



FINAL FIELD REPORT 1995

C.C.G.S. NAHIDIK

HYDROGRAPHIC SURVEYS of the NORTHWEST PASSAGE

August to September

A. R. Raymond
Hydrographer-in-Charge

CANADIAN HYDROGRAPHIC SERVICE
DEPARTMENT OF FISHERIES AND OCEANS
INSTITUTE OF OCEAN SCIENCES
SIDNEY, B.C.

027105

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Canadian Coast Guard Ship Nahidik

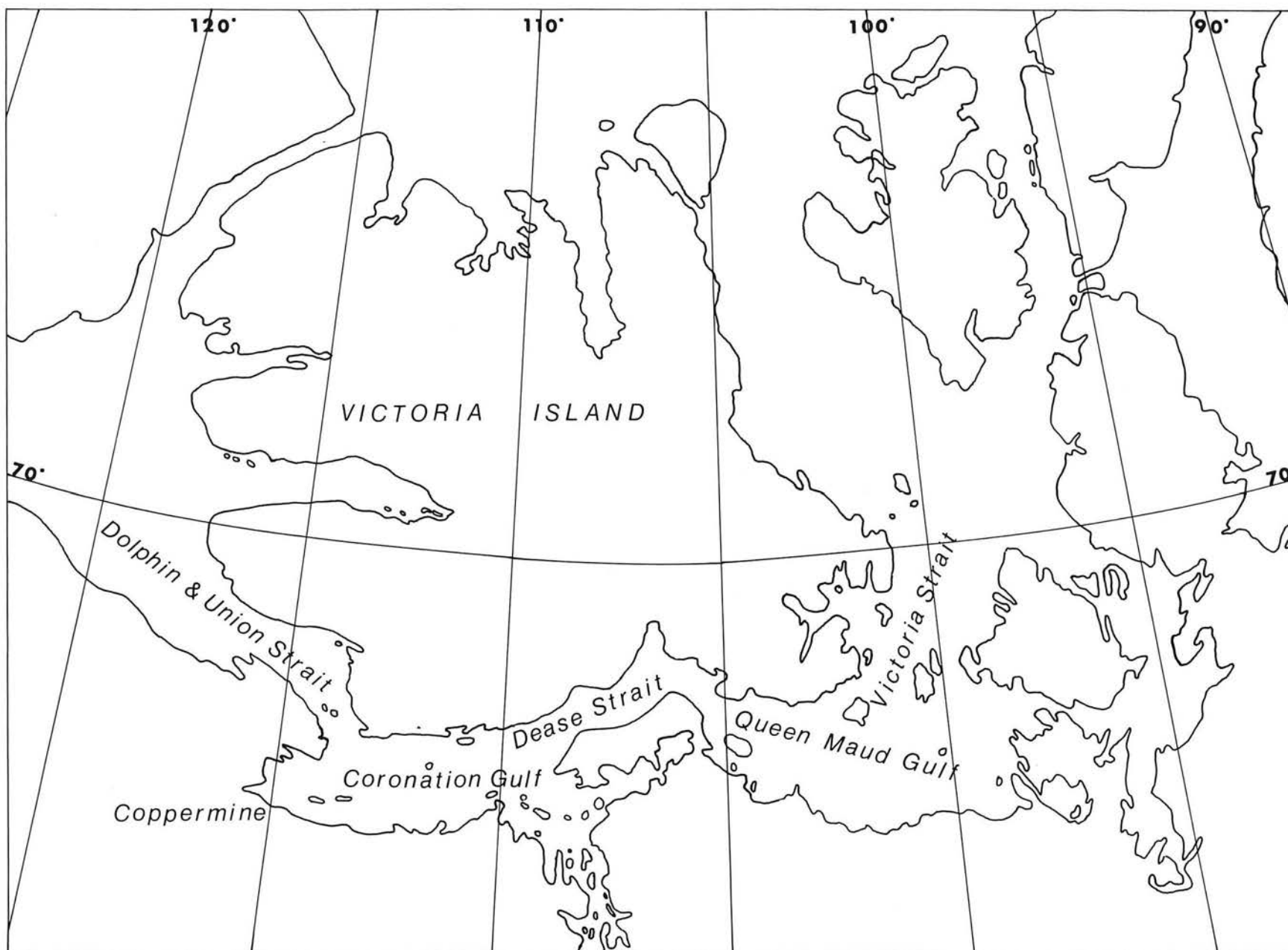
ARCTIC 1995

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Raymond, A.R.
C.C.G.S. Nahidik,
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STAFF LIST

Gordon Allison	Coxswain	August 2 - September 15
Doug Cartwright	Hydrographer	July 19 - September 15
Ron Korhonen	Hydrographer	August 2 - September 15
Knut Lyngberg	Hydrographer	July 26 - September 15
Doug Popejoy	Hydrographer	August 2 - September 15
Alex Raymond	Hydrographer-in-Charge	August 2 - September 15
Dennis Sinnott	Hydrographer	August 2 - September 15
Alan Thomson	Electronics Technologist	July 26 - September 15

LIST OF PROJECTS

Queen Maud Gulf	Project Number 7783/95	Scale 1:40,000
Victoria Strait	Project Number 7783/95	Scale 1:50,000

MAJOR CRAFT AND EQUIPMENT

C.C.G.S. Nahidik

53 metre, 2 metre draft, special river navaid's tender

C.S.L. Bright

7.6 metre modified Bertram survey launch

Positioning

Global Positioning Systems Magnavox 4200D

Differential Corrections Novatel 315R Reference Station

Sounding

Sounders Raytheon DSF6000

Transducer Raytheon 200 Khz

Navigation and Logging

ISAH Data Acquisition System

Computer Processing Equipment

DEC micro VAX 3100 computer

4211 Tektronix graphics terminal

Targa data storage cartridge reader

DEC 100 printer

CHRONOLOGY OF EVENTS

July 26, Wednesday

Advance Party of Lyngberg and Thomson depart Victoria for Cambridge Bay.

July 27, Thursday

Advance party setting up differential site in Cambridge Bay.

July 28, Friday

Advance party setting up differential site.

July 29, Saturday

Advance party setting up differential site.

July 30, Sunday

Advance party fine tuning differential site.

July 31, Monday

Advance Party surveying differential site position and Canadian Coast Guard Ship Nahidik arrives at Cambridge Bay.

August 1, Tuesday

Advance party preparing ship for survey.

August 2, Wednesday

Allison, Korhonen, Popejoy and Raymond depart Victoria and arrive in Cambridge Bay.

August 3, Thursday

Preparing ship and launch for noon August 4 departure from Cambridge Bay.

August 4, Friday

Ship ready to survey. Southeast winds and unfavorable sea state postpone departure. Time well used preparing for survey.

August 5, Saturday

Winds abate to East 17. Ship departs Cambridge for Survey Area. While enroute, ships sounder and positioning are tested. Positioning working, but sounder marginal in one metre seas.

August 6, Sunday

Winds Northeast 16. Ship sounding at reduced speed (7 knots) to get usable trace from sounder.

August 7, Monday

Winds Northeast 17. Ship sounding all day. Launch Bright deployed in afternoon, running parallel line with ship.

August 8, Tuesday

Winds West 8, seas calm. Ship sounding all day. Bright sounding for ten hour shift.

August 9, Wednesday

Winds Northwest, seas calm. Ship sounding all day. Launch sounding day shift. Helicopter from Ivik used in morning to confirm configuration of differential shore station.

August 10, Thursday

Winds Southeast 7, seas calm. Ship sounding all day. Launch Bright sounding daytime shift. Sinnott and Thomson traveled via Ivik helicopter to Coppermine to recover submerged tide gauge.

August 11, Friday

Winds Southeast 8, seas calm. Ship and launch sounding.

August 12, Saturday

Winds Southwest 10, seas smooth. Ship and launch sounding.

August 13, Sunday

Winds Northwest 4, seas calm, heavy fog. Ship and launch sounding. Launch radar broken. Repaired same day.

August 14, Monday

Winds Southeast 10, seas rippled. Ship alongside Louis St. Laurent in morning and early afternoon. Launch sounding in afternoon and early evening.

August 15, Tuesday

Winds Southeast 10, seas rippled. Ship and launch sounding.

August 16, Wednesday

Winds Southeast 5, seas calm. Ship sounding to 0600 hours. Ship breaks from survey for Cambridge Bay to obtain water and supplies. Shore party dispatched to differential site to determine and solve problems with low altitude satellites. Choke collar removed. All visible satellites were then received. DSF6000 sounder 200 kHz transducer was lowered approximately one inch to help in rough water conditions.

August 17, Thursday

Winds Northeast 15. Ship ready to depart at 0700. Departure delayed 24 hours due to eye injury to Captain. Time used to service tide gauge. Launch Bright used to recover two channel buoys.

August 18, Friday

Winds Southeast 10, one metre swell. Nahidik departs Cambridge Bay at 0900 hours. Both ship and launch sounding in early afternoon. Receiving all satellites from differential station. Now experiencing short outages of signal several times during day. Sounder working slightly better, but still must slow down in half metre seas to achieve usable sounding trace.

August 19, Saturday

Winds Northeast 12 with a half metre chop. Ship sounded all night. Launch deployed in morning. Differential link failed to provide corrections. Thomson sent to Cambridge Bay to investigate. Ship followed. At transmitter site a malfunction discovered in Harris Radio used for differential correction. Radio returned to ship. VHF differential station equipment staged for deployment. Ship remained at anchor in Cambridge Bay over night.

August 20, Sunday

Winds Northwest 5, seas calm. Ship departs Cambridge Bay at 0600 hours. Off Trap Point at 0830 hours. Launch Bright with shore party deploy differential station. Both ship and launch back sounding at 1100 hours.

August 21, Monday

Winds Northwest 5, seas calm. Launch on splits and exams. Ship running check lines. Injector problems in ship. Engines repaired in 10 hours.

August 22, Tuesday

Winds Northwest 15, one metre seas. Ship running check lines, splits and exams all day. Weather too rough for launch deployment.

August 23, Wednesday

Winds Northwest 12, half metre seas. Ship breaks off sounding at 0600 for Cambridge Bay. Second engineer flies home. Ship awaits arrival of replacement. Differential station at Cambridge Bay repaired and put back on air.

August 24, Thursday

Winds West 10, half metre seas. Ship in Cambridge to 1300. Sets sail for Victoria Strait. Launch and shore party recover differential station at Trapp Point in morning.

August 25, Friday

Winds West 5, seas calm. Ship collects bottom qualities until ice reached in Victoria Strait at 69.5 degrees north. Differential from Cambridge Bay being received by ship which is now one hundred miles away. Ship starts sounding in Victoria Straits block in late afternoon.

August 26, Saturday

Winds Northwest 15, one metre seas. Differential corrections too unreliable in early morning hours to sound. Heavy seas made launch deployment inadvisable. Decision made to head south of Jenny Lind collecting a bottom sample every five miles. Ship ran track lines over night in uncharted waters.

August 27, Sunday

Winds Southeast 20, one metre sea. Sounding with ship or launch inadvisable due to heavy seas. Ship found shelter in M'Clintock Bay.

August 28, Monday

Winds Southeast 20-25, one metre seas. Ship and launch unable to work primary areas due to heavy seas.

August 29, Tuesday

Winds Southwest 20-25, one metre seas. Ship departs for Gjoa Haven to take on supplies and tend to medical problems.

August 30, Wednesday

Winds South 30, seas heavy. Low power tide gauge installed at Gjoa Haven in morning. Arrangements made with Arctic Ivik to pick up gauge in two weeks. Ship departs mid afternoon.

August 31, Thursday

Winds Southwest 20-25 knots, one metre swell. Ship anchors overnight south of Eta Island for current observations.

September 1, Friday

Winds Northwest 30 knots, seas heavy. Ship anchored south of Eta Island waiting for gale to pass. Positioning system calibrated late afternoon showing less than two metre error in position. Ship anchored overnight.

September 2, Saturday

Winds West 20 knots, one metre sea. Overnight sounding abandoned due to heavy weather. Ship anchors in Jenny Lind Bay.

September 3, Sunday

Winds West 20 knots in Jenny Lind Bay. Gale warnings in Queen Maud Gulf. Benchmarks recovered at Jenny Lind and water level determined. Ship departs at 2200 hours for Queen Maud Gulf.

September 4, Monday

Winds Southeast 8 knots, seas calm. Launch examining shoals during day. Ship running check lines overnight. Differential corrections spotty due to night effect on signal.

September 5, Tuesday

Winds Northwest 20-25 knots. Ship ties up in Cambridge Bay in morning. Differential site in Cambridge Bay dismantled and shipped back to Victoria.

September 6, Wednesday

Winds Northwest 10 knots. Ship in Cambridge Bay all day. Departure at 1800 delayed until noon tomorrow waiting for replacement seaman.

September 7, Thursday

Winds Northwest 12 knots, light chop. Ship departs Cambridge Bay at noon, steams toward Dolphin and Union stopping hourly for bottom sample to calibrate RoxAnn.

September 8, Friday

Winds East 30, seas heavy. Ship arrives Austin Bay at noon. Shore party sets out VHF differential station at Lady Franklin Point.

September 9, Saturday

Winds East 30, seas heavy. Ship at anchour in Lambert Channel conducting current survey. Ship moves to Bernard Harbour in late afternoon.

September 10, Sunday

Winds East 35, seas heavy. Ship at anchour awaiting break in weather. Ship departs in PM for Coppermine for medical attention to member of engineering staff.

September 11, Monday

Winds East 30, seas heavy. Ship at Coppermine in AM. Departs for Bernard Harbour in PM.

September 12, Tuesday

Winds East 15, seas moderate. Recover low power tide gauge. Deploy submerged gauge in AM. Current meter and differential station recovered in PM. Ship departs for Tuktoyuktuk.

September 13, Wednesday

Winds light, seas flat. Ship enroute to Tuktoyuktuk. Survey equipment packed for shipping.

September 14, Thursday

Winds light, seas flat. Ship arrives Tuktoyuktuk in morning. Hydrographers and equipment ashore. Ship departs to refuel Arctic Ivik. All staff overnight in Inuvik.

September 15, Friday

Staff departs for Victoria at noon for evening arrival. **END OF SEASON.**

SURVEY AREAS

The priorities for the Arctic Survey this summer were to complete the connecting portion of the corridor between Queen Maud Gulf and Dease Strait, and to examine shoal depths in Victoria Strait as indicated by the 1995 spring TIBS survey.

Queen Maud Gulf (68-20N, 102-00W) is the connecting body of water between Dease Strait and Victoria Strait. In 1993, the surrounding areas of Jenny Lind Island (including Icebreaker Channel) were surveyed. In 1994, a ten kilometre corridor towards Dease Strait was extended, leaving a gap of approximately 80 kilometres of unsurveyed waters.

Victoria Strait (69-30N, 100-00W) separates Victoria Island from King William Island, and leads northward from Queen Maud Gulf to Larsen Sound. A corridor survey was completed in 1994 by C.H.S. Pacific Region. In the spring of 1995 the corridor was expanded with additional spot and TIBS soundings. Approximately two hundred shoals were identified for shoal examinations.

PREPARATIONS

The survey launch Bright was fully outfitted and serviced at the Institute of Ocean Sciences. It was shipped to Hay River in mid June.

An advance party of Alan Thomson and Doug Popejoy drove to Hay River in mid June taking all the necessary electronics and hardware to outfit the Canadian Coast Guard Ship Nahidik. The ship departed for Cambridge Bay on June 11.

On July 25, Alan Thomson and Knut Lyngberg flew to Cambridge Bay in advance of the ship's arrival. A differential GPS shore station was installed and positioned at the Ministry of Transport transmitter site.

OPERATIONS

The Nahidik arrived in Cambridge Bay on July 31. All remaining hydrographic staff arrived on the afternoon of August 2. The next two days were used to ready the ship for survey operations.

The Nahidik departed Cambridge Bay on August 5, and commenced sounding operations in Queen Maud Gulf. The original plan was to run north-south lines starting from last years work progressing easterly along the corridor. Inclement weather forced an immediate change. Twenty knot winds from the west and a one metre sea made it impossible for the DSF 6000 sounder to produce a usable sounding trace, regardless of ship's speed. The line pattern was altered to long east-west lines, affording a smoother ride and a usable sounding trace.

On August 12, the launch Bright was deployed for the first time, commencing data collection. With the ship sounding twenty-four hours a day, and the launch sounding ten hours, quick progress was made in extending the corridor.

The differential station worked well in broadcasting corrections in this period. It soon became obvious that corrections for satellites with an elevation of less than twenty degrees were not being broadcast. This problem caused two one hour periods each day when an insufficient number of satellites were available for accurate positioning. On August 16, the choke collar was removed from the differential antenna. Immediately the low level satellite problem was remedied.

Shortly after sounding was resumed in Queen Maud Gulf, the Cambridge Bay differential station began suffering outages lasting from a few minutes to over an hour. On the nineteenth, the ship returned to Cambridge Bay to find the differential station unable to broadcast at the proper signal strength. The radio transmitter was recovered for repairs, and a VHF differential site was placed on Trapp Point to finish the last portion of the survey. On August 23, the Queen Maud survey was complete, except for a few check lines on the eastern end. The Cambridge Bay differential station was put back on the air that evening, with a highly increased signal strength.

On August 24, the ship departed Cambridge Bay for Victoria Strait. While enroute, it stopped every five miles during daylight hours to collect bottom samples for calibrating the RoxAnn bottom classification system. The main component of all bottom samples was mud. The ship arrived in Victoria Strait on August 25. After a proper tuning of the ships differential receiving antenna, the ship was now receiving the Cambridge Bay differential corrections from over one hundred miles away. The ship commenced running sounding lines overnight. The Cambridge Bay differential site which was working well during daylight hours, was having trouble with fading signals after dusk.

The differential signal was steady the next morning, but high winds and heavy seas made it impractical to deploy the survey launch. The weather maps were indicating inclement weather for the next several days, so the ship moved south looking for more protected waters. Over the next week, it attempted running track lines south of Jenny Lind Island, expanding the Franklin 1993 survey. With extremely poor weather conditions and a flat bottom river ship, sounding was next to impossible and extremely uncomfortable.

On September 3, the ship returned to Queen Maud Gulf to complete all exams and check lines.

The ship returned to Cambridge Bay on September 5, to dismantle the differential station and to take on water and food supplies. After departing Cambridge Bay on the sixth, the ship collected trackline and RoxAnn Bottom classification data enroute to Dolphin and Union Strait.

For the next three days the ship collected current information. On the afternoon of September 12, the ship started heading for Tuktoyuktuk. While on route, the hydrographic sounding equipment was packed and readied for shipping. The ship arrived in Tuktoyuktuk on September 14, and all hydrographic staff departed with equipment.

ELECTRONIC EQUIPMENT

The electronic equipment for the most part functioned well. As usual, Institute Electronics had everything well prepared. Any problems in the field were quickly identified and repaired by electronic technologist Alan Thomson.

DIFFERENTIAL CORRECTIONS

The differential station at Cambridge Bay using the Harris Radio and broadcasting corrections every five seconds, has had a few teething problems. The original Harris radio failed to broadcast at high power and was replaced by a spare unit. The advantages of having this medium frequency differential station, broadcast over a hundred mile range, outweighed the problems. This survey had no helicopter support to deploy differential stations over the wide area of coverage required.

The problem acquiring satellites with an elevation of under twenty degrees was resolved by simply removing the choke collar from the antenna.

SOUNDERS

The Raytheon DSF 6000 sounders have worked well. The ship has problems with air under the hull which would render any sounder useless. The sounder has very little difficulty when the sea is directly on the bow or following on the stern. When a sea of over half a metre is hitting the ship on either forward quarter, the ship has to reduce to about five knots in order to achieve a usable sounding trace. With careful planning this shortcoming of the ship was overcome, and sizable amounts of data were collected.

ISAH

The ISAH units have worked extremely well. The 1995 version of software has only one known bug. Attempts by ISAH to correct the Magnavox time latency of approximately one second, failed. The timing was close, but the software failed to correct decimal parts of seconds correctly.

COMMUNICATIONS

VHF communication between launch and ship was better than on previous Arctic Surveys. The Geomagnetic activity charts were extremely accurate, with most types of radio communications fading during peak activity. The satellite phone and fax units on the ship were of great benefit in resolving technical problems. The quick response from all office staff to numerous requests was appreciated.

DATA PROCESSING

All data has been effectively processed by Knut Lyngberg at a scale of 1:20,000 regardless of final field sheet scale. The SENSUR program has difficulty disregarding large amounts of usable information due to backward time jumps. By sorting the raw data, this problem was eliminated. When processing track line sounding which can either be differentially corrected or single point, the SENSUR program has a bug causing data gaps.

TIDES AND CURRENTS

The permanent tide gauge at Cambridge Bay has worked well. In early August, current meters were deployed by the Arctic Ivik off Cache Point and Edinburgh Channel. Both of these meters were recovered in September.

WEATHER AND ICE

The weather for the first three weeks in August was excellent, allowing for completion of the Queen Maud Gulf survey. When the ship moved into Victoria Strait at the end of August, the strait was clear of ice. Unfortunately an intense low pressure system produced high winds and heavy seas which greatly affected hydrographic operations for over a week.

TIBS

In Victoria Strait, the instructions were to examine approximately two hundred shoals as indicated by TIBS. Time and weather did not permit these exams. The TIBS soundings on the 1995 field sheets indicate large areas of depths less than 50 metres and numerous shoal areas under 10 metres. The TIBS information was collected at a line spacing of 250 metres and only represent single line profiles. It is the opinion of the HIC that regardless of the number of shoal examinations done in these shallow areas, conventional sounding with a minimum line spacing of 100 metres is still required in order to meet Hydrographic standards.

ARCTIC IVIK

Hydrographer Doug Cartwright, on board the Arctic Ivik, deployed two current meters and positioned 75 aids to navigation. This job would have been impossible from the Nahidik. The co-operation between Ocean Physics and C.H.S. has been greatly appreciated, especially in acquiring current information.

NAHIDIK

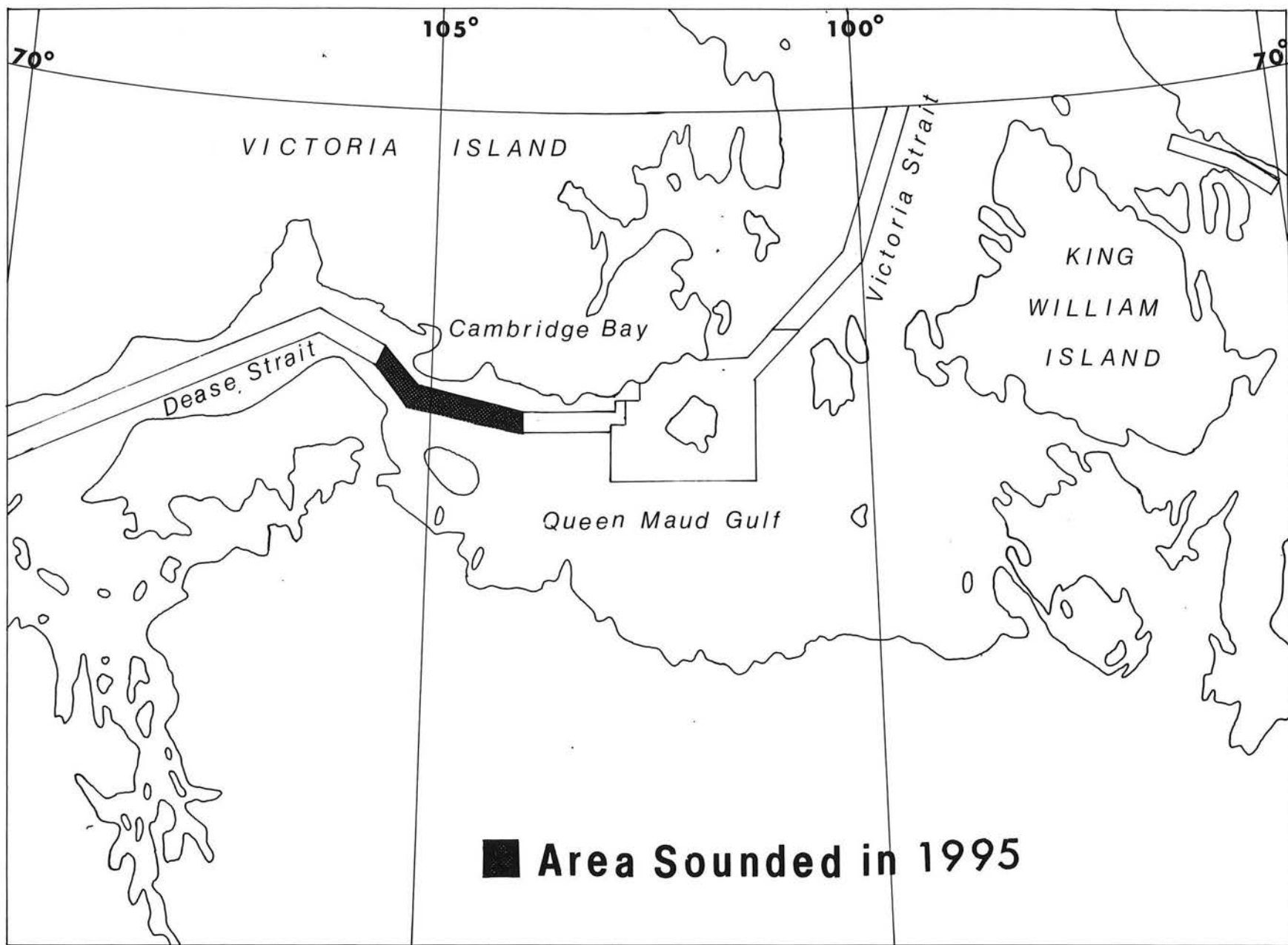
The captain and crew worked hard to ensure that the survey was a success. The ship served well for this survey. There was no problem deploying the launch almost daily. The rope bridle used to lift the launch worked well and eliminated the hazard of a half ton spreader bar swinging out of control in rough conditions. The living and working space on the ship was tight, but both crew and hydrographers were upbeat and enjoyed their Arctic experience.

CONCLUSION

The narrow ship corridor between Coppermine and Victoria Strait is now complete. No shoal soundings were discovered that would impede deep draft vessels from navigating this portion of the Northwest Passage.



Launch Bright at work.



FIELD REPORT STATISTICS:

MONTHLY

FINAL FIELD .X...

YEAR: 1995 FROM JULY 19

TO SEPTEMBER 14

ESTABLISHMENT: CHS

HYDROGRAPHER-IN-CHARGE: A. RAYMOND

Project Name	Project Number	Project Number	Project Number	Project Number	Total
1. Queen Maud Gulf	7783				
2. Other					
3. Arctic Ivik					
4.					
No. of Personnel (person days = PD)					
Hydrographers/(3 persons work 30 days = 3/90)	7/155	7/42	1/60		8/355
Scientists					
Students					
Electronic Technicians	1/30	1/19			1/49
Ships Officers and Crew					
Helicopter Personnel					
No. of Vehicles					
Ships	1	1	1		2
Launches	1	1			1
Land Vehicles					
Aircraft (specify type)					
Hours flown - Transport Canada					
Hours flown - contract					
Work Record					
Total days in field	23	20	60		
Total days actual field work	23	20	60		
Total person days worked (staff)	161	140	60		361
Days lost (weather) ship/launch	3	3	0		6
Days lost, other causes (specify)					
Sounding Kilometres					
Launch	1860	320			2180
Ship	3720	165			3885
GEBCO					
Spot (through ice)					
Total Sounding	5580	485			6065
Reconnaissance (track)		2250	460		2710
Area Sounded (sq. km.)	960	40			1000
Shoals Examined by:					
Ship	8				8
Launch	23	22			45
Other (specify)	31	22			53
Total Examination					
Navigational Aids Positioned					
Fixed Aids (including ranges)			75		75
Floating Aids	10				10
Conspicuous Objects					

Project Name	Project Number	Project Number	Project Number	Project Number	Total
1 Queen Maud Gulf	7783				
2 Other					
3 Arctic Ivik					
4					
Control Stations					
New stations built					
Stations recovered and rebuilt	3				3
Tower stations built					
Total stations built					
No. of stations occupied	3				3
No. of stations permanently marked					
Measured, km -- distances					
- Elevations					
- Heights					
- Clearances					
Tide and Current Data					
Tide gauges established/recovered (e.g.2/1)	1	2	1		4
Tide staffs established					
Bench marks established					
Old bench marks checked out	3	14	3		20
Current meters stationed/recovered(e.g.5/4)		1/1	2/1		3/2
Oceanography/Geoscience					
No. of Oceanographic Stations			127		127
Gravity Profile-Surveyed (km)					
Gravity Profile-Track (km)					
Seismic Profile-Surveyed (km)					
Side Scan Profile-Surveyed (km)					
No. Gravity Stations					
Magnetic Profile-Surveyed (km)					
Magnetic Profile-Track (km)					
No. of Water Samples					
Bottom Samples, Numbers of:					
Grab - cores e.g. 10-2					
Armed Lead					
Samples retained					
Miscellaneous Items					
Wharves Surveyed					
Shorelining (km)					
Rocks and other obstructions fixed			8		8
No. of Electronic Positioning Sites (Hi-fix Six Argo, etc.)	2	2			4
No. Calibrations - Positioning Systems	3	2			5
Low Water line (km)					

Note: Items that are not applicable indicate with a N/A.

Field Report Arctic Hydrographic Survey from 1995 July 26 to Sept. 15

Canadian Hydrographic Service, Client Liaison & Support Alan Thomson
Electronics Technologist

General

New on this survey was the use of a Medium Frequency (MF) radio link. Differential corrections were sent from the Cambridge Bay reference station to the CCGS Nahidik at ranges of 45 to 250 km.

Most of the installation on the Nahidik of equipment and cables was done when Doug Popejoy and I drove the equipment up to Hay River N.W.T. in mid June. This made the Nahidik ready to survey when we joined her at Cambridge Bay upon installation of the reference station.

Electronics work was done in cabin 1-2-3-4, on the counter top Doug Popejoy constructed on the lower bunk. This cabin was shared with Processor, Knut Lyngberg with his computer equipment on his lower bunk also on a counter top and desk extension constructed by Doug. Knut and I slept on the upper bunks above our work areas. This was efficient use of cabin space and worked well. Bulky spares and boxes were stored 2 decks down in the main hold. Some spares were stored in the HIC's cabin, passenger 5-6.

All data acquisition equipment was installed in the wheelhouse on the starboard side.

Thank-you to Charlie Warburton for repairing and loaning us 2 sets of Harris equipment, and thank-you to Larry Dorosh for getting the Harris interfacing and Paccomm TNC working together.

Positioning

1) Differential corrections sent from our Cambridge Bay reference station were omitting satellites with elevations less than 17 to 23 degrees above the horizon. Frequently only 4-5 satellites contributed to the position from the Magnavox MX4200D but 7-11 satellites from the Novatel 3151R reference station. To correct this we removed the choke ring and shortened the coax line from 100 to 50 feet. These installation changes to the Novatel 501 GPS antenna increased the number of differential corrections so that there was almost always a correction for each of the MX4200D satellites used by the Nahidik and the Bright. The suspect choke ring and two 50 foot cables are identified for testing at IOS.

2) One Novatel 501 GPS antenna was not "seeing" satellites in two sectors of azimuth at least 90 degrees wide. This antenna was replaced by a used loan-out 501 and the defective antenna returned to Novatel.

MF Differential Link

Location: Cambridge Bay Transport Canada transmitter site antenna masts and building.

Outdoor: A 24 m vertical wire antenna was supported with Spectron 12-plate rope over a 300 foot span between two 25 m high masts. A Harris RF281 antenna coupler

and porcelain strain insulator were bolted to wooden shipping boxes filled with rocks. Under this were 80 ground radials, each 15 m in length. The length of RG213 feedline and ATU control cable needed is 76 m.

Indoor: An access key was signed out from the site manager. A steel 2 m high rack was bolted to the floor beside the 245 kHz beacon TX rack. A cable trough in the floor with sliding cover plates leads cables to this rack. At the bottom was the 120 vac outlet box from C.B. 25, triplite isobar 4, 12vdc power supply, two 20 Ah batteries for backup. First shelf supported Harris RF236 power supply and RF230M transceiver, external fan kit modified to be always on, Bird wattmeter. Second shelf supported Novatel 5131R GPS receiver, Paccomm TNC-320 modem. A portable bench was moved to the east side of this rack to operate the notebook computer for GPS configuring, and initialization.

Harris RF-230M sn 511 transmitter failed with its output power dropping from 90 to 6 Watts upon PTT, dropping to less than 1.0 Watt after 2 seconds. RF-230M sn 3199 was prepared (tune power adjusted for 40 Watts to override signal on our antenna from nearby T.C. and CCG transmitters, PA filter #1 relay K3 replaced, mounting ears, fan hardware). RF230M sn 511 needs more repairs before returning to R.S.D.

Frequency of MF radio link.

Initial operation was on our Industry Canada frequency assignment of 1707.0 kHz. This frequency, and almost all 3 kHz slots between 1675. and 1723. kHz were in use by other commercial data or radio positioning systems. After many hours of listening to the radio positioning band with the JRC NRD-92 and recording signal strengths throughout the day and night, 3 frequency slots were open. Another constraint on frequency selection is staying away from Transport Canada's ICAO transmitter IF frequency of 1750 kHz. I chose 1725 kHz as the best compromise, and it served us much better than 1707. kHz and Transport Canada reported no problems. An application should be made to Industry Canada to add 1725. kHz (or replace 1707 with 1725 kHz if only one frequency is possible).

Nahidik MF receiving antenna tests.

The receiving MF data link antennae were compared using the following methods.

- a) The JRC NRD-92 receiver's signal strength meter is useful for relative signal strengths.
- b) HPC age of differential corrections and results are:
 - 0-29 seconds = differentially corrected position.
 - 30-99 seconds = single point mode.
 - >100 seconds = differential link inactive.
- c) Paccomm TNC-320 modem DCD threshold and LED bargraph provide relative signal strengths.
- d) speaker or headphones and listening to signal tone quality and noise level.

MF data link antennae listed in order of performance.

- 1) Valcom NDB antenna mounted on starboard funnel fed the Harris ATU RF-281. RG-213 feedline ran between the starboard funnel and Reaction Instruments multicoupler. Manually tuning for best signal to noise on the NRD-92 worked best. Tuning became necessary during a rising geomagnetic activity at a range of 120 km, with about 40% land path 60% arctic ocean.
- 2) Valcom antenna, 4 to 1 transformer borrowed from T.C., RG-213 Feedline and Reaction Instruments Multicoupler. This worked for the first 22 days of the survey and up to 120 km with geomagnetic field strengths up to 150 nT.
- 3) Taiyo MF/HF RDF loop antenna, This has the lowest noise of all and third highest signal strength at 250 km at Gjoa Haven, but was needed for the Nahidik's RDF.
- 4) The long wire antenna runs from starboard forward pipe up to the main mast port winglet and then back down to a pipe on the port funnel pipe. RG58 feedline ran to the Reaction Instruments multicoupler. Signal strengths were about 3-6 dB below the Valcom, but worked well during Harris ATU tuning.
- 5) The Sony AN-1 active antenna was mounted 4 m above the wheelhouse forward railing, where it was only shielded by the main mast 6 m aft. The indoor box that contains the amplifier was modified by TD Communications. Two internal switches were not moveable and the original Sony case, with switch labels, not supplied. This antenna should be used only as a last resort as signal strength was about 10 dB lower than any of the above antennae. Perhaps it is defective.

MF radio datalink recommendations... a smarter system would help.

- a) Apply for permission to modulate the Transport Canada Nautel radio beacon on 245 kHz just like the CCG marine radio beacons. Perhaps this could extend the beacons useful life. At Gjoa Haven the signal strength of this beacon averaged 15 dB stronger than our transmitter. The audio quality suffered much less degrading by in-band fading, due to propagation and geomagnetic disturbances than our data link audio during simultaneous monitoring.
- b) Aboard Nahidik, running HPC, we observed that the age of corrections via the MF radio link increases rapidly as the number on satellites increases. Since there is no error correction, if only one bit out of a possible 640 bytes is bad, all of the RTCM message is rejected at the ship end.
- c) Single point mode navigation (age of corrections >30 seconds) occurred frequently due to noise at a 4 to 6 Hz rate superimposed on a stronger 0.25 to 2.0 Hz noise cycle. The Paccomm modem would decode correctly for periods of 0.5 to 1.0 seconds followed by garbage for 0.5 to 1.0 seconds. The average signal strength was often more the needed during these conditions.
- d) During difficult radio conditions the message length needs to adapt to the fading period and noise repetition rate.

- e) An error correcting two-way HF link would have problems with: 1) unequal transmitting antenna efficiency and other unequal factors controlling range. 2) RFI with ship's communications. Instead we could provide propagation information to the reference station in an open loop manner.
- f) Radio and data link observations on this survey indicate propagation could be predicted at the reference station. We could use a monitor receiver and A to D to generate a signal to noise number (combining geomagnetic activity and other RFI). Then pass this number to a routine in the HPC computer. The length of the RTCM message could be adapted to suit the observed period of fading and noise.
- g) To keep the RTCM message short, send differential corrections for only those satellites used on the ship and launch. Selection of satellites with best geometry rather than highest elevation produced better results.
- h) An example of a shorter RTCM message would be corrections for only one satellite, followed by the corrections for the next satellite 0.5 seconds later.

Underwater

1) DSF6000 EMI interfered with the ships MF / HF radios and the data link radio equipment. Strong harmonics were detected from below 50 kHz to above 10 MHz using the JRC NRD-92. Filter components borrowed from the prototype Analytic power supply, aluminum foil shielding and grounding the case reduced the RFI by only 6 dB. At least 2 should have their RFI reduced before operating near MF / HF equipment.

2) **Velocimeters:** Odom Digibar velocimeter sn 187 can display 20 m/s errors, for example, on a 30 meter cast (3 measurements every 5 m), speeds of 1438 m/s had 2 speeds of 1458 m/s. The Applied Microsystems SVP-16, cast beside the digibar, showed 1439 m/s at these depths. The water temperature was -1 °C. Keeping the Digibar cooler in box out on deck at +3°C reduced the frequency of these errors.

3) Air bubbles under the **Nahidik** reduced our sounding speed in seas greater than 0.5 meter. The top flange of the transducer well is above the water line so we took it apart at Cambridge Bay. The transducer face was approx. 8 mm above the hull. To reduce air bubble collection in this recess, spacer washers were added to drop the transducer face to approx. 4 mm below the hull where the transducer face could flush clean. A marginal improvement was observed, but sea conditions greater than 0.5 m still reduced sounding speed on the Nahidik.

Digital

1) One ISAH power supply with 120 vac input, caused the video monitors to display horizontal shaded bars to rise continuously. This ISAH was connected to 24vdc for many days. Another EHVQ supply was sent up in case it died.

2) Supporting the time recovery pulse from the MX4200D into the ISAH trigger input requires enabling the interrupts that were disabled once they were found to hang ISAH. We had sufficient documentation to enable QTC SX8 boards but more information was needed for the DY-4 serial boards. We should test the interrupt enabled boards to check for unwanted noise triggers prior to next field season.

Communications

- 1) Icom IC-M5 VHF handheld radios using Renewal Alkaline batteries performed better than nicads, even at low temperature +2 °C.
- 2) Inmarsat standard M voice and FAX worked 4 out of 5 times between ship and shore but we were not successful between Nahidik and Arctic Ivik. The first three digits 011 for shore to ship and 001 would not work. Near Cambridge Bay both 872 Pacific Ocean Region and 874 Atlantic Ocean Region West worked, with 874 having less echo.
- 3) The JRC NRD-92 signal strength meter was not working properly by September 12 (near geomagnetic peak) and needs repair.

Tides and Currents

1) The **Bendix Q-9** current meter needed repair. Only one of the eight magnets on the savonius rotor produced a signal. The clearance between the rotor and magnetic pickup changed by 4-5 mm due to the top bearing centering and a small warp in the bottom face of the rotor. The set screws in the top bearing were removed as they had cracked the bearing holder. Plastic was inserted until 1 mm of end-play remained. This position it closer to the center of the rotor. Sometimes the magnetic pickup would stay closed circuit (300 to 40k ohms) due to dirty contacts. A de-magnetizing coil was made with 30 m of 16g wire and connected to 26 vac at 20 Amps. Now 5 of the magnets were detected and a more consistent 220 ohms measured. Shaving rubber off the face of the magnetic pick-up, inserting a shiming washer under the magnetic pickup was filed until the rotor just cleared. Now all eight of the magnets were detected, although one is only detected over a very small angle. The top bearing, magnetic pickup and / or magnets do need replacing to be reliable.

2) The **General Oceanics** current meters needed repair. One had its propeller shaft bent so that it would not rotate. The other was bent enough to need straightening and adjusting the prop along the flat spot on the shaft to increase clearance with the case. The results are inconsistent due to friction from the mechanical counters changing from 999 to 000. The lack of a swivel in the signal cable could cause a directional bias once current eddies have rotated this current meter one revolution. We used a syringe to fill with water and displace air. In the arctic at -2°C our wet tools froze to the ship. There was also a risk of freezing the internal water and ice cracking the case. This current meter must be taken inside within a few minutes of recovery. For these reasons I recommend not using these instruments.

3) Denny Sinnott showed me how to operate the level and read a rod and reduce observations for water levels near Coppermine, Gjoa Haven tide gauges. Denny also briefed me on safety surface support for his Coppermine tide gauge 15 m dive at -2 °C.

CCGS Nahidik Equipment operation

- 1) Elac LAZ72 was cleaned and adjusted to 1450 m/s and tracked the bottom better than the Raytheon DSF6000. The main two reasons are its transducer is 2 m closer to the center of the ship, operating frequency is 150 kHz. Depth Digitizer DAZ13 was not working. Fault was a power regulator, replaced with one from our spare DSF6000 spares. Once repaired and adjusted for 1450 m/s to agree with paper echogram.
- 2) Gyro compass repeater at helm repaired (metal across stepper terminals).
- 3) Nautel NDB High VSWR fault. Cleaned sandblasting paint residue off ATU inductors.
- 4) Navlink (ship to helicopter communications) sending emergency messages to helicopter 354. Interconnect cable shield connected to hood.
- 5) Motorola HF transceiver 2-tone autoalarm activating during voice transmissions.
- 6) Ground from transceiver to ship was not in-plane, only ATU to ship ground.
- 7) 3 VHF handhelds and one desk-top charger were repaired.

Remaining at Cambridge Bay T.C. transmitter site:

The power cable from electrical panel, circuit breaker 25 (15 Amp 120 vac) is tagged and BX cable 2/14 grounded. It runs under the floor in the cable trough and under rack space beside the 245 kHz beacon transmitter. It is terminated with a metal box. Both ends are tagged.

The rack is in the south end of the building, felt pen circles are around the holes in the floor to align and secure the rack to the floor.

GPS coax can now be routed out the west wall fan enclosure through a hole in the bottom left corner. This hole was forced larger to clear the TNC connector.

GPS antenna mounting is at the peak of the roof, a location mark is on the roof at the top of the ladder. Access to this ladder is another ladder kept by the fuel tanks at the north end of the building. The GPS antenna and choke rings were braced with two pieces of galvanized angle 0.6 m long. These were mounted at 90 ° to the roof ladder. The braces are stored under the east side of the building.

Remaining on CCGS Nahidik:

- 1 mounting bracket for ISAH helm monitor above wheelhouse center steering console.
- 1 each video coax and 120 vac power cables leading to starboard counter.
- 3 antenna mounting pipes, hose clamped onto railings above wheelhouse.
- 1 PVC cable feed through above starboard counter to pass antenna cables.
- 1 ground braid (20 mm), 4 m long, bolted to a welded frame to ground all equipment.
- 1 RG58 cable running from ISAH rack to HIC's cabin for a remote monitor.
- 1 Serial cable running from processor's cabin to HIC's cabin for a terminal.

- 1 transducer cable terminated with DSF6000 high frequency connector and 200 kHz Airmar transducer. It is in the Nahidik's transducer well located between the water tight door and the engine room workshop bench.
 - 1 RG213 cable running from starboard counter to starboard funnel for using Valcom.
 - 2 Kepco 24 vdc, 5 Amp power supplies with ac plugs and dc receptacles on one, terminal strip and cable on the other are mounted on plywood.
 - 4 blue hardware drawers 1) machine screws 2) sheet metal screws 3) cable clamps and tie-wrap saddles, fuses 1.25 inch, good assortment. 4) electrical power plugs and receptacles, 120 vac, 12 vdc, 24 vdc.
- Fence frame and fencing to enclose the ATU and antenna.
- 2 new VHF marine antennae Shakespeare 5206C.
 - 1 box of cable, unterminated assorted power and coaxial.
 - 1 box of cable, terminated coaxial and serial DB25.
 - 1 pail of Voltesso transducer oil, with about 5 liters remaining.