INSTITUTE OF GEOLOGICAL SCIENCES
CONTINENTAL SHELF DIVISION
MARINE GEOPHYSICS UNIT

Report No. 090

Cruise Report for Project 78/02, Legs 1-3
South North Sea Gravity Survey
April-May 1978, MV Sperus

Edited by

E J Armstrong

Murchison House
West Mains Road
Edinburgh EH9 3LA.

June 1978

CONTENTS

INTRODUCTION

This report covers the mobilisation of the m.v. Sperus and legs 1, 2 and 3 of the North Sea Gravity Project 78/02, which was carried out during the period 5 April 1978 to 21 May 1978.

The three legs were designed to extend the gravity coverage of the North Sea obtained in previous years, to the area south of 54^{o}N on a 7½km by 17½km grid of predominantly N-S, E-W survey lines. Pinger and magnetometer records were to be collected at the same time.

The m.v. Sperus, of dimensions 63m overall length, 11m beam, 4m draught and 921 tons net weight was chartered from Cosag Marine Services Ltd and mobilised at Leith from 5 April to 16 April 1978 for this work.

The senior scientist's, geophysical, surveying and technical reports, summary charts and log sheets, on which this report is based, are located on open file in the Marine Geophysics Unit, Murchison House, West Mains Road, Edinburgh. The authors of the reports for the periods covered are listed below:-

Leg 1 Mobilisation

R A Floyd	Senior Scientist
M C Tully M Glen	Geophysical
A S Mould	Surveying
P Roberts	Technical

Leg 2

M C Tully	Senior Scientist
M C Tully M Glen	Geophysical
R A Floyd	Surveying
A J Davies	Technical

Leg 3

A Dobinson	Senior Scientist
E J Armstrong	Geophysical
A S Mould	Surveying
A D Wilson	Technical

MOBILISATION

Leith and Grangemouth, 5 to 16 April 1978

Mobilisation occupied the above period with the ship coming on charter at 0800 hours on 10 April. This period was longer than planned due to labour problems at Leith. These problems forced the ship to drydock in Grangemouth on Tuesday 11/Wednesday 12 April, after which the final phase of refitting took place in Leith Docks with the installation of the gravity meter systems.

Vibration problems were encountered with the LaCoste and Romberg gravity meter which exhibited up to 5mGal swings on the beam motion detect circuitry. This was resolved by resiting the meter. The Askania GSS-3 meter was installed without difficulty.

The satellite navigation equipment was installed satisfactorily apart from aft channel doppler sonar drift and associated transducer cable screening and earthing problems. All other geophysical equipment was installed without abnormal difficulties.

LEG 1

Edinburgh to Newcastle: 16 April-24 April

A total of 1926km of line was surveyed in calm but foggy seas during this leg.

After sailing, pinger trials and doppler sonar drift tests were carried out in Anstruther Bay. The pinger performed satisfactorily while a drift rate of 150m/hr was observed on the aft channel of the doppler sonar. On replacement of some circuit boards, aft drift decreased to 55m/hr while further tests in 24m of water gave values of c.300m/hr which decreased to 200m/hr by using shallow mode, automatic blanking. During all these tests spurious aft counts of 150-300Hz above normal were observed at times. It was attempted to compensate for these drift rates by means of TADJ.

During four runs in the cardinal directions, used to calibrate the sonar/gyrocompass units, the previous year's gyrocompass torquing constants were retained. Variations in ABIA were small and unsystematic and omitting shallow water values, a figure of 1.018 was used for TADJ.

Attempts were made to correct for shallow water effects, which resulted in large along-course errors, by the use of shallow mode, automatic blanking and minimum manual blanking but due to lack of time these tests were not conclusive. Strong currents caused large cross course errors.

Bunching of the five operational satellites, twice daily, caused 3 to 4 hour blank periods, however, mutual interference between satellites was minimal.

Line analysis indicated a mean drift rate of 120m/hr from a mean update of 150m with an average of 77 minutes between the total of 64 satellites observed. Decca positioning was not used due to poor coverage in this area.

Continuing vibration problems and the need to completely check out the LaCoste gravity meter system meant that the instrument did not record data for 1½ lines of the survey. A further resiting of the meter on the instrument deck solved these problems.

Plotted profiles of Bouguer anomaly values showed a variation of $\pm$ 2-3mGal between the meters with a correlation of 1-2mGal with course direction, indicating a cross coupling error on the LaCoste meter.

Due to poor operation of the automatic pilot, short period anomalies of up to 5mGal were seen on the analogue traces. The mean cross tie was 1.7mGal for both meters with the base tie at Newcastle indicating a drift of +0.4mGal for the LaCoste and -0.7mGal for the GSS-3 with a 1.0mGal difference between the meters.

The magnetometer was run on lines 3 to 11 inclusive with some lines being cut short due to shipping, shallow water and fog. Cross-over errors were generally within $\pm$ 10 γ, the data exhibiting a general increase in value towards the north with no significant large amplitude features.

LEG 2

Newcastle to Den Helder: 25 April-8 May

The ship sailed at 0630 on 28 April after delays due to power supply troubles and bad weather. Foggy and unsettled conditions continued for much of the leg and ten hours surveying was lost due to severe weather. A few hours more were lost when generator failure caused the instruments to be powered down.

This leg extended the gravity coverage obtained during Leg 1 in the area 53°N to 54°N including four long N-S lines in the eastern sector of the area, two of which, 15 and 17, were surveyed in rough seas. During this leg the automatic pilot worked well after its repair in Newcastle and over 3500km of

survey were completed.

The LaCoste meter, repositioned back in the gravity meter container near the ship's centre of gravity, tended to read low in rough seas, further indicating a cross coupling error. Magnetic tapes from the 9400 data logger have been sent to LaCoste and Romberg to be analysed for such cross coupling errors.

Omitting lines 17 and 15 from the analysis of mean cross-ties, a value of 1.2mGal was obtained for the LaCoste and 1.47mGal for the GSS-3. The GSS-3 generally did not perform well, giving erratic traces and had a tendency to read high in heading seas.

The magnetometer was run only on lines 13 and 15 to 22 inclusive, due to the same problems as leg 1. Plotted values showed mainly low cross over values but with some larger values on lines surveyed towards the end of the leg. The same general trends as observed on Leg 1 were again noted.

During the period 24 to 27 April the sat/nav system was shut down to allow essential maintenance to the power supplies. On powering up, a voltage fluctuation blew a 250mA fuse in the HP2100 computer and simultaneously shut down the LaCoste meter.

On sailing, satellite radio interference and bunching of the satellites was observed. Large cross course updates which were obtained during this period shifted to large along course updates when the shallow range, sonar blanking was switched on.

Between 30 April and 3 May bad weather and shoals caused large updates. Abnormal frequencies were also recorded at this time and observed speeds over sand banks varied by $\pm$ 4 knots on occasion.

Weather improved by 3/4 May and a new ABIA value of -0.438 was entered resulting in decreased cross course updates.

LEG 3

Den Helder to Plymouth: 8-21 May

During this leg work in the southern North Sea continued with 3458 line kilometres being surveyed. There was no down time due to bad weather and apart from some fog, conditions were excellent for surveying. Heavy shipping and shoals complicated survey planning but a good coverage was obtained in most areas.

The LaCoste meter data gave a mean cross tie value of 1.06mGal and the instrument performed well, the only malfunctions being a digital reading error and spurious line feeds on the 9400 data logger.

The mean cross tie of 3.06mGal observed in data from the GSS-3 indicated a deterioration in performance of this system. During the Den Helder port call the system had been checked by an IOS technician but after clamping the meter early in this leg, persistently low readings relative to the LaCoste meter were observed, with a step-like trace, and a tendency to go non linear at approximately 15,000mGal acceleration.

This problem was investigated over two days by another IOS technician who rechecked the system and reset it producing a D.C. shift of approximately 16mGal between the meters. Calm weather prevented proper checks being made on the Brown platform. Disagreement between the two meters of about $\pm$2mGal was observed after this time until the Plymouth port call, at which point the drift of the LaCoste was found to be -0.1mGal and -13.9mGal for the GSS-3.

Again, the magnetometer was used on only a small number of lines due to heavy traffic and variable bottom topography; lines 59 to 70 inclusive and lines 72 and 73 being recorded.

The spurious counts noted on the doppler sonar during previous legs were not observed in Den Helder, where interference on the 150MHz channel caused the abandonment of a 3-D solution and furthermore, the loss of a number of otherwise good satellite passes later, at sea.

On sailing, trouble was experienced clearing the "water track" condition and on clearing it, doppler counts on the aft and port channels were grossly in error, as were derived speeds, for a number of minutes. The problem did not reoccur after this. A failure of speed input to the computer during the survey was solved by moving the sonar and computer interface cables.

In water depth of less than 15 metres, gross errors in doppler sonar derived speeds were obtained and noticeable errors still occurred in up to 30 metres of water. Minimum manual blanking caused no decrease in the minimum workable depth. Shallow range, automatic blanking was not used.

Large updates occurred at the beginning of most lines and bunching of satellites continued between midday to 1900 hours and midnight to 0700 hours.

Unadjusted fix accuracies were generally about $\pm$ 100metres with up to 300+ metre updates in shallow water. Minor alterations in calibration were due to short lines with frequent, shallow water disruption inhibiting assessment of calibration constants.

EQUIPMENT PERFORMANCE SUMMARY

Integrated Satellite Navigation System

Drift on the aft doppler sonar channel was the main problem and was decreased initially by board replacement.

Screening and earthing problems in the doppler sonar cable were resolved during mobilisation by extensive cable repair and reconnection.

At Newcastle, a voltage fluctuation blew a 250mA fuse in the HP2100 computer and necessitated replacement of the main timing board.

A "water track" problem after Den Helder was cleared with difficulty and a speed input failure to the HP computer associated with normal doppler counts and the computer detecting an 'off' on the sonar switch when it was switched on, was eventually solved by moving the doppler sonar and computer interface cables.

LaCoste and Romberg Gravity Meter Systems

Apart from vibration problems this system performed well. The associated 9400 data logger gave spurious line feeds and transposed some of the least significant digits of the spring tension values at times.

Askania GSS-3 Gravity Meter System

This system did not perform as well as the LaCoste system. During Leg 1 a temporary repair was made after failure of the digital voltmeter which was used to display the output from the gravity system. At Den Helder, bared wires in the test plug of the Brown platform were repaired. A recheck was made at sea when two intermittent faults were repaired and gains and offsets were set up.

Barringer Magnetometer

After replacement of one faulty unit the magnetometers worked well.

Decca Data Logger

One minor problem was cured during mobilisation. During Leg 2 the Watt box was stripped down and all edge connectors cleaned. Magnetic tape unit 1 failed and intermittent RBW and RAW problems on unit 2 occurred during Leg 3.

Atlas Deso 10

After operating satisfactorily for Legs 1 and 2, the unit was out of operation during Leg 3 for 1½ days due to a reversal of the ship's DC power supply feeding the laboratory, damaging a number of components. On repair the unit was converted to mains supply.

Edo Pinger

Worked satisfactorily.

Hydrophone

Operated satisfactorily on tests.

Sparker Systems

After remaking the MESS source the systems worked well on tests.

Sidescan Sonar

The fish operated well on tests after stretching the fish cable bracket to fit the fish line. The band drive on the chart recorder was in poor condition.

Analogue Recording System

During tests on Leg 3 this system worked well for single source recording.

Uninterruptable Power Supply

Failed after generator problems during mobilisation and was run for one hour only at Newcastle in the invertor mode before a large transient affected the other laboratory equipment, after which it was powered down.

Generators

Generator 1 did not function during Leg 1. Generator 2 started surging during Leg 2 and was powered down. Generator 1 supplied the laboratory during Leg 3 and the surging problems on Generator 2 were not observed in tests during this leg.

TABLE 1

Personnel on Project

Leg 1: 10 April-24 April: Leith to Newcastle

R A Floyd	Senior Scientist	MGU, IGS
M C Tully		
A S Mould		
M Glen		
P R Roberts		
A J Davies		
P Mason		MSES, IOS, Barry

Leg 2: 25 April-8 May: Newcastle to Den Helder

M C Tully	Senior Scientist	MGU, IGS
R A Floyd		
M Glen		
E J Armstrong		
A J Davies		
A Oliver		

Leg 3: 9 May-21 May: Den Helder to Plymouth

A Dobinson	Senior Scientist	MGU, IGS
A S Mould		
S E Deegan		
E J Armstrong		
A D Wilson		
A Oliver		
C Paulson	16-18 May	MSES, IOS Barry
J Price		
S Kramvis	8-15 May Observer	Cyprus Geological Survey
G Strang van Hees	Observer	Technisch Hogeschool, Delft.

Table 2

LINE NO.	FIX NOs.	START		END		LINE LENGTH	MAIN NAV AID	EQUIPMENT USED					
		Day	Time	Day	Time			Echo Sounder	Pinger	Magnetometer	Data Logger	L/R S75 / 400	Ask. GSS3
CAL.A	1-37	107	0810	107	1410	134Km	SAT NAV UNCALIB	✓				✓ / ✓	✓
CAL.B	1-51	107	1510	107	2330	160 Km	"	✓				✓ / ✓	✓
001	1-32	108	1540	108	2050	98Km	SAT NAV OOP	✓	✓			✓ / ✓	✓
002	1-23	108	2310	109	0250	79Km	"	✓	✓			✓ / ✓	✓
003	1-64	109	0420	109	1450	204Km	"	✓	✓	✓		✓ / ✓	✓
004	1-61	109	1710	110	0310	201Km	"	✓	✓	✓		✓ / ✓	✓
005	1-63	110	0450	110	1510	191Km	"	✓	✓	✓		TILL FIX #14 ✓	✓
006	1-57	110	1630	111	0150	186Km	"	✓	✓	TILL FIX #20		FROM FIX #7 ✓	✓
007	1-51	111	0320	111	1140	166Km	"	✓	✓	FROM FIX #18	-	✓ / ✓	✓
008	1-23	111	1300	111	1640	75km	"	✓	✓			✓ / ✓	✓
009	1-27	111	1800	111	2220	85Km	"	✓	✓	FROM FIX #6		✓ / ✓	✓
010	1-38	112	0150	112	0800	135Km	"	✓	✓	TILL FIX #33		✓ / ✓	✓
011	1-38	112	0920	112	1530	130Km	"	✓	✓	FROM FIX #30		✓ / ✓	✓
012	1-27	112	1700	112	2110	82Km	"	✓	✓			✓ / ✓	✓
013	1-80	118	1010	118	2320	197Km	"	✓	✓	✓	PART	✓ / ✓	✓
014	1-95	119	0050	119	1630	295Km	"	✓	✓		✓	FROM FIX #38 ✓	✓
015	1-88	119	1840	120	0910	267Km	"	✓	FIXES 1-47	FROM FIX #7	✓	✓ / ✓	FIXES 1-41
016	1-87	120	1100	121	0120	289Km	"	✓	✓	✓	✓	✓ / ✓	✓
017	1-91	121	0300	121	1800	278Km	"	✓	✓	✓	✓	✓ / ✓	✓
018	1-7	121	2000	121	2100	20 Km	"	✓		✓	✓	✓ / ✓	✓
019	1-4	121	2230	121	2300	8 Km	"	✓		✓	✓	✓ / ✓	✓
020	1-68	122	1200	122	2310	209Km	"	✓	✓	✓	✓	✓ / ✓	✓
021	1-61	123	0010	123	1010	197Km	"	✓	✓	✓	✓	✓ / ✓	✓
022	1-57	123	1130	123	2050	179Km	"	✓	✓	✓	✓	✓ / ✓	✓
023	1-78	123	2210	124	1100	279Km	"	✓	✓		✓	✓ / ✓	✓
024	1-31	124	1120	124	1620	104Km	"	✓	✓		✓	✓ / ✓	✓
025	1-114	124	1730	125	1220	382Km	"	✓	✓		✓	✓ / ✓	✓
026	1-24	125	1300	125	1650	90Km	"	✓	✓		✓	✓ / ✓	✓
027	1-16	125	1820	125	2050	54Km	"	✓	✓		✓	✓ / ✓	✓
028	1-27	125	2310	126	0420	102Km	"	✓	✓		✓	✓ / ✓	✓
029	1-13	126	0540	126	0740	45Km	"	✓	✓		✓	✓ / ✓	
030	1-42	126	0840	126	1530	138Km	"	✓	✓		✓	✓ / ✓	✓
031	1-28	126	1830	126	2300	103Km	"	✓	✓		✓	✓ / ✓	✓
032	1-15	127	0010	127	0230	44Km	"	✓	✓		✓	✓ / ✓	✓
033	1-25	127	0500	127	0900	81Km	"	✓	✓		✓	✓ / ✓	✓

Table 2(cont)

LINE NO.	FIX NOs.	START		END		LINE LENGTH KM.	MAIN NAVAID	EQUIPMENT USED					
		Day	Time	Day	Time			Echo Sounder	Pinger	Magnet ometer	Data Logger	L/R S75 / 9400	Ask. GSS3
034	1-24	127	1050	127	1440	68	SATNAV DOP	✓	✓		✓	✓✓	✓
035	1-9	127	1530	127	1650	28	"	✓	✓		✓	✓✓	✓
036	1-43	127	2120	128	0420	133	"	✓	✓		✓	✓✓	✓
037	1-20	129	1940	129	2250	69	"		✓		✓	✓✓	✓
038	1-50	130	0050	130	0900	160	"		✓		✓	✓✓	✓
039	1-61	130	1440	131	0040	198	"		✓		✓	✓✓	✓
040	1-17	131	0220	131	0500	62	"		✓		✓	✓✓	✓
041	1-65	131	0700	131	1740	204	"	FROM FIX #23	✓		✓	✓✓	✓
042	1-22	131	1810	131	2140	72	"	✓	✓		✓	✓✓	✓
043	1-18	131	2330	132	0220	58	"	✓	✓		✓	✓✓	✓
044	1-17	132	0320	132	0600	55	"	✓	✓		✓	✓✓	✓
045	1-40	132	0910	132	1540	101	"	✓	✓		✓	✓✓	✓
046	1-15	132	1650	132	1910	49	"	✓	✓		✓	✓✓	✓
047	1-19	132	1940	132	2240	66	"	✓	✓		✓	✓✓	✓
048	1-17	133	0050	133	0330	52	"	✓	✓		✓	✓✓	✓
049	1-15	133	0550	133	0810	50	"	✓	✓		✓	✓✓	✓
050	1-40	133	0920	133	1550	140	"	✓	✓		✓	✓✓	✓
051	1-22	133	1700	133	2030	73	"	✓	✓		✓	✓✓	✓
052	1-18	133	2200	134	0050	54	"	✓	✓		✓	✓✓	✓
053	1-12	134	0245	134	0435	40	"	✓	✓		✓	✓✓	✓
054	1-18	134	0650	134	0940	59	"	✓	✓		✓	✓✓	✓
055	1-22	134	1330	134	1700	73	"	✓	✓		✓	✓✓	✓
056	1-16	134	1910	134	2140	49	"	✓	✓		✓	✓✓	✓
057	1-29	135	0040	135	0520	94	"	✓	✓		✓	✓✓	✓
058	1-14	135	1355	135	1605	49	"	✓	✓		✓	✓✓	✓
059	1-24	135	2050	136	0040	81	"	✓	✓	✓	✓	✓✓	✓
060	1-4	136	0140	136	0210	8	"	✓	✓	✓	✓	✓✓	✓
061	1-26	136	0345	136	0755	87	"	✓	✓	✓	✓	✓✓	✓
062	1-19	136	0850	136	1150	62	"	✓	✓	✓	✓	✓✓	✓
063	1-26	136	1755	136	2205	85	"	✓	✓	✓	✓	✓✓	
064	1-30	136	2310	137	0400	99	"	✓	✓	✓	✓	✓✓	
065	1-32	137	0435	137	0945	105	"	✓	✓	✓	✓	✓✓	
066	1-30	137	1045	137	1535	100	"	✓	✓	✓	✓	✓✓	
067	1-32	137	1610	137	2120	101	"	✓	✓	✓	✓	✓✓	✓
068	1-31	137	2210	138	0310	103	"	✓	✓	✓	✓	✓✓	✓

Table 2(cont)

LINE NO.	FIX NOs.	START		END		LINE LENGTH K.M.	MAIN NAV AID	EQUIPMENT USED					
		Day	Time	Day	Time			Echo Sounder	Pinger	Magnet ometer	Data Logger	L/R S75 / 9400	Ask. GSS3
069	1-33	138	0345	138	0905	103	SAT NAV DOP	✓	✓	✓	✓	✓ / ✓	✓
070	1-26	138	0955	138	1405	82	"	✓	✓	✓	✓	✓ / ✓	✓
071	1-14	138	1900	138	2110	39	"	✓	✓		✓	✓ / ✓	✓
072	1-28	138	2210	139	0240	83	"	✓	✓	✓	2nd PART	✓ / ✓	✓
073	1-34	139	0330	139	0900	84	"	✓	✓	✓	✓	✓ / ✓	✓
074	1-30	139	1025	139	1515	89	"	✓	✓		✓	✓ / ✓	✓
075	1-33	139	1820	139	2340	89	"	✓	✓		✓	✓ / ✓	✓
076	1-49	140	0050	140	0850	154	"	✓	✓		✓	✓ / ✓	✓
077	1-51	140	1040	140	1900	78	"	✓	✓		✓	✓ / ✓	✓

Table 3

1 Base	2 g* at harbour base	3 mGal diff to dock	4 F.A.* corr to m.s.l.	5 6 Meter Rdg S 75	5 6 Meter Rdg GSS3	7 Tidal corrn. to 5/6	8 9 Meter Rdg$_c$ S 75	8 9 Meter Rdg$_c$ GSS3	10 *g corr	11 * ΔMxC.F S 75	12 ΔMxC.F GSS3	13 *Δg corr	14 Drift* L/R / GSS3
LEITH No.4 SHED IMP. DOCK 16-4-78	981598·8	—	+0·7$_{mg}$	12391·6	3840·7	—	12391·6	3840·7	9815995				
NEWCASTLE TYNE DOCK 24-4-78	981507·0	0·30	+0.6	12298·8	3747·0	—	12298·8	3747·0	981507·9	L-N −92	L-N −90.9	L-N −91.6	L-N −0.4 / +0.7
NEWCASTLE TYNE DOCK 27-4-78	981507	0.30	+0.6	12299·1	3746·4	—	12299·1	3746·4	981507·9	N-N +0.3	N-N −0.6	N-N 0	N-N +0.3 / −0.6
DEN HELDER 8-5-78	981324·7	−1·3	+0·9	12113·0	3557·6	+0·2	12113·2	3557·8	981324·3	N-DH −184·2	N-DH −182·9	N-DH −183·6	N-DH −0.6 / +0·7
DEN HELDER 9-5-78	981324·7	−1·3	+0·7	12113·7	3559·0	−0·2	12113·5	3558·8	981324·1	DH-DH +0·3	DH-DH +1·0	DH-DH −0·2	DH-DH +0.5 / +1·2
MILLBAY WEST WHARF CRAIN No 22-5-78	981115·0	−0·2	+1.6	11903·1	3329·5	0·7/0·8	11903·8	3330·3	981116·4	DH-M 207·8	DH-M 221·6	DH-M 207·7	DH-M −0.1 / −13·9

* All readings in milligals

TABLE 4

Survey Equipment Installed on m.v. Sperus

1A. LaCoste and Romberg air-sea gravity meter, S75.

B. LaCoste and Romberg 9400 data acquisition system.

2. Askania GSS-3 gravity meter and Brown platform.

3. Two Barringer magnetometers.

4. Edo Western pinger with hull mounted transducer and EPC 4100 graphic recorder.

5. Atlas Deso 10 echo sounder with hull mounted transducer and EDIG 10 digitiser unit.

6. Magnavox satellite navigation system integrated with MX610 doppler sonar.

7. Decca MK21 main chain receiver.

8. Decca data logger.

9. Three 60KVA AC generators.

10. Uninterruptable power supply system (UPS).

Equipment carried for testing prior to succeeding legs

1. Klein sidescan sonar and winch.

2. Multi-element sparker array (IGS).

3. EG & G 9-element sparker array.

4. EG & G trigger, power and capacitor units.

5. Two 30m Geomecanique hydrophones.

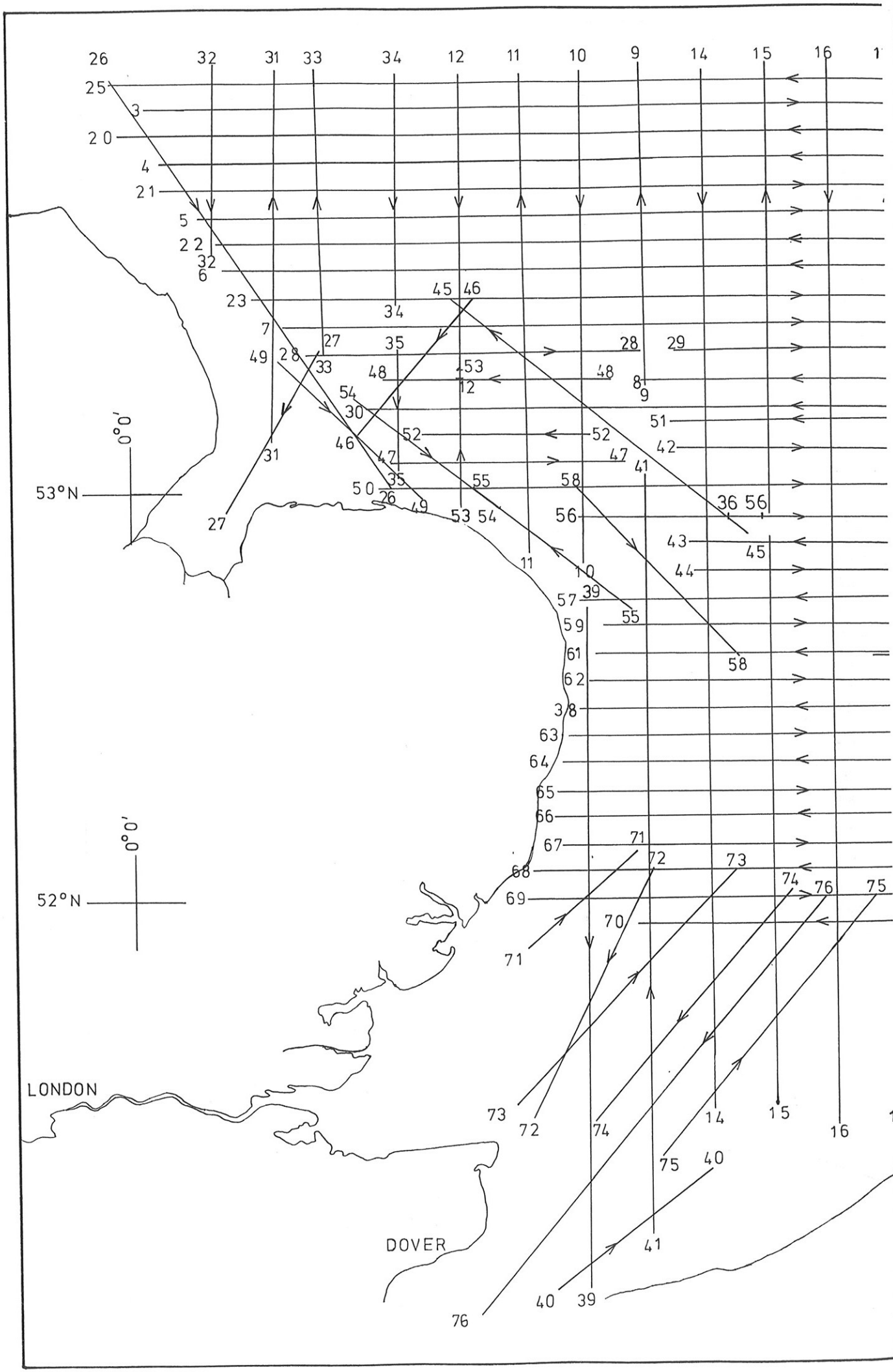
6. EPC graphic recorders (4600 and 4100).

7. Analogue tape recording system.

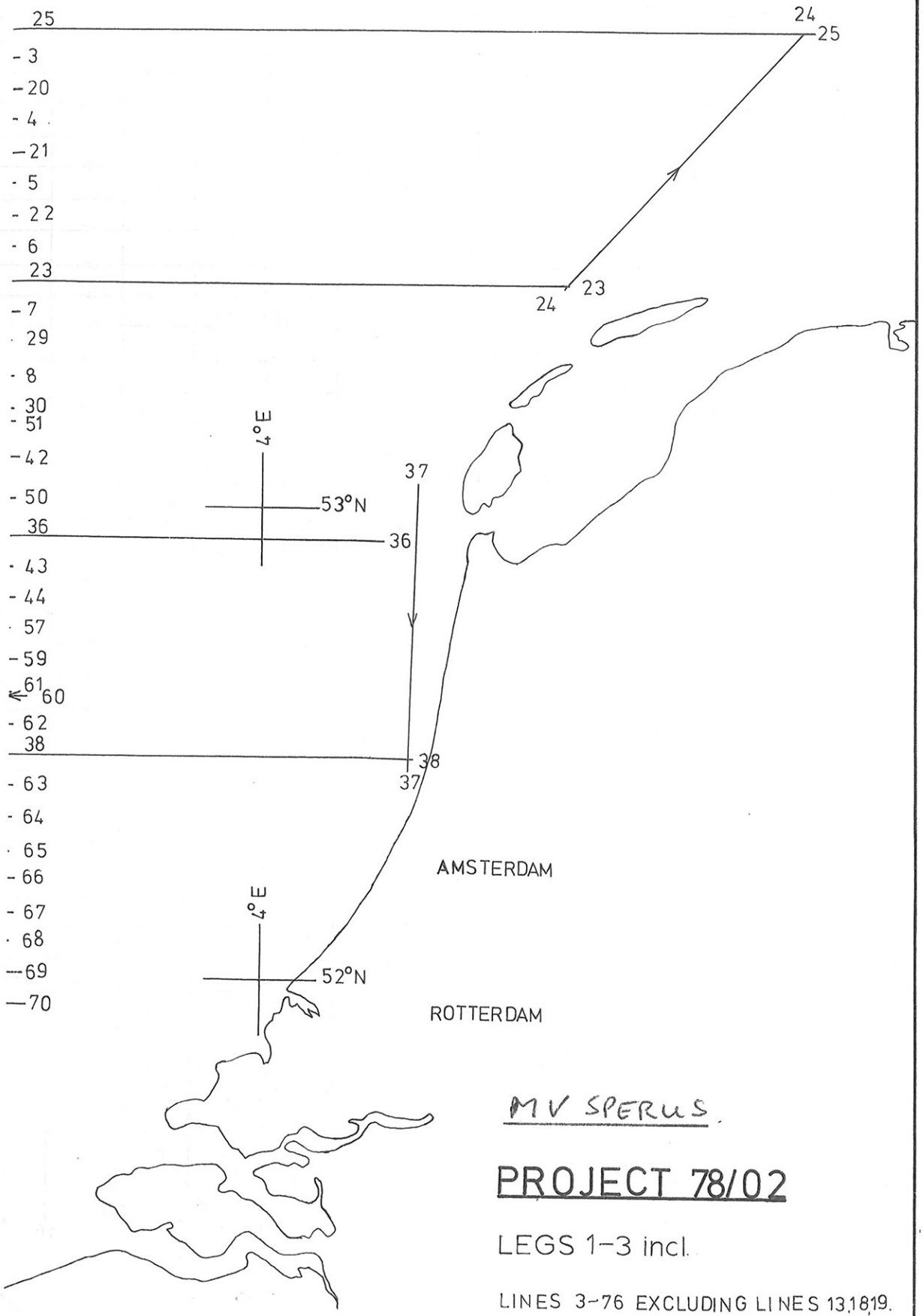
TABLE 5

Lines 1, 2, 13, 77 (transit lines outside main survey area).

	Position			
Line No	Start		End	
1	55° 34.894'N	01° 29.918'W	54° 45.333'N	01° 05.133'W
2	54° 37.237'N	00° 39.175'W	54° 03.813'N	00° 06.532'E
13	54° 51.552'N	00° 37.708'W	54° 15.367'N	02° 20.314'E
77	50° 45.739'N	01° 03.566'E	50° 25.941'N	01° 00.688'W


53°N
52°N
0°0'
LONDON
DOVER

MIAS 2119



MV SPERUS.

PROJECT 78/02

LEGS 1–3 incl.

LINES 3–76 EXCLUDING LINES 13,18,19.

10 0 10 20 KILOMETRES

10 0 10 20 STATUTE MILES

10 0 10 20 NAUTICAL MILES

INSTITUTE OF GEOLOGICAL SCIENCES

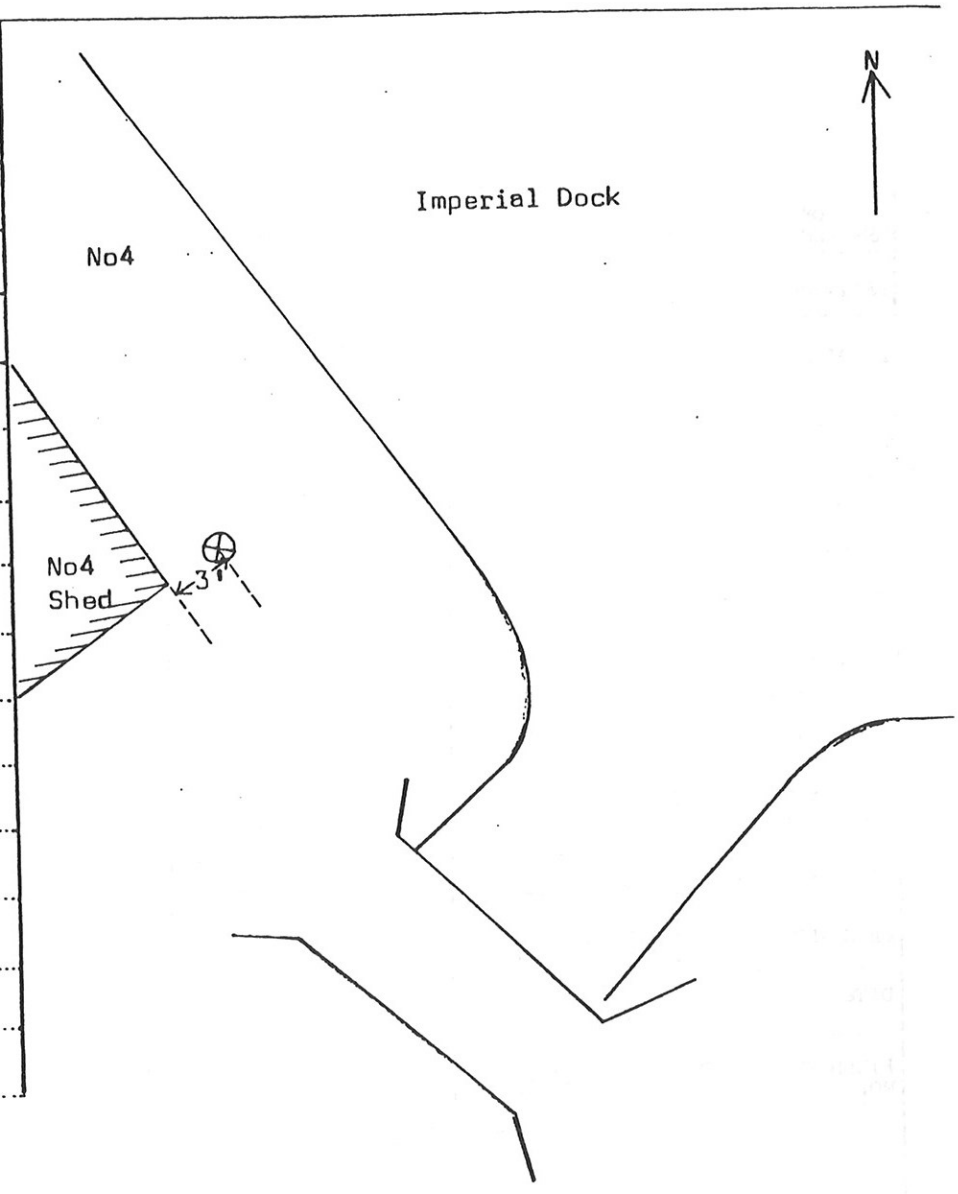
MARINE GEOPHYSICS UNIT

GRAVITY BASE STATION

STATION NAME: No 4 Shed, Imperial Dock, Leith NO.(if any):

SITE DESCRIPTION: 3ft from NE wall of No4 shed, Imperial Dock, at SE corner.

STATION REFERENCE NO.	
LATITUDE	55°58'50''N ~
LONGITUDE	03°10'W ~
HEIGHT	
$g_{obs.} - g_{P.H.}$	
GEOLOGY	
BOUGUER ANOMALY e=	
BOUGUER ANOMALY e=	
FREE AIR ANOMALY	
TERRAIN CORRECTION	
METER NO.	W/W 36
OBSERVER	M C Tully
DATE	5.4.1977
FIELD SHEET NO.	
g(NGRN'73)	981,598.78



GEOLOGICAL SURVEY AND MUSEUM: [MGU HARBOUR. GRAVITY BASE STATION] NO.:

STATION NAME: SOUTH SHIELDS DOCK

1 METRE GRID REF.:

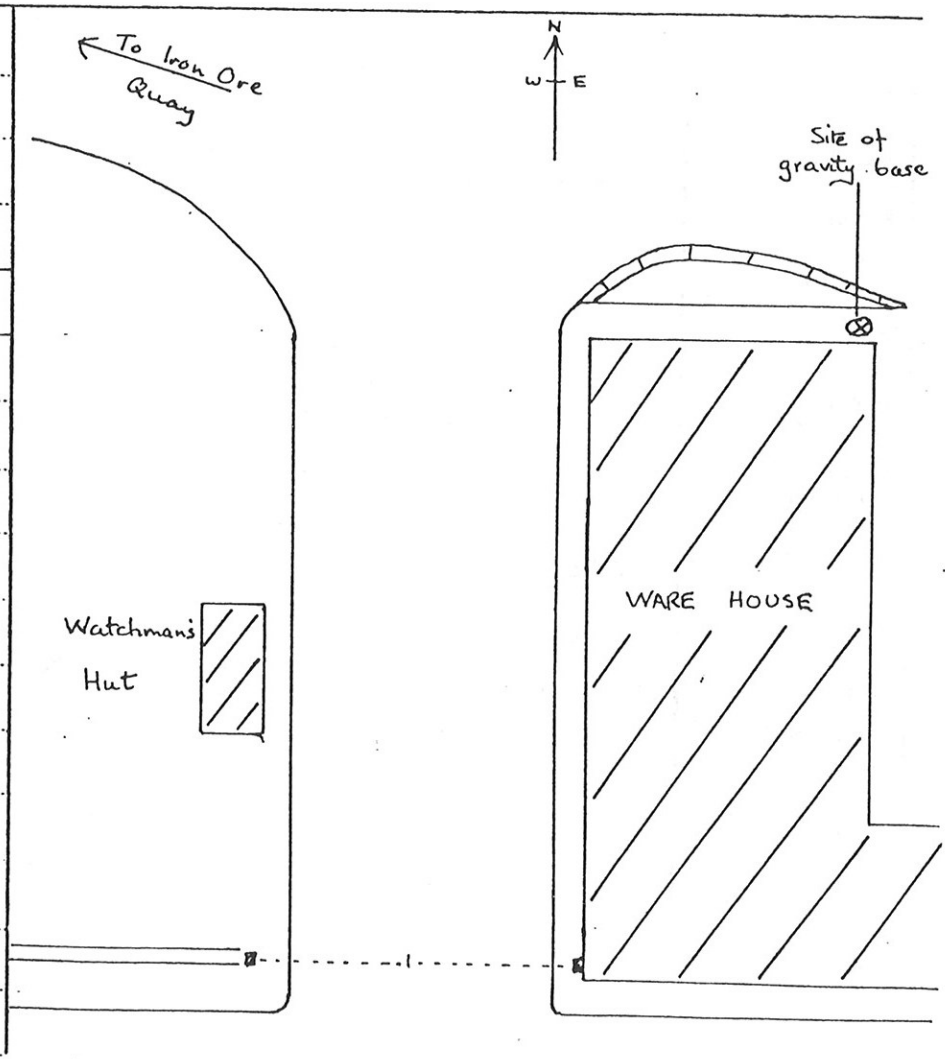
1" O.S. MAP: COUNTY:

1" GEOL. MAP: 6" O.S. MAP:

SITE DESCRIPTION:

Gravity base on pavement 0.5 m from ware house wall just west of ~~eastern to~~ line of eastern wall of warehouse

STATION REFERENCE NO.	
LATITUDE	
LONGITUDE	
HEIGHT	
~~$g_{obs.} - g_{p.H.}$~~ NGRN 73	981,506.98
GEOLOGY	
BOUGUER ANOMALY ρ = ... gms./c.c.	
BOUGUER ANOMALY ρ = 2.67 gms./c.c.	
FREE AIR ANOMALY	
TERRAIN CORRECTION	
METER NO.	World wide
OBSERVER	R. McQuillin
DATE	30/10/76.
FIELD SHEET NO.	Project 76/4
	Base connections



DS 87305/1/76 2m 2/61 DL

← Gateshead

Round about (CLOCK)

South Shields →

GRAVIMETERPUNT : Den Helder-Rijkswerf

R.D. :x = ... , y = ...

Top. Kaart :x = ... , y = ...

φ = 52°57'45" , λ = 4°46'05"

H_{Bout} = 2,15 , γ_o = ...

$H_{G.P.}$ = +1,38 , $\Delta\gamma$ = ...

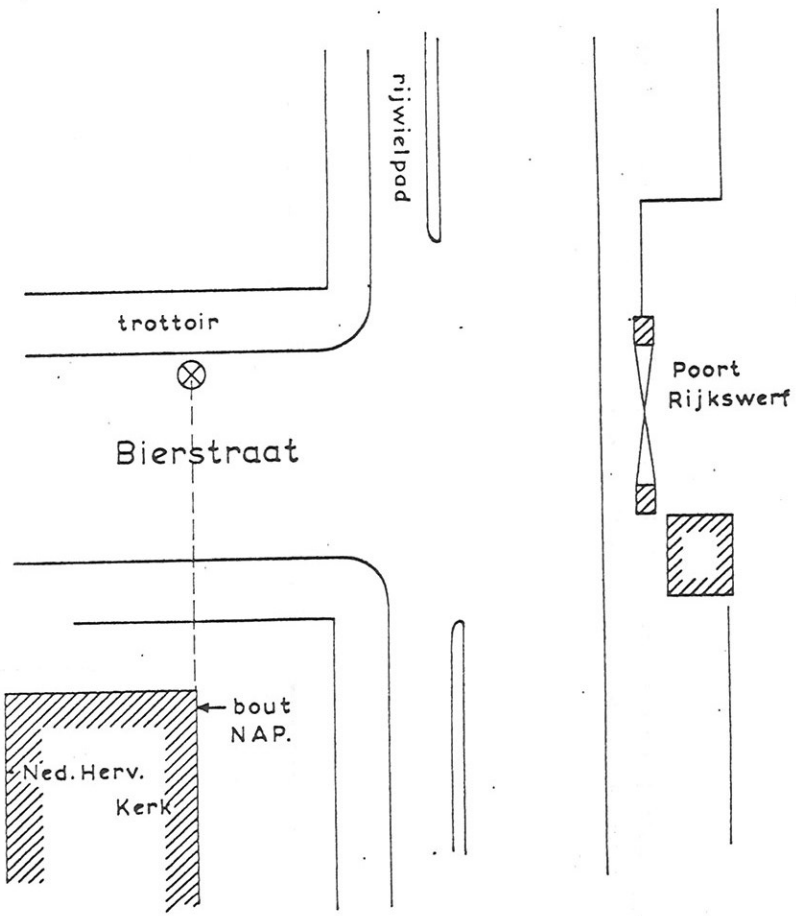
ΔH = 0.77 , γ_H = 981.330,50 (ellipsoid 1967)

Beschrijving :

g = 981.324,65 (observed)

datum : .....

Aanmeting :



INSTITUTE OF GEOLOGICAL SCIENCES

MARINE GEOPHYSICS UNIT

GRAVITY BASE STATION

STATION NAME: DEVONPORT, Trinity Pier, Devon. NO.(if any):

SITE DESCRIPTION:

Half way along northern side of Trinity Pier beside third small bollard from western end of pier.

STATION REFERENCE NO.	
LATITUDE	50°21'50"N.
LONGITUDE	04°09'07"W
HEIGHT	
$g_{obs.} - g_{P.H.}$	
GEOLOGY	
BOUGUER ANOMALY ρ=	
BOUGUER ANOMALY ρ=	
FREE AIR ANOMALY	
TERRAIN CORRECTION	
METER NO.	W427 W470
OBSERVER	Hydrog. D. MoD
DATE	1974
FIELD SHEET NO.	
g (IGSN'71/ NGRN'73)	981,115.0