house would then need to be built as a concrete bunker. **This known extra cost will deter residential land purchasers, and as a consequence, developers will be less inclined to develop residential estates in 20-25 ANEF zones. Clearly, this would be in the best interest of Defence.** However, this will only occur if developers know that consumers are likely to be aware of this information. Unfortunately, the information is currently difficult to obtain. The Defence response may be to use their Transparent Noise Information Package (TNIP), but that program is not easy to use and understand, and it is unclear whether it provides ANL or LAmax data. **Therefore, Defence has a duty of care to present ANL data in an easy to understand format for prospective residential land purchasers. No other agency can provide this information.**

7. The Defence F-35A Noise Data at Appendix 1 shows that for an F-35A operating with After Burner (AB) at 1000 feet above ground level, the noise pressure level is 120 dBA. When 'A weight' adjusted, the logarithmic sum of the nine octave values provided for AB takeoff is calculated to be 120.2 dBA. Therefore, although not specifically stated, it seems that the octave values provided are Lmax values in dB, and the 120 dBA value to the left of the octave values is the overall LAmax value. At Williamtown for F-35A takeoff with AB on Runway 30, noise levels in excess of Australian Standards for occupational noise will be exceeded. This may occur for motorists and spectators on Medowie Road who will be located as close as 260 m from the aircraft noise source, and for arriving and departing civil airport passengers who will be located as close as 300 m from the noise source. From an internet video on an F-35A takeoff with AB, it seems the end of runway runup time before brakes release is about 4 seconds, and the takeoff time over a distance of about 4000 feet is about 20 seconds. From this data, and the fact that jet engine thrust on takeoff is usually constant, the aircraft acceleration is calculated to be 20 ft/sec squared. Using the foregoing information for observers on both the civil apron and Medowie Road, noise levels, adjusted for distance attenuation and Atmospheric Absorption, can be calculated for each aircraft position for every second from the beginning of runup. When these noise levels are 'anti-logged', then added and averaged, and then 'logged', an LAeq value of 118 to 119 dBA is obtained. This calculation assumes an aircraft runup time of 4 seconds and a rolling time of 10 seconds afterwards, the latter time being selected to produce the LAeq for 14 seconds. The LAeq is the A weighted equivalent continuous noise level, or that level which has the same total energy for varying noise levels emitted over a selected time period. The LAeq can also be described as the average noise intensity level over a selected time period.

The following table shows the internationally accepted total daily limits for LAeq to prevent hearing loss:

LAeq (dBA)	Max Time (secs)
115	28
116	22
117	18
118	14
119	11
120	9
121	7

As fighter aircraft usually operate in twos or fours, then Medowie Road users and spectators, as well as airport passengers will often be subjected to at least two (2) AB takeoffs, as they occur about a minute apart. In this case, it can be shown that the allowable daily dose decreases by 3 dBA (10 log 2). Moreover, as the exposure time increases from 14 to 28 seconds, the allowable LAeq will then decrease to 115 dBA which is well **below the forecast LAeq** of 118 to 119 dBA.

However, the above calculations assume that ground noise levels for an aircraft at 1000 feet altitude are the same for an aircraft on the ground but 1000 feet horizontally distant, which it is not; and, that there is no noise directivity, which there is. The real situation will then be better or worse than calculated above.

Clearly, noise measurements need to be urgently taken at an appropriate United States establishment to simulate the LAeq noise experienced by motorists/spectators at Medowie Road, and passengers at the Williamtown Airport. If these measurements confirm that expected noise AB dosage exceeds the allowable limits, then Newcastle Airport will require Aerobridges and/or they will need to provide hearing protection to all embarking and disembarking passengers. Defence may need to provide a long tunnel to cover part of Medowie Road or a suitable noise-absorbing fence.

Brief exposures to extremely loud sounds can cause permanent aural damage to children. However, as there is ambiguity in health literature articles on the noise pressure level that will cause permanent aural damage from single or occasional noise events, Defence should seek advice from the Commonwealth Department of Health and the NSW Department of Health on the permissible LAeq for the situation described in the foregoing. This action is necessary to protect our community and our children in particular, and to minimise the risk of compensation claims made against the Commonwealth and/or Newcastle Airport.

Appendices:

1. PDF File - Defence Letter to Port Stephens Council of 30 April 2010

2. Word File - ‘Normalised’ and General Noise Addition Formulae Derivations

3. XL File - Modified F-35A Spectral Data

Australian Government
Department of Defence
Defence Support Group

2005/1112532/7
LPSI/OUT/2010/52

David Broyd
Group Manager, Sustainable Planning
Port Stephens Council
PO Box 42
RAYMOND TERRACE NSW 2324

Dear David,

Re: Aircraft Noise Management

I refer to your letter of 2 March 2010 and to the workshops held on 12 April 2010 to work through a number of aircraft noise management issues associated with the proposed introduction into service of the Joint Strike Fighter (JSF) to RAAF Base Williamtown and Salt Ash Weapons Range (SAWR) and the promulgation of Australian Noise Exposure Forecast 2025 (ANEF 2025).

I also refer to Council's request on 1 March 2010 for more specific noise level information in relation to 9 development sites in your Council's Local Government Area.

Aircraft Noise Levels
At the workshops, Defence presented average maximum noise level information for each development site. Enclosed please find this information which identifies the arithmetic average of maximum noise levels for current and future military aircraft at each development site.

In considering the impacts of the F/A-18 Hornet, Hawk Lead-In Fighter and JSF military aircraft at each development site, Defence determined the calculated and forecasted noise level for each aircraft operation on each of the separate flight tracks (for example, flights down the Instrument Landing System, Initial and Pitch tracks, 'Touch and Go' circuits around the base and other standard arrival and departure tracks) that may impact each site, then arithmetically averaged the results for each operation/mode. In accordance with Australian Standard AS2021-2000 - 2000 – *Acoustics, Aircraft Noise Intrusion - Building Siting and Construction* (AS2021) the highest average maximum level for the various operation/mode becomes the external aircraft noise level at each site.

Defence understands the average maximum noise levels for the various operation/modes is the only concept that can be used to determine the aircraft noise levels and in turn, the appropriate noise control measures defined as the Aircraft Noise Reduction in AS2021. At the afternoon workshop, local acoustic consultants noted this is the information they require to determine the degree of aircraft noise reduction in order to comply with AS2021.

In the near future, Defence intends to provide Council with additional noise data for land along Rees James Road (development site 8) to assist Council and the NSW Department of Planning in the determination of this rezoning proposal.

***Defending Australia** and its National Interests*

Aircraft Noise Reduction
Defence noted Council's desire to work towards a more standardised approach to noise attenuation, design and construction in accordance with AS2021. Accordingly, Defence engaged an acoustic consultant to identify the outcome of two conceptual noise control measures that could be used, in conjunction with the average maximum noise levels, to assess whether or not the indoor design sound levels given at Table 3.3 in AS2021-2000 can be achieved.

Enclosed please find information relating to aircraft noise reduction and indicative noise control measures that can be used to assess compliance or otherwise with the indoor design sound levels given at Table 3.3 in AS2021-2000. Also enclosed is a table identifying the external average maximum noise levels at each of the development sites and corresponding indoor design sound levels that are obtained firstly from typical residential construction and secondly by using either of the acoustic upgrade alternatives given. The spectral data for the JSF, which is required to be considered in instances where the average maximum noise levels exceed 85dBA has now been declassified and is also included. This information can be made available to the local acoustic consultants.

I trust this information will be of assistance to Council. Please do not hesitate to contact me if you wish to discuss the information further.

Yours sincerely

John Kerwan
Director Land Planning & Spatial Information
Department of Defence
BP3-1-A052
Brindabella Park
Canberra ACT 2600

30 April 2010

Cc: Michael Leavey, Regional Director, Hunter and Central Coast Region, NSW Department of Planning.

Defending Australia and its National Interests

Indicative Aircraft Noise Levels

	2012 ANEF		
Development Hot-Spots	**Hornet**	**Hawk**	**JSF**
1. DAREZ (Industrial)	88	78	94
2. Medowie East	79	66	87
3. Medowie South East	76	61	83
4. Medowie South West	77	61	84
5. Oyster Cove	83	74	89
6. Salt Ash	89	77	91
7. Richardson Road	95	84	101
8. Riverview Ridge	92	76	96
9. Kings Hill (Riding School)	81	76	79
		2025 ANEF	

NOISE CONTROL CONCEPTS

AS2021 requires use of the external noise level (average maximum) as the basis of determining the building constructions to achieve compliance with recommended internal levels set out in Table 3.3.

For bedrooms of a residence the internal design level is not exceeding 50 dB(A).

If doors and windows are required to be closed to achieve the internal noise target then mechanical ventilation is required.

For consideration of Noise Control measures assume the following"

- A bedroom 3.5m x 3m x 2.5m
- The bedroom has two external walls. The other two walls adjoin other rooms in the residence (attenuation via other rooms of residence to the bedroom is 10 dB).
- 1 external wall has a $2m^2$ window
- Aircraft above the building, a 3 dB attenuation due to directivity is allocated for the external window

The starting point refers to a **typical** brick veneer construction but with the assumption of thicker glass than normal:

- Pitched tile roof with sisalation + 14 kg/m3 batts + 10 mm plasterboard ceiling
- Brick veneer construction (internal plasterboard 10mm)
- 6.4 mm thick laminated glass
- 1 bed + 1 bookcase + 1 adult
- Carpet on floor

For noise control concepts there are two alternatives assessed. Acoustic upgrade 1 is upgrading the walls and ceiling with more plasterboard an double glazing, whilst alternative 2 is a much more significant construction.

Acoustic upgrade 1:

- Pitched roof ceramic tiles + 100 insulation + 2 x 13mm layers of plasterboard
- Brick veneer with 100m insulation + 1 layer of 16 mm plasterboard
- Double glazed window being - 3mm glass + 125mm gap + 6.38mm glass

Acoustic upgrade 2:

- Pitched roof with ceramic tiles + easiboard + 100 R2.5 + 10mm plasterboard ceiling (Rw56)
- 230 extruded double brick 100mm cavity with 13 mm render inside (Rw 60)
- Double glazed window - 10.7mm glass + 200 air gap + 10.mm glass (Rw55)

Where the ANR is greater than 30 (i.e. for a bedroom an external level greater than 50 + 30 = 80 dB(A)) the Standard recommends use of spectral (frequency) data.

Different modes of aircraft flight produce different spectrums, i.e. overflights have less low frequency sound than take off or landing.

External noise spectra for Hornet from file from NoiseMap. JSF spectra from DoD recently publicly released.

NoiseMap data @ 1000ft

	dB(A)	31.5Hz	63	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Hornet F18A/C										
Landing	106	85	87	100	102	104	101	98	86	80
Take off	107	85	88	102	105	105	102	99	95	92
AB	114	100	101	114	113	112	108	106	104	102
JSF results										
JSF										
Landing	97	86	86	100	98	95	93	87	76	71
Take off MIL	115	90	94	110	111	110	108	107	109	104
75%	107	92	94	108	107	104	102	100	98	96
AB	120	98	107	116	114	112	113	116	111	108
cruise 35%	94	80	81	96	93	92	91	85	72	67

Noise spectra in all cases were normalised to INM derived external noise level for each residential location.

Normalised to 85 dB(A)

	dB(A)	31.5Hz	63	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Hornet F18A/C										
Landing	85	64	66	79	81	83	80	77	65	59
Take off	85	63	66	80	83	83	80	77	73	70
AB	85	71	72	85	84	83	79	77	75	73
JSF results										
JSF										
Landing	85	74	74	88	86	83	81	75	64	59
Take off MIL	85	60	64	80	81	80	78	77	79	74
75%	85	70	72	86	85	82	80	78	76	74
AB	85	63	72	81	79	77	78	81	76	73
cruise 35%	85	71	72	87	84	83	82	76	63	58

Location	Movement	Hornet				JSF			
		External Level	Building Construction			External Level	Building Construction		
			Typical	upgrade			Typical	upgrade	
				1	2			1	2
1	Landing	88	64	56	47	94	74	68	61
2	Strafing (take off)	79	54	47	38	87	72	65	58
3	Strafing (take off)	75	51	43	35	83	68	61	53
4	Take off	77	53	45	36	84	58	51	43
5	overflight	83	59	51	42	89	58	52	44
6	Strafing (landing)	89	55	57	50	91	71	65	57
7	Landing ILS	95	71	63	51	101	81	75	68
8	Landing ILS	92	68	61	54	96	76	70	62
9	Departure 30	81	57	49	42	79 (MIL 100%)	64	57	50

‘NORMALISED’ NOISE ADDITION FORMULA DERIVATION

$$L_A \text{ (in dBA)} = 10 \log (10^{(L1 - A1) / 10} + \ldots. + 10^{(Li - Ai) / 10} + \ldots. + 10^{(Ln - An) / 10})$$

where L_i and A_i are respectively the sound intensity level (or sound pressure level) and the associated ‘A’ weighted reduction level in dB for each of n octave frequencies.

If L_A is reduced by ‘k’ dB, and as $10 \log 10^{k/10} = k \log 10 = k$, then:

$$L_A\square = L_A - k = 10 \log (10^{(L1- A1) / 10} + \ldots. + 10^{(Li - Ai) / 10} + \ldots. + 10^{(Ln - An) / 10}) - 10 \log 10^{k/10}$$

$$= 10 \log \{(10^{(L1- A1) / 10} + \ldots. + 10^{(Li - Ai) / 10} + \ldots. + 10^{(Ln - An) / 10}) * 10^{-k/10}\}$$

$$= 10 \log (10^{(L1- A1- k) / 10} + \ldots. + 10^{(Li - Ai - k) / 10} + \ldots. + 10^{(Ln - An - k) / 10})$$

then $L_i \square = L_i - k$

and $L_A\square = 10 \log (10^{(L1 \square - A1) / 10} + \ldots. + 10^{(Li \square - Ai) / 10} + \ldots. + 10^{(Ln \square - An) / 10})$

Therefore if an overall L_A level is reduced by a constant ‘k’ dBA, then each octave frequency L_i level is in turn reduced by ‘k’ dB. However, this formula is only valid for about 100 metres, as beyond that distance, atmospheric absorption needs to be considered.

GENERAL NOISE ADDITION FORMULA DERIVATION

Taking account of distance attenuation and atmospheric absorption, where r’ and r are distances from a free field noise source, a_i is in dB/km or dB/1000ft, and spectral data at distance r is known,

then $L_i \square = L_i - (20 \log r'/r + a_i (r' - r))$

and $L_A\square = 10 \log (10^{(L1 \square - A1) / 10} + \ldots. + 10^{(Li \square - Ai) / 10} + \ldots. + 10^{(Ln \square - An) / 10})$

In this case, $L_i \square$ is frequency dependent as atmospheric absorption is frequency dependent.

F35-A AFTER BURNER NOISE										
Overall		**OCTAVE CENTRE FREQUENCIES**								
LA (dBA)	**ITEM DESCRIPTION**	**31**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
	L in dB at 1000 ft Altitude	98	107	116	114	112	113	116	111	108
	L to LA Conversion (dB to dBA)	-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1.0	-1.1
120.2	L in dBA at 1000 ft Altitude	58.6	80.8	99.9	105.4	108.8	113	117.2	112	106.9
	Atmospheric Absorption (dB/km)	0.03	0.12	0.44	1.3	2.7	4.7	9.9	30	105
	Atmospheric Absorption (dB/1000 ft)	0.01	0.04	0.13	0.40	0.82	1.43	3.02	9.14	32.00
	Distance Attenuation for 2000 ft (dB)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	L in dB at 2000 ft Altitude	92.0	100.9	109.8	107.6	105.2	105.5	107.0	95.8	70.0
	Normalised Values (120.2 - 111.2 = 9.0)	89.0	98.0	107.0	105.0	103.0	104.0	107.0	102.0	99.0
	delta	**-3.0**	**-3.0**	**-2.9**	**-2.6**	**-2.2**	**-1.6**	**0.0**	**6.2**	**29.0**
111.2	L in dBA at 2000 ft Altitude	52.6	74.7	93.7	99.0	102.0	105.5	108.2	96.8	68.9
	Distance Attenuation for 3000 ft (dB)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
	L in dB at 3000 ft Altitude	88.4	97.4	106.2	103.7	100.8	100.6	100.4	83.2	34.4
	Normalised Values (120.2 - 105.6 = 14.6)	83.4	92.4	101.4	99.4	97.4	98.4	101.4	96.4	93.4
	delta	**-5.1**	**-5.0**	**-4.8**	**-4.3**	**-3.4**	**-2.2**	**1.0**	**13.2**	**58.9**
105.6	L in dBA at 3000 ft Altitude	49.0	71.2	90.1	95.1	97.6	100.6	101.6	84.2	33.3
	Distance Attenuation for 4000 ft (dB)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	L in dB at 4000 ft Altitude	85.9	94.8	103.6	100.8	97.5	96.7	94.9	71.5	-0.1
	Normalised Values (120.2 - 101.3 = 18.9)	79.1	88.1	97.1	95.1	93.1	94.1	97.1	92.1	89.1
	delta	**-6.8**	**-6.7**	**-6.4**	**-5.6**	**-4.4**	**-2.5**	**2.2**	**20.6**	**89.2**
101.3	L in dBA at 4000 ft Altitude	46.5	68.6	87.5	92.2	94.3	96.7	96.1	72.5	-1.2
	Distance Attenuation for 8000 ft (dB)	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1
	L in dB at 8000 ft Altitude	79.9	88.7	97.0	93.2	88.2	84.9	76.8	28.9	-134.1
	Normalised Values (120.2 -90.4 = 29.8)	68.2	77.2	86.2	84.2	82.2	83.2	86.2	81.2	78.2
	delta	**-11.7**	**-11.5**	**-10.8**	**-9.0**	**-6.0**	**-1.7**	**9.4**	**52.3**	**212.3**
90.4	L in dBA at 8000 ft Altitude	40.5	62.5	80.9	84.6	85.0	84.9	78.0	29.9	-135.2

	Distance Attenuation for 12000 ft (dB)	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
	L in dB at 12000 ft Altitude	76.3	85.0	92.9	88.1	81.4	75.7	61.2	-11.2	-265.6
	Normalised Values (120.2 - 83.8 = 36.4)	61.6	70.6	79.6	77.6	75.6	76.6	79.6	74.6	71.6
	delta	**-14.7**	**-14.4**	**-13.3**	**-10.5**	**-5.8**	**0.9**	**18.4**	**85.8**	**337.2**
83.8	L in dBA at 12000 ft Altitude	36.9	58.8	76.8	79.5	78.2	75.7	62.4	-10.2	-266.7

	Distance Attenuation for 11000 ft (dB)	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8
	L in dB at 11000 ft Altitude	77.1	85.8	93.8	89.2	82.9	77.8	65.0	-1.3	-232.9
	Normalised Values (120.2 - 85.2 = 35)	63.0	72.0	81.0	79.0	77.0	78.0	81.0	76.0	73.0
	delta	**-14.1**	**-13.8**	**-12.8**	**-10.2**	**-5.9**	**0.2**	**16.0**	**77.3**	**305.9**
85.2	L in dBA at 11000 ft Altitude	37.7	59.6	77.7	80.6	79.7	77.8	66.2	-0.3	-234.0