The aircraft noise pollution on the noise mapping and track map

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ABSTRACT

Currently, about 70% of the area of US military bases nationwide is concentrated in Okinawa, which is about 10.4% of Okinawa's prefectural land area.Many US military bases are located in and around the city center and have many influences on urban planning.Above all, the problem of aircraft noise is serious and has a great influence on the living environment of the local residents, such as takeoff and landing sounds and engine adjustment sounds.In response to this, the country is taking measures such as soundproofing work, but it has not yet been solved.The purpose of this study is (1) to grasp and consider the actual situation by visual inspection of noise problems related to US military training, (2) to derive the wake of US military aircraft from the measurement results of precision sound level meter and visual inspection, and the measurement environment is appropriate from the results Consideration of whether or not, ③ Consideration of the noise damage situation for each point from the obtained noise data and track map

1. Research purpose

The purpose of this study is (1) to grasp and consider the actual situation by visual inspection of noise problems related to US military training, (2) to derive the wake of US military aircraft from the measurement results of precision sound level meter and visual inspection, and the measurement environment is appropriate from the results Consideration of whether or not, (3) Consideration of the noise damage situation for each point from the obtained noise data and track map.

2. Measurement point

This study mainly focused on Kadena and Futenma bases. Fig. 1 shows the locations where measurements were made with each sound level meter and where visual inspection was performed.

In the visual survey, a visual survey was conducted to compare the noise data with the housing in Ginowan City, Aichi Prefecture. In addition, visual inspections of the wake routes around the

Futenma base were conducted at five locations: Aichi Prefectural Housing, Ginowan City, Futenma No.2 Elementary School, Wakamatsu Park, University of the Ryukyus, and Urasoe Grand Park.

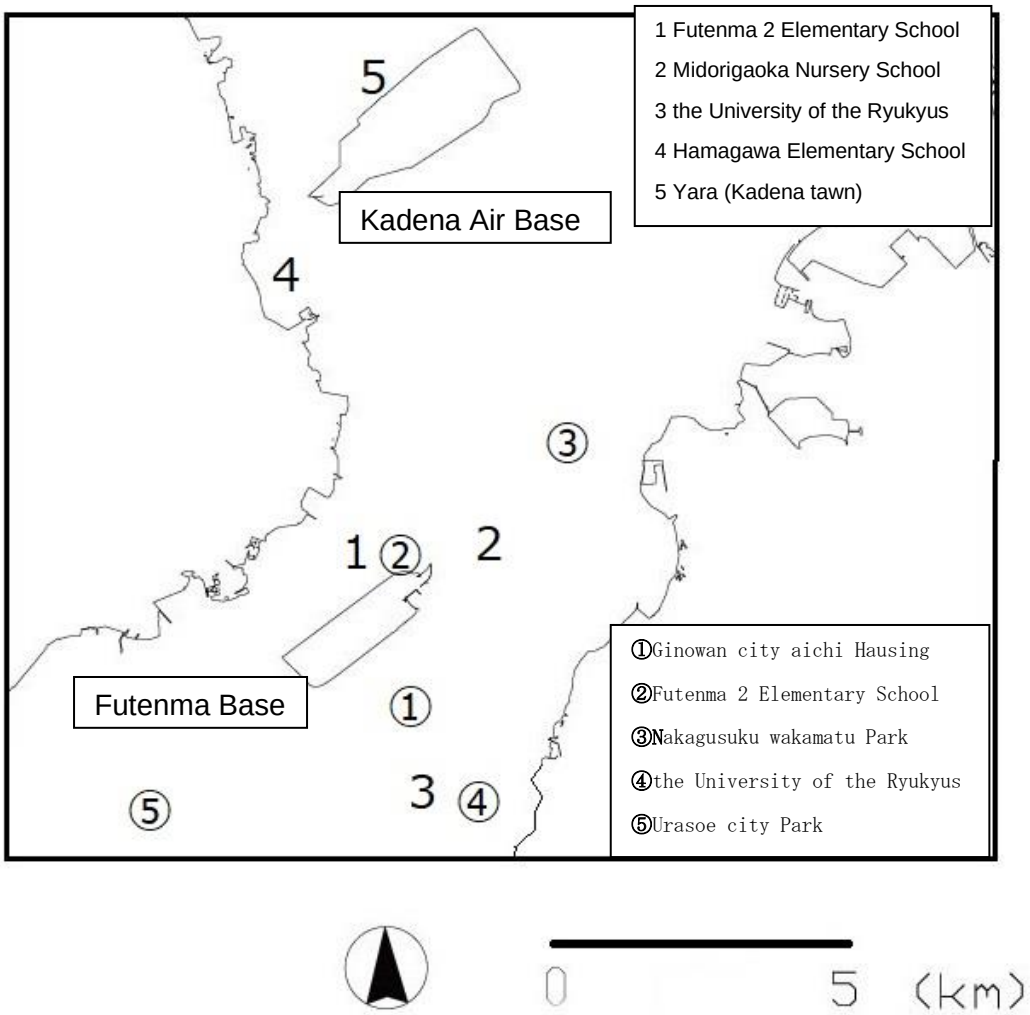


Fig. 1 Measurement points

3. Evaluation formula

The following two equations are used as environmental standards for evaluating aircraft noise.

WECPNL = dB (A) + $10\log_{10}N$-27 (1)

$$L_{den} = 10\log\left\{\frac{T_0}{T}\left(\sum_i 10^{\frac{L_{AE,di}}{10}} + \sum_j 10^{\frac{L_{AE,ej+5}}{10}} + \sum_k 10^{\frac{L_{AE,nk+10}}{10}}\right)\right\} \quad (2)$$

Both of these two formulas is divided into three time zones, daytime, evening and nighttime, and weights aircraft noise respectively. This is because the silence in the morning, daytime, and night differs depending on the time zone. WECPNL (W value) is the old environmental standard, and since April 1, 2013, the new environmental standard Lden has been adopted. With the exception of exceptions, the calculation of Lden was performed in a calculation interval of 10 seconds.

4. Visual inspection

When analyzing noise data taken from measurement equipment, it is not possible to completely judge the noise data as noise from an aircraft. Therefore, an accurate analysis can be performed by performing a visual inspection and matching all visual records of the day with the noise data. Based on this data, we will improve the accuracy and efficiency of the analysis.

4.1 Visual inspection and noise measurement results

The survey target was Futenma Base, and the noise measurement points were Futenma Daini Elementary School, Midorigaoka Nursery School, and the University of the Ryukyus (see Fig. 1). The measurement period is January 18, 2019. The standard values for aircraft noise are set for each type of area based on the Basic Environmental Law. Hereinafter, Lden is 57 dB or less (see Table 1,Table 2).

Table 1 Results of visual inspection and noise data analysis

	Futenma 2 Elementary School	Midorigaoka Nursery School	the University of the Ryukyus
WECPNL	77.4	77.8	63.2
L_{den}(dB)	60.4	60.7	54.5
Number of noise	65	62	40
Implementation time	8:30−17:00		
Analysis time	0:00−24:00		

Table 2 Breakdown of noise occurrence time (cases)

N1: 0-7, N2: 7-19, N3: 19-22, N4: 22-24

WECPNL	N2	N3	N4	N1	total
L_{den}(dB)	n1	n2	n3		
Futenma 2 Elementary School	59	5	1		65
Midorigaoka Nursery School	57	3	1	1	62
the University of the Ryukyus	39	1			40

4.2 Visual inspection and noise data consideration

Only the University of the Ryukyus met the criteria, and the other measurement points exceeded the environmental standards. WECPNL and Lden have a relationship of “WECPNL-Lden ≒ 13”. As a result of the data analysis of the visual inspection, the difference between them was as large as about 17. This is because Lden performs the evaluation by reflecting the actual duration of the noise, whereas the WECPNL calculation method performs the evaluation by assuming that the duration of all noises is uniformly 20 seconds. When the

noise level is high, the difference depending on the duration has a large effect, and it is considered that such a relationship is obtained.

In addition, the Lden values of Futenma Nikko and Midorigaoka show that they are almost the same distance from the noise source (aircraft flight route).

5. Results obtained from visual inspection data analysis

Noise level, Lden value in noise measurement at Futenma Daini Elementary School and Midorigaoka Nursery School, Faculty of Engineering, University of the Ryukyus around Futenma Base,

In addition, from the results of the visual inspection, it is possible to obtain a rough track map of the aircraft around the Futenma Air Base that flew on January 18, 2019.

・Fig. 2 and Fig.3 show the relationship between noise level graphs and measurement points by model.

・The track maps obtained from the above are shown in Fig.4, Fig.5, Fig.6 .

As can be seen from the graphs shown in Fig. 2 and Fig. 3, the noise levels are almost the same in Futenma No.2 Elementary School Small and Midorigaoka Nursery School close to the base.

From this, it can be seen that the damage caused by noise is similar not only around the base but also at the point where the aircraft passes over the sky. In addition, since many passages over the sky above Ryukyu University Hospital were confirmed on the east side of the point of the Faculty of Engineering where noise measurement was performed at Ryukyu University, it is considered necessary to review the noise measurement point.

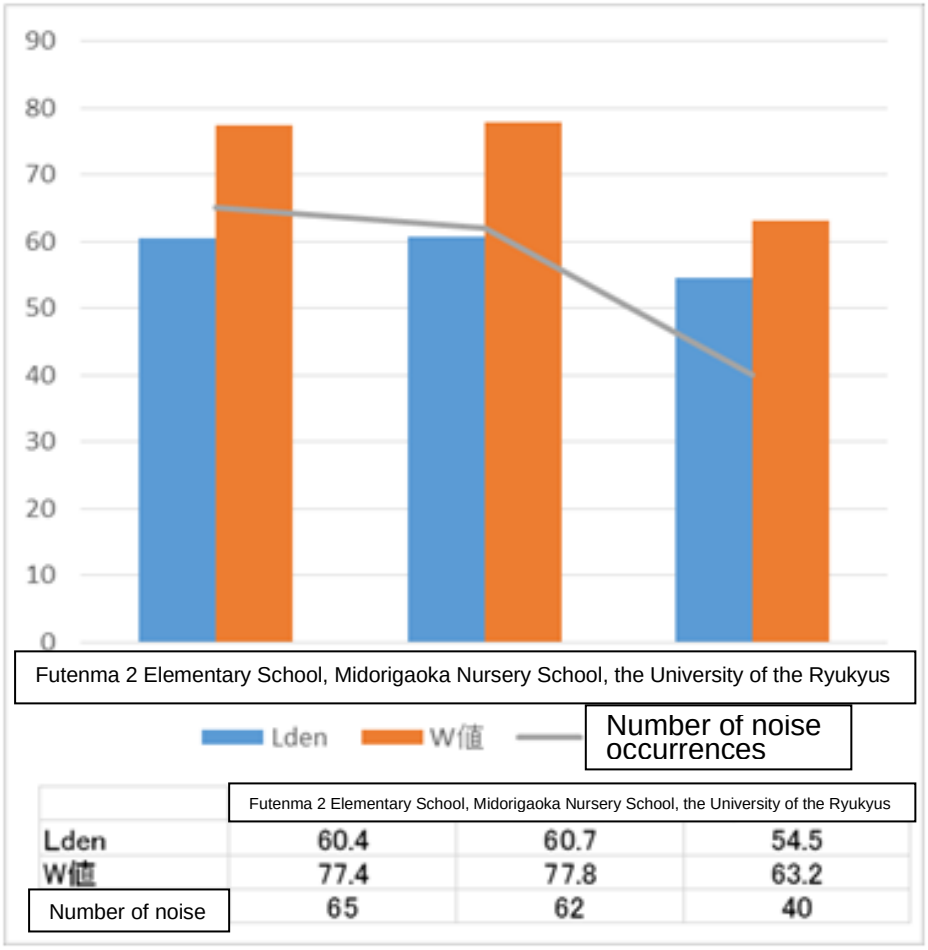
６．Summary

A wake figure around the Futenma base after 2010 when I contact Okinawa Bureau of Defense Policy, by a site, it wasn't being published any more and it was also possible to read a wake figure until 1 year before of nearest at present, but it was said that whether future's wake data is published was uncertain.

I found out that accuracy can be taken out of the value of Lden and the noise level of the noise measurement by the result by it could be predicted whether an airplane was passing through the distance which is how long away from the noise measurement spot, and doing more watch investigations. It'll be necessary to increase more measurement spot and number of data and be raising the precision from now on.

Data of the noise this measurement gave, precise sound, it was possible to confirm the outline's wake of the airplane and the flight route of U.S. forces by total and a watch investigation, but it wasn't possible to get a correct wake figure.

I can think it leads to get correcter data and wake figure by also increasing a measurement spot by a noise meter from now on from this thing.



	Futenma 2 Elementary School	Midorigaoka Nursery School	the University of the Ryukyus
Lden	60.4	60.7	54.5
W値	77.4	77.8	63.2
Number of noise	65	62	40

Fig. 2 – Diagram showing the relationship between noise levels and measurement points

Fig. 3 Diagram showing the relationship between noise level and measurement points

Fig. 4 Futenma flight result.

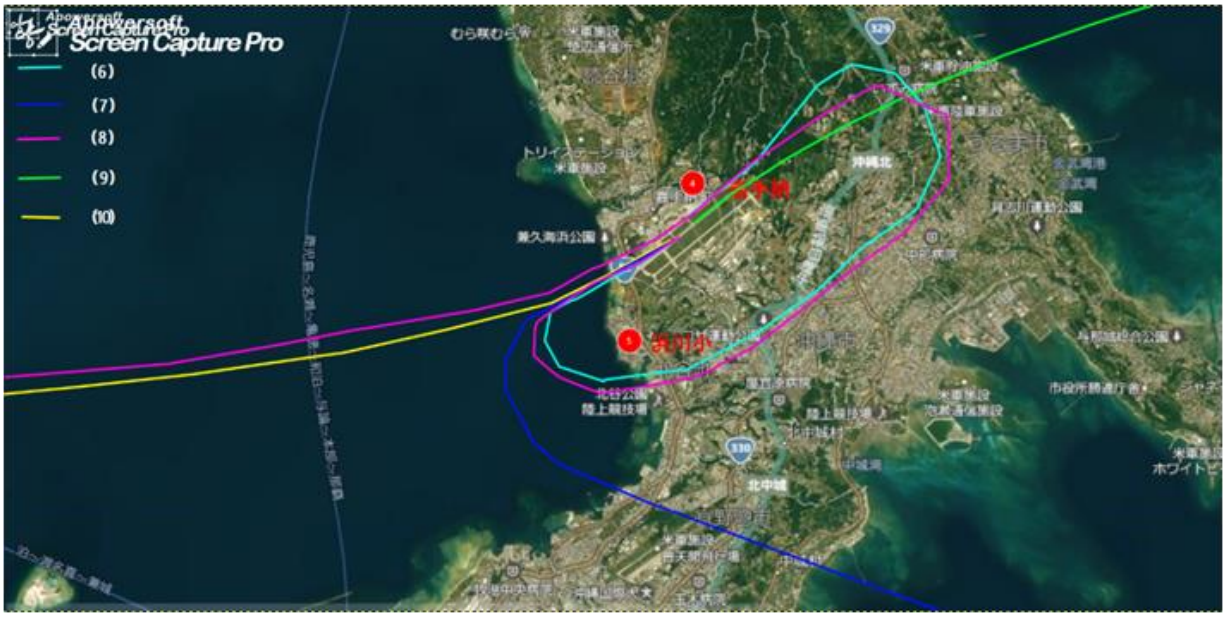


Fig. 5 Kadena flight result.

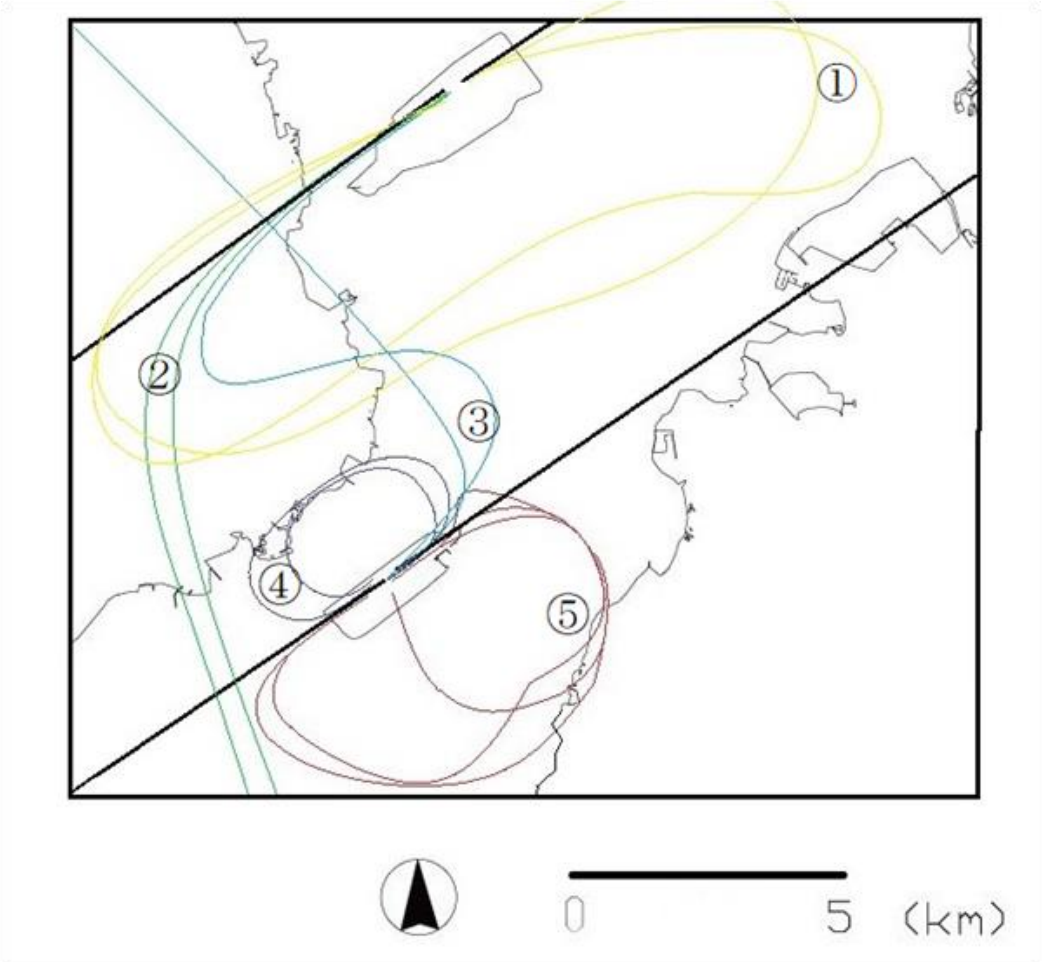


Fig. 6 Wake figure Futenma airport and Kadena base.

①：Routes for turning, touch and go, etc. at Kadena base (KC135, F15 were many)

②：From the south, pass over Urasoe Grand Park and land at Kadena Air Base (mainly F15 confirmation)

③：After taking off from Futenma Base, make a turn to the north or Kadena Base and land

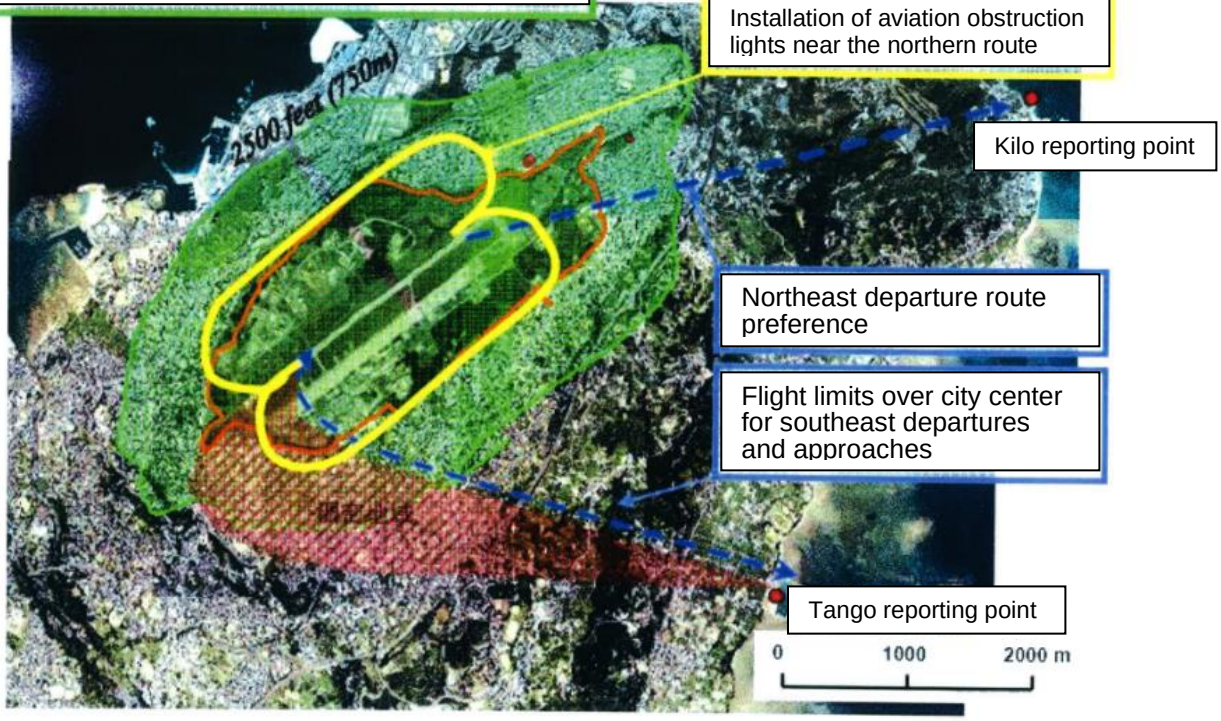
④：Take off the helipad at Futenma Air Base, turn left, and land on the helipad again (mainly helicopter AH1W)

⑤：Turn right after taking off at Futenma Air Station, turn around the University of the Ryukyus or around Urasoe Grand Park, and land again at Futenma Air Station (KC135, CH53E, Cessna)

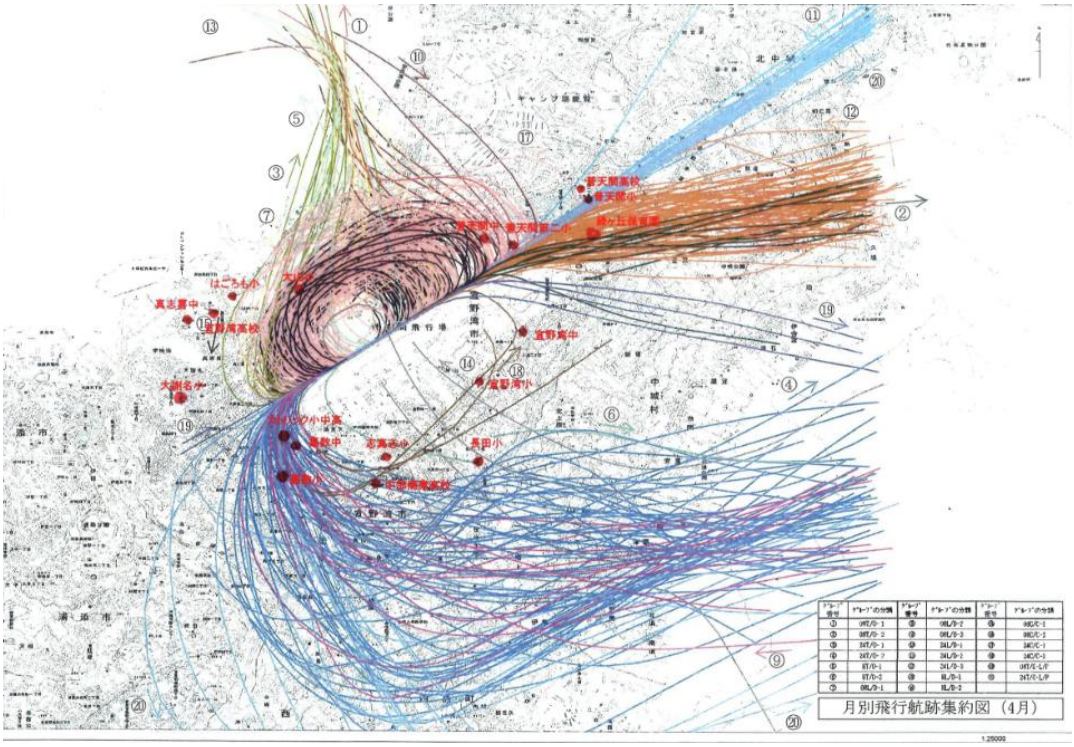
Regarding the "Report on the Review of the Route around Futenma Air Base and the Study of Further Possible Safety Measures" (Ministry of Foreign Affairs, August 10, 2007)

Re-examination of perimeter routes (results of technical analysis and verification

Attachment (Appended figure)



Attached chart 1 Flight training area figure around the Futenma airport



Attached chart 2 2016.04 wake figure

NO	年.月.日.	H:M:S秒	Runway (North: South)	Direction (East: West)	take off	landing	Model	Passing over the sky	Turning (right: left)	Ascending (low, up, steep)	Remarks	
1	31. 1. 16 .	12:59:40	South			○	Osprey				2 consecutive	Futenma Base
2	31. 1. 16 .	13:00:20	South			○	Osprey				2 consecutive	Futenma Base
3	31. 1. 16 .	13:04:30	North	East	○		KC-130					Futenma Base
4	31. 1. 16 .	13:34:50	North			○	AH-1W				2 consecutive	Futenma Base
5	31. 1. 16 .	13:35:00	North			○	AH-1W				2 consecutive	Futenma Base
6	31. 1. 16 .	13:36:30	South			○	AH-1W					Futenma Base
7	31. 1. 16 .	13:40:50	South			○	CH-53E					Futenma Base
8	31. 1. 16 .	14:18:40	North			○	CH-53E					Futenma Base
9	31. 1. 16 .	14:47:50	South			○	CH-53E					Passing near Ryudai
10	31. 1. 16 .	14:48:30	North	East	○		CH-53E					Futenma Base
11	31. 1. 16 .	14:54:30	South	East	○		Osprey					Futenma Base
12	31. 1. 16 .	15:05:20		West			CH-53E		right		touch&go	Passing near Ryudai
13	31. 1. 16 .	15:05:25	South	East	○		AH-1W					Futenma Base
14	31. 1. 16 .	15:07:50		West			CH-53E		right		touch&go	Passing near Ryudai
15	31. 1. 16 .	15:11:30	South	West		○	CH-53E		right		touch&go	Futenma Base
16	31. 1. 16 .	15:16:05	North	East	○		AH-1W					Futenma Base
17	31. 1. 16 .	15:22:10	South	East	○		Osprey					Futenma Base
18	31. 1. 16 .	15:25:10					Osprey	○			Passing over the sky	Futenma Base
19	31. 1. 16 .	15:32:40	North	East	○		UC-35					Futenma Base
20	31. 1. 16 .	15:34:10		East			KC-130				touch&go	Futenma Base
21	31. 1. 16 .	15:38:25					Osprey	○			Passing over the sky	Futenma Base
22	31. 1. 16 .	15:40:45				○	KC-130					Kadena Air Base
23	31. 1. 16 .	15:44:20					Osprey	○			Passing over the sky	Futenma Base
24	31. 1. 16 .	15:46:45				○	F-15				2 consecutive	Kadena Air Base
25	31. 1. 16 .	15:47:30				○	F-15				2 consecutive	Kadena Air Base
26	31. 1. 16 .	15:55:00					Osprey	○			Passing over the sky	Futenma Base
27	31. 1. 16 .	16:02:30					Osprey	○			Passing over the sky	Futenma Base
28	31. 1. 16 .	16:05:30				○	KC-130					Kadena Air Base
29	31. 1. 16 .	16:10:10					Osprey	○			Passing over the sky	Futenma Base
30	31. 1. 16 .	16:11:40				○	KC-130					Kadena Air Base
31	31. 1. 16 .	16:14:10	South			○	AH-1W					Passing near Ryudai
32	31. 1. 16 .	16:15:30	North	West	○		CH-53E				2 consecutive	Futenma Base
33	31. 1. 16 .	16:15:35	North	West	○		CH-53E					Futenma Base
34	31. 1. 16 .	16:18:10	South			○	Osprey					Futenma Base
35	31. 1. 16 .	16:20:20	North			○	AH-1W					Passing near Ryudai
36	31. 1. 16 .	16:22:20	South			○	Osprey					Futenma Base
37	31. 1. 16 .	16:24:25	South		○		Osprey		left		touch&go	Futenma Base
38	31. 1. 16 .	16:26:20	South			○	Osprey		left		touch&go	Futenma Base
39	31. 1. 16 .	16:26:50	South		○		AH-1W		left		touch&go	Futenma Base
40	31. 1. 16 .	16:29:20	South			○	AH-1W		left		touch&go	Futenma Base
41	31. 1. 16 .	16:29:55					Osprey	○			Passing over the sky	Futenma Base
42	31. 1. 16 .	16:31:00	South		○		AH-1W		left		touch&go	Futenma Base
43	31. 1. 16 .	16:31:30	South		○		Osprey		left		touch&go	Futenma Base
44	31. 1. 16 .	16:32:30	South			○	AH-1W		left		touch&go	Futenma Base
45	31. 1. 16 .	16:33:30	South		○		AH-1W		left		touch&go	Futenma Base
46	31. 1. 16 .	16:33:35	South			○	Osprey		left		touch&go	Futenma Base
47	31. 1. 16 .	16:35:05	South		○		Osprey		left		touch&go	Futenma Base
48	31. 1. 16 .	16:35:30	South			○	AH-1W		left		touch&go	Futenma Base
49	31. 1. 16 .	16:36:40	South		○		AH-1W		left		touch&go	Futenma Base
50	31. 1. 16 .	16:37:20	South			○	Osprey		left		touch&go	Futenma Base
51	31. 1. 16 .	16:38:25	South		○		Osprey		left		touch&go	Futenma Base
52	31. 1. 16 .	16:38:50	South			○	AH-1W		left		touch&go	Futenma Base
53	31. 1. 16 .	16:41:10	South			○	Osprey		left		touch&go	Futenma Base
54	31. 1. 16 .	16:44:10					Osprey	○			Passing over the sky	Futenma Base
55	31. 1. 16 .	16:46:20	South		○		Osprey		left		touch&go	Futenma Base
56	31. 1. 16 .	16:47:30	South			○	Osprey		left		touch&go	Futenma Base
57	31. 1. 16 .	16:49:40	North		○		AH-1W		left		touch&go	Futenma Base
58	31. 1. 16 .	16:49:50	South		○		Osprey		left		touch&go	Futenma Base
59	31. 1. 16 .	16:52:30	South			○	Osprey		left		touch&go	Futenma Base
60	31. 1. 16 .	16:53:20	South		○		Osprey		left		touch&go	Futenma Base
61	31. 1. 16 .	16:55:10	South			○	Osprey		left		touch&go	Futenma Base
62	31. 1. 16 .	17:00:00	South			○	CH-53E				2 consecutive	Futenma Base
63	31. 1. 16 .	17:00:05	South			○	CH-53E				2 consecutive	Futenma Base
64	31. 1. 16 .	17:01:30	North	East	○		AH-1W				2 consecutive	Futenma Base
65	31. 1. 16 .	17:01:35	North	East	○		AH-1W				2 consecutive	Futenma Base

Attached chart 3 Kadena airport Futenma airport watch survey result

Reference

[1] Okinawa times , 2006.5.17

[2] low frequency sound Manual corresponding to a problem and the Ministry of the Environment Environmental Management Bureau atmosphere life environment office and June, 2004.

[3] Tokashiki Takeshi and Nakasone kidai: About the current state of the U.S. military base in Okinawa-ken, noise and vibration workshop material N - 2013 - 15 or 2013.3.18

[4] Tokashiki Takeshi: About the noise problem U.S. forces facilities in Okinawa exert, noise and vibration workshop material N - 2015 - 63 or 2015.12.18

[5]Takeshi Tokashiki:Inter Noise Hong Kong 2017,Research on the effect of the aircraft noise pollution on the noise environment in Okinawa due to the U.S. military Bases,pp3269-3277