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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1968 / 103

Magnetic Survey of Three Compass Swinging sites, Kingsford Smith Airport, Mascot, New South Wales 1966 – 1967

by

J. van der Linden

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ILLUSTRATIONS

SUMMARY

A re-survey of two compass swinging sites at Kingsford Smith Airport was made and a third new site was established.

The surveys were made with an Askania declinometer from an eight-feet high platform. The platform was used to raise the instrument to the height of the aircraft's navigational system. This was done to attenuate the effect of many small surface magnetic anomalies.

At the new site, which is magnetically disturbed, the magnetic declination was measured at the position of the aircraft's fluxvalve sensors, part of the electronic compass system.

The magnetic accuracy of a Wild TO 2 Compass Theodolite was determined.

1. INTRODUCTION

In june 1966, a re-survey was made of two compass swinging sites on Kingsford Smith Airport at Mascot, New South Wales, and a new site was surveyed. The new site was re-surveyed in January 1967.

The surveys were undertaken at the request of QANTAS Airways to improve on the magnetic data obtained in 1965 (van der Linden, 1965) and to establish a new site in a more convenient situation for aircraft compass swinging.

The 1965 survey had disclosed many scattered magnetic anomalies caused by magnetic materials used when the airport was built. The effect of these surface anomalies will be attenuated at the height of 13 feet of the aircraft's compasses. To obtain magnetic data at this height, the 1966 and 1967 surveys were made using an 8-feet high non-magnetic platform provided by QANTAS.

A Wild Compass Theodolite, model TO 2, was tested for magnetic accuracy at Canberra in December 1966.

2. PREPARATION OF SITES

The positions of the three sites are shown in Plate 1. QANTAS altered the radii of the 'compass roses' of sites 1 and 2 because the original circles were too tight to manoeuvre the aircraft efficiently.

For the Boeing 707-338C, twelve equidistant points were marked on a circle with a radius of 102 feet $9\frac{3}{4}$ inches. The same was done for the Boeing 707-138 on a circle with a radius of 102 feet $2\frac{1}{2}$ inches. In each case the first point was marked in the position vertically below the sextant of the aircraft with the aircraft pointing in the magnetic north direction.

Site 3 (Plate 2) presented a problem. This site has a concrete surface and many underground drains, presumably magnetic. This site being magnetically suspect therefore required the marking of the positions of the fluxvalve sensors on the ground, as well as the sextant positions. The 707-338C has sensors in each wing tip, and the 707-138 has one sensor on the port side of the fuselage. When the aircraft is swung, the magnetic bearings indicated on the sextant in the cockpit are determined by the magnetic conditions at the fluxvalve sensors, which are compared with the magnetic bearings resulting from the survey.

3. INSTRUMENTS AND METHOD

Askania declinometer No. 508320 mounted on an Askania circle was used to measure declination, magnetic bearings, and true bearings.

Elsec proton precession magnetometer No. 592/271 was used for testing site 3 for artificial magnetic disturbances.

At sites 1 and 2, magnetic bearings were taken at the sextant positions of the reference marks.

At site 3 tests were first made with the Elsec magnetometer. Magnetic anomalies of the total magnetic field up to ± 150 gammas were found. These did not rule out the site as a compass swinging base.

Using the Askania circle as a theodolite, true bearings of the reference marks (Plate 3) from the sextant positions were measured. The black mirror on the circle was used for measuring the horizontal angle of the sun; frequent time checks were taken from the telephone time signal. The same procedure was followed to measure the magnetic declination at the fluxvalve positions, viz sun observations to provide true north, and the declinometer for magnetic north.

4. RESULTS AND DISCUSSION

Tables 1 to 6 give the magnetic bearings of the reference marks. In Tables 5 and 6 these are relative to the magnetic declination existing at the fluxvalve systems.

The mean declinations as measured from the platform are :

Site 1: 11° 28' East

Site 2: 11° 30' East

Site 3: 11° 29' East

Plate 4 illustrates the extent of the magnetic disturbances in the total field and the declination at site 3.

Compass swinging sites 1 and 2 are not very anomalous and should give good results for a compass swing. The problem of the artificial magnetic disturbances at site 3 is adequately solved by measuring the magnetic declination at the exact fluxvalve positions. Applying these values to the appropriate sextant bearings will give good results for testing the respective fluxvalve compass systems provided great care is taken in exactly positioning the sextant as well as the fluxvalves.

5. REFERENCE

van der LINDEN, J. 1965 Magnetic survey of two compass swinging sites, Kingsford Smith Airport, Mascot, NSW 1965. Bur. Min. Resour. Aust. Rec. 1965/157

APPENDIX

The Wild TO 2 Compass Theodolite

This theodolite differs from the standard type theodolite. The horizontal circle, called compass circle, is fitted with a magnetic plate, which orientates it to magnetic north. The compass circle swings freely on a pin but is raised and clamped to prevent damage during transport. When raised, the circle is not connected to the alidade but to the base, and with the circle raised the instrument can be used as an ordinary theodolite.

The instrument was forwarded to Canberra in December 1966 by QANTAS for testing the magnetic accuracy. For this purpose, magnetic measurements taken with the Wild Compass Theodolite were compared with measurements taken with the Askania declinometer (a precision instrument).

The following tests were made:

1. With the Askania declinometer, magnetic bearings were taken of distant objects. Next the Wild Compass Theodolite was set up in the same position and magnetic bearings were taken of the same objects. This was done by releasing the compass circle with the instrument pointing in the magnetic north direction; the circle was then clamped and the bearings were taken. Close agreement with the Askania was found, after applying a correction of -2 minutes of arc to the Wild instrument.

2. A circle with a diameter of 200 feet was set out forming a compass rose with markings from magnetic north in intervals of 30°. First the Askania was set up in the centre and magnetic bearings were taken from the Askania to the Wild and vice versa, the Wild successively occupying the 30° marks on the compass rose. Next the Wild was set up in the centre and the Askania moved along the circle. The following corrections were necessary to make the Wild agree with the Askania:

30° mark	Correction (minutes)	30° mark	Correction (minutes)
0°	-2	180°	-3
30°	-2	210°	-5
60°	-3	240°	-5
90°	-1	270°	-4
120°	-1	300°	-2
150°	-2	330°	-2

The mean correction using this test is -3 minutes of arc. As the data show, the corrections range from -1 to -5 minutes.

The following methods of using the Wild Compass Theodolite are recommended.

1. Where a high accuracy is required, always release the compass circle with the instrument pointing in the magnetic north direction. Without moving the instrument, take readings with the circle clamped and unclamped. When these readings are constant, the instrument (clamped) is ready to take any magnetic bearing from the points on which it is set up. A correction of -2 minutes of arc has to be applied to the magnetic bearings.

2. Where a lower accuracy is required, point the instrument in the required direction, release the compass circle and take the magnetic bearing after the circle has settled. The correction in this case is -2 minutes of arc. The accuracy is ± 2 minutes. If the same accuracy is required as under method 1, the correction table given for the compass rose can be used. In this case the instrument has to be clamped and unclamped a few times until a constant reading is obtained.

3. Control of diurnal variation, during a compass swing, can be obtained. This only applies to site 3, where during the magnetic survey the mean magnetic bearing from the centre to the true north reference mark was established to be 348° 28'. If the compass theodolite is set up over the centre marking and, during the swing, bearings are taken of the true north reference mark, the difference between those bearings and 348° 28' will indicate the diurnal variation corrections to be applied to the results of the compass swing. Ideally these readings should be made simultaneously with the readings made on a second instrument at each point on the compass swing. The circle must be released and clamped at each reading, as in method 1.

TABLE I

SITE 1: SIGHTING DATA 707-138 AIRCRAFT

Magnetic Heading	Compass Rose Location	Reference mark	True Bearing of object	Magn. Decl. of Fluxvalve	Magn. Bearing of object
000	1	A	331.06°	11.38°	319.68°
		B	104.79		93.41
630	2	A	330.87	11.47	319.40
		B	107.08		95.61
060	3	A	330.51	11.48	319.03
		B	108.10		96.62
090	4	B	107.53	11.35	96.18
		C	140.00		128.65
120	5	B	105.48	11.55	93.93
		C	139.97		128.42
150	6	B	102.20	11.60	90.60
		C	139.64		128.04
180	7	C	139.43	11.48	127.95
		D	286.88		275.40
210	8	A	330.91	11.57	319.34
		C	138.96		327.39
240	9	A	331.22	11.52	319.70
		D	287.98		276.46
270	10	A	331.43	11.50	319.93
		D	287.80		276.30
300	11	A	331.47	11.47	320.00
		D	287.17		275.70
330	12	A	331.39	11.47	319.92
		B	102.09		90.62

A = Flagpost on Penfold's Building
B = D.F. Aerial
C = Beacon in water
D = Striped mast

TABLE 2

SITE 1: SIGHTING DATA 707-338C AIRCRAFT

Magnetic Heading	Compass Rose Location	Reference mark	True Bearing of object	Magnetic Declination	Magn. Bearing of object
000	1	A	331.02°	11.40°	319.62°
		B	104.27		93.87
030	2	A	330.62	11.50	319.12
		B	107.32		95.82
060	3	B	108.05	11.37	96.68
		C	139.90		128.53
090	4	B	107.17	11.33	95.84
		C	139.99		128.66
120	5	B	104.83	11.67	93.16
		C	139.99		128.32
150	6	B	101.50	11.70	89.80
		C	139.37		128.03
180	7	A	330.75	11.50	319.25
		C	139.33		127.83
210	8	A	331.18	11.50	319.68
		D	287.88		276.38
240	9	A	331.28	11.33	319.95
		D	287.95		276.62
270	10	A	331.57	11.45	320.12
		D	287.79		276.34
300	11	A	331.62	11.38	320.24
		D	287.13		275.75
330	12	A	331.42	11.50	319.92
		D	286.12		274.62

A = Flagpost on Penfolds Building
B = D.F. Aerial
C = Beacon in water
D = Striped mast

TABLE 3

SITE 2: SIGHTING DATA 707-138 AIRCRAFT

Magnetic Heading	Compass Rose Location	Reference mark	True Bearing of object	Magnetic Decl.	Magnetic Bearing of object
000	1	A	not measured	not measured	343.92°
		B			95.40
030	2	A			343.53
		B			95.69
060	3	A			342.92
		B			95.75
090	4	A			342.66
		B			95.68
120	5	A			342.46
		B			95.54
150	6	B			95.36
		C			262.32
180	7	B			95.17
		C			262.77
210	8	A			343.02
		C			263.02
240	9	A			343.46
		C			263.08
270	10	A			343.82
		C			263.07
300	11	A			344.13
		C			262.66
330	12	A			344.21
		C			262.31

A = Flagpost on Penfold's Building
B = D.F. Aerial
C = Beacon in water
D = Striped mast

TABLE 4

SITE 2: SIGHTING DATA 707-338C AIRCRAFT

Magnetic Heading	Compass Rose Location	Reference mark	True Bearing of object	Magnetic Decl.	Magnetic Bearing of object
000	1	A	not measured	not measured	343.73°
		B			95.46
030	2	A			343.41
		B			95.61
060	3	A			343.04
		B			95.71
090	4	A			342.50
		B			95.55
120	5	B			95.47
		C			262.03
150	6	B			95.19
		C			262.50
180	7	B			95.12
		C			262.86
210	8	A			343.16
		C			263.08
240	9	A			343.56
		C			263.03
270	10	A			343.86
		C			262.78
300	11	A			344.01
		C			262.38
330	12	A			343.99
		C			262.01

A = Flagpost on Penfolds Building
B = D.F. Aerial
C = Beacon in water
D = Striped mast

TABLE 5

SITE 3: SIGHTING DATA 707-138 AIRCRAFT

Magnetic Heading	Compass Rose Location	Reference mark	True Bearing of object	Magn. Decl. at Fluxvalve	Magnetic Bearing of object
000	1	A	216.61°	11.53°	205.08°
		D	216.35		204.82
030	2	A	215.23°	11.83°	203.40°
		C	113.60		101.77
060	3	A	211.60°	11.57°	200.03°
		C	112.69		101.12
090	4	B	352.62°	11.60°	341.02°
		D	206.07		194.47
120	5	B	353.62°	11.50°	342.12°
		D	203.00		191.50
150	6	B	353.56°	11.38°	342.18°
		D	201.16		189.78
180	7	B	352.31°	11.63°	340.68°
		D	201.50		189.87
210	8	B	118.40°	11.70°	106.70°
		D	202.53		191.83
240	9	C	119.37°	11.67°	107.70°
		D	206.69		195.02
270	10	C	119.36°	11.68°	107.68°
		D	210.13		198.45
300	11	C	118.56°	11.73°	106.83°
		D	213.40		201.67
330	12	C	117.00°	11.77°	105.23°
		D	215.67		203.90

A = QANTAS Antenna (R.O.S.)

B = D.C.A. Antenna (Hangar 20)

C = Northern Light Post (Engine Run Area)

D = Light on QANTAS Antenna

TABLE 6

SITE 3: SIGHTING DATA 707-338C AIRCRAFT

				Fluxvalve system 1		Fluxvalve system 2	
Magnetic Heading	Compass Rose Location	Reference marks	True Bearing of object	Magn. Decl.	Magn. Bearing of object	Magn. Decl.	Magnetic Bearing of object
000	1	A	36.57°	12.10°	24.47°	11.53°	25.04°
		D	36.30°		24.20°		24.77°
030	2	A	34.50°	11.57°	22.93°	11.53°	22.97°
		C	293.25°		281.68°		281.72°
060	3	A	30.53°	11.63°	18.90°	11.67°	18.86°
		C	292.67°		281.04°		281.00°
090	4	B	173.03°	11.53°	161.50°	12.02°	161.01°
		D	25.72°		14.19°		13.70°
120	5	B	173.77°	10.10°	163.67°	11.40°	162.37°
		D	22.30°		12.20°		10.90°
150	6	B	173.40°	12.02°	161.38°	11.22°	162.18°
		D	21.03°		9.01°		9.81°
180	7	B	171.82°	11.45°	160.37°	11.47°	160.35°
		D	21.30°		9.85°		9.83°
210	8	C	298.75°	11.47°	287.28°	11.47°	287.28°
		D	24.30°		12.83°		12.83°
240	9	C	299.50°	11.60°	287.90°	11.40°	288.10°
		D	27.63°		16.03°		16.23°
270	10	C	299.23°	11.70°	287.53°	11.40°	287.83°
		D	31.00°		19.30°		19.60°
300	11	C	298.23°	11.60°	286.63°	11.37°	286.86°
		D	34.10°		22.50°		22.73°
330	12	C	296.52°	11.57°	284.95°	11.47°	285.05°
		D	36.05°		24.48°		24.58°

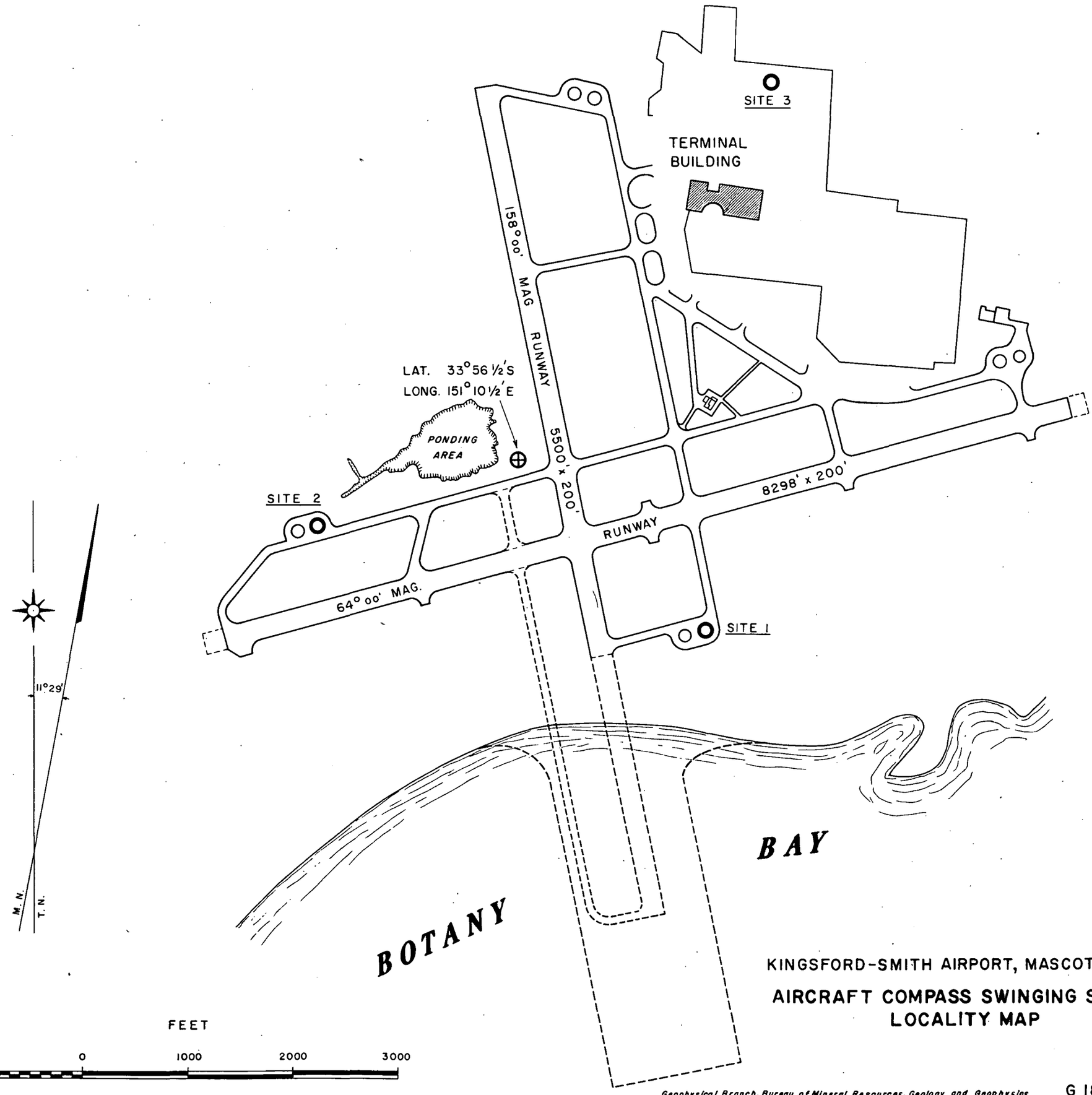
A = QANTAS Antenna (R.O.S.)

C = Northern Light Post (Engine Run Area)

B = D.C.A. Antenna (Hangar 20)

D = Light on QANTAS Antenna

PLATE 1



KINGSFORD-SMITH AIRPORT, MASCOT N S W

AIRCRAFT COMPASS SWINGING SITES LOCALITY MAP

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TO ACCOMPANY RECORD No 1968/103

PLATE 2

Datum Line
Survey to true geographic north

11°30'
Magnetic variation

R = 102' 9 3/4"
707-338 ONLY

R = 102' 2 1/2"
707-138 ONLY

R = 100' 0"

LEGEND

- ●1 Nose wheel Boeing 707-338C
- ◆1 Nose wheel Boeing 707-138
- ○1 Position of number 1 flux-valve Boeing 707-338C
  - Number 1 system outermost circle
  - Number 2 system innermost circle
- ◎1 Position of number 1 flux-valve Boeing 707-138
- ⊕1 Position of sextant Boeing 707-338C
- ○1 Position of sextant Boeing 707-138

NOTE : Aircraft not to scale

KINGSFORD SMITH AIRPORT, MASCOT, NSW

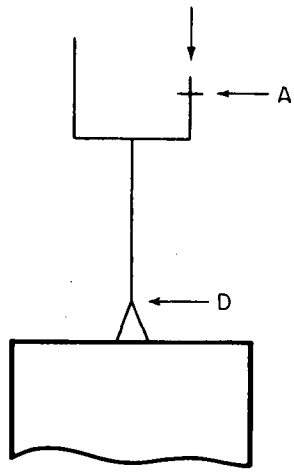
AIRCRAFT COMPASS SWINGING SITE No. 3

FEET
20 0 20 40 60

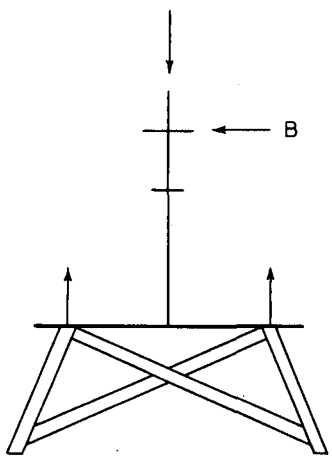
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics **G188-32**

TO ACCOMPANY RECORD No 1968/103

PLATE 3



QANTAS ANTENNA
(located on water tank behind R.O.S.)



LARGE D.C.A. ANTENNA
(located behind Hangar 20)

MOST NORTHERN LIGHT POST
(engine run-up area)

NOTE : Arrows denote centre line of sighting points

COMPASS SWINGING SITE No.3 (HANGAR AREA)

FIXED REFERENCE MARKS

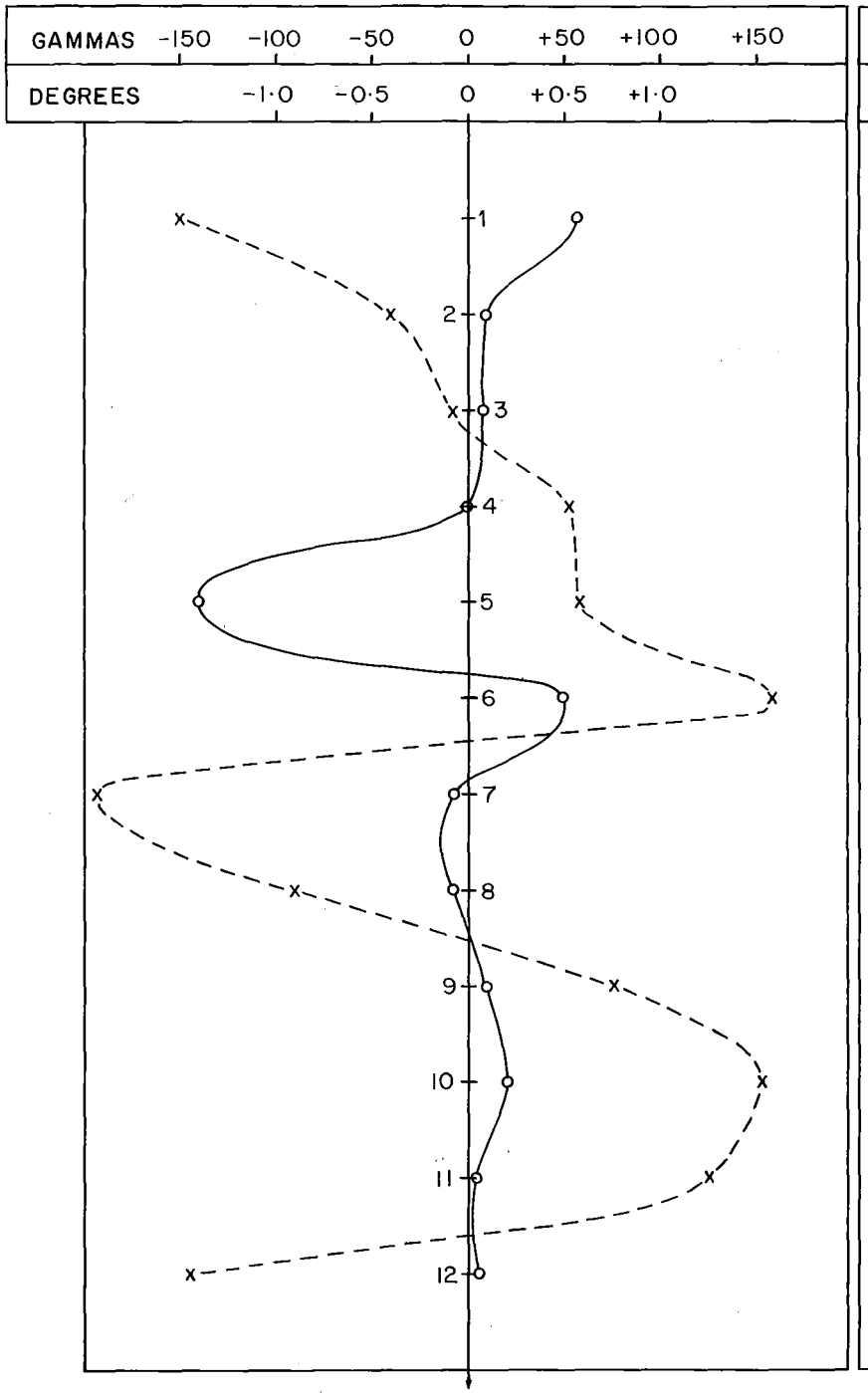
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G188-34

TO ACCOMPANY RECORD No 1968/103

MASCOT, NSW

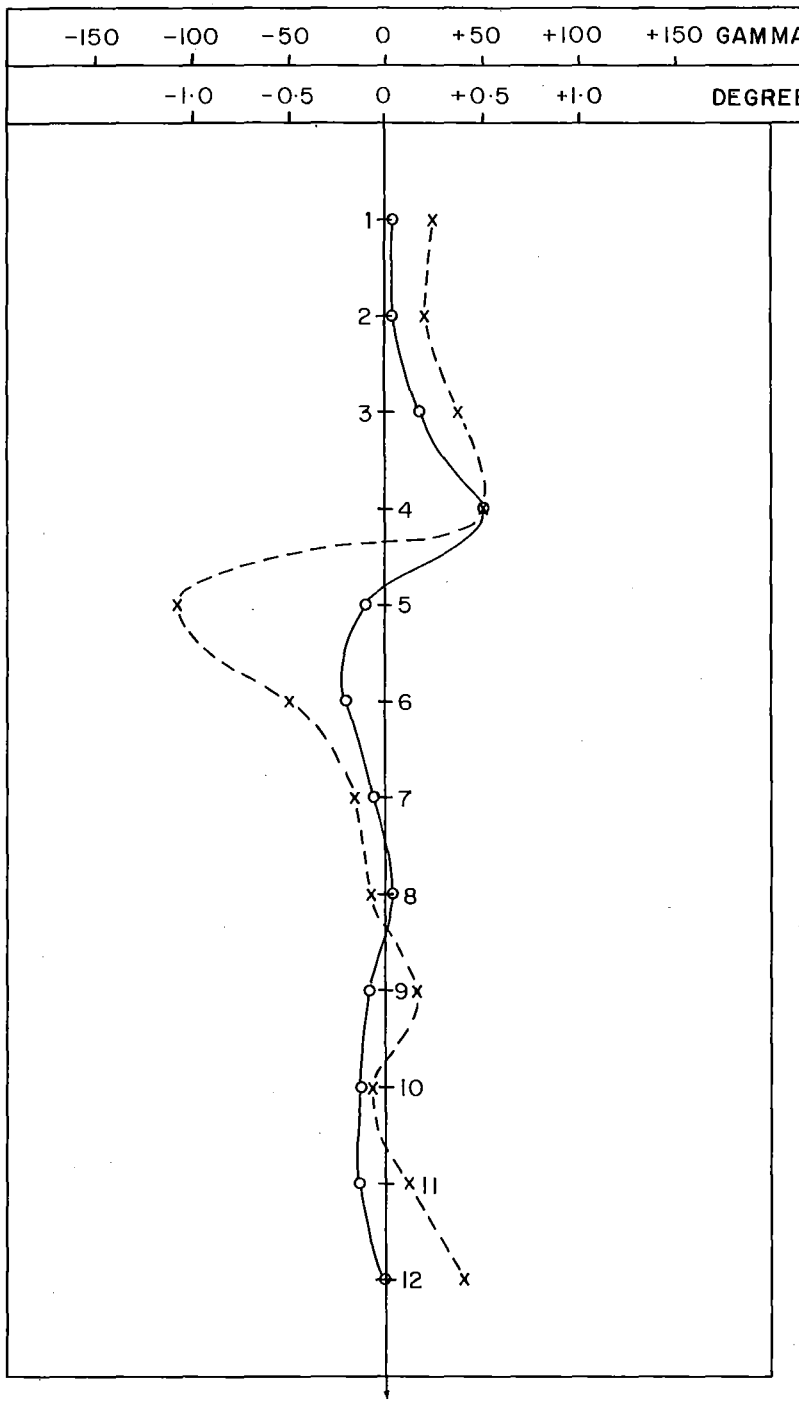
PLATE 4

FLUXVALVE SYSTEM 1



Mean F = 57,951 gammas
Mean D = 11·59°

FLUXVALVE SYSTEM 2



Mean F = 58,063 gammas
Mean D = 11·54°

—— Deviation from mean D

– – – Deviation from mean F

┼ 1 Flux-valve position on circle

COMPASS SWINGING SITE No.3
AIRCRAFT BOEING 707-338C

DEVIATION FROM MEAN F AND D

MASCOT, NSW

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