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 $C_{3} = \frac{\left[1 + \left(\frac{5\lambda}{e}\right)^{2}\right]}{\frac{1}{3} + \left(\frac{5\lambda}{e}\right)^{2}}$

Calculation of Barrier Correction (ISO 9613-2) for Helipad

From ISO 9613-2, the barrier attenuation Dz, in decibels, shall be calculated by the following equation:

$$D_z = 10 \log \left[3 + \left(\frac{C_2}{\lambda}\right) C_3 z K_{met} \right]$$

where

 $C_2 = 20$ includes the effect of ground reflections

Frequency (f)*	500	Hz	
Velocity (v)	343	m/s	
Wavelength (λ)	0.69	m	$\lambda = v/f$

(*) Note 1 of ISO 9613-2: If only A-weighted sound power levels of the sources are known, the attenuation terms for 500Hz may be used to estimate the resulting attenuation.

Z is the difference between the path lengths of diffracted and direct sound, in meter.

$$K_{mst} = \exp\left[-\left(\frac{1}{2000}\right)\sqrt{\frac{d_{ss} d_{sr} d}{2z}}\right] \qquad \text{for } z > 0$$

e is the distance between the two diffraction edges in the case of double diffraction (see figure 7).

Helicopter Normal Operation (Without Lateral Movements: Idling / Normal Hovering)

\rightarrow	e	$\overline{\mathbf{A}}$
d=5		l de
		R
s d		



Figure 7 — Geometrical quantities for determining the pathlength difference for double diffraction

		Height	(mPD)		[Distance (m)		Path Diffe	rence (m)					
NSR	Source (S)	Barrier 1 (B1)	Barrier 2 (B2)	Receiver (R)	S-B1	B1-B2	, B2-R	dss	е	dsr	z	C2	C3	Kmet (Barrier Correction*
N7b	72.5	72	41	31.5	35	510	35	35	511	36	0.8	20	3.00	0.71	17
N9c	72.5	72	59	29.3	28	305	275	28	305	277	0.3	20	3.00	0.27	11
N10b	72.5	60	39	29.8	26	310	150	29	311	150	2.0	20	3.00	0.69	20
N11b	72.5	72	52	29.9	30	285	100	30	286	102	0.9	20	3.00	0.66	18
N12a^	72.5	64		40.3	233	62		233		66	2.8	20	2.98	0.64	20
N13	72.5	72	37	28	25	255	60	25	257	61	0.2	20	3.00	0.54	10
N14	72.5	83	73	20.3	60	140	170	61	140	178	5.6	20	3.00	0.74	20
N15^	72.5	72		24.9	35	405		35		408	0.2	20	3.00	0.11	7
N16	72.5	81	48	28.1	45	325	130	46	327	132	2.0	20	3.00	0.65	20

Notes: (*) Barrier correction has been limited to 20 dB(A) for conservative approach.

(^) Single Diffraction

Helicopter Type A Training (Hovering) at 40-50 ft. (12-15 m)

		Height	(mPD)]	Distance (m	I)		Path Diffe	erence (m)					Porrior
NSR	Source	Barrier 1	Barrier 2	Receiver	S-B1	B1-B2	B2-R	eeh	_	dsr	7	C2	C3	Kmet	Correction*
	(S)	(B1)	(B2)	(R)	0-01	01-02	DZ-K	U 33	C	431	2				confection
N7b^	85	41		31.5	545	35		547		36	0.6	20	2.94	0.21	11
N9c^	85	59		29.3	333	275		334		277	0.1	20	3.00	0.00	5
N10b	85	60	39	29.8	26	310	150	36	311	150	7.9	20	3.00	0.82	20
N11b^	85	52		29.9	315	100		317		102	0.5	20	2.99	0.16	10
N12a^	85	64		40.3	233	62		234		66	2.0	20	2.98	0.58	20
N13^	85	37		28	280	60		284		61	0.0	20	2.98	0.00	5
N14	85	83	73	20.3	60	140	170	60	140	178	2.8	20	3.00	0.65	20
N15 [#]	85														0
N16	85	81	48	28.1	45	325	130	45	327	132	0.1	20	3.00	0.19	7

Notes: (*) Barrier correction has been limited to 20 dB(A) for conservative approach.

(^) Single Diffraction

([#]) No Barrier Correction

P:\Hong Kong\ENL\PROJECTS\351613 Kong Nga Po\07 Working\03 Noise\Helicopter Noise\Appendix 4.10 Helicopter Noise Impact Assessment_Rev F_v6.xls

Predicted Noise Level from Helicopter during Day-time Period (With Lateral Movements)

With reference to the data provided by the helicopter manufacturer through GFS, the Lmax (with lateral movements) for Airbus Helicopters H175 were :

	Airbus Helicopters H175								
Flying Mode	ICAO Max. Noise Level	Demonstrated Noise Level	Lmax	Reference Distance					
	EPNdB	EPNdB	dB(A)	(m)					
Approach	98.8	95.1	85.8	120					
Take-off	95.8	89.8	82.8	150					
Flyover	93.8	91.0	80.8	150					

Notes:

(*) Reference distances of the ICAO max. noise levels for Airbus Helicopters H175 are 120 / 150 / 150 metre for Approach / Take-off / Flyover, respectively under conservative approach. Details please refer to Appendix 4.9.

(^) Lmax, dB(A) = EPNdB-13, with reference to "Transportation Noise Reference Book" (Nelson, 1987).

Bold: Highest EPNdB / Lmax, dB(A) noise levels were adopted in the assessment for conservative approach.

Nearest	Vertical Distance to Flig	ht Path (m)				Approaching:	16	degree	Taking-off:	12	degree
NSR	Ground Level (mPD)	Building Height (m)	Assessment Level (mPD)	Helipad Level (mPD)	Distance from Helipad (m)	Flight Height - 16 de. (m)	Flight Height (mPD)	Vertical Distance (m)	Flight Height - 12 de. (m)	Flight Height (mPD)	Vertical Distance (m)
N7b	28.5	3	31.5	70	545	148	220	189	116	188	156
N9c	26.3	3	29.3	70	580	148	220	191	123	195	166
N10b	26.8	3	29.8	70	460	132	204	174	98	170	140
N11b	26.9	3	29.9	70	395	113	185	155	84	156	126
N12a	37.3	3	40.3	70	270	77	149	109	57	129	89
N13	22	6	28	70	315	90	162	134	67	139	111
N14	17.3	3	20.3	70	340	97	169	149	72	144	124
N15	21.9	3	24.9	70	405	116	188	163	86	158	133
N16	19.1	9	28.1	70	475	136	208	180	101	173	145

Minimum Distance from Helicopter Flight Paths (m)

NGD	Horizontal Distance
NON	(m)
N7b	431
N9c	163
N10b	113
N11b	156
N12a	175
N13	338
N14	363
N15	238
N16	281

Surface Profile of Helicopter





Predicted Unmitigated Noise Level (L max) at Identified NSRs - Approaching

	Separation Distance	I may at 120m	No. of		Cori	rection		Corrected	Noice Criteria	
NSR	(m)	dB(A)	Helicopter	Qty. dB(A)	Distance dB(A)	Barrier dB(A)	Facade dB(A)	Lmax dB(A)	dB(A)	Exceedance
N7b	470	85.8	1	0	-12	0	3	77	85	
N9c	251	85.8	1	0	-6	0	3	82	85	
N10b	208	85.8	1	0	-5	0	3	84	85	
N11b	220	85.8	1	0	-5	0	3	84	85	
N12a	206	85.8	1	0	-5	0	3	84	85	
N13	364	85.8	1	0	-10	0	3	79	85	
N14	392	85.8	1	0	-10	0	3	79	85	
N15	289	85.8	1	0	-8	0	3	81	85	

N16	334	85.8	1	0	-9	0	3	80	85	

Notes:

Surface profile please refer to "Surface Profile of Helicopter" diagram.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Taking-off

	Soparation Distance	I max at 150m	No. of		Corr	ection		Corrected	Noiso Critoria	
NSR	(m)	dB(A)	Helicopter	Qty. dB(A)	Distance dB(A)	Barrier dB(A)	Facade dB(A)	Lmax dB(A)	dB(A)	Exceedance
N7b	458	82.8	1	0	-10	0	3	76	85	
N9c	233	82.8	1	0	-4	0	3	82	85	
N10b	180	82.8	1	0	-2	0	3	84	85	
N11b	201	82.8	1	0	-3	0	3	83	85	
N12a	196	82.8	1	0	-2	0	3	83	85	
N13	356	82.8	1	0	-8	0	3	78	85	
N14	384	82.8	1	0	-8	0	3	78	85	
N15	273	82.8	1	0	-5	0	3	81	85	
N16	316	82.8	1	0	-6	0	3	79	85	

Notes:

Surface profile please refer to "Surface Profile of Helicopter" diagram.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Flyover

	Separation Distance	I may at 150m	No. of		Cori	rection		Corrected	Noiso Critoria	
NSR	(D1)* (m)	dB(A)	Helicopter	Qty. dB(A)	Distance dB(A)	Barrier dB(A)	Facade dB(A)	Lmax dB(A)	dB(A)	Exceedance
N7b	189	80.8	1	0	-2	0	3	82	85	
N9c	191	80.8	1	0	-2	0	3	82	85	
N10b	190	80.8	1	0	-2	0	3	82	85	
N11b	190	80.8	1	0	-2	0	3	82	85	
N12a	180	80.8	1	0	-2	0	3	82	85	
N13	192	80.8	1	0	-2	0	3	82	85	
N14	200	80.8	1	0	-2	0	3	81	85	
N15	195	80.8	1	0	-2	0	3	82	85	
N16	192	80.8	1	0	-2	0	3	82	85	

Notes:

(*) The minimum separation distance between the helicopters and NSR during flyover mode is 220mPD minus the assessment level of NSR.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Flyover along the Assessment Boundary

	Horizontal Distance	Soparation	I max at 150m	No. of		Correc	ction		Corrected	Noiso Critoria	
NSR	from Assessment Boundary (D2)* (m)	Distance [^] (m)	dB(A)	Helicopter	Qty. dB(A)	Distance dB(A)	Barrier dB(A)	Facade dB(A)	Lmax dB(A)	dB(A)	Exceedance
N7b	154	243	80.8	1	0	-4	0	3	80	85	
N9c	118	224	80.8	1	0	-3	0	3	80	85	
N10b	256	319	80.8	1	0	-7	0	3	77	85	
N11b	305	359	80.8	1	0	-8	0	3	76	85	
N12a	432	468	80.8	1	0	-10	0	3	74	85	
N13	372	419	80.8	1	0	-9	0	3	75	85	
N14	368	419	80.8	1	0	-9	0	3	75	85	
N15	316	371	80.8	1	0	-8	0	3	76	85	
N16	208	283	80.8	1	0	-6	0	3	78	85	

Notes:

(*) The minimum horizontal distance between the helicopters and NSR during flyover mode outside the assessment area is the distance between the 694m assessment boundary and NSR.

(^) The minimum separation distance between the helicopters and NSR = $(D1^2 + D2^2)^{0.5}$

Predicted Noise Level from Helicopter during Day-time Period (Without Lateral Movements)

With reference to the approved EIA Study "Helipad at Yung Shue Wan, Lamma Island" (EIA-114/2005), the Lmax (without lateral movements) for Super Puma AS 332 L2 were :

Measurement Configuration	Lmax Noise Level at 150m, dB(A) Super Puma AS332 L2*
Helicopter on ground, Idling	82
Helicopter in the air	90.6 ^[1]

Notes:

[1] Noise level was measured during the hovering mode (free field)

[*] No noise data of the Airbus Helicopters H175 data is available, that of Super Puma AS332 L2 is adopted for conservative approach.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Idling

	Separation Distance I may at 1		No. of		Correction				Noiso Critoria	
NSR	(m)	dB(A)	B(A) Helicopter Q	Qty. dB(A)	Distance dB(A)	Barrier dB(A)	Facade dB(A)	Lmax dB(A)	dB(A)	Exceedance
N7b	545	82	1	0	-11	-17	3	57	85	
N9c	580	82	1	0	-12	-11	3	63	85	
N10b	460	82	1	0	-10	-20	3	55	85	
N11b	395	82	1	0	-8	-18	3	59	85	
N12a	270	82	1	0	-5	-20	3	60	85	
N13	315	82	1	0	-6	-10	3	68	85	
N14	340	82	1	0	-7	-20	3	58	85	
N15	405	82	1	0	-9	-7	3	70	85	
N16	475	82	1	0	-10	-20	3	55	85	

Notes:

Barrier correction based on ISO 9613-2 is adopted for screening by terrain or no line of sight to the helipad.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Hovering at 40-50 ft. (12-15 m)

	Separation Distance	I max at 150m	No. of Helicopter		Corr	ection		Corrected	Noise Criteria	
NSR	(m)	dB(A)		Qty. dB(A)	Distance dB(A)	Barrier dB(A)	Facade dB(A)	Lmax dB(A)	dB(A)	Exceedance
N7b	545	90.6	1	0	-11	-11	3	71	85	
N9c	580	90.6	1	0	-12	-5	3	77	85	
N10b	460	90.6	1	0	-10	-20	3	64	85	
N11b	395	90.6	1	0	-8	-10	3	75	85	
N12a	270	90.6	1	0	-5	-20	3	68	85	
N13	315	90.6	1	0	-6	-5	3	82	85	
N14	340	90.6	1	0	-7	-20	3	66	85	
N15	405	90.6	1	0	-9	0	3	85	85	
N16	475	90.6	1	0	-10	-7	3	76	85	

Notes:

Barrier correction based on ISO 9613-2 is adopted for screening by terrain or no line of sight to the helicopter. Surface profile please refer to "Surface Profile of Helicopter" diagram.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 1

The predicted noise levels of the Operation Mode 1 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	1+1	71	85	
N9c	29.3	1+1	77	85	
N10b	29.8	1+1	64	85	
N11b	29.9	1+1	75	85	
N12a	40.3	1+1	69	85	
N13	28.0	1+1	83	85	
N14	20.3	1+1	67	85	
N15	24.9	1+1	85	85	
N16	28.1	1+1	76	85	

Notes:

(*) Operation Mode 1 = Predicted Noise Level from 1 Helicopter Idling on the helipad + Predicted Noise Level from 1 Helicopter (Hovering) at 12-15 m over the helipad.

The Noise Contours of Operation Mode 1 based on the assessment level of the worst noise affected NSR (i.e. N15) have been shown in Figure 4.9.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 2

The predicted noise levels of the Operation Mode 2 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	1+1	77	85	
N9c	29.3	1+1	82	85	
N10b	29.8	1+1	84	85	
N11b	29.9	1+1	84	85	
N12a	40.3	1+1	84	85	
N13	28.0	1+1	80	85	
N14	20.3	1+1	79	85	
N15	24.9	1+1	81	85	
N16	28.1	1+1	80	85	

Notes:

(*) Operation Mode 2 = Predicted Noise Level from 1 Helicopter Idling on the helipad + Predicted Noise Level from 1 Helicopter Approaching within the restricted ranges.

The Noise Contours of Operation Mode 2 based on the assessment level of the worst noise affected NSR (i.e. N12a) have been shown in Figure 4.9.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 3

The predicted noise levels of the Operation Mode 3 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	1+1	76	85	
N9c	29.3	1+1	82	85	
N10b	29.8	1+1	84	85	
N11b	29.9	1+1	83	85	
N12a	40.3	1+1	83	85	
N13	28.0	1+1	79	85	
N14	20.3	1+1	78	85	
N15	24.9	1+1	81	85	
N16	28.1	1+1	79	85	

Notes:

(*) Operation Mode 3 = Predicted Noise Level from 1 Helicopter Idling on the helipad + Predicted Noise Level from 1 Helicopter Taking-off within the restricted ranges.

The Noise Contours of Operation Mode 3 based on the assessment level of the worst noise affected NSR (i.e. N10b) have been shown in Figure 4.9.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 4

The predicted noise levels of the Operation Mode 4 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	1+1	81	85	
N9c	29.3	1+1	84	85	
N10b	29.8	1+1	85	85	
N11b	29.9	1+1	84	85	
N12a	40.3	1+1	84	85	
N13	28.0	1+1	81	85	
N14	20.3	1+1	80	85	
N15	24.9	1+1	82	85	
N16	28.1	1+1	82	85	

Notes:

(*) Operation Mode 4 = Predicted Noise Level from 1 Helicopter Approaching within the restricted ranges + Predicted Noise Level from 1 Helicopter Flyover along the assessment boundary.

The Noise Contours of Operation Mode 4 based on the assessment level of the worst noise affected NSR (i.e. N10b) have been shown in Figure 4.9.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 5

The predicted noise levels of the Operation Mode 5 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	1+1	81	85	
N9c	29.3	1+1	84	85	
N10b	29.8	1+1	85	85	
N11b	29.9	1+1	84	85	
N12a	40.3	1+1	84	85	
N13	28.0	1+1	80	85	
N14	20.3	1+1	79	85	
N15	24.9	1+1	82	85	
N16	28.1	1+1	82	85	

Notes:

(*) Operation Mode 5 = Predicted Noise Level from 1 Helicopter Taking-off within the restricted ranges + Predicted Noise Level from 1 Helicopter Flyover along the assessment boundary.

The Noise Contours of Operation Mode 5 based on the assessment level of the worst noise affected NSR (i.e. N10b) have been shown in Figure 4.9.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 6

The predicted noise levels of the Operation Mode 6 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	1+1	80	85	
N9c	29.3	1+1	80	85	
N10b	29.8	1+1	77	85	
N11b	29.9	1+1	76	85	
N12a	40.3	1+1	74	85	
N13	28.0	1+1	76	85	
N14	20.3	1+1	75	85	
N15	24.9	1+1	77	85	
N16	28.1	1+1	78	85	

Notes:

(*) Operation Mode 6 = Predicted Noise Level from 1 Helicopter Idling on the helipad + Predicted Noise Level from 1 Helicopter Flyover along the assessment boundary.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 7

The predicted noise levels of the Operation Mode 7 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	1+1	80	85	
N9c	29.3	1+1	82	85	
N10b	29.8	1+1	77	85	
N11b	29.9	1+1	79	85	
N12a	40.3	1+1	75	85	
N13	28.0	1+1	83	85	
N14	20.3	1+1	75	85	
N15	24.9	1+1	85	85	
N16	28.1	1+1	80	85	

Notes:

(*) Operation Mode 7 = Predicted Noise Level from 1 Helicopter (Hovering) at 12-15 m over the helipad + Predicted Noise Level from 1 Helicopter Flyover along the assessment boundary.

The Noise Contours of Operation Mode 7 based on the assessment level of the worst noise affected NSR (i.e. N15) have been shown in Figure 4.9.

Predicted Unmitigated Noise Level (L max) at Identified NSRs - Operation Mode 8

The predicted noise levels of the Operation Mode 8 were as follows:

NSR	Assessment Level (mPD)	No. of Helicopter *	Corrected Lmax dB(A)	Noise Criteria dB(A)	Exceedance
N7b	31.5	2	85	85	
N9c	29.3	2	85	85	
N10b	29.8	2	85	85	
N11b	29.9	2	85	85	
N12a	40.3	2	85	85	
N13	28.0	2	85	85	
N14	20.3	2	84	85	
N15	24.9	2	85	85	
N16	28.1	2	85	85	

Notes:

(*) Operation Mode 8 = Predicted Noise Level from 2 Helicopters Flyover directly above the NSR.

The Noise Contours of Operation Mode 8 based on the assessment level of the worst noise affected NSR (i.e. N12a) have been shown in Figure 4.9.

NSR (31.5 mPD) Х

LEGEND:

- EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT
- - NORMAL HOVERING HEIGHT OF HELICOPTER (2.5M)
- B1 ٠

 - B2

- HOVERING HEIGHT OF HELICOPTER (15M)



Appendix 4.10 Helicopter Noise Impact Assessment







LEGEND:

- EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT NORMAL HOVERING HEIGHT OF HELICOPTER (2.5M)
- HOVERING HEIGHT OF HELICOPTER (15M) B1 •

- Х NSR (29.3 mPD)
- •
- - B2

LEGEND:

- EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT NORMAL HOVERING HEIGHT OF HELICOPTER (2.5M)
 - HOVERING HEIGHT OF HELICOPTER (15M)
 - B1 • • B2

- NSR (29.8 mPD) Х

LEGEND:

EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT NORMAL HOVERING HEIGHT OF HELICOPTER (2.5M)

Hovering height of helicopter (15M)

NSR (29.9 mPD) Х

• B1

• B2

LEGEND:

EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT NORMAL HOVERING HEIGHT OF HELICOPTER (2.5M)

HOVERING HEIGHT OF HELICOPTER (15M)

• B1

NSR (40.3 mPD) Х

LEGEND:

EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT B1 ٠ Normal Hovering Height of Helicopter (2.5M) • B2

HOVERING HEIGHT OF HELICOPTER (15M)

NSR (28.0 mPD) Х

- EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT NORMAL HOVERING HEIGHT OF HELICOPTER (2.5M)

X NSR (20.3 mPD)

- X NSR (24.9 mPD)
- EXISTING GROUND PROFILE GROUND PROFILE OF PROPOSED DEVELOPMENT NORMAL HOVERING HEIGHT OF HELICOPTER (2.5M)
- HOVERING HEIGHT OF HELICOPTER (15M) • B1

- NSR (28.1 mPD) Х
- GROUND PROFILE OF PROPOSED DEVELOPMENT Normal Hovering Height of Helicopter (2.5M)

EXISTING GROUND PROFILE

- B2 •
- •
- B1
- Hovering height of helicopter (15M)

