Annex D
To Report 79-139

ANALYSIS OF COCKPIT VOICE RECORDER ANDDIGITAL FLIGHT DATA RECORDER DATA EX AIR NEW ZEALAND DC 10 ZK NZP

Introductory Notes:

1. All times quoted in this report are in GMT, as this was considered the most accurate time base. This is the time used in the accident report. The aircraft's DFDR records time intervals precisely, however its time base was determined to be ten seconds behind GMT. Any examination of raw DFDR data therefore needs to have ten seconds added to the recorded aircraft GMT. Timing correlation between the CVR and DFDR is less precise and in some cases, errors of up to approximately plus or minus three seconds in the CVR timing were experienced.

2. Several non mandatory items shown in the raw DFDR print out were, in fact, not recorded or were recorded erroneously. These include, gross weight and CG position, left wheel brake pedal position, ground proximity warning and autothrottle speed control. The Flight Data Acquisition Unit (FDAU) column's significance could not be satisfactorily explained by the Douglas Aircraft Co. representative or the NTSB. It is believed to be an internal computer check of the bit sampling rate from the number one FDAU.

General:

The CVR transcript starts at 0017:00 hours and covers the last 32:50 minutes of the flight. At this stage the aircraft is in cruising flight at FL 330. The last items of the descent checklist are being called by the flight engineer who reminds the pi8lots to set their altimeters through the transition altitude.

Although some 25 hours of DFDR data is available, only the last 41 minutes were read; starting with the aircraft at its cruising altitude of FL 330. The quality of the readout is excellent with very little 'bit' loss and with the loss of synchronisation only occurring at the tape splices and impact points. The breakage of the tape in 2 places at impact caused some problems, however following a bit dump and manual rearranging of the raw data all the available information was recovered. The isolated loss of information at the tape fractures is not significant and does not affect the overall readout.

Except for the last few seconds of flight (discussed later) the aircraft is flown with the number 2 autopilot in the command (normal 'on') position. Examination of the airspeed and No. 1 engine data show that the auto-throttles were engaged at various times. They were engaged during the approach to the accident site at 1,500 feet AMSL.

At 0017:13Z, when the aircraft is some 144 miles north of McMurdo, the Captain indicated he would start his descent a little early. This was initiated at 0018:44 by the standard practice of rotating the Rate of Descent wheel to establish a rate of descent which reached about 2900 feet per minute (fpm). As the aircraft approached the standard climb/descent speed (320 kts/.82 M) the "IAS hold" mode was engaged. The engagement of this mode caused the aircraft to hold the speed indicated, (in this case 323 kts) during changes in the aircraft's pitch attitude but precluded the authothrottles being operated in the 'speed' mode.

The flight crew had requested descent clearance to the minimum safe altitude (MSA) for the leg of 16000 feet, however they were only cleared to FL 180 by "Mac Centre". Approaching FL 180 the 'Vert speed' mode was engaged to reduce the rate of descent and at 0025:10 the flight guidance system automatically levelled the aircraft at FL 180. Throughout this period the aircraft had been in the 'Nav track' mode; tracking along the direct Hallett to McMurdo track with a grid heading of 358-359 degrees.

At 0031:01 the Captain sighted a hole in the cloud cover which extended to ground level but the left of track. He stated his intention to do an orbit to get below the cloud. The co-pilot and possibly an engineer indicated

that it was not clear to the right of the track. Further descent clearance was sought from "Mac Centre" and approved; and the aircraft continued descending, VMC, in an orbit approximately 43 miles north of McMurdo.

The 'Nav track' mode was disengaged at 0032:05 by pulling out the "Heading select" knob and turning the aircraft with the auto-pilot. A right turn was commenced although the preceding discussion indicated it wasn't clear to the right and that the hole to ground level was on the Captain's (left) side. A further descent was started almost immediately. The Captain instructed the co-pilot to set 10000 feet in the altitude window. The altitude was armed as at 0033:01 someone read the FMA's as, 'ALT', 'Heading Select, 'VERT Speed'.

The co-pilot advised "McMurdo Centre" when they were descending through flight level 130. The pressure altitude recorded on the DFDR at the same time indicated that they had not set QNH at this stage.

A lengthy consideration was given to the sound of 3 altitude alerts at about time 0036:00. The only logical explanation is that 11000 feet was initially set in the altitude window and after the first alert this was reset to 10000 feet as the Captain had instructed. After the second "alert" the flight engineer confirmed from the FMA's that 10000 feet had been set and armed. This is also confirmed by the aircraft automatically capturing and levelling out at an indicated altitude of 10000 feet. Corresponding QNH altitude was 9400 feet.

The aircraft rolled out of the first right hand orbit on a selected heading of 344° Grid and then remained on this heading for 1 minute 20 seconds. The Captain then stated that to stay VMC he would have to do another orbit. A left had turn was then commenced.

At 0039:07 the co-pilot advised "McMurdo Centre" that they were maintaining ten thousand. The actual altitude was 9400 feet as the altimeters were still set to the standard pressure setting.

The left turn was stopped on a heading of 179° grid. On the Captain's instructions the co-pilot asked "McMurdo Centre" for a clearance to let down VMC on a grid heading of 180° and to proceed visually to McMurdo. Immediately after this approval was given a further descent was commenced.

Two thousand feet was set and armed in the flight guidance system. Someone, probably an engineer, stated 'IAS Hold', 'IAS Hold' at 0042:47 and right at this time the modes change from 'vert speed' which was used to initiate the descent to 'IAS Hold'. The air speed at the time 'IAS Hold' was selected was 272 kts.

A few seconds later when the aircraft was passing through 9300 feet the Captain stated that as "it's VMC" around his side, he was going to turn in again and immediately commenced a left turn.

While turning through a grid heading of 100° the Captain stated that he would arm the "NAV" again and immediately the roll mode annunciator changed from "Heading select" to 'NAV capture', confirming he had done this and the aircraft was within the capture zone for "Nav track". The aircraft continued to descend in the "IAS Hold" mode with an air speed of around 272 kts.

At 0044:40 the aircraft again locked onto the Hallett-McMurdo track and the FMA changed to 'NAV track'. This was not immediately announced by the crew, possibly due to the distraction caused by answering McMurdo Centre's query on the height of the cloud tops and talking to the official flight commentator who arrived in the cockpit during the aircraft's last turn.

The co-pilot advised McMurdo at 0045:00 that they were at 6,000 feet, descending to 2000 feet, VMC. At this time the aircraft was passing through an altitude of 5400 feet, confirming that QNH still had not been set on the pilots' main altimeters.

Up to this point the aircraft had been descending in the 'IAS Hold' mode with a speed of around 272 kts and a rate of descent of around 1300 to 1500 fpm. At 0045:35 the 'vert speed' mode was engaged. While this was an acceptable procedure to reduce the rate of descent as the assigned altitude approached, in this case the rate of descent increased and IAS built up to a maximum of 303 kts at 3500 feet QNH. The engine N_1

speeds during this manoeuvre were at the flight idle speed of about 42%. This manoeuvre may have been necessary to keep clear of cloud.

In response to a statement "altimeters" by some unidentified person, the Captain reset his altimeter to the correct QNH as the aircraft passed through 4000 feet indicated altitude. The co-pilot announced "a thousand to go" as they passed through 3000 feet QNH confirming both pilots altimeters were then set to QNH.

At 0046:25 the Captain called 'Speed' as he set 260 kts, which had previously been calculated and agreed to, in the autothrottle speed command window. The autothrottles held the engines at a low power setting until this speed was reached then power was reapplied to hold the selected speed.

The altitude alert sounded 750 feet above the set altitude and the aircraft automatically levelled off at 2000 feet. The FMA's showed an 11 second gap between the time "altitude hold" was displayed and vert speed was selected for a further descent following the Captain's comment that he would further descend to 1500 feet. The DFDR readout showed the aircraft level at 2000 feet for about the same period. A very short period was spent at the nominated lower limit altitude of 2000 feet before the Captain stated "We might have to pop down to 1500 feet here I think". This is supported by the co-pilot's agreement in his comment "Yes. Probably see further in anyway", comments by the flight engineer of "You're really a long while on instruments at this time" and comments from other unidentified persons of "bit thick here", - "What's wrong here" – "Make up your mind you got to go" ……

McMurdo Centre was not advised of the descent to 1500 feet.

The FMA displayed "Alt hold" at 0048:23 when the aircraft was at 1515 feet. One unusual aspect of the level off at 1500 feet was that it was not as precise as other automatic level offs portrayed by the DFDR. Over the next 25 seconds the aircraft continued a slow descent to a minimum altitude of 1443 feet, then it commenced a slow climb to reach a maximum altitude of 1540 feet, 17 seconds before impact. Both are minor deviations in selected altitude.

The final approach to the accident site was with the autothrottles in the "Speed" mode with 260 kts commanded. The roll mode was selected to "Nav track" with the aircraft maintaining a grid heading of 357-358 degrees; the pitch mode was selected to "Alt hold" with 1500 feet commanded.

Passage over the ice cliffs on the edge of Ross Island is noted by a reduction of 270 feet in 1.5 seconds on the radio altitude readout. This occurred 11 seconds prior to impact, which was exactly the timing achieved during later trials in the DC 10 flight simulator. The average radio altitude descent rate as the aircraft flew towards the slope was 6300 fpm. The GPWS warning commenced in the half second between radio altitude samplings of 637 feet and 583 feet. In the simulator the GPWS warning commenced at 610 feet. The flight engineer's calls of "500 feet" and "400 feet" radio altitude were almost at identical times to those noted during the simulator exercise.

A study of the vertical acceleration data which is sampled 8 times a second showed that the aircraft experienced no significant turbulence or downdraughts during the later stages of the flight. The vertical acceleration trace reached a maximum value of plus 1.67 G two seconds before impact. This is associated with a pitch up of the aircraft some 2.5 seconds before impact from a level flight altitude of 5° nose up to a maximum of 10.9° nose up.

No change in altitude is recorded as a result of this pitch up although the NCU memory recorded a plus 10 fps vertical acceleration at impact.

This pitch up resulted from a sudden (7° in 2 seconds) application of nose up elevator, 4 seconds prior to impact. The discrete data for the auto-pilot (which in this particular area contains some doubtful information as the result of the tape break) indicates that the No. 2 auto-pilot was disengaged 4 seconds prior to impact. A sudden elevator input will cause the auto-pilot to disengage and it appears that this is what happened as the crew reacted to the "pull up" warning from the GPWS.

A small but significant increase in the longitudinal acceleration (which is sampled 9 times a second) was noted in the last 2 seconds of the flight. This acceleration was due to the application of engine power. No increase in air speed had been registered.

Eight seconds prior to impact and 2 seconds before the GPWS warning started, the roll mode FMA changed from 'NAV Track' to 'Heading Select' as the 'Heading Select' knob was pulled out. This would be done to turn the aircraft through the auto-pilot and followed a discussion by the pilots on which way to turn to get out of their present position. The co-pilot said "it's clear to turn to the right" but the Captain contradicted him. Immediately the 'Heading Select' knob was pulled out the aircraft commenced to roll to the right. This right roll which was also evidenced by the movement of ailerons and spoilers which reached a maximum of 11° bank 3.5 seconds before impact. The roll was then reversed, as the pilot attempted to commence a left turn. This reverse roll which was the result of control surface movement, results in the aircraft striking the ground while rolling left through a wings level attitude. These rolling manoeuvres had no significant effect on the aircraft heading which was last recorded as 358.95° grid.

In the last 3.5 seconds of flight there was a sudden large application of left rudder of some three degrees which rapidly increases to reach a maximum of 13 degrees left rudder angle just prior to impact. A study of the last 40 minutes of flight showed that the auto-pilot in the 'Heading Select' mode only applied the maximum of 1 degree of rudder for very short periods. This rudder input was thus applied manually. This rudder application resulted in a small change in lateral acceleration and skidding of the aircraft.

One of the pilot's FMAs was recovered from the wreckage and was examined by the Douglas Aircraft Company to determine the modes being displayed at impact. This confirmed the information on mode status being displayed at impact. This confirmed the information on mode status obtained from the DFDR namely:

Autothrottle mode	-	Speed
Armed mode	-	Nil
Roll mode	-	Heading Select
Pitch mode	-	Altitude Hold

Conclusions

The following conclusions are derived from a detailed study of the DFDR data in conjunction with analysis of the CVR Tape:

Throughout the last 40 minutes of flight the aircraft was airworthy and capable of normal operation.

The aircraft encountered no atmospheric conditions such as turbulence or downdraught which in any way contributed towards the cause of this accident.

The navigational and flight guidance systems performed normally. The number 2 auto-pilot flew the aircraft through all but the last seconds of flight when it was disengaged during the recovery manoeuvre.

The flight crew did not set their main altimeters to the McMurdo QNH until the aircraft had descended below 4,000 feet indicated altitude.

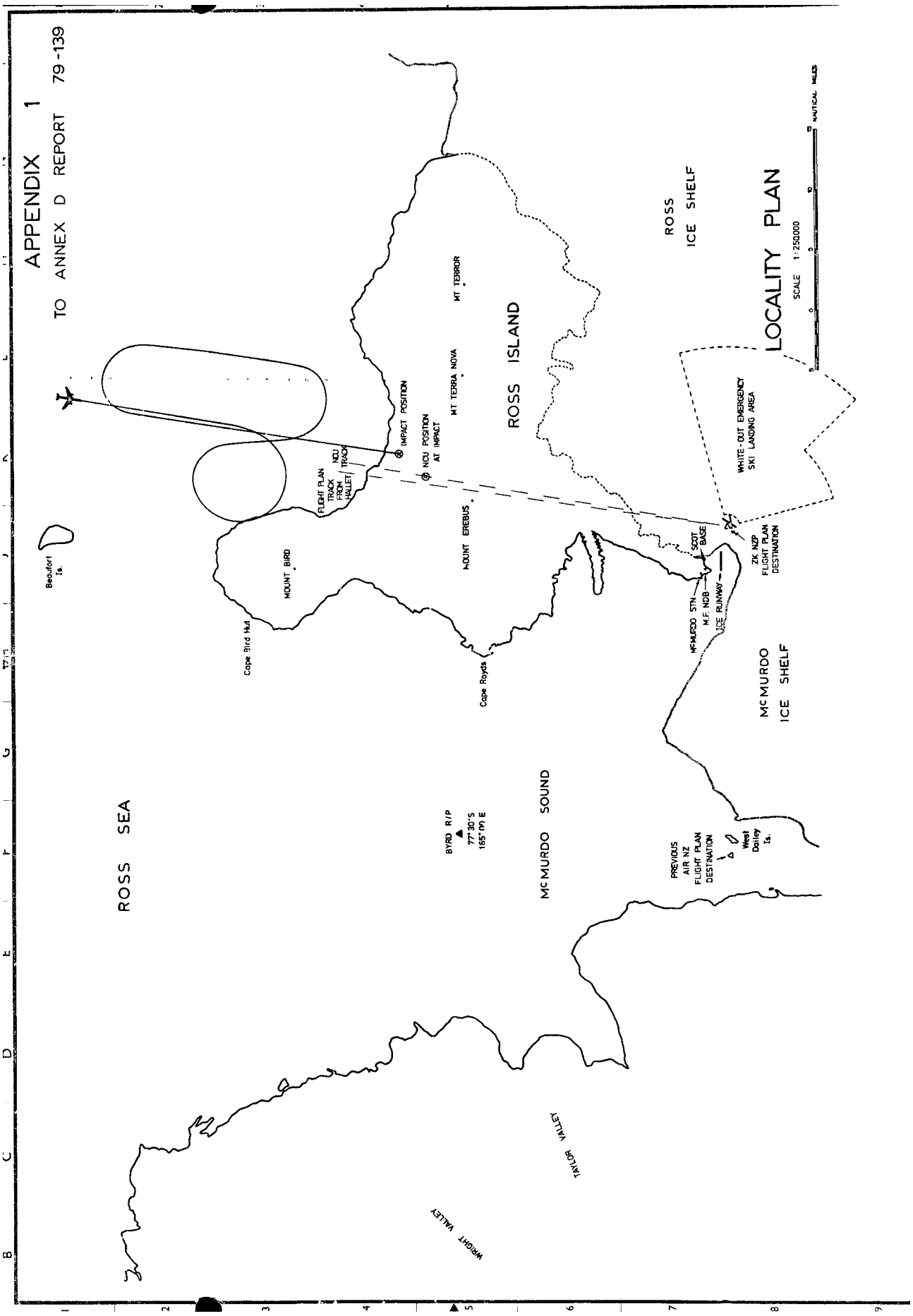
Action had been taken to turn the aircraft prior to the GPWS warning soundings.

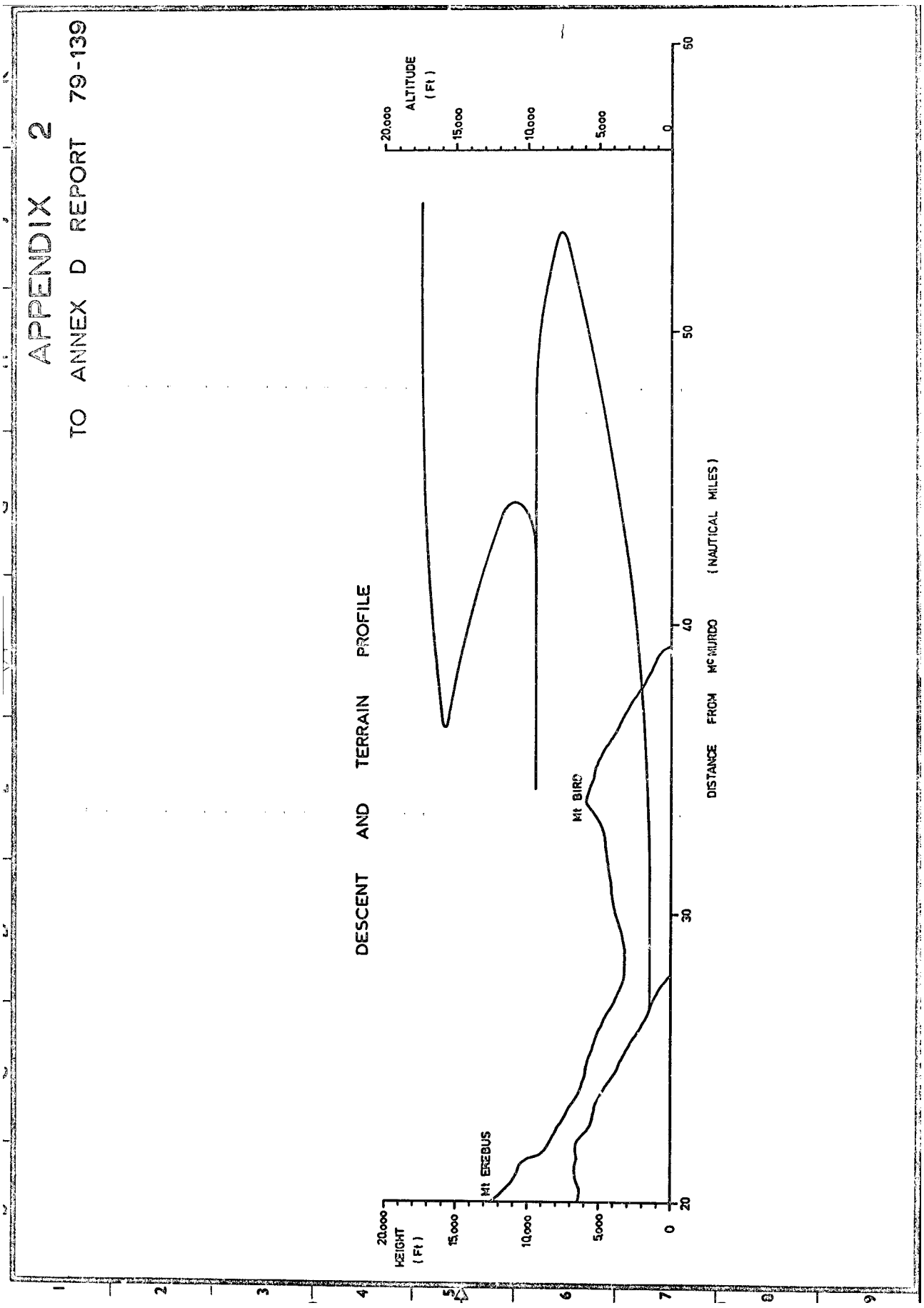
The GPWS operated within its design parameters and provided 6.5 seconds of warning.

The crew responded expeditiously in the circumstances to the GPWS warning. Simulator trials proved conclusively that with an unexpected warning such as this, it would have been impossible to avoid the accident with a normal pilot's response allowing reasonable identification and reaction times to the GPWS warning.

The aircraft had barely commenced to respond to the avoidance manoeuvres and power application prior to impact.

The DRDR and CVR tape transport modules were undamaged in the extensive disintegration of the aircraft at impact. The DFDR provided an excellent record and the CVR record was of the standard expected when the main input was from the cockpit area microphone. The two recorders were extremely valuable in providing the essential basic information for a detailed investigation of this accident.


APPENDIX 1
TO ANNEX D REPORT 79-139
LOCALITY PLAN
SCALE 1:250000
NAUTICAL MILES
ROSS SEA
ROSS ISLAND
ROSS ICE SHELF
McMURDO SOUND
McMURDO ICE SHELF
MOUNT EREBUS
MT TERROR
MT TERRA NOVA
MOUNT BIRD
Beaufort Is.
Cape Bird Hut
Cape Royds
IMPACT POSITION
NCU POSITION AT IMPACT
FLIGHT PLAN TRACK FROM HALLETT
NCU TRACK
WHITE-OUT EMERGENCY SKI LANDING AREA
SCOTT BASE
ZK NZP FLIGHT PLAN DESTINATION
McMURDO STN
M.F. NDB
ICE RUNWAY
PREVIOUS AIR NZ FLIGHT PLAN DESTINATION
West Dailey Is.
BYRD R/P
77° 30'S
155° 00' E
TAYLOR VALLEY
WRIGHT VALLEY


APPENDIX 2
TO ANNEX D REPORT 79-139
DESCENT AND TERRAIN PROFILE
ALTITUDE (Ft)
20,000
15,000
10,000
5,000
0
HEIGHT (Ft)
Mt EREBUS
Mt BIRD
20
30
40
50
DISTANCE FROM McMURDO (NAUTICAL MILES)

APPENDIX 3

TO ANNEX D REPORT 79-139

EXTRACTS FROM THE COCKPIT VOICE RECORDER OF ZK-NZP

A. I'LL HAVE TO DO AN ORBIT HERE I THINK (CAM-1)

B. WELL ACTUALLY ITS CLEAR OUT HERE IF WE CAN GET DOWN (CAM 1)

C. IT'S NOT CLEAR ON THE RIGHT HAND SIDE HERE (CAM-2)

D. WE'D LIKE FURTHER DESCENT OR WE COULD ORBIT IN OUR PRESENT POSITION WHICH IS APPROXIMATELY 45 MILES NORTH DESCENDING VMC. (RDO 2)

E. I'LL DO AN ORBIT HERE TO GET DOWN I THINK (CAM 1)

F. WE ARE PRESENTLY DESCENDING THROUGH FLIGHT LEVEL 130 VFR AND THE INTENTION AT THE MOMENT IS TO DESCEND TO 10000 (RDO 2)

G. TRANSPONDER NOW RESPONDING (CAM 2)

H. WE'VE LOST HIM AGAIN (CAM-2)

I. YOU'RE THROUGH 10000 ARE YOU GOING TO HOLD IT HERE? (CAM-4)

J. I'VE GOT TO STAY VMC HERE SO I'LL BE DOING ANOTHER ORBIT (CAM-1)

K. WE'RE MAINTAINING 10000 PRESENTLY 34 MILES TO THE NORTH OF MCMURDO (RDO-2)

L. STILL NEGATIVE CONTACT ON VHF WE'RE VMC - WE'D LIKE TO LET DOWN ON A GRID OF 180 AND PROCEED VISUALLY TO MCMURDO (RDO-2)

M. WELL WE'RE JUST GOING VMC TO MCMURDO AND THEN COME BACK IN (CAM-1)

N. WE'RE VMC AROUND THIS WAY SO I'M GOING TO DO ANOTHER TURN IN (CAM-1)

O. YOU CAN'T TALK IF YOU CAN'T SEE ANYTHING (CAM-5)

P. THERE YOU GO THERE'S SOME LAND AHEAD (CAM-5)

Q. I'LL ARM THE NAV AGAIN (CAM-1)

R. ALT, NAV CAP, IAS HOLD (CAM-1)

S. WE ARE NOW AT GOOD DESCENDING TO 2000 AND WE'RE VFR (RDO-2)

T. WE HAD A MESSAGE FROM THE WRIGHT VALLEY AND THEY'RE CLEAR OVER THERE (CAM-2)

U. THE TAYLOR OR THE WRIGHT NOW OR DO YA? (CAM-5) NO - I PREFER HERE FIRST (CAM-1)

V. I STILL CAN'T SEE VERY MUCH AT THE MOMENT - AS SOON AS I SEE SOMETHING THAT GIVES ME A CLUE AS TO WHERE WE ARE I'LL LET YOU KNOW (CAM-5)

W. ALTIMETERS (CAM-3)

X. 29 - 29.50 (CAM-1)

Y. ALT, WAY TRACK, VERT SPEED (CAM-2)

Z. WHERE'S EREBUS IN RELATION TO US AT THE MOMENT? (CAM-5) LEFT ABOUT (TWENTY) 5R (TWENTY) 5 MILES (?) LEFT DO YA RECKON (?) - WELL I DON'T KNOW I THINK (?) I'VE BEEN LOOKING FOR IT (?) I THINK IT'LL BE (?) I'M JUST THINKING OF ANY HIGH GROUND IN THE AREA THAT'S ALL (CAM 3)

AA. THAT'S THE EDGE (CAM-5)

BB. WE MIGHT HAVE TO POP DOWN TO 1500 HERE I THINK (CAM-1) PROBABLY SEE FURTHER IN ANYWAY (CAM-2)

CC. BIT THICK HERE EH (BERT)? YES MY xxxx OATH! (CAM 4)

DD. YOU'RE REALLY A LONG TIME ON xxx INSTRUMENTS AT THIS TIME AREN'T YOU? (CAM-4)

EE. I RECKON BIRD'S THROUGH HERE ... AND ROSS ISLAND'S THERE ... EREBUS SHOULD BE HERE (CAM-5)

FF. ALT HOLD (CAM-2)

GG. ACTUALLY THOSE CONDITIONS DON'T LOOK VERY GOOD AT ALL DO THEY (CAM-1) NO THEY DON'T (CAM-5)

HH. THAT LOOKS LIKE THE EDGE OF ROSS IS. THERE (CAM-5)

II. I DON'T LIKE THIS (CAM-3)

JJ. WE'RE 26 MILES NORTH I'LL HAVE TO CLIMB OUT OF THIS! (CAM-1)

KK. IT'S CLEAR TO THE RIGHT AND (HELL) AHEAD - YOU'RE CLEAR TO TURN RIGHT THERE S NO HIGH GROUND IF YOU DO A 180 (CAM-2) NO - NEGATIVE (CAM-1)

LL. (GPWS) WOOP-WOOP PULL UP WOOP-WOOP

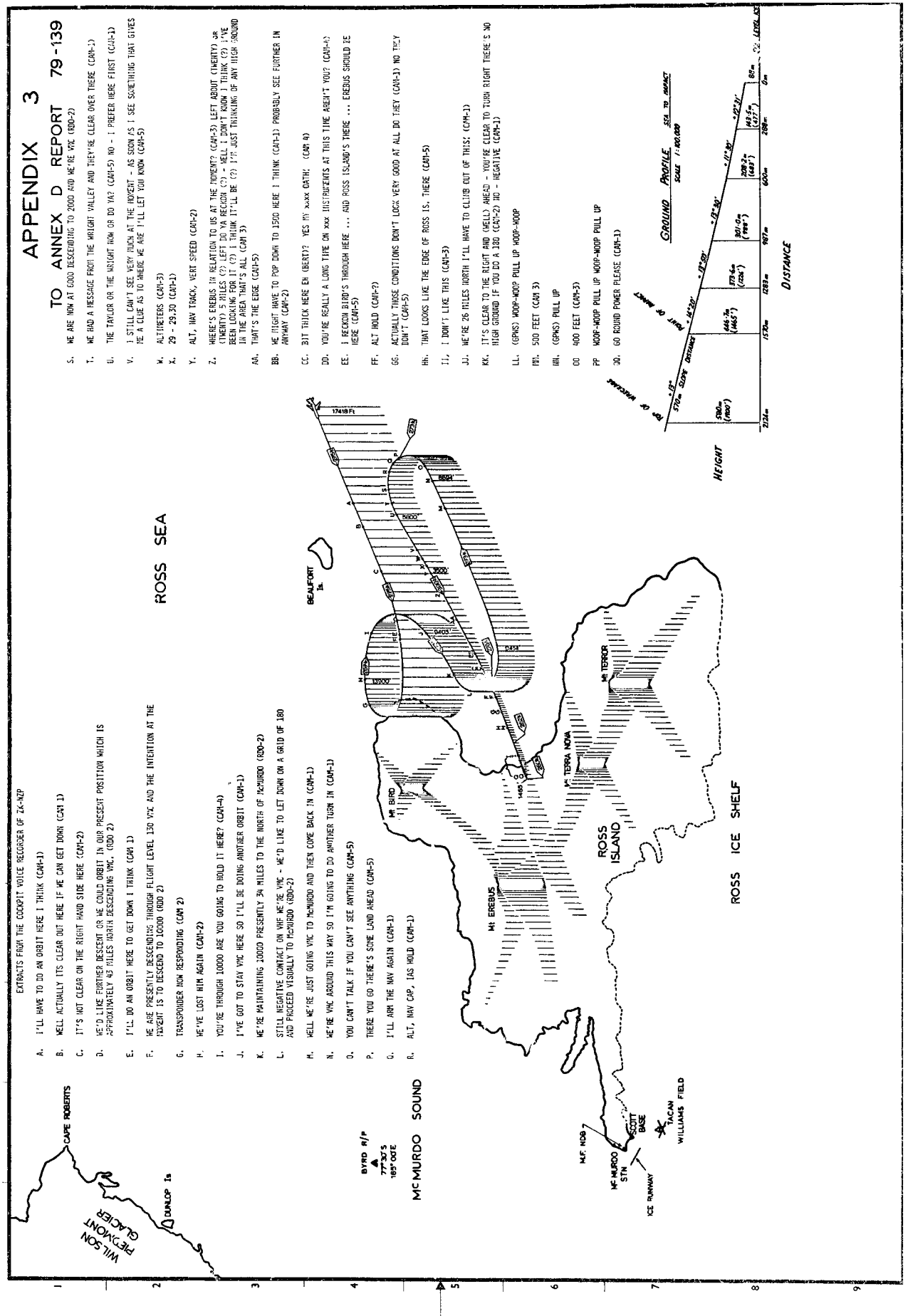
MM. 500 FEET (CAM 3)

NN. (GPWS) PULL UP

OO 400 FEET (CAM-3)

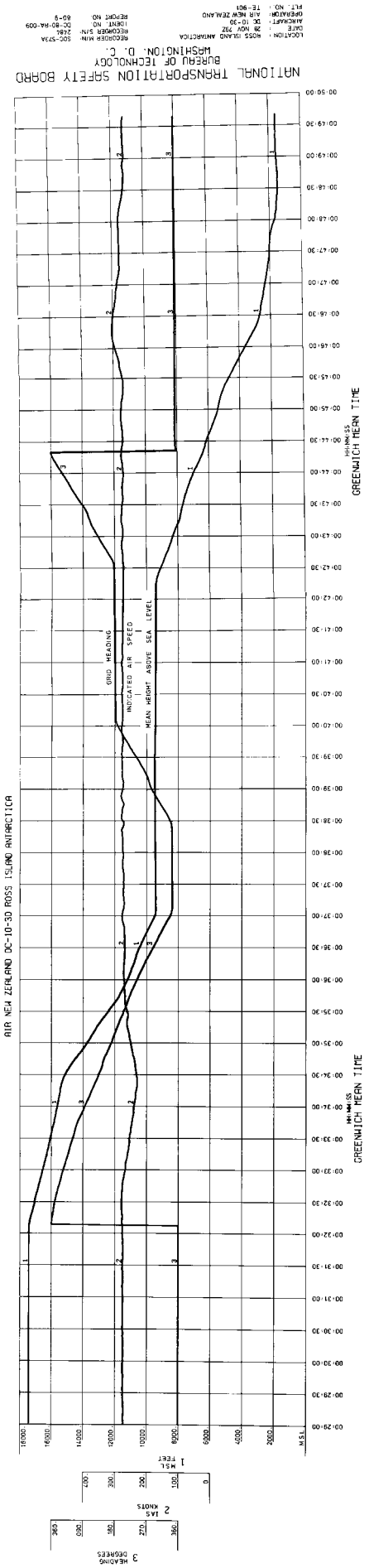
PP WOOP-WOOP PULL UP WOOP-WOOP PULL UP

QQ. GO ROUND POWER PLEASE (CAM-1)



APPENDIX 4

TO ANNEX D REPORT 79-139

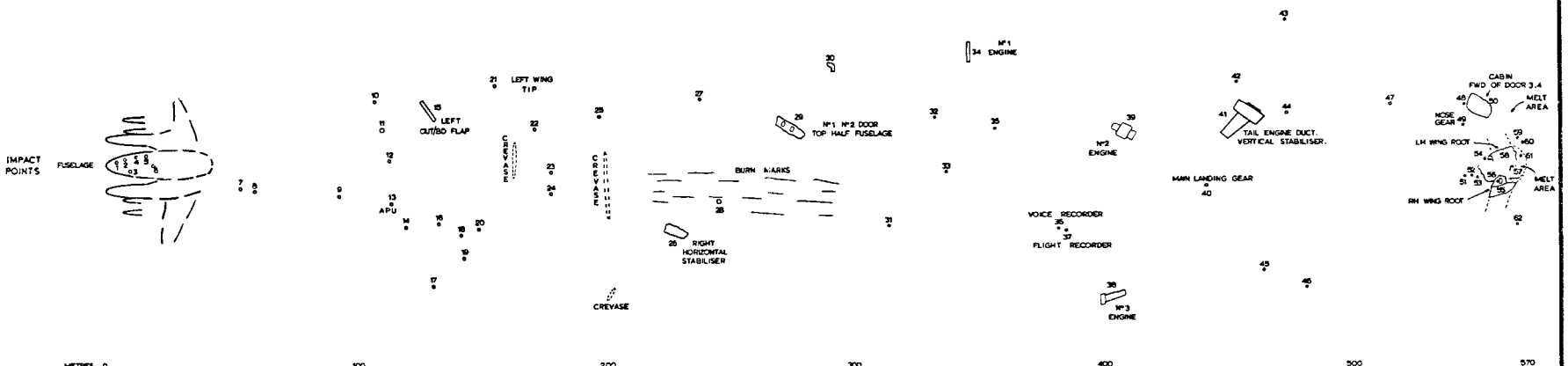


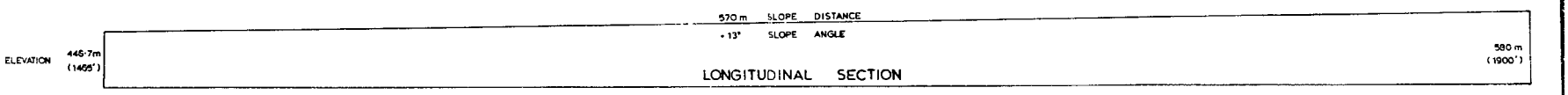
ANNEX E
TO REPORT 79-139

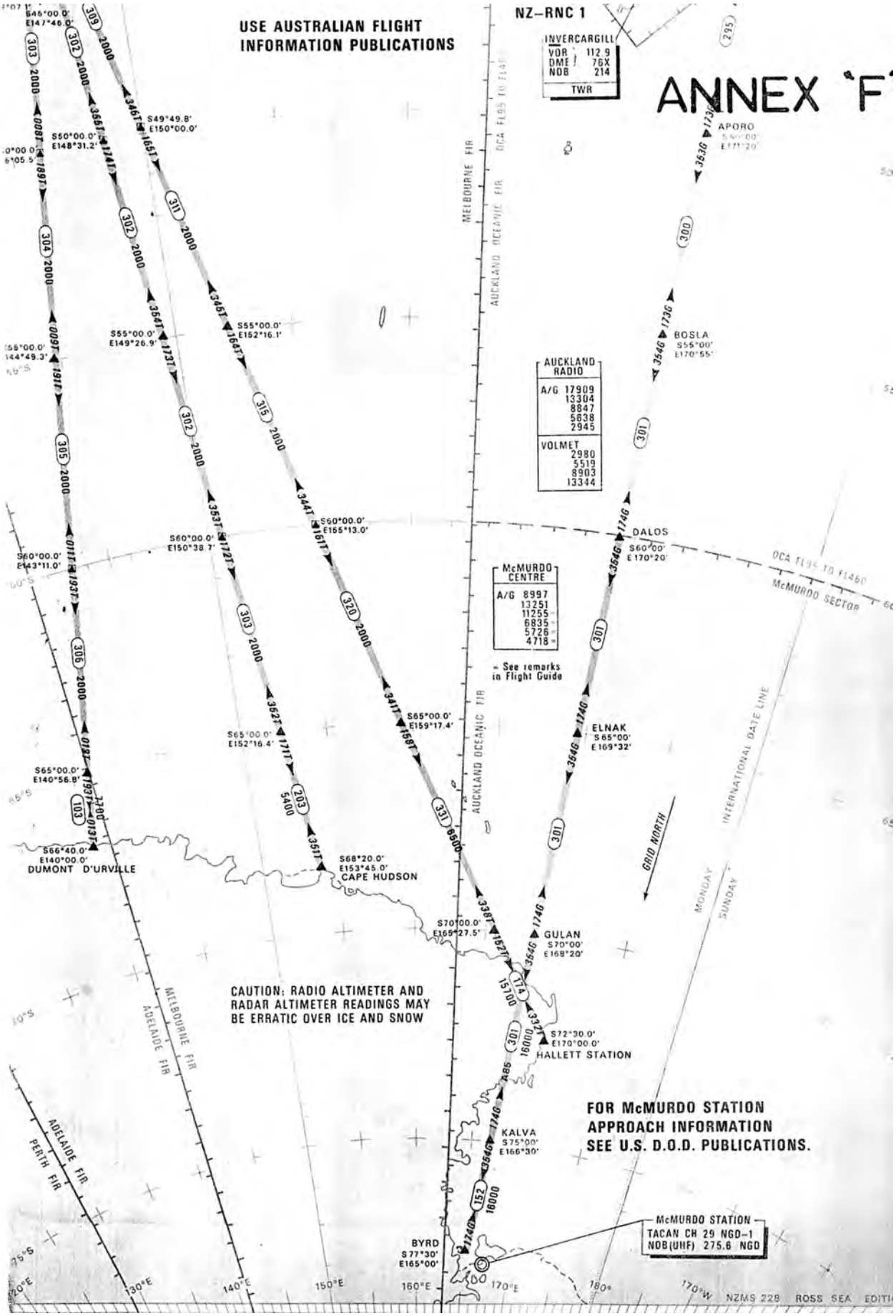
KEY TO SITE PLAN OF WRECKAGE ZK-NZP

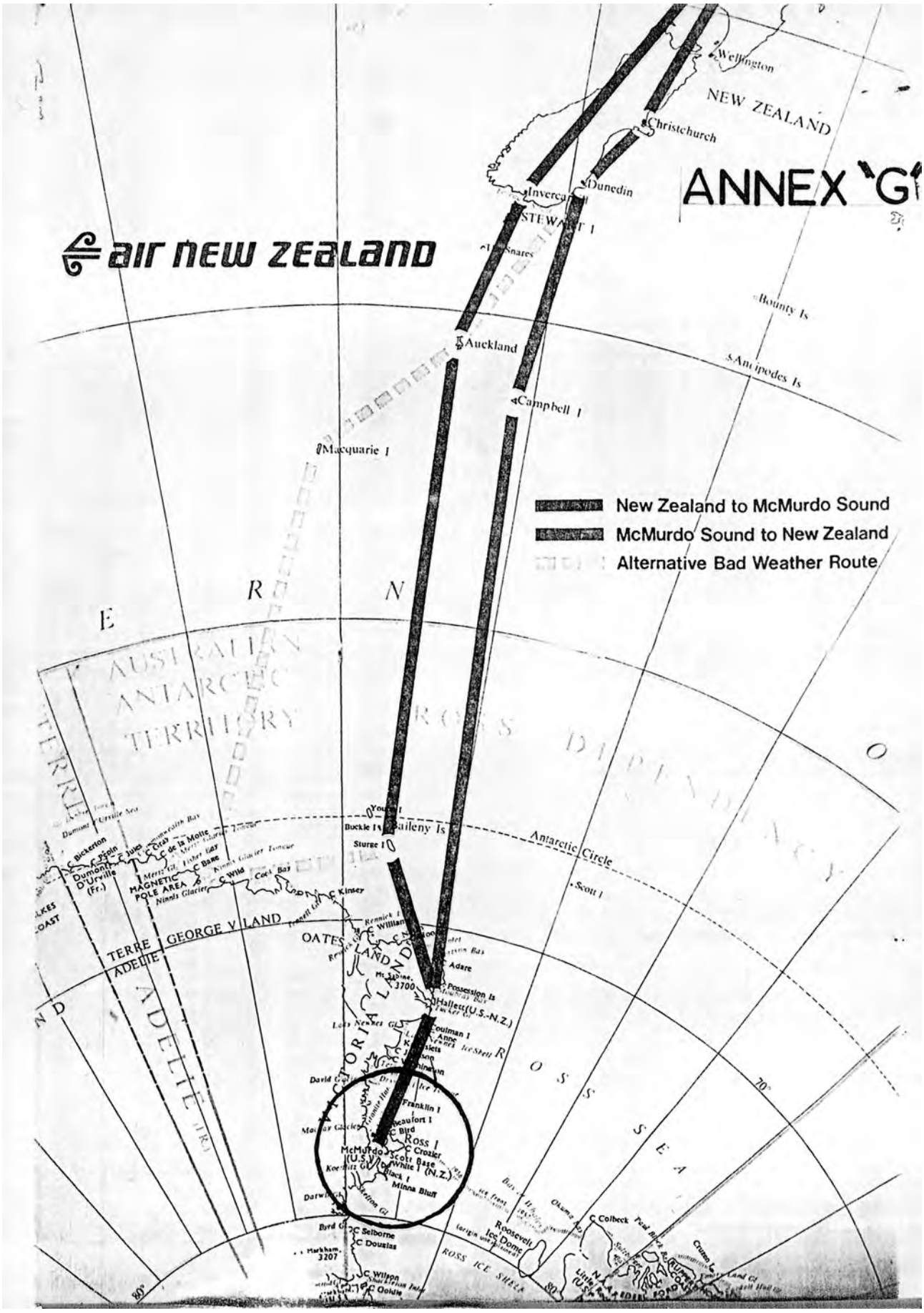
NO.	ITEM
1.	OUTSIDE SKIN STRUCTURE
2.	REAR TOILET DRAIN ACCESS PANEL
3.	DRAIN MAST
4.	APU DOOR FRAME
5.	BULK CARGO DOOR
6.	EMBEDDED LOWER WING SECTION STRUCTURE
7.	TURBINE DISC
8.	TAILCONE LOWER ACCESS DOOR
9.	OUTBOARD AILERON
10.	MAIN GEAR DOOR
11.	LEFT STABILISER
12.	OUTBOARD ELEVATOR
13.	APU
14.	LEADING EDGE SLAT
15.	LEFT OUTBOARD FLAP
16.	ENGINE LOW PRESSURE TURBINE
17.	OUTBOARD ELEVATOR
18.	7 or 8 L/E SLAT
19.	HIGH PRESSURE TURBINE DISC
20.	RH L/E SLAT
21.	LEFT WING TIP
22.	ENGINE CASING L/P TURBINE
23.	UPPER TAILCONE PLATFORM
24.	TAILCONE
25.	H/P TURBINE
26.	RH HORIZONTAL STABILISER
27.	FAN ROTOR
28.	INBOARD ELEVATOR
29.	TOP HALF FUSELAGE No 1 & No 2 DOOR
30.	FAN CASE
31.	MAIN WHEEL WELL STRUCTURE
32.	ENGINE COMPRESSOR STATOR
33.	FAN CASE
34.	No 1 ENGINE
35.	COOLING TURBINE
36.	COCKPIT VOICE RECORDER
37.	FLIGHT DATA RECORDER
38.	No 3 ENGINE
39.	No 2 ENGINE
40.	MAIN LANDING GEAR
41.	TAIL ENGINE DUCT/VERTICAL STABILISER
42.	MAIN LANDING GEAR AXLE
43.	AXLE ASSEMBLY
44.	SEATS
45.	FAN CASE/FAN SPEED SENSOR
46.	FORWARD MAIN AXLE
47.	CENTRE MAIN LANDING GEAR
48.	FLIGHT DECK
49.	NOSE GEAR
50.	CABIN FORWARD OF DOOR 3 & 4
51.	VIEW WINDOW
52.	HYDRAULIC GEAR
53.	FLOOR ABOVE GEAR
54.	INBOARD AILERON
55.	RH WING ROOT
56.	DOOR 6
57.	DOOR 5
58.	LH WING ROOT
59.	L/E SLAT
60.	WING STRUCTURE
61.	CABIN SIDE
62.	WING STRUCTURE

SITE PLAN

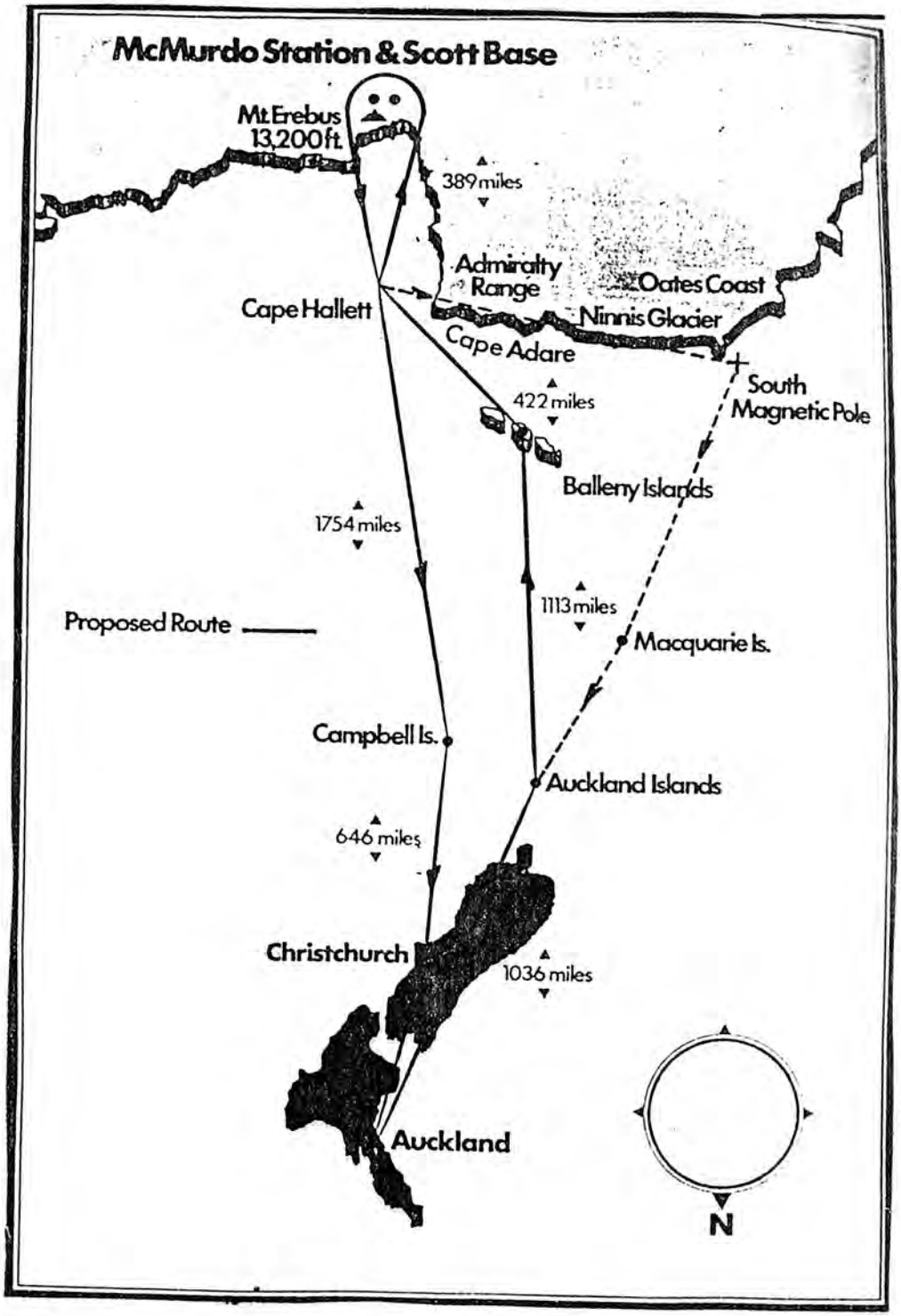





NZ–RNC 1
USE AUSTRALIAN FLIGHT INFORMATION PUBLICATIONS
ANNEX 'F
INVERCARGILL
VOR 112.9
DME 76X
NDB 214
TWR
APORO
BOSLA
S55°00'
E170°55'
DALOS
S60°00'
E170°20'
ELNAK
S65°00'
E169°32'
GULAN
S70°00'
E168°20'
HALLETT STATION
S72°30.0'
E170°00.0'
KALVA
S75°00'
E166°30'
BYRD
S77°30'
E165°00'
AUCKLAND RADIO
A/G 17909
13304
8847
5638
2945
VOLMET
2980
5519
8903
13344
McMURDO CENTRE
A/G 8997
13251
11255
6835
5726
4718
* See remarks in Flight Guide
McMURDO STATION
TACAN CH 29 NGD–1
NDB(UHF) 275.6 NGD
DUMONT D'URVILLE
S66°40.0'
E140°00.0'
CAPE HUDSON
S68°20.0'
E153°45.0'
CAUTION: RADIO ALTIMETER AND RADAR ALTIMETER READINGS MAY BE ERRATIC OVER ICE AND SNOW
FOR McMURDO STATION APPROACH INFORMATION SEE U.S. D.O.D. PUBLICATIONS.
MELBOURNE FIR
AUCKLAND OCEANIC FIR
ADELAIDE FIR
PERTH FIR
McMURDO SECTOR
OCA FLRS TO FL460
GRID NORTH
INTERNATIONAL DATE LINE
MONDAY
SUNDAY
NZMS 228 ROSS SEA


air new zealand
ANNEX 'G'
New Zealand to McMurdo Sound
McMurdo Sound to New Zealand
Alternative Bad Weather Route
Wellington
NEW ZEALAND
Christchurch
Dunedin
Auckland
Bounty Is
Antipodes Is
Campbell I
Macquarie I
Antarctic Circle
Scott I
McMurdo (U.S.)
Scott Base (N.Z.)
Hallett (U.S.-N.Z.)
Possession Is
Franklin I
Ross I
Minna Bluff
Roosevelt Ice Dome
Colbeck
ROSS SEA
ROSS ICE SHELF
TERRE ADELIE
GEORGE V LAND
OATES LAND
AUSTRALIAN ANTARCTIC TERRITORY
ROSS DEPENDENCY

ANNEX 'H'


McMurdo Station & Scott Base
Mt Erebus
13,200 ft
389 miles
Admiralty
Range
Oates Coast
Cape Hallett
Ninnis Glacier
Cape Adare
South
Magnetic Pole
422 miles
Balleny Islands
1754 miles
1113 miles
Proposed Route
Macquarie Is.
Campbell Is.
Auckland Islands
646 miles
Christchurch
1036 miles
Auckland
N