H10153

NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

DESCRIPTIVE REPORT

Type of Survey Hydrographic

Field No. OP-05-01-84

Registry No. H-10153

LOCALITY

State Minnesota

General Locality Lake Superior

Sublocality Two Harbors

19 84-85

CHIEF OF PARTY
P.H. Kronfield

LIBRARY & ARCHIVES

DATE September 30, 1987

Charts

14960
14961
14966 & Inset
Ref
L-46 (87)
L-883 (87)

NOAA FORM 77-28 (11-72)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HYDROGRAPHIC TITLE SHEET

REGISTER NO.

H-10153

INSTRUCTIONS - The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

FIELD NO.

OP-5-1-84

State MINNESOTA

General locality LAKE SUPERIOR

Locality TWO HARBORS

Scale 1:5000 Date of survey 21 Aug. - 6 Oct. 1984

Instructions dated _____ Project No. Z137-OP-84

Vessel M/V AVON (VESNO 8000) SKIFF (VESNO 8002)

Chief of party P. H. KRONFIELD

Surveyed by R. Zaunere, J. Hudson

Soundings taken by echo sounder, ~~hand lead pole~~ DE719; IT412, Pole Sounding

Graphic record scaled by Gardline Surveys personnel: R. Frost, C. Erni

Graphic record checked by J. Hudson, A. Sibold

Protracted by N/A Automated plot by ~~VOYAGER~~ XYNETICS 1201 Plotter (AMC)

Verification by D.V. Mason

Soundings in ~~fathoms~~ feet at MKW ~~MKLW~~ ~~Great Lakes Datum = 600.0 ft. MSL~~ (IGLD 1955: 600 ft)

REMARKS:

Notes in red were made during office processing.

4-21-97 AWOIS AND SURF CHECK RWD 10/88

NOAA FORM 77-28 SUPERSEDES FORM C&GS-537.

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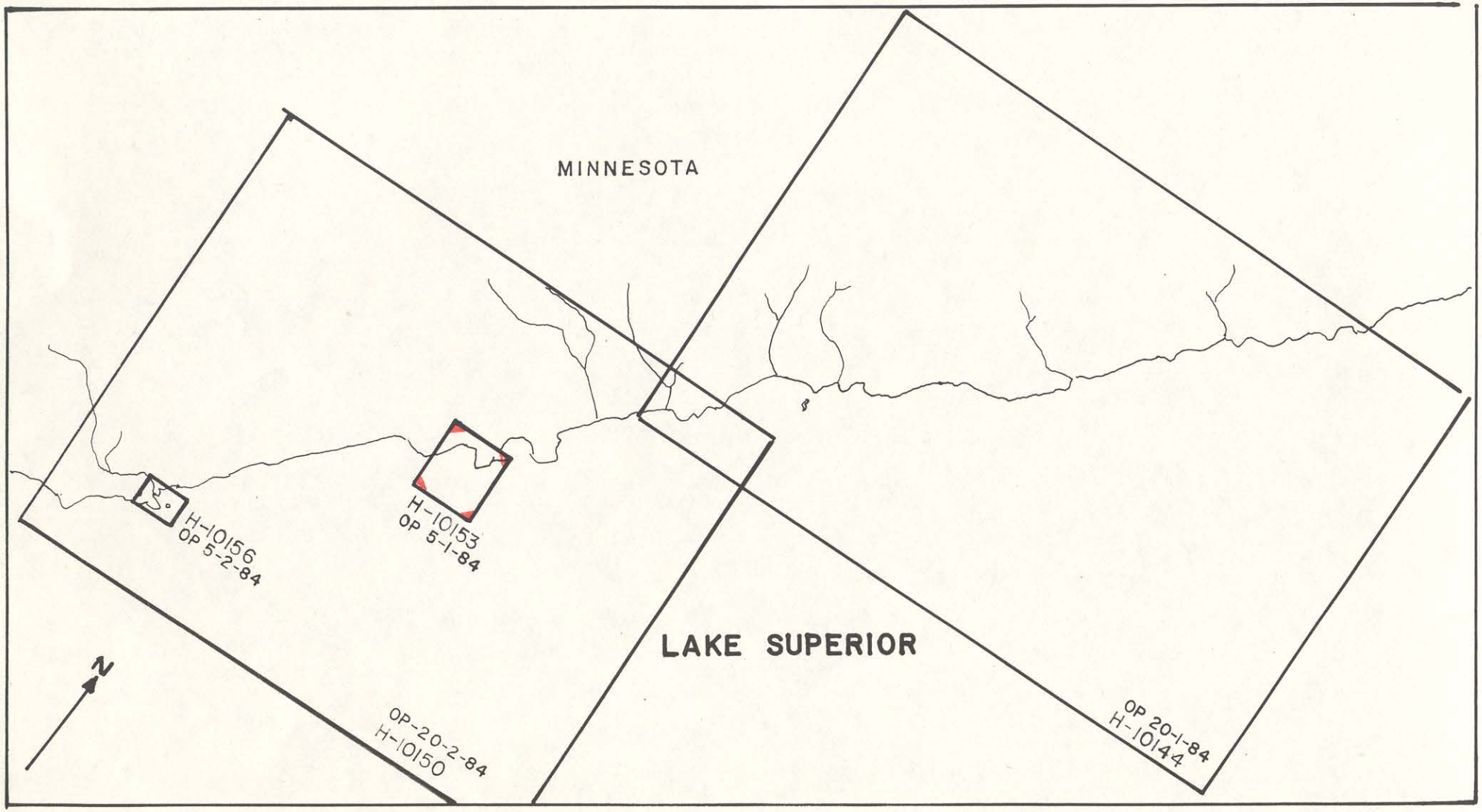
MINNESOTA
H-10156
OP 5-2-84
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LAKE SUPERIOR
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OP 20-1-84
H-10144

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APPENDICES

* Filed with original survey data

DESCRIPTIVE REPORT

to accompany

HYDROGRAPHIC SURVEY H-10153

OP-5-1-84

Surveyed By:	Oceanprobe, Inc.
Subcontractors:	Seaway Engineering, Inc. Gardline Surveys, Inc. Roger Zaunere Kenneth A. MacDonald
Hydrographer:	John Hudson

A. PROJECT

This survey was accomplished under Project instructions OPR-Z-137-OP-84.

The survey was to obtain basic hydrographic data, in order to update the Two Harbors inset (1:10000) on nautical chart 14966.

Oceanprobe, Inc. (Houston), Seaway Engineering, Inc. (Duluth) and personnel from Gardline Surveys, Inc. (Houston) conducted the field work.

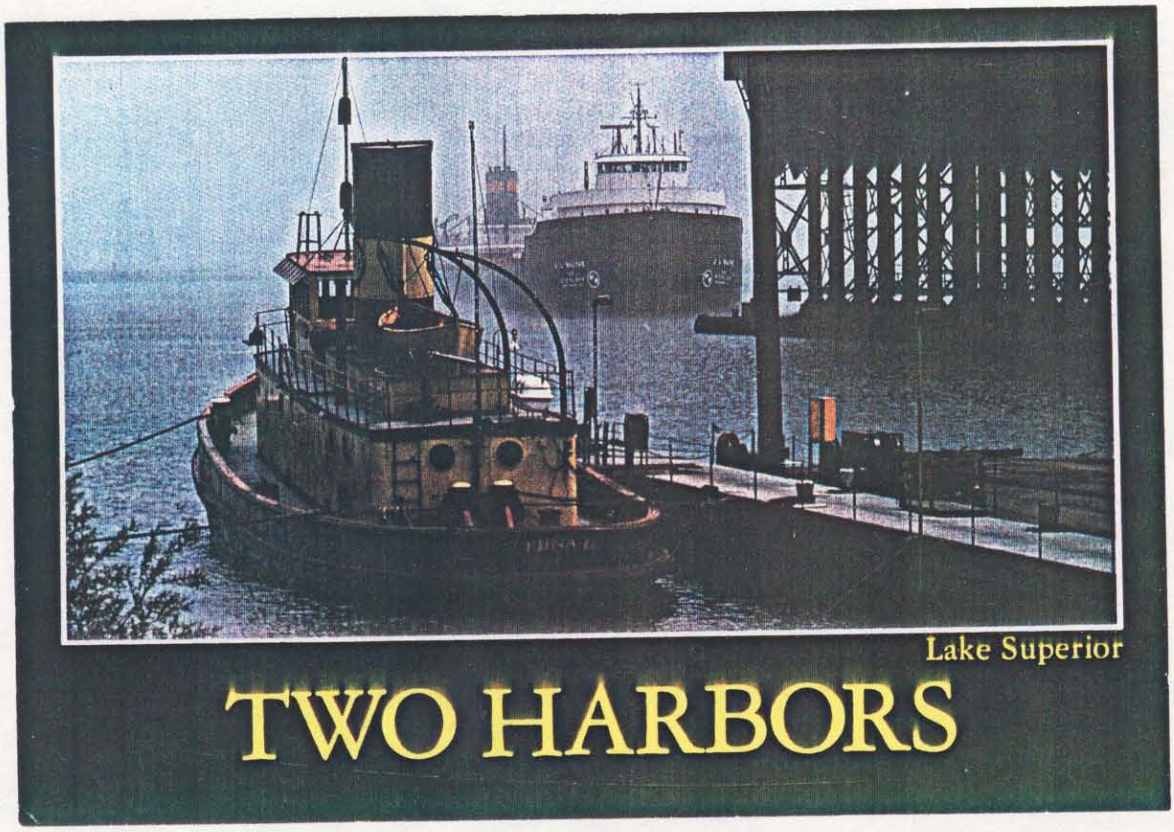
B. AREA SURVEYED

The area surveyed is Two Harbors, Minnesota, on the western shore of Lake Superior, about twenty miles northeast of Duluth. The area surveyed coincides with the inset of Two Harbors and is an area about 7,600 feet in E-W dimension, and 7,000 feet N-S.

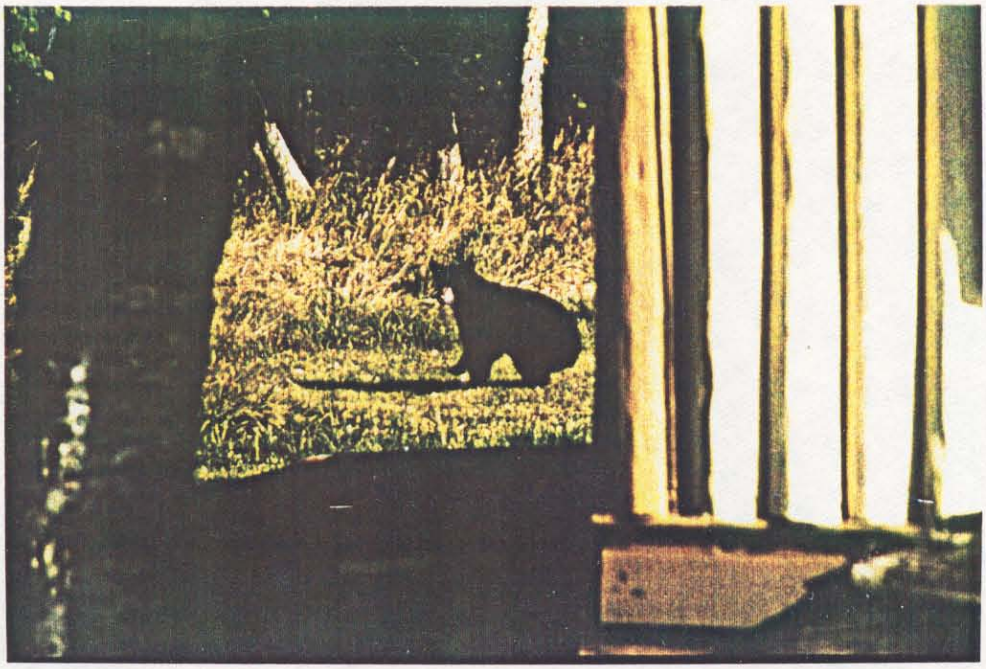
Soundings were obtained both inside and outside the harbor area, which is protected by two concrete breakwaters.

Field work was started on July 10, 22 1984. Soundings and PSR work was accomplished between August 21 and October 1, 1984. The last day to field work was October 7, 1984.

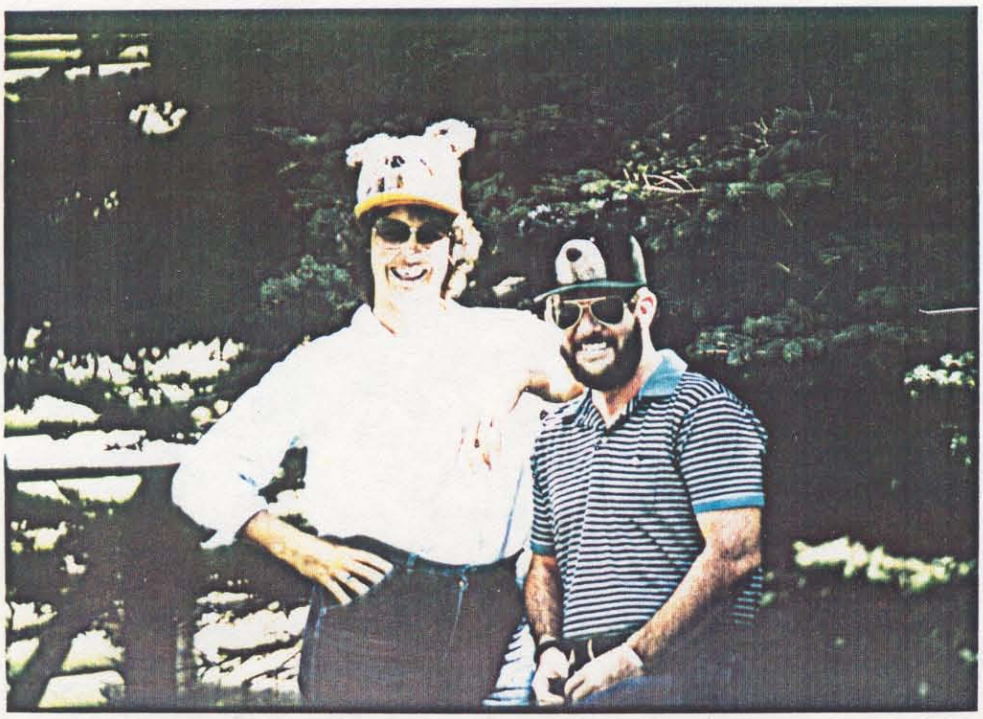
Typical Lake Superior shore in project area



Typical Lake Superior shore in project area



A nightly visitor to the office and berthing cabins,
Castle Danger, Minnesota



The COTR LCDR D. Peterson and ACOTR LT V. Newell,
with their COTR hats

C. SOUNDING VESSEL

All echosoundings and bottom samples on this survey were collected by:

AVON (VESNO 8000) - 26 Ft. Inflatable Launch.

Pole and leadline soundings inside the harbor, to map the topographic detail, were conducted from a small skiff.

SKIFF (VESNO 8002) - Inflatable Zodiac.

C.1. Launch AVON

AVON is a flat-bottom, inflatable rubber launch. It has no keel. It is made of two hull pontoons, separated by a rigid plywood floor and a one-piece wooden transom. The launch was seaworthy. Interior space was tight. It was powered by twin outboard motors. The echosounder transducer was mounted at the transom, between the two outboard motors. The electronic positioning master unit was mounted on a pole directly over the transducer.

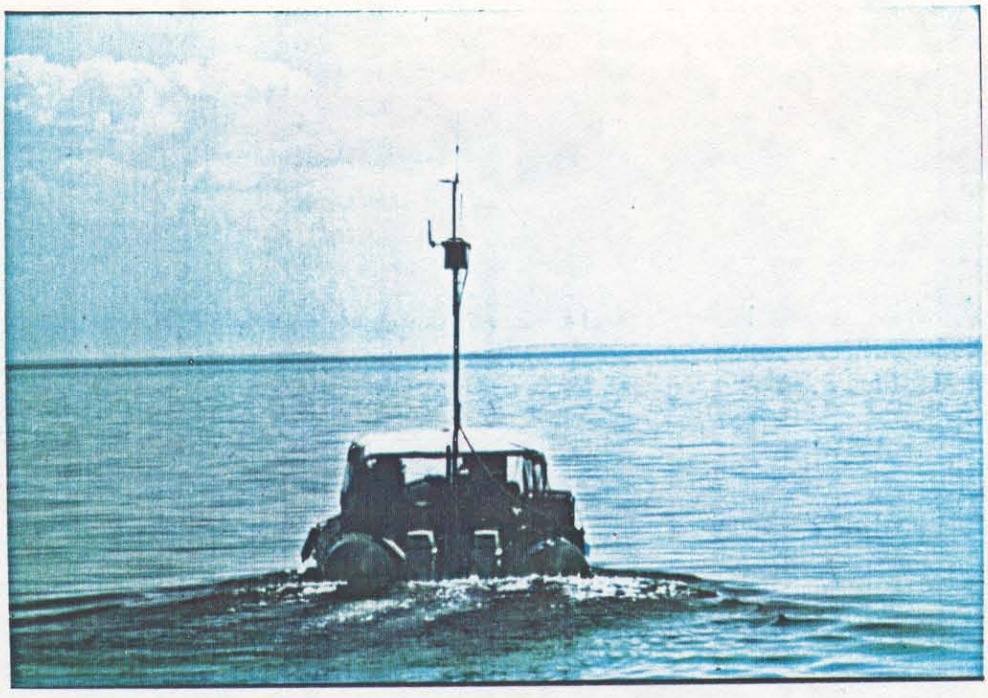
The graphic recorder, data acquisition computer, and positioning receiver were mounted on a wood table along the port pontoon. The track plotter was installed on the forward end of the table, so that the helmsman could view it.

The helmsman's guidance display was installed in front of the helm console, located forward and along the starboard pontoon.

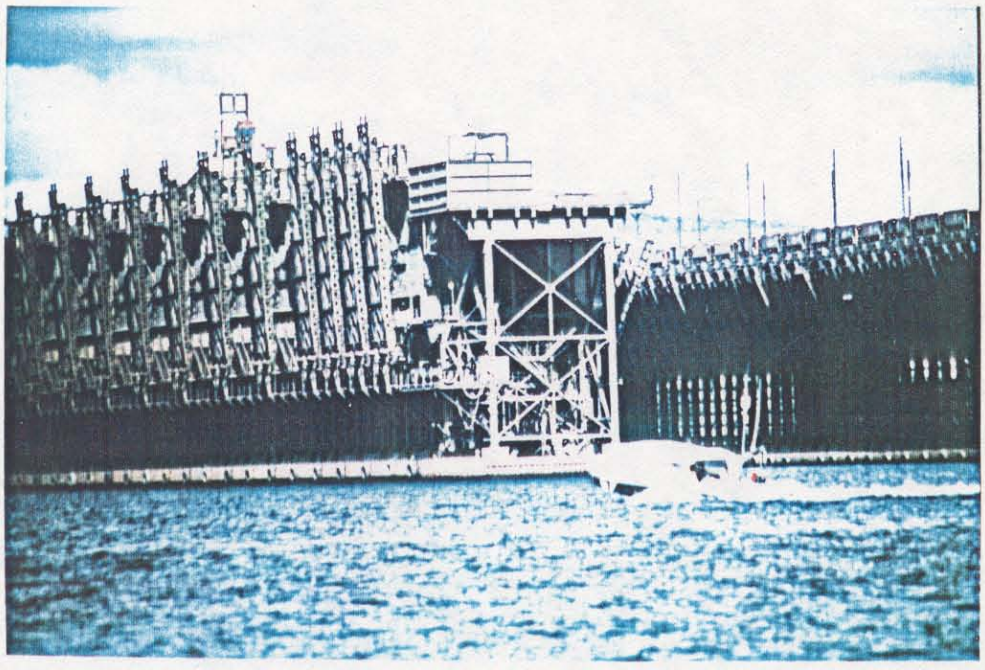
The launch had a canvas and plastic canopy; open at the rear. The front flap could be closed; it was normally open during fair and calm days, and closed on windy and cold days.

The hydrographic team consisted of three persons: 1) the party chief, who controlled the daily survey operations, was a hydrographic surveyor. He also operated the fathometer (graphic recorder); 2) the helmsman steered and handled the radio; 3) the data acquisition system operator was a survey technician, responsible for computer operation, track plot annotation, record-keeping in NOAA 77-44, positioning receiver operation, and radio operation.

A gasoline generator set (Honda model EM1800X - 1.5kw) was mounted on the rear of the starboard pontoon. This generator provided adequate 120 volt AC power to the computer, plotter and printer. A bank of six lead-acid batteries (12 volt DC automobile type) provided DC power to the positioning receiver, fathometer, and radio.



Oceanprobe AVON W-800 26-ft. inflatable workboat
rigged for hydrography



The W-800 launch running past ore loading dock
in Agate Bay, Two Harbors, MN, Sheet H-10153

D. SOUNDING EQUIPMENT

D.0. Equipment - AVON

Vessel: 8000 (M/V AVON)

Raytheon DE719B fathometer was installed aboard this survey launch. This fathometer was used for all AVON echosounding between 27 July through 3 October.

	Model	Unit	S/N
Analog Depths:	Raytheon DE719B	Transceiver/Recorder	4805
Digital Depths:	Innerspace 412	Depth Digitizer	013

D.1. Installation - AVON

A standard 208 kHz transducer was installed, upon the transom of the launch. The transducer was threaded onto a galvanized pipe, with the cable running up the inside of the pipe. The mounting pipe in turn was fitted inside a circular clamp bolted to the transom. A hex bolt served as the set screw to hold the transducer pipe in place, and a ring was welded around the uppre end of the pipe, like a collar, so that the transducer could not slip down if the hex bolt came loose. In other words, the transducer could be lowered and clamped at the same level.

The start/stop signal from the DE719 was hard-wired to a depth digitizer. The digitized depth was then fed to the data acquisition interface of the VOYAGER data acquisition system.

D.2. Operation

Between 2 and 199 feet, the DE719 was generally run on the high resolution scale.

Depth Range	Analog Coding
0 to 55 Feet	Solid transducer line
50 to 105 Feet	—— - - ——
100 to 155 Feet	—— — — — ——
150 to 205 Feet	—— — — — ——

Between 200 and 400 foot depths, the DE719 was shifted to the X2 scale. On occasion, the X2 scale was also used in areas less than 200 foot depth, where the hydrographer was searching for shoaling indications.

The IT412 was operated at a sounding update date of 2 soundings/ second (approx.).

The DE719 and IT412 operated as independent units; that is, the start/stop signals were split. The DE719 fired the transducer and the firing pulse was transmitted to the depth digitizer as the "start" pulse. The returning acoustic pulse burned the graphic record and also was passed to the digitizer as the "stop" pulse. An oscillator circuit timed out the elapsed time and displayed it as a digital value converted to feet.

Consequently, depths scaled from the analog record are subject to errors from:

1. Stylus belt rotation speed (cal zero and cal 50 controls)
2. Initial setting (tide & draft control)

Digital soundings are subject to errors from:

3. Speed of sound oscillator circuit frequency (sound velocity control)
4. Digital draft setting (draft control)

It should be noted that improper adjustment or setup of one instrument does not adversely affect the operation of the other instrument. If the DE719 is incorrectly adjusted, this does not change the reading of the digitial depth; if the depth digitizer is out of adjustment, this will not change the analog depth which is being recorded.

D.3. Other Sounding Equipment - AVON

Echosoundings were supplemented by pole soundings on ~~sunken~~ submerged rocks.

D.4. Static Draft - AVON

The static draft is recorded on the "Direct Comparison Log".

From JD	To JD	Static Draft
209	224	1.3 Feet
233	234	1.0 Feet
235	277	0.9 Feet
278	280	1.5 Feet

The reason the static draft changed, is because on both 17th and 18th of August, the transducer struck ~~sunken~~ submerged rocks while sounding the shoreline and the mounting pipe was broken. In order to avoid further damage the decision was made to lower the transducer only to 0.9 feet, and run the launch at a lower rpm, beginning 22 August. The 1.5 feet static draft on JD278-280 reflects the change in echo-sounder, from DE719 to IT440.

The static draft, as tabulated, was added to the observed analog and digital depths, when completing the direct comparison log. The bar check abstracts therefore include static draft.

D.5. Settlement & Squat - AVON

A settlement & squat test was performed on the M/V AVON on JD207 (25th July), at the breakwater at Two Harbors.

Settlement & squat results were tabulated as correction vs. rpm. In the sounding volume, we recorded the rpm and changes in rpm. so that the dynamic draft could be determined at any time.

We used the method described in the HM 4.9.4.2 (level instrument and rod readings).

D.6. Direct Comparisons

Normal procedure was to obtain two bar checks each sounding day; one in the morning and one after the sounding day ended. On some occasions, only one bar check was obtained; the reasons are noted in the sounding volume.

From 26 July through 2 August, a 9" wide steel bar, 10 feet long, suspended by two steel cables, was used as the reflector. This check bar proved unwieldly and the procedure was time-consuming. On 3 August, we shifted to using a 2 ft diameter aluminum plate, weighted with three lead diver weights. This circular plate was raised and lowered by a single steel cable connected in turn to three short (2 foot length) steel cables from which the plate was suspended.

The bar check lines were marked at 5 foot intervals, to 80 feet.

The procedure used for bar checks:

1. Launch AVON was anchored. The reflector plate was lowered.

2. In the case of the bar, two men were required to lower and raise it. The third man recorded the digital depth. The analog depth was scaled from the record later, at the office.

3. In the case of the circular disk reflector, one man could easily lower and raise the plate. A second man recorded the digital depths; the analog depths were scaled later, at the office.

4. A frequency meter was used to monitor the oscillator frequency of the IT412 depth digitizer. During bar checks, the frequency was kept within ± 20 cycles of 240,000 cycles, by fine-tuning the speed-of-sound potentiometer. (During actual sounding operations, the frequency was maintained within ± 50 cycles.

I have studied the bar check data acquired during hydrography of sheet H-10153 at great length. Up to Julian Day 246 the digital-analog difference remained fairly constant -0.9 foot. On J.D. 247 a slight increase was noted. I have compiled a table showing these inconsistancies during sheet H-10153.

Julian Day 247 exhibited a -0.9 difference in the morning bar check, and a -1.3 reading in the afternoon. Upon close examination of the analog records I have determined high reading is subject to interpretation and could have well been from -1.1 to -1.2 foot. Similarly the -0.9 difference could be interpreted to be -1.0 foot.

A study of J.D. 249 data is similar. the -1.3 foot reading could be averaged down to -1.2. The low difference of -0.7 foot resulting from the 23.55 Z bar check may be a digital instrument reading error in the launch. Surrounding data on the digital graph is consistantly -0.8 foot.

From J.D. 247 - 252, these are the only anomalous readings. On J.D. 254 the draft setting on the Innerspace 412 digitizer was noted set at +0.6 feet. The analog-digital difference resulted in -1.7 foot. Adjusting for the draft setting we have our now-familiar -1.1 A-D reading.

I have averaged data from J.D. 247-254 and determined the mean analog to digital difference as -1.117 during this period.

Analog-Digtal Diff.

J.D.	Reading
246	- 0.8
247	- 1.3
247	- 0.9
248	- 1.1
248	- 1.2
249	- 1.3
249	- 0.7
250	- 1.2
250	- 1.1
251	- 1.1
252	- 1.1
253	- 1.2
253	- 1.2
254	- 1.7
259	- 0.9
270	- 1.1
271	- 1.2
276	- 0.9

At first, I was mystified as to the cause of this apparent drift in the Innerspace digitizer. Oceanprobe management was alarmed there might have been an inexplicable problem with the instrument causing lack of confidence with the hydrographic data to national and international hydrographic specifications.

The Julian Day 254 discovery of an improper setting on the draft adjustment prompted me to look carefully at this occurance and the Innerspace instrument itself. Oceanprobe's very high accuracy Fluke frequency meter hard-wired into the digitizer precluded any affect of drift due to the sound velocity circuits. That instrument was in plain view of the hydrographer in the launch and the Innerspace was constantly and accurately kept at 4800 feet per second.

I physically inspected the Innerspace in our electronics shop on March 24. It was then that I realized what had happened to cause the analog-to-digital differences. The draft setting on the Innerspace model 412 is a knob protruding from the front panel approximately 0.8 inch. It is equipped with a locking device to hold the setting.

Our launch survey team manually set the draft adjustment to zero and locked the knob. The launch vibrations could not move it, but a slight grip could move the knob even when the lock was set.

The Avon launch was open to the rear in the cold Minnesota nights on the water. We found condensation to be a problem in the morning as the day warmed up and as three men worked in the launch. During hydrographic work on sheet H-10144 a large tarp was stretched over the entire launch and a heater was rigged inside the canopy. We were able to do this at Sve's dock. As the hydrography progressed down the Lake Superior shoreline, we did not have the facilities to continue this practice. Instead a plastic cover was rigged over the instrument panel and lashed firmly in place with light line and small diameter bungee cord.

The Innerspace digitizer is equipped with handles on either side of the front panel, and they protrude approximately 2.5 inches. The bungee cord was lashed directly under these handles as they provided a convenient retained position for the lashings.

It is clear to me that the plastic cover was held against the draft setting knob in this fashion. In removing this plastic prior to commencing hydrography mornings, and in covering and lashing the instruments upon completion of hydrography, the draft setting knob was turned slightly.

I submit that the setting was never changed during a day's hydrography. The locking mechanism was always in place. Only prior to a day's hydrography or after completion of work, would this setting be slightly changed. Therefore, there is no danger of an unverifiable drift in digitized readings. Our twice-daily bar check procedures give us an opportunity to verify these analog-digital differences.

Oceanprobe is confident that the instrument error on J.D. 246 was our familiar -Ø.9 foot. From J.D. 247 - 252 we find -1.1 foot as an accurate representation. J.D. 253 appears to be -1.2 foot. J.D. 254 we have a constant instrument error of -1.7. J.D. 25Ø and 259 is -Ø.9. J.D. 27Ø is -1.1. J.D. 271 is -1.2. Finally, J.D. 276 yielded an instrument error of -Ø.9 foot. These differences are entered into our T1 file tape on the master digital record submitted with sheet H-1Ø153.

D.7. Other Instrument Corrections

Digital Draft:

This particular depth digitizer (IT 412 s/n Ø13) indicated a constant +Ø.2 foot draft set into the instrument. Several attempts were made to reduce this value to zero, including changing three circuit boards inside the digitizer. We have determined this draft setting had been inadvertently changed after work days on several occasions. (See Section D.6.)

Careful scrutiny of bar check data yields daily analog-digital instrument error values. These values are averaged and included in the TRA computation for correctors. See D.8 (a) for more detail.

Analog Draft:

In cases where the analog draft (tide/draft control) drifted off zero by more than ±Ø.2 feet, a correction has been applied to any analog depths scaled off and inserted into the magnetic tape file. However, an error here does not affect the digital depth recorded on tape.

Analog Sound Velocity:

If the indicator marks from the stylus do not hit exactly on the Ø- and 5Ø-foot marks, then the stylus belt is rotating too fast or too slowly.

For example, if the marks are too close together (e.g. 49 feet instead of 5Ø feet apart), then the stylus belt is rotating too slowly and all analog depths during this period must be adjusted by 2% (i.e. multiply the scaled depth by 1.Ø2).

D.8. Depth Digitizer

Innerspace Technology Model 412 "Autotrack" s/n 013

This depth digitizer takes the "start" and "stop" signals from the DE719B and converts the elapsed time to depth. Therefore the digitizer operated independently of the DE719 as far as depth measurement goes.

Two controls affect the digital result:

a. DRAFT Control

A potentiometer allows the hydrographer to set a value into the depth display, which corresponds to the static draft. By NOAA practice, this value should be zero. The value can be checked at any time by turning a display switch. To set any desired draft value, the pot is turned until the desired "draft" value is displayed. At this point the pot is normally "locked" so it cannot be turned accidently.

b. SOUND VELOCITY Control

A potentiometer allows the hydrographer to adjust the timing circuit oscillator so that it clocks at a frequency corresponding to a known or measured sound velocity. The potentiometer knob is a ten-turn marked knob.

In order to maintain the oscillator circuit at 240 kHz, (which corresponds to a two-way travel time of 4800 ft/second), a Fluke frequency meter was wired to the oscillator circuit, so that the hydrographer and system operator could visually monitor the oscillator frequency. The frequency was kept within $\pm$ 50 cycles of 240 kHz. Most of the time the frequency was maintained within $\pm$ 20 cycles.

Circuit and outside temperature affected the oscillator frequency; during the first hour of the day, frequency drift of approximately 300 cycles was noted, and this required that the operator monitor the digitizer every few minutes and make a fine-tune adjustment of the oscillator pot.

$50 \div 240{,}000 = 0.02\%$, or 0.04 feet at 200 feet depth.

D.9. Not Applicable

D.10. Not Applicable

D.11. Not Applicable

D.12. Not Applicable

D.13. Instrument Correction

Per HM and AMC OPORDER 84, instrument correction was applied to analog insert soundings and to missed digital depths.

D.14. Velocity of Sound Determinations

Model	Unit	Serial #
Sippican MK9	XSV Probe	840210

A Nansen cast was obtained on 2 August, at the same location as XSV #1. Reversing thermometers recorded insitu temperature, and water samples were analysed for conductivity using a YSI conductivity instrument. Standard Hewlett-Packard programs were run on our HP-41CV converting conductivity to chlorinity and then converting temperature and chlorinity to sound velocity. Data derived using this classical method compared with the XSV results very closely. LCDR D. Peterson and LT V. Newell observed this procedure and verified accuracy.

JD	XSV Probe Nbr.	Lat.	Long.	Posit. Nbr.	Depth
215	XSV 1	47-09-19	91-19-22	5001	984 Ft.
221	XSV 2	47-09-20	91-20-55	5674	984 Ft.
228	XSV 3	47-59-09	91-40-49	6634	262 Ft.

These were the only three velocity casts obtained during the project. COTR LCDR D. Peterson was consulted on numerous occasions throughout the project regarding drops and advised the project management that data gathered was sufficient so long as frequent bar checks were obtained. One XSV drop from the Avon launch was attempted in deep water off Two Harbors on October 8, and the unit did not operate. Two probes were deployed with no data gathered.

See section 4f. of the Evaluation Report

Oceanprobe became aware during a February meeting at Atlantic Marine Center that NOAA field units the previous year in Lake Superior dropped very frequent XBT probes. At no time, from negotiations for the contract, to award, and throughout the field work, did NOAA offer this information to Oceanprobe. Had project management become aware of this fact, Oceanprobe would have acquired XBT probes and deployed them very frequently.

During the survey period, a University of Wisconsin research vessel, L.L. Smith, Jr., conducted temperature profiles in our general area using a YSI Tele-thermometer model 4-3 TD serial #22167. Temperature profile data is enclosed herewith to further substantiate our velocity correctors.

All three XSV casts indicated a very stable water column below 200 feet with no noticeable variation in sound velocity - a constant 1,424 m/sec. The apparent depth of thermocline where sound velocities began to stabilize was 40 feet.

Subcontractor Gardline Surveys hydrographer inexplicably chose to use the shallowest XSV drop for velocity data for the entire project. AMC verifiers returned data to Oceanprobe in February, 1985, for further work. AMC found that a potential serious general deficiency existed because of insufficient numbers of XSV probe drops. Moreover, Gardline Surveys grouped daily bar check data in an improper fashion, and generated an insufficient number of velocity tables. Furthermore, Gardline Surveys hydrographers selected the 80-foot depth to measure analog-digital error from the bar check data - standard NOAA procedure is approximately 20-foot depths.

When data was returned to Oceanprobe in a flawed and incomplete state, Gardline Surveys was terminated as subcontractor for their poor workmanship and negligence. Oceanprobe solely reworked, corrected, and verified the data.

The velocity curve of August 8 was selected for velocity correction tables to be applied to all MYSIS hydrography and for deep correctors applied to shallow water hydrography. Paul Kronfield analyzed each day's bar checks and individually graphed them. After careful comparison, bar check derived correctors were mated to the August 8 velocity correction curve at the 40-foot level. Bar checks were typically taken to 80-foot depths, but appeared to be most accurate commencing at 40 feet and shallower. XSV data indicated a zero sound velocity correction from 40 to 55 feet throughout the survey.

This sheet required the launch to survey in three potentially differing water masses: the protected waters inside Two Harbors' Agate Bay, another protected area inside Burlington Bay, and the exposed Lake waters outside of the Two Harbors breakwater. Some of the surveying was done in two of these locales in one work day.

Most impact is due to warming of shallow waters, particularly in Agate Bay. Our August 8, 1984 XSV cast is applicable to water depths greater than 40 feet, however, as that thermocline affects all of Burlington Bay and even Agate Bay behind the breakwaters. The main channel depth entering Agate Bay is well over 40 feet and the cold Lake Superior waters exist inside Agate Bay in depths exceeding 40 feet.

Numerous velocity tables are necessary for this sheet because of the three different areas surveyed, and the late-summer warming of the lake surface waters. Therefore, fifteen velocity corrector tables were compiled based upon this study.

Table 1 utilized data from a September 2, 1984 (JD 246) bar check conducted at 01.50 hrs. UCT, outside of the Two Harbors breakwater. This table corrects that day's hydrography, all accomplished outside the breakwater.

Two barchecks were conducted the next day, JD 247. One was outside the harbor and the other was inside of Agate Bay behind the breakwater. Table 2, compiled from barcheck data inside Agate bay corrects hydrography of JD 247 from 16.02 - 22.20 hrs. UCT inside Agate Bay. The launch then surveyed outside the breakwater from 22.28 - 22.33 hrs. Velocity table 3, constructed from bar check data gathered outside of Agate Bay, corrects this work.

A barcheck was taken on JD 248, but the data quality was poor. It was decided not to use this bar check for velocity correctors. Since hydrography between 16.10 and 16.51 hrs. UCT was conducted inside of Two Harbors' Agate Bay, Table 2 was used for velocity correctors as the bar check from the previous day would still be valid inside the harbor.

Also on JD 248, a bar check was successfully conducted outside of Agate Bay at 23.55 hrs. Velocity table 4, compiled with this data, corrects hydrography accomplished outside of Agate Bay from 17.44 hrs. to completion of that day's work at 23.49 hrs. UCT.

On JD 249, one coastline run was accomplished along the breakwaters of Agate Bay and in the very shallow waters near it. Although these waters were outside the sheltered harbor, we felt there could be some affect on shallow water velocities, and a bar check conducted here indicated this might, in fact, be true. Therefore, velocity table 6 was compiled based on bar check data conducted at 23.55 hrs. UCT just outside the breakwater. This table corrects the coastline and shallow water hydrography conducted from 20.23 hrs. to 20.33 hrs. The rest of the day was spent in the exposed waters and velocity table 5 corrects this work. This table was constructed from barcheck data gathered in the exposed lake waters at 15.13 hrs. Sept. 5, 1984 (JD 249).

JD 250 work was divided between Burlington Bay work and Agate Bay work. Most definitely shallow water velocities differed in these two areas. Velocity table 7, compiled from a Burlington Bay bar check at 14.58 hrs., corrects this area's hydrography (17.05 - 20.32 hrs. UCT). The bar check was initially misgraphed due to an arithmetic error on the abstract. This mistake was caught and corrected in time, however.

Velocity table 8 corrects the Agate Bay hydrography on JD 250 between 22.44 and 23.57 hrs. UCT. Table 8 is the result of a bar check at 23.55 hrs. inside Agate Bay.

Table 9 is the result of smoothed bar check data gathered on JD 251. Analog records indicate a problem with bar check accuracy after the 35-foot level. Bar check data at 40 feet was ignored here and data from 0 - 35 feet is felt to be accurate. This table corrects the hydrography accomplished on JD 251 inside Agate Bay.

Burlington Bay is the site of hydrography accomplished on JD 252 (September 8, 1984). A bar check at 15.50 hrs. in 60 feet of water corrects this data through velocity table 10.

Two bar checks were taken inside Burlington Bay on JD 253; one at 02.03 and the other at 16.35 hrs. Data from these two bar checks were meaned and used to compute velocity table 11, correcting that day's hydrography.

The launch again worked Burlington Bay on JD 254 and JD 258. A successful bar check at 14.50 hrs. JD 254 was the basis for velocity table 12. JD 258 barcheck was unsuccessful due to adverse weather. It was felt that the relatively sheltered waters of Burlington Bay would remain stable enough for both days for the application of one velocity table based on JD 254 data. This was done.

Moreover, 14 minutes of hydrography was accomplished in Burlington Bay on JD 259. Velocity table 12 also is applied to this work from 00.04 - 00.18 hrs. UCT. The launch then worked inside of Two Harbors. A barcheck conducted at 01.42 hrs. JD 259 inside of Agate Bay revealed a nearly constant 0 sound velocity corrector. This data was used in constructing velocity table 13 that was applied to the hydrography inside of Agate Bay.

Another indication of the sheltered aspects of Burlington Bay was demonstrated by the bar check of JD 271, September 27, 1984. This 15.30 Z bar check revealed a zero velocity corrector all the way to thermocline. Table 14 is a result of this data, and corrects hydrography conducted in Burlington Bay from 16.41 to 21.20 hrs. UCT.

The final hydrography conducted inside of sheet H-10153 was on JD 275 (October 1, 1984) from 22.51 - 23.13 hrs. UCT. A bar check was conducted 45 minutes later at 00.04 hrs. UCT on October 2. This bar check was not exactly in the survey area, as the launch was traversing across several sheets filling in areas needing additional soundings. Velocity table 15 was compiled and used for this work. We are confident with its useage as the shoalest sounding of this day for sheet H-10153 was 19 feet. Most soundings this day were 40-80 feet with a few in the 30's. The barcheck data compares favorably with that from sheet H-10156, and we are confident in its accuracy. It is felt that all soundings in depths surveyed JD 275 in sheet H-10153 are accurately corrected by this table.

D.15. Corrections to Echo Soundings

AMC OPORDER 84, plus HM 4.9.1, 4.9.4, and 4.9.5 were used as guidelines in developing and abstracting the various correctors.

Workpapers prepared by the ex-supervising hydrographer are included in the supplemental data folder labelled "Echosounding Corrections".

E. HYDROGRAPHIC SHEETS (FIELD)

Track plot sheets and preliminary field sheets were plotted in the field, by the VOYAGER Data Acquisition/Plotting System. These working sheets were plotted on paper. Working charts were plotted at same scale used for the field sheet.

VOYAGER calculates and plots data in plane coordinates, either Lambert or Transverse Mercator. Gardline Surveys chose to use the Minnestoa State Plane Coordinates (Lambert Projection), to make working charts for this project. All X, Y coordinates shown on Gardline's printouts and working charts are Minnesota North Zone.

The field sheet was plotted on the same Minnesota North Zone projection. The geographical graticle was super-imposed upon this field sheet, for registration of junction hydrography and shoreline manuscripts.

The field sheet was plotted by a HP Model 7585B Plotter, driven by VOYAGER offline program CHART. This program plots soundings, DP's, and other positions by X, Y coordinate. The field sheet was prepared at Gardline's Houston office.

Hydrographic records, supporting data, and work papers were forwarded to NOAA Atlantic Marine Center for processing.

Field sheet OP-5-2-85 was plotted at scale 1:2500, because 1) the sounding was accomplished at this scale; 2) because of the density of shoreline detail and sounding detail; and 3) because the topographic map and chart 14966 overlay were already prepared at this scale.

E. HYDROGRAPHIC SHEETS (FIELD)

Track plot sheets and preliminary field sheets were plotted in the field, by the VOYAGER Data Acquisition/Plotting System. These working sheets were plotted on paper. Working charts were plotted at same scale used for the field sheet.

VOYAGER calculates and plots data in plane coordinates, either Lambert or Transverse Mercator. The Minnesota State Plane Coordinates (Lambert Projection) was selected to make working charts for this project. All X, Y coordinates shown on printouts and working charts are Minnesota North Zone.

The field sheet was plotted on the same Minnesota North Zone projection. The geographical graticle was super-imposed upon this field sheet for registration of junction hydrography and shoreline manuscripts.

The field sheet was plotted by a HP Model 7585B Plotter, driven by Voyager offline program CHART. This program plots soundings, DP's, and other positions by X, Y coordinate. The field sheet was prepared at Gardline's Houston office. Gardline surveys denied entry to Oceanprobe management throughout the data processing. Oceanprobe management never saw the product until a February, 1985, meeting at the Atlantic Marine Center in Norfolk.

Hydrographic records, supporting data, and work papers were forwarded 2 weeks late to NOAA Atlantic Marine Center for processing.

AVON mainscheme hydrography, shoreline and electric control stations are plotted on the field sheet.

F. CONTROL STATIONS *See section 2 of the Evaluation Report.*

Most hydrographic control stations were established specifically for this project by a traverse which was run along the coast by Seaway Engineering Company of Duluth. The traverse was closed and adjusted between existing NGS stations (JERN, SPLIT, SPLIT ROCK, LIND BACHMAN and PION). Based upon field review of data, this traverse meets third-order, class 1 standards. Gardline Surveys lost all original traverse data and records. Seaway Engineering Company sent copies to the Atlantic Marine Center for processing.

The newly established hydrographic control stations were generally sited upon salient ledges or coastal features. These stations were marked by NOS disks.

In Two Harbors, a private engineering company (IF&A) established some horizontal control. The common stations were TH102 and TH100. The IF&A coordinates, noted as "second-order", differed slightly from the coordinates developed (for TH100 nd TH 102) by Seaway during their traverse between FLOOD and STONY POINT.

Number	Station	Source	X-Correction to IF&A	Y-Correction to IF&A
045	TH100	Seaway Traverse	-.87'	+.77'
110	TH102	Seaway Traverse	-.83'	+.72'
309	TH101	n/a	-.85'	+.74'
310	AGATE BAY	n/a	-.85'	+.74'

The coordinates on the Signal List for TH101 and AGATE BAY are therefore based upon the adjustment of the IFA coordinates to fit them into the Seaway traverse.

Please refer to project report on traverse.

G. HYDROGRAPHIC POSITIONING CONTROL See Section 2.4. of the Evaluation Report.

The launch AVON was positioned and controlled by the range-angle method. Ranges were supplied by a Motorola Falcon 484. Angles were produced by Target Digital Transit. The digital transit was set up over the control stations, and the ranging unit was set alongside, as close as was feasible.

During the survey an occasional incorrect angle was received from the digital transit. The error occurred in the whole degrees; tenths and hundredths of degrees were not affected. For example, the whole degree was received as "7" instead of "5", "77" instead of "55", or "177" instead of "155". These obviously incorrect angles have been corrected on the Master Hydrographic Data File. The original raw data is available on the online printout.

The soundings and topographic detail collected by the skiff were positioned by using a Leitz DSM3E Total Station.

The only known problem which may have degraded hydrographic positioning control is a slight range walk-out. This does not affect the plotted accuracy of soundings.

Further details are in the Project Report: Electronic Position-Fixing, a copy of which can be found in Appendix E.

H. SHORELINE See section 2.6. of the Evaluation Report.

Shoreline was transferred from TP-00082, a class III map. The shoreline was verified and is accurate.

I. CROSSLINES See Section 3.a. of the Evaluation Report.

11.5% crosslines were run.

Agreement was excellent, within one foot in most cases.

J. JUNCTIONS See section 5. of the Evaluation Report.

This survey joins H-10150 (1:20000) (1984) on the east, west and south.

Mainscheme lines on H-10150 run through the southern half of H-10153. A direct comparison of depth curves was not made, however.

K. COMPARISON WITH PRIOR SURVEYS See section 6. of the Evaluation Report.

The following surveys were provided for comparison

LS-254	1:16000	1941
LS-1754	1:15000	1938
LS-1765	1:5000	1941
LS-2049	1:5000	1954

K.1 LS-2049

This survey has topographic detail and ten spot soundings along the tug wharf. This survey is superseded for topographic detail by TP-00082. The ten soundings are illegible on the print, and no comparison was made. The "10 spot soundings" are dolphins. There are no soundings on this prior survey.

K.2 LS-1765

This survey appears to be based upon leadline soundings, obtained at discrete locations. Outside the harbor, no offlying shoals or other significant features are shown, except those features already on chart 14966. In general, the 1941 soundings outside the harbor are the same or deeper, than the 1984 soundings. No systematic pattern of difference was found; but it is hard to see how positioning control could account for the differences in depths. The 1984 survey should supersede this 1941 survey.

Inside the harbor, the soundings and depth curves agree well, considering the dredging and construction that has occurred. Again, the 1984 survey supersedes the 1941 survey.

K.3 LS-1754

No comparison was made to this survey.

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 02391

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: 1963 Revisory Survey

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
234	Diver investigation
235 / 62-70	Shoreline verification
248	Diver search of position
251 / 1136-1137	1 / 22

See also PSR 03057 Report.

Geographic position:

	Latitude	Longitude	Method
Charted:	47/00/41.5	91/40/43.2	
Observed:	47/00/42.895	91/40/40.955	LD *5.0

* ~~scaled from field sheet~~

Method of Investigation:

Identified by local diver Clarin as wreck of ELY.

Buoy positioned by EDM total station. Diver executed circular search on position finding no obstruction on submerged pile. Shallowest portion of shipwreck were bits on port beam. Least depth measured by Helicoid series 1000 precision depth transducer of ~~7.2~~ 5 feet. See photograph with diver report.

All effort was put into investigating the sunken wreck of Schooner ELY located about 160 feet to the NE. On JD 235, the shoreline in this vicinity was walked/swum by Chief of Party, Kronfield, and no submerged pilings were found. See sections 7.A.4) and 5) of the Evaluation Report for discussion and charting recommendations of the wreck "ELY".

Charting Recommendation:

Delete pilings from chart. LD on sunken wreck was 5 ft feet. ~~Do not~~ Concur. See Section 7.a.2) of the Evaluation Report.

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 03057 (Obstruction)

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: Unknown

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
234	Visual search and dive
235 / 69	Position of marker
247 / 90-98	1 / 6
248	Precision least depth measurement and diver search
251 / 1135-1137	1 / 22

Geographic position:

	Latitude	Longitude	Method
Charted:	47/00/41.5	91/40/40.5	
Observed:	47/00/42.8 95	91/40/40.9 55	LD * 5.0

* ~~sealed from field sheet~~

Method of Investigation:

Visible search on August 21. No piling was seen in this vicinity. Investigation by careful visual search from skiff. JD251/pos. 1136 falls right on PSR location. Echo depth 17 feet. No evidence on fathogram. JD247/pos. 90-98: no evidence of submerged piling on fathogram.

See diver report of ELY investigation. No echosounder search was done, at the charted location. No visible piling is here.

As with AWOIS Nbr. Ø2391, a buoy was dropped on reported location, positioned by EDM total Station. Divers Clarin and Party Chief, Kronfield, executed a circular search, encountering no pile or obstruction. Some wreckage, presumably of the ELY, was located on the bottom, but presented no hazard to shipping. Diver report states that the visible pile is part of submerged wreck of schooner ELY.

Charting Recommendation: See section 7.A.3) of the Evaluation Report.

Delete visible pile. Add sunken wreck symbol with stern at position of pile. (Pos. 88 bow, pos. 89 stern). The LD on the wreck at bow was 5 7 feet. ~~Do not concur. Position 89 (stern) is approximately 25 meters NE of the charted visible pile.~~ 50 W

Additional wreckage of the ELY exists approx 50m NW of the stern in lat 47-00-43.72W, long 91-40-43.56W and uncovers 2Ft.

Diver Report See sections 7.A.4) and 5) of the Evaluation Report.

The three divers proceeded in the zodiac to the West breakwater for investigation of Pre-Survey Review items. Kronfield showed the positions of these items to Mr. Clarin who immediately replied that they could be nothing else but the wreck of the schooner Ely. The PSR items are described as submerged piles.

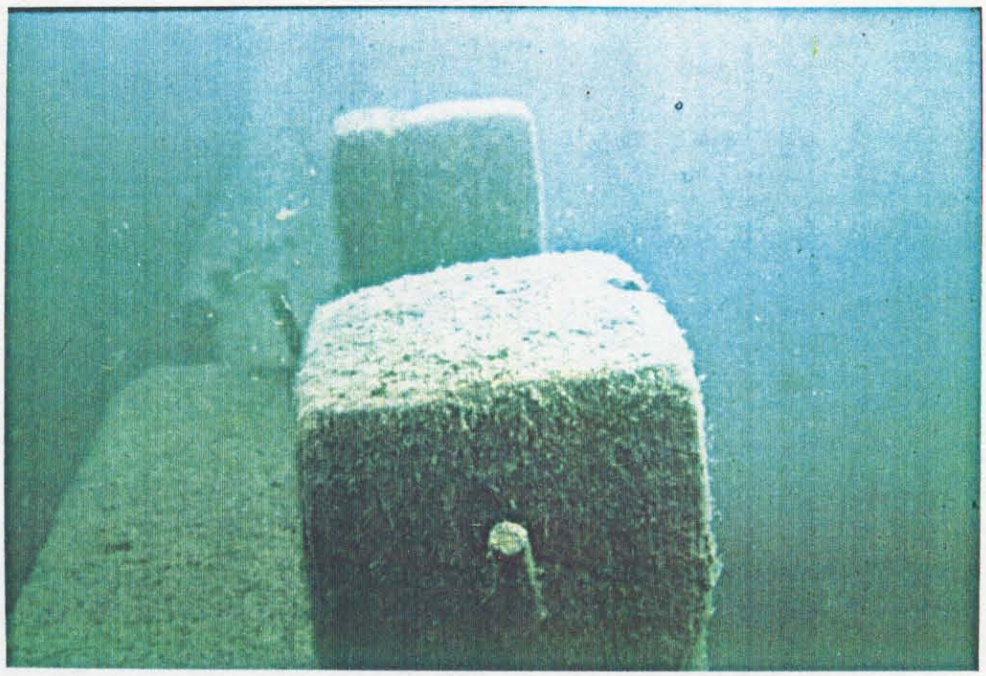
Clarin described how the schooner Ely, under tow, broke loose in a storm, lunged broadside over a rubble breakwater, now the West breakwater of Agate Bay, and immediately sank. The three-masted schooner was in excess of 200 feet long. Seas during the gale were as high as 20 feet. The three men aboard the schooner climbed the masts and waited over three hours for rescue by the then-new harbor tug, "Edna G".

Diving commenced at 15.30 hours. Kronfield, Zaunere and Clarin slipped off the West breakwater and immediately encountered the hull of the schooner Ely. Visibility was poor, 3 feet. The wreck was immediately impressive - fresh water did not seem to have severely damaged the wood in the ship's 100-year submergence.

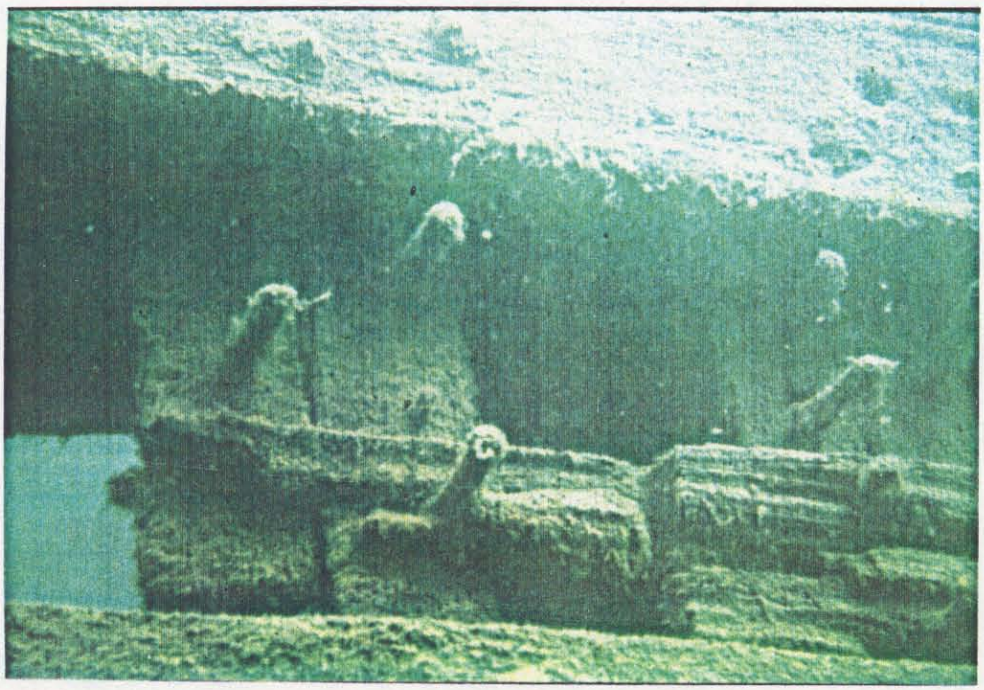
Zaunere tied off a buoy to the wreck stern. The divers proceeded to the bow. Part of the swim was in the hold of the vessel, completely enclosed by the decking above. Zaunere tied off a buoy to the bow section of the wreck near the center line. Kronfield located the shallowest portion of Ely. This consisted of large twin bits on the port bow of the wreck. From the surface on a day of fair visibility, these bits would certainly appear as submerged piles. Least depth was measured by Kronfield's depth guage at the top of the bits was 10 feet. The wreck would certainly offer a hazard to any vessel anchoring nearby.

Note: Bow was PSR #2391, stern of Ely is #3057. Do not concur
Total dive final = 45 mins.

Next day (258), Clarin and Kronfield dove again on the Ely. The Oceanprobe Helicoid series 1000 precision depth transducer measured least depth on the wreck bits as ~~7.2~~ 7.5 feet, at LWD.



PSR item AWOIS ~~#02391~~ AND #03057 wreck of Schooner ELY
Sheet H-10153, LD ~~7.2~~ 5.0 feet



Hull of Schooner ELY

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 03059 (Obstruction)

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: BP 105637 Photo Revision

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
236 / 147, 148	Diver investigation 147, 148
247 / 128-139, 154-155	1
248	Diver investigation and LD measurement

Geographic position:

	Latitude	Longitude	Method
Charted:	47/00/58.2	91/40/10.0	
Observed:	See shoreline verification data		

Method of Investigation:

Survey launch with echosounder. Positioning control by range-angle method LD of 5 feet.

Diving Report:

Buoy tied on two outer corners of the submerged ~~dock~~ pier. Kronfield and Clarin dove on the ruins of the old merchant ~~dock~~ pier - Presurvey Review Item #3059 - and marked the two outboard corners of the ~~dock~~ pier with buoys. Numerous submerged piles were noted on the ~~dock~~ pier ruins, one higher than the rest. Chief of Party, Kronfield, dove on least depth sites with precision depth transducer, JD 248, ~~4.8~~ 5 feet.

The average depth of the ruins is 10 feet. The buoys were located using the sounding pole and mirrors. Both features (outboard corners of submerged ~~dock~~ pier) were sounded using the sounding pole.

Charting Recommendation: See section 7.A.10) of the Evaluation Report.

Show submerged ~~dock~~ pier ruins on new chart edition. Concur

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 03060 and 03061 (29 ft. soundings)

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: C/E

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
250 / 1103-1106	1 / 20
251 / 1154-1179	1 / 22, 23
258 / 1730-1740	1 / 34

Geographic position:

	* Latitude	Longitude	Method
3060 Charted:	47/00/52.2	91/40/07.3	
3061 Charted:	47/00/50.7	91/40/07.5	range-angle

* NAD 1902

Method of Investigation:

Both these PSR items were investigated together, with a survey launch and echosounder. The nominal line spacing (150 feet) was split twice. Ten lines spaced 35 feet apart were run across the PSR locations.

Range-angle positioning method was used to control and fix the survey launch.

Position Numbers	LD (Corrected)*	
1168 + 4.5	30.4'	30
1175	29.9'	29
1139 + 3.5	30.3'	29
1730 + 5	30.4'	30

* LD = sounding corrected for draft (+0.9'), water level (-1.2'), and instrument error adjust. (-1.1' JD 251; and -0.9' JD 259).

Charting Recommendation: (AWOIS ITEM 3061)

Chart as sounded. Concur. ^Echosounder least depth of 29 feet was found in the same area. Supersede with present survey soundings.

AWOIS ITEM 3060 - 29 FT DEPTH FROM COE DWG, JUNE 1972, NOT ADEQUATELY DEVELOPED, RETAIN AS CHARTED.

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 03062 (Obstruction)

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: 1963 Revisory Survey

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
235 / 112-118	Diver investigation (shoreline)
247 / 132-134, 147-149	1 / 7
248 / 191-193	1 / 10
248	Diver investigation and least depth
251 / 1213	1 / 23
251	Diver investigation

Geographic position:

	Latitude	Longitude	Method
Charted:	47/00/58.4	91/40/00.6	
Observed:	47/00/57.7	91/40/00.6	range-angle

Method of Investigation:

No exposed structure seen during visual inspection of shoreline by diver on JD 235.

Two sounding lines, 75 feet apart, were run in the vicinity. Nothing showed on fathogram (JD 247).

On JD 248, one buoy was dropped on position. Chief of Party, Kronfield and technician, Zaunere, swam a 150-foot circle search. Three remains of ships were found with timbers rising from harbor bottom. Lines were tied off on wreck high points and buoys were placed, marking least depth features of both wrecks. Least depth was measured by Helicoid pressure transducer as 5.2 feet.

This feature was a portion of PSR #3063. A line of three parallel shipwrecks were sunk with stones to serve as a crib foundation for piers.

Charting Recommendation: See section 7.A.12) of the Evaluation Report.

~~Chart crib ruins in observed location, least depth 5.2 feet.~~

per telcon with R. Whitfield 8/19/88
RWD

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 03063 (Obstruction)

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: LS 1765 (1941)

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
235	Diver investigation of shoreline
247 / 147-149, 132-133	1 / 7
251 / 1212	Diver circular search

Geographic position:

	Latitude	Longitude	Method
Charted:	47/00/57.0	91/40/00.0	
Observed:	47/00/57.~~4~~ 3	91/~~40/00.0~~ 39/59.9	range - angle

Method of Investigation:

One marker buoy set on ruins of old pier.

Survey launch with echosounder, crossed the area marked by diver's buoy. 150-foot radius diving search conducted by Kronfield and Zaunere. Diver investigation of AWOIS Nbr. 03062 revealed these are both part of the same series of old shipwreck/cribs. The observed positions are accurate.

Position Numbers	LD (Corrected)
192 + 2	~~7~~ 9
1212	~~6~~ 3
1213	~~5~~ 3

Diver Report:

Diver Kronfield walked/swam the shoreline, JD 235, in this vicinity, but encountered nothing.

See Diver Report, AWOIS number 03062.

Charting Recommendation: See section 6. e. of the Evaluation Report.

~~Chart crib ruins in observed location, least depth 5.2 feet.~~

per telcon with R. Whitfield 8/19/88 RWD

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 03064 (Obstruction)

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: 1972 Revisory Survey

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
234	Diver investigation
252 / 1292	1 / 26

Geographic position:

	Latitude	Longitude	Method
Charted:	47/01/07.2	91/39/30.4	range - angle
observed	47/01/07.11	91/39/31.28	

Method of Investigation:

Divers tied marker buoy onto PWI crib. Positively identified by divers. Sounding launch maneuvered around buoy and determined LD by echosounder. Launch positioned and controlled by range-angle method.

The diver reported that water depth at top of crib was 19' in general depths of 25', according to diver's depth gage. (19' - 1'-18' reduced depth.)

Position Number	LD (Corrected)*
1292	17 ~~18~~

* LD = sounding corrected for draft (+0.9'), water level (-1.2') and instrument error (-1.1')

Height of crib top off seabed from echosounder is 7 feet.

Charting Recommendation: See section 7.A.2.b) of the Evaluation Report.

Chart PWI crib in observed location: LD ~~18~~ 17 feet.

PSR REPORT

Project: OPR-Z137-OP-84 Survey: H-10153

AWOIS Nbr: 03058

Chart Nbr: 14966 (19th edition/Jan 83)

Source: BP105673 Photo Revision

Investigated on:

JD/Position Nbrs Sndg Vol/Page

277 KAM Red Notebook p.30

Geographic Position:	Latitude	Longitude	Method
Charted:	47/01/01.6	91/40/22.5	
Observed:			

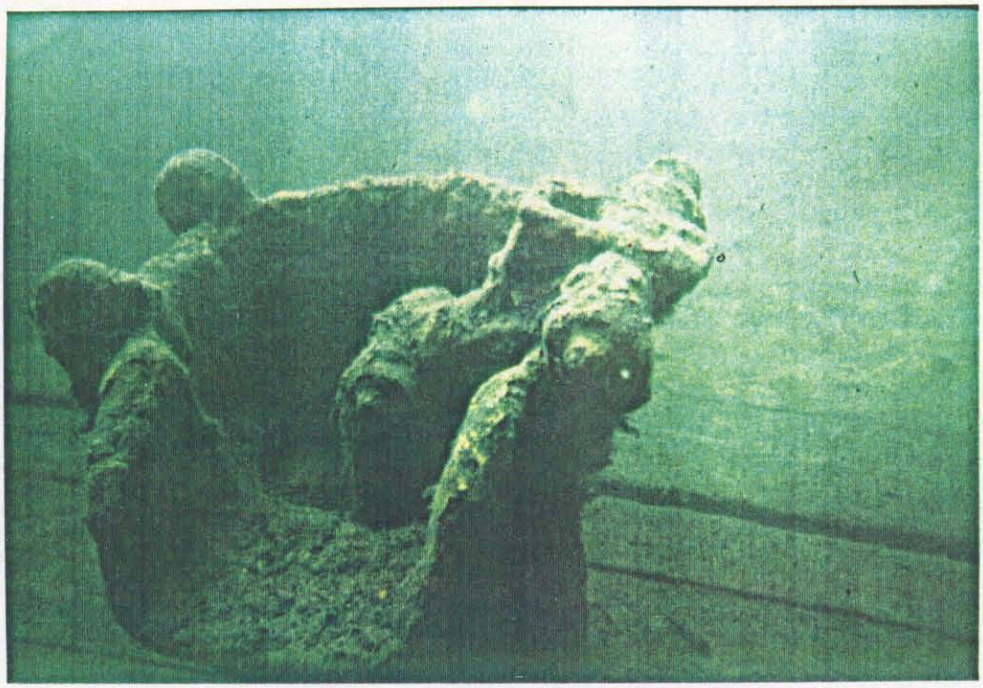
Method of Investigation:

Divers and shoreline inspectors could find no evidence of ths wreck in August and September 1984. On 3 October 1984, Mr. Marty Hoganson (of the Two Harbors Port Manager's office) provided the following information, to Ken MacDonald (CAPT-NOAA-ret.).

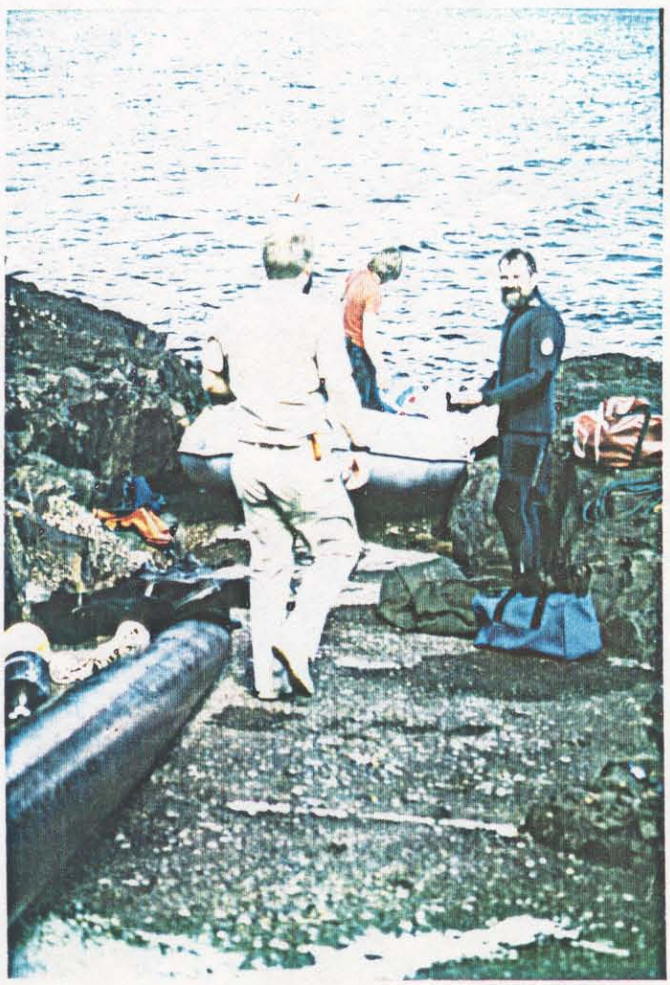
In 1978, an old wooden barge was beached in this position, at the north side of the small pier, directly north of ore dock #1, and astern of where the steam tug "EDNA G" is now berthed as a museum. This barge was used as a platform to work on the hull of the EDNA G. But it was old and rotting, and about 1980 it was lifted out by crane and junked.

Charting Recommendation:

Do not show wreck on new chart edition. Concur. See also section 7.A.7) of the Evaluation Report.



Deck pump main deck, wreck of Schooner ELY AWOIS# 3057



Preparing to dive on PSR AWOIS No. 3068. Dan Clarin in zodiac, Roger Zaunere suited up. COTR LCDR D. Peterson is dive master. Fresh water intake pipe visible in foreground.

Photographs by Chief of Party, Paul Kronfield

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: 03065 (Obstruction)

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: 1966 Revisory Survey

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
234	Diver investigation
252 / 1291-1304	1 / 26-27

Geographic position:

	Latitude	Longitude	Method
Charted:	47/01/02.7	91/39/28.3	
Observed:	47/01/04.1	91/39/27.2	range - angle

Method of Investigation:

Diver investigated and identified obstruction as PWI crib. Top of crib reported at 15 feet above seabed depths of 45 feet, by diver's depth gage. Diver ~~corrected~~ Placed a marker buoy.

Survey launch maneuvered around the marker buoy and determined LD by echosounder. Launch was controlled by range-angle positioning.

Position Number	LD (Corrected)*
1291	43.3

Launch also crossed the pipeline. See Pos. 1298-1304 for pipeline locations by echosounder.

Position Number
1298 + 3.5
1300 + 1
1301 + 3.5
1303 + 0.5
1304

* LD = sounding corrected for draft, tide, instrument (net -1.4').

Charting Recommendation:

Chart PWI crib in observed location with LD ~~13~~ 12 feet. Concur. See also Section 7.A.2.1) of the Evaluation Report.

PSR REPORT

Project: OPR-Z137-OP-84

Survey: H-10153

AWOIS Nbr.: None

Chart Nbr.: 14966 (19th Edition/January 1983)

Source: N/A

Investigated on:

JD/Position Nbrs.	Sndg Vol/Page
247 / 42-182 (various)	1

Geographic position:

	Latitude	Longitude	Method
3060 Charted:	n/a	n/a	
3061 Charted:	47/00/45.~~0~~ 32	91/40/~~10.0~~ 09.37	~~Scaled from chart~~

Method of Investigation:

The ruins of the old east breakwater (from LS 1765) were found. Survey lines at 75 feet spacing were run across this feature. Shoal depths of ~~31~~ 30 feet to 33 feet in surrounding depths of 41 feet to 56 feet.

Position Numbers	LD (Corrected)
42 + 5.5	32.7'
111 + 0.5	33.7'
114 + 1.75	31.7'
124 + 3.5	33.7'

Survey launch with echosounder. Positioning range-angle method.

* LD = sounding corrected for tide (-1.2'), draft (+0.9'), instrument error (-0.9'): net -1.2'.

Diver Report:

Chief of Party, Kronfield, investigated this item by diving and reported a crib of wooden beams filled with rocks. A bollard was attached to the western end, indicating these ruins of original eastern breakwater.

Charting Recommendation: See section 6.F. of the Evaluation Report.
Show obstr (breakwater) ~~submerged ruins~~ with LD 30 ~~31~~ feet.

L. COMPARISON WITH THE CHART *See section 7. of the Evaluation Report.*

The survey was compared to Chart 14966 (19th Edition/Jan 83). This chart is 1:10000 inset of Two Harbors.

There were ten PSR items, that plot upon this chart.

In general, the chart compares poorly outside the breakwater. The chart soundings basically represent almost all the prior survey sounding available. Thus the chart does not adequately depict the depth contours outside the harbor. Inside the breakwater, depths generally agree with the current survey.

Recommendation

It is recommended that the Two Harbors inset be revised totally, to reflect the 1984 survey results.

The old east breakwater (LS-1765) was apparently demolished, but the ruins of the foundation are exposed on the harbor bottom, rising to depths of 34' to 35' in surrounding depths of 41' to 56'. A PSR report was written up in Section K on this item.

Next to buoy "2" a 29' sounding is charted. The 1984 survey confirmed this shoal sounding, as well as the other shoal soundings of 29' and 30' in the turning basin. See PSR report for details.

M. ADEQUACY OF SURVEY

This survey is sufficiently complete and adequate to supercede prior surveys for soundings.

The survey did not completely cover the survey limits on the east. This is due to an error in scaling the survey limits from the chart inset. Another three or four survey lines should have been run to reach the edge of chart 14966 inset, but the lack of these lines is nugatory.

Position numbers 1321, 1375, 1348, 1700 and 1861 surveyed in this area. Moreover, on JD 242, sheet H-10150, the launch conducted hydrography in this area. Also, on JD 227, R/V MYSIS surveyed in this area on position numbers 6379, 6391, 6394, 6400, 6408, 6413, 6414, 6433 and 6434.

N. AIDS TO NAVIGATION *See section N.b. of the Evaluation Report.*

N.1. Floating Aids - Two Harbors

There are three floating aids to navigation inside Two Harbors breakwater. These correspond to the Light List Vol. 4 aids (Agate Bay Buoys 2, 4 and 6).

There are no other floating aids within the survey limits.

N.2. Non-Floating Aids - Two Harbors

The four fixed lights, listed in L.L. Vol. 4, were verified. NOAA 76-40 from Compilation Branch is attached, and the positions listed were verified. The 1984 position is shown on NOAA 76-40 written by this field party; however, the 1982 position should be used for charting.

The light characteristics, as of September 5 are indicated on the 1984 form NOAA 76-40. The light characteristic for E. Breakwater Light is Fl R 6 sec. This light characteristic was confirmed with Coast Guard as being incorrect; and a notice to Mariners was issued when the light was changed. *Concur*

O. STATISTICS

	AVON
Total number of positions	1746
Lineal n.m. of mainscheme hydrography	58.57
Lineal n.m. of development hydrography	6.5
Lineal n.m. of crosslines and coastline hydrography	8.4
Number of bottom sample stations	45
Water level stations	1
XSV casts	1

P. MISCELLANEOUS

The EDNA G, a steam-tug, which served as harbor tug at Two Harbors for many years, is on the National Registry of Historical Places.

The cahier supporting the Coast Pilot Report contains postcards and brochures describing the coastline, the harbor facilities, landmarks, and other features of interest. Reference to these materials may aid in understanding the survey results.

Q. RECOMMENDATIONS

Q.1. Additional Field Work *See section 9. of the Evaluation Report.*

No additional field work is recommended.

Q.2. Planned Construction

During interview with Port Manager, he mentioned plans for a small breakwater just north of buoy 4. This breakwater will protect a launching ramp.

R. AUTOMATED DATA PROCESSING

R.0 Automatic Data Processing

Sounding data was collected by M/V AVON and by R/V MYSIS, using the VOYAGER data acquisition/plotting system. This system logged raw survey data onto magnetic tapes, as it was received by three sensors. Raw data was logged once per second. All logged data was time-tagged.

Refer to Project Report Data Acquisition System and to the VOYAGER/23 Operation Manual (January 1984 edition) for a more detailed explanation of the programs and hardware.

R.1 Hydrographer Data Acquisition - AVON

The sequence of daily activity is outlined below, in order to acquaint NOAA processors and verifiers with the particulars of this survey.

After getting underway, the M/V AVON proceeded to the work area. Electronic equipment was warmed up enroute.

The launch was anchored. A bar check was observed. Helmsman lowered the reflecting plate over the stern. Party Chief (or system operator) observed and logged the digital depths on a form. Depth digitizer was monitored by the frequency counter.

A daily positioning system check was observed. Online program HYDROS loaded. Data constants loaded and printout made of survey data. When both shore control team, and survey system operator were ready, simultaneous observations were made, of position location.

In order to begin running sounding lines, the system operator called up the coordinates of the initial line, and entered the off-set to that line. The helmsman's left/right screen showed the boat position relative to the intended sounding line. The track plotter was activated, making the pen move automatically to the position on chart corresponding to the boat location.

Just before the boat reached the starting point of the line, the following sequence took place (listed in chronological order):

1) the shore control observer notified to commence tracking,

2) the data logging onto tape was activated, and

3) the automatic fixing was activated.

The party chief normally operated the fathometer, including changing scales, annotating event marks with position number, and adjusting the gain. The party chief also had to keep track of shoal indications, and plan ahead for positioning control. He made descisions about development sounding lines, rocks, shoreline sounding, and weather conditions.

While the sounding line was being run, VOYAGER operator annotated the track plot by hand, adding position numbers as time allowed. He also wrote notes in the Sounding Volume, and annotated his online printout.

At the end of the working day, a positioning system check was observed, and a bar check was made. The echosounder scroll, track chart, online printout, and data tapes were removed from the launch each night.

Bar checks were normally abstracted at the field office the following day. The previous day's work was plotted onto a preliminary field sheet, by hand.

R.3 Offline Data Reduction

Once the data was logged onto tape online, it was extracted offline, by the CHART program, and an output file was created. This file is the equivalent of the NOS HYDROPLOT punched paper tape produced online. This output file was reduced and edited offline to produce the input for the Master Hydrographic Data File.

For each survey data, the following hydrographic data records were produced aboard the survey launch:

a. graphic sounding record
b. track plot
c. printout - online survey record
d. cartridge containing logged survey data
e. sounding volume (NOAA 77-44 and attachments)

Offline, the following data records was produced:

f. printout of logged data at each event mark. (This printout was annotated by hand to include position numbers.)

In the Houston office, the above records were utilized to reduce and edit the hydrographic data, and then produce the field sheet and final data tape.

R.4 Tape Records

Instead of the standard NOAA practice of correcting observed soundings (on the Master Hydrogrphic Data File) by means of the Corrector File, Oceanprobe followed the procedures described below:

a. Additional soundings were inserted into the master file in chronological sequence.

b. Soundings inadvertently not logged due to operator error were added to the file in proper chronological order.

c. Soundings associated with bad positioning data were deleted.

d. Incorrectly digitized soundings were corrected.

These processing procedures were discussed with COTR in advance, and a written request made to NOAA. The letter and NOAA reply are included and are self-explanatory.

The result was a master file containing:

Time
Position
Raw Positioning Data
Raw Soundings (a)
Corrected Soundings (original raw sounding replaced) (d)
Additional Soundings (d) (inserts for peaks and slope changes)
Analog Soundings not initially recorded online (b)

Note that:

Raw Soundings (a)
Corrected Soundings (d)
Analog Soundings not initially recorded (b)

were put onto the Master Hydrographic Data File as a "Fix Record", because they have raw positoning data still associated with them. The "additional soundings" were put onto the Master Hydrographic Data File as a "Depth Record".

R.5 Online Hydrographic Printout

Verifiers and processor should be aware that the VOYAGER operator controls the various data acquisition operations by keyboard command. In reading through the on-line printout, the following messages continually appear:

Command (Printout)	Which Means
R1:RA	Begin range-angle computation of boat position
R6:FT	Begin automatic fixing on time interval
R8:LO	Begin logging data onto tape
R8:SU	Suspend logging data onto tape

Several other commands, messages, and abreviations appear on the online printout; however, familiarity with all of them is not essential to analyzing the hydrographic record. Refer to the VOYAGER Operation Manual if explanation is needed (Appendix D).

S. REFERRAL TO REPORTS

The following Project Reports with supporting field notes and records were submitted separately to Atlantic Marine Center.

a. Horizontal Control

b. Electronic Position-Fixing

c. Automated Data Processing (VOYAGER System)

d. Coast Pilot

e. NOS Product Evaluation

Personnel from Oceanprobe, Inc., and its subcontractors, performed the hydrographic and topographic field work. Initial data processing reduction, editing and production of the field sheet and report were accomplished by Gardline Surveys. Final corrections to the incomplete and flawed data were executed by Oceanprobe, Inc.

Oceanprobe divers investigated the PSR items at Gooseberry Reef, Two Harbors, Burlington Bay, and in the Knife River area. and installed and serviced the water level recorders. A field crew from Seaway Engineering Company (Duluth) established the primary horizontal control by traverse. Additional hydrographic stations were surveyed in by Oceanprobe. Captain Ken MacDonald (retired NOAA) was invaluable in his assistance and guidance throughout this survey, particularly in those cases where Gardline Surveys was unable, or unwilling, to perform their hydrographic duties.

This report was written, and is respectfully submitted by:

Paul H. Kronfield
Oceanprobe, Inc.
Chief of Party

Dated: April 1, 1985

APPROVAL SHEET

Oceanprobe completed delivery of processed data on Sheet H-10153 to AMC by December 3, 1984, two weeks after the deadline date of November 19, 1984. Data processing was carried out by Oceanprobe's subcontractor, Gardline Surveys.

In February of 1985, AMC found the data did not meet Government specifcations and therefore deemed it unacceptable by NOAA and returned all data to Oceanprobe. Oceanprobe took final delivery of all the data returned by AMC on Feb. 26, 1985.

I first learned of the problems with the data in late January, 1985, and viewed the final product at a meeting at AMC on Feb. 6-8, 1985, where I was able to discuss all the necessary changes and corrections that would render the data acceptable to NOAA standards.

It was at this time that I became aware of the deficiencies in Gardline Surveys' data processing and the degree to which they fell short of what was required of them. Prior to this point, Oceanprobe had been refused access to view any of the data processing sequence. Gardline also omitted to make any reports, verbal or written, to Oceanprobe regarding progress on the data processing they had agreed to perform under contract to Oceanprobe, although frequently requested to do so. This is mentioned here solely to demonstrate that Oceanprobe made numerous attempts to apprise itself of the progress of the work, but lacked Gardline's cooperation.

I would like mention here that it is my opinion that six weeks is an insufficient amount of time in which to complete processing of data and submission of the final field sheets and descriptive reports. This is an admirable goal to be sought after for NOAA units, but in the case of a private contractor attempting the science and art of hydrography under strict NOAA standards and procedures for the first time, this may be impossible.

In spite of this, Oceanprobe did succeed in delivering the majority of the processed data to AMC by the deadline with final delivery being completed by December 3, 2 weeks after deadline.

To highlight this point, I learned that a NOAA survey of Sheet H-10111, authority HFP-20-2-83 in Lake Ontario from Point Breeze to Sandy Hook began work on June 14, 1984. Surveying was completed on August 15, 1984. The six-week deadline date for delivery of data to AMC was September 26, 1984. This data was not delivered until January 7, 1985 - a 3.5 month late delivery. The complexity of this survey was 26, where our Sheet H-10144 complexity was rated 30.

I point this out as I feel it is partly due to this very tight schedule that Gardline submitted data that did not meet NOAA requirements. However, after having completely reviewed the data

submitted by Gardline to AMC, I am forced to conclude that the main reason for the deficiencies and errors in the data processing can only be attributed to Gardline Surveys' inability to perform the work to the standards required by Oceanprobe, and by NOAA.

Concerning this sheet H-10153, we note the following deficiencies of the data as processed and submitted by Gardline Surveys:

* 16 position numbers needed to be inserted
* 25 position numbers needing to be changed on the master digital tape, as well as the sounding volumes, the position abstracts, and the analog records.
* 13 incorrect shore control station heights.
* 13 incorrect shore control codes on the signal tape.
* 1 omitted shore control point on signal tape (217).
* 28 faulted files in the T1 corrector tape.
* was required to insert 98 files on T1 corrector tape.
* 80 faulted/useless files in the velocity corrector tape.
* was required to insert 517 files on velocity corrector tape.
* 1 sounding line needing to be deleted from the digital file.
* 32 soundings inexplicably deleted by Gardline on digital file were replaced.
* 15 erroneous corrector records in the range-azimuth master tape.
* was required to insert 130 lines of shoreline verification data in master digital file.

Moreover, Gardline Surveys had not included positions of bottom samples. Oceanprobe extracted them from the Voyager printout in Lambert X-Y coordinates and converted them to the required latitude-longitude.

All position and sounding abstracts were required to be redone.

38 peaks, deeps, and corrections were not inserted by Gardline Surveys into the digital records for this sheet. This was accomplished by Oceanprobe. Gardline's magnetic data files were not in their proper order.

All the above have been corrected to specifications solely by Oceanprobe, Inc.

Oceanprobe plotted each day's bar checks and generated 15 velocity tables for the correction of soundings.

After receiving all the data returned by AMC (February 26, 1985) I have worked solely on completing the data processing to the satisfaction of NOAA. This sheet was completed today, March 31, 1985. My work hours were 10 hours per day for 7-day weeks. Oceanprobe is grateful to Integrated Data Systems Inc., Houston, for the use of their HP-1000 computer facilities and the programming abilities of Don Baeker. I also am indebted to Captain Ken MacDonald who gave his time at his home to look over and complete the horizontal survey data.

In personally correcting this data, I have given great attention to all details of this sheet. I was present for all field work, and supervised all of the hydrography and surveying. At this time I am very familiar with all details of the sheet, and feel the survey is complete and adequate.

I would like to point out in conversations with Dan Mumford at AMC, he indicated in response to my questions that AMC computer needs a "flag" inserted when a sounding file ends or begins a new hydrographic line. We have inserted peaks or deeps at ends and beginning of some lines. The following area will appear to need a position number at the end of a line, where in fact a "flag" only is needed: Position 5646. There may be a few other cases requiring a flag, but they will be immediately obvious and easy to locate.

I am including with the data shipment listings of the original Gardline data requiring corrections and completion. My working notes on this listing should be of great assistance to the verifier if he has questions concerning position numbers and any other changes I have made on this final submission.

I am convinced that velocity data and correctors should be sufficient for this hydrographic data to stand up to international, and NOAA, convention for accuracy. My work on bar check data is included in this report, and supplemental temperature data gathered by University of Wisconsin research vessel is also included.

I therefore approve of this field sheet and all accompanying records for completeness and accuracy in accordance with the Statement of Work.

Paul H. Kronfield
Chief of Party

SIGNAL LIST 113

NUM	STATION NAME	YEAR	LATITUDE	LONGITUDE	ELEV	SOURCE
025	LAFAYETTE	1984	47 05 37.0798	91 32 59.3029	186.5	SE
026	GULL	1984	47 05 16.9743	91 33 04.4107	192.6	SE
027	E 1 NORTH(a)	1984	47 05 26.852	91 33 08.542	185.3	OP
028	EFA	1984	47 05 05.2651	91 34 37.6312	185.0	SE
029	FJORD	1984	47 04 23.7428	91 35 05.4050	186.2	SE
030	PION MNDOT	1977	47 04 00.4335	91 35 38.0336	248.0	NGS
031	TRAV PT SC	1984	47 03 46.7436	91 35 57.7522	188.5	SE
032	VIOLA	1984	47 03 24.0586	91 36 58.6283	186.5	SE
033	JESS	1984	47 03 04.1507	91 37 18.3293	184.1	SE
034	DUNN	1984	47 02 42.6360	91 37 54.5710	187.8	SE
035	OLSON	1984	47 02 26.7377	91 38 08.3676	184.4	SE
036	FLOOD NOS (b)	1981	47 02 29.3979	91 38 09.5240	186.4	SE
037	BAY	1984	47 02 02.1221	91 38 14.4569	186.5	SE
038	TRAV PT FB(c)	1984	47 01 49.4795	91 38 07.9088	186.5	SE
039	KLINK-SOREN	1984	47 01 39.9197	91 38 10.7974	185.3	SE
040	TRAV PT BURL	1984	47 01 36.5933	91 38 16.4793	185.2	SE
041	DOG	1984	47 01 33.3541	91 38 30.7479	185.3	SE
042	AGATE ARGO(d)	1983	47 00 48.394	91 39 47.660	190.1	OP
043	IRON STAKE	1984	47 00 47.5678	91 39 46.9225	185.6	SE
045	TH 100	1982	47 00 38.3982	91 40 09.5288	185.6	SE
046	TWIN POINT	1984	47 00 23.2714	91 41 05.4439	184.4	SE
047	TRAV PT DF	1984	47 00 00.7957	91 42 39.1319	185.0	SE
048	ALDER	1984	46 59 48.9027	91 42 57.0328	185.6	SE
049	CLAY	1984	46 59 26.8966	91 43 30.2672	187.5	SE

SIGNAL LIST 2/3

NUM	STATION NAME	YEAR	LATITUDE	LONGITUDE	ELEV	SOURCE
~~050~~	~~KLEIN~~	~~1984~~	~~46 59 02.2424~~	~~91 44 06.5083~~	~~186.2~~	~~SE~~
~~051~~	~~PHIL~~	~~1984~~	~~46 58 39.0377~~	~~91 44 30.3722~~	~~185.6~~	~~SE~~
~~052~~	~~MURPHY~~	~~1984~~	~~46 57 48.6323~~	~~91 45 33.7049~~	~~188.7~~	~~SE~~
~~053~~	~~RUBBLE~~	~~1984~~	~~46 56 56.2019~~	~~91 46 37.3922~~	~~183.8~~	~~SE~~
~~054~~	~~KR 101~~	~~1982~~	~~46 56 37.1462~~	~~91 46 43.2089~~	~~185.8~~	~~SE~~
~~055~~	~~KNIFE~~	~~1984~~	~~46 56 31.1048~~	~~91 47 04.0606~~	~~185.3~~	~~SE~~
~~056~~	~~STONY POINT(e)~~	~~1983~~	~~46 55 26.4407~~	~~91 49 02.1535~~	~~183.8~~	~~NOS~~
~~103~~	~~LITE~~	~~1984~~	~~47 12 00.9087~~	~~91 21 57.7663~~	~~217.3~~	~~SE~~
~~104~~	~~DEB~~	~~1984~~	~~47 12 00.3554~~	~~91 22 01.1861~~	~~221.0~~	~~SE~~
~~105~~	~~MARK~~	~~1984~~	~~47 11 18.2009~~	~~91 22 59.1783~~	~~194.8~~	~~SE~~
~~106~~	~~ROCK POINT~~	~~1984~~	~~47 11 14.7669~~	~~91 23 10.5827~~	~~231.3~~	~~SE~~
107	CHURCH(f)	1984	47 01 33.3602	91 38 44.4379	185.0	SE
108	COON	1984	47 00 54.9803	91 39 37.4380	186.2	SE
109	DART	1984	47 00 07.2144	91 42 29.3287	185.6	SE
110	TH 102	1982	47 00 48.8204	91 39 54.5481	185.6	SE
~~111~~	~~KNIFE ISLAND~~	~~1984~~	~~46 56 48.7397~~	~~91 46 18.7238~~	~~184.7~~	~~SE~~
~~112~~	~~MARINA~~	~~1984~~	~~46 56 41.9078~~	~~91 46 57.3439~~	~~184.4~~	~~SE~~
~~113~~	~~CLOUD~~	~~1984~~	~~46 56 17.0753~~	~~91 47 45.7151~~	~~185.6~~	~~SE~~
~~203~~	~~SPLIT RK LTHS~~	~~1943~~	~~47 12 00.25~~	~~91 12 00.62~~	~~.~~	~~NGS~~
~~211~~	~~PALISADE MAST(h)~~	~~1977~~	~~47 19 12.937~~	~~91 12 42.038~~	~~.~~	~~NGS~~
215	TWO HBRS LTHS(j)	1952	47 00 50.488	91 39 49.274	.	NGS
216	STACK,POWER CO.		47 01 06.710	91 39 35.787		NGS
217	TWO HBRS R.M.(k)	1977	47 00 45.259	91 41 13.274	.	NGS
~~304~~	~~DEB EGG (m)~~	~~1984~~	~~47 12 00.262~~	~~91 22 01.117~~	~~221.~~	~~OP~~

SIGNAL LIST 3/3

NUM	STATION NAME	YEAR	LATITUDE	LONGITUDE	ELEV	SOURCE
309	TH 101 (g)	1982	47 00 42.731	91 39 58.656	185.6	IFA
310	AGATE BAY (g)	1982	47 00 48.390	91 39 54.892	186.	IFA
~~312~~	~~MARINA TARGET(m)~~	~~1984~~	~~46 56 41.835~~	~~91 46 57.314~~	~~184.~~	~~OP~~
345	AOKO (m)	1984	47 00 38.669	91 40 08.723	185.6	OP
~~352~~	~~RUBBLE TARGET(m)~~	~~1984~~	~~46 56 56.050~~	~~91 46 37.948~~	~~183.~~	~~OP~~
~~353~~	~~RUBBLE ECC. (m)~~	~~1984~~	~~46 56 56.077~~	~~91 46 38.146~~	~~183.~~	~~OP~~
~~354~~	~~KR 101 TARGET(m)~~	~~1984~~	~~46 56 37.132~~	~~91 46 43.031~~	~~185.6~~	~~OP~~
~~355~~	~~GRANITE PT LT(m)~~	~~1984~~	~~46 56 37.157~~	~~91 46 43.178~~	~~.~~	~~OP~~

The following established horizontal control stations were recovered during this project.

Station Name	Year Established	Quad No.	Signal List
BUCHANAN	1952	460914	
BURLINGTON	1943	470913	
GOOSEBERRY	1943	470912	
SPLIT ROCK LTHSE	1943	470912	Y
SPLIT ROCK USLS	1943	470912	Y
TWO HARBORS LTHS	1952	470913	Y
TWO HARBORS POWER/LIGHT CO. STACK	1952	470913	Y
PALISADES STATE PATROL RADIO MAST		470912	Y
JERN MNDT	1977	470912	Y
SPLIT MNDT	1977	470912	Y
LIND MNDT	1977	470912	Y
BACHMAN MNDT	1977	470912	Y
PION MNDT	1977	470913	Y

The following stations were reported by this field party, as destroyed.

Station	Year Established	Quad No.
TWO HARBORS BETH. LUTHERAN CHURCH SPIRE	1952	470913
TWO HARBORS DM AND IR RR POWER PLANT STACK	1952	470913
TWO HARBORS EMMANUEL LUTH. CHURCH SPIRE	1952	470913
LAKE HIGH	1952	470913

NOAA FORM 76-40 (8-74)
Replaces C&GS Form 567.

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NONFLOATING AIDS [redacted] FOR CHARTS

ORIGINATING ACTIVITY
- ☐ HYDROGRAPHIC PARTY
- ☐ GEODETIC PARTY
- ☐ PHOTO FIELD PARTY
- ☒ COMPILATION ACTIVITY
- ☐ FINAL REVIEWER
- ☐ QUALITY CONTROL & REVIEW GRP.
- ☐ COAST PILOT BRANCH

(See reverse for responsible personnel)

☐ TO BE CHARTED
☒ TO BE REVISED
☐ TO BE DELETED

REPORTING UNIT (Field Party, Ship or Office)	STATE	LOCALITY	DATE
Coastal Mapping Unit, Rockville, Maryland	Minnesota	Two Harbors and Knife River, Lake Superior	3/84

The following objects HAVE ☐ HAVE NOT ☒ been inspected from seaward to determine their value as landmarks.

OPR PROJECT NO.	JOB NUMBER	SURVEY NUMBER	DATUM
	CM-8316	TP-00082	1927 NA

CHARTING NAME	DESCRIPTION (Record reason for deletion of landmark or aid to navigation. Show triangulation station names, where applicable, in parentheses)	POSITION LATITUDE ° ′	LATITUDE ″ D.M. Meters	POSITION LONGITUDE ° ′	LONGITUDE ″ D.P. Meters	METHOD AND DATE OF LOCATION (See instructions on reverse side) OFFICE	Position [redacted] Quality	CHARTS AFFECTED
	NORTHWEST SIDE Knife River Harbor							
- LT	Knife River Light. - ENTRANCE LIGHT	46-56	37.17 7	91-46	43.20 198	82Z(C)2958 5/30/82	Aero-triangulated	14966
	Two Harbors							
- LT	(Two Harbors Lighthouse 1952)	47-00	50.488	91-39	49.274	82Z(C)2943 5/30/82	Geodetic	14966
-E BKW LT	- EAST BREAKWATER LIGHT	47-00	38.45 399	91-40	09.58 529	82Z(C)2943 5/30/82	Aero-triangulated	14966
-W BKW LT	- WEST BREAKWATER LIGHT	47-00	43.39 373	91-40	20.67 631	82Z(C)2943 5/30/82	Aero-triangulated	14966
	Ne- superceded by L-46(87)							

NOAA FORM 76-40 (8-74)
Replaces C&GS Form 567.

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

[redacted] LANDMARKS FOR CHARTS

ORIGINATING ACTIVITY
- ☐ HYDROGRAPHIC PARTY
- ☐ GEODETIC PARTY
- ☐ PHOTO FIELD PARTY
- ☒ COMPILATION ACTIVITY
- ☐ FINAL REVIEWER
- ☐ QUALITY CONTROL & REVIEW GRP.
- ☐ COAST PILOT BRANCH

(See reverse for responsible personnel)

☐ TO BE CHARTED
☒ TO BE REVISED
☐ TO BE DELETED

REPORTING UNIT (Field Party, Ship or Office): Coastal Mapping Unit, Rockville, Maryland
STATE: Minnesota
LOCALITY: Two Harbors and Knife River, Lake Superior
DATE: 3/84

The following objects HAVE ☐ HAVE NOT ☒ been inspected from seaward to determine their value as landmarks.

OPR PROJECT NO.:
JOB NUMBER: CM-8316
SURVEY NUMBER: TP-00082
DATUM: 1927 NA

CHARTING NAME	DESCRIPTION (Record reason for deletion of landmark or aid to navigation. Show triangulation station names, where applicable, in parentheses)	POSITION LATITUDE ° ′	LATITUDE ″ D.M. Meters	POSITION LONGITUDE ° ′	LONGITUDE ″ D.P. Meters	METHOD AND DATE OF LOCATION (See instructions on reverse side) OFFICE	Position [redacted] Quality	CHARTS AFFECTED
STACK	(Two Harbors Power and Light Co. Stack 1952)	47-01	06.710	91-39	35.787	82Z(C)2943 5/30/82	Geodetic	14966
CUPOLA		47-01	12.87	91-40	16.41	82Z(C)2943 5/30/82	Aero-triangulated	14966
CUPOLA		47-00	49.70	91-39	50.55	82Z(C)2943 5/30/82	Aero-triangulated	14966
	The following charted landmarks were verified during compilation, but are located outside the limits of the Two Harbors Inset:							
TANK		47-02	08.01	91-40	21.88	82Z(C)2943 5/30/82	Aero-triangulated	14966
R RELAY MAST	(Two Harbors Radio Mast 1977)	47-00	45.259	91-41	13.274	82Z(C)2943 5/30/82	Geodetic	14966
	See page 211							
	superceded by NC-L46(87)							

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NOAA FORM 76-40 (8-74)
Replaces C&GS Form 567.

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

[redacted] LANDMARKS FOR CHARTS

ORIGINATING ACTIVITY
- [X] HYDROGRAPHIC PARTY
- [ ] GEODETIC PARTY
- [ ] PHOTO FIELD PARTY
- [ ] COMPILATION ACTIVITY
- [ ] FINAL REVIEWER
- [ ] QUALITY CONTROL & REVIEW GRP.
- [ ] COAST PILOT BRANCH

(See reverse for responsible personnel)

- [X] TO BE CHARTED
- [ ] TO BE REVISED
- [ ] TO BE DELETED

REPORTING UNIT (Field Party, Ship or Office): OCEANPROBE, INC.
STATE: MINNESOTA
LOCALITY: Lake Superior (Two Harbors and Knife River
DATE: 1 OCT 84

The following objects HAVE [X] HAVE NOT [ ] been inspected from seaward to determine their value as landmarks.

OPR PROJECT NO.: Z137
JOB NUMBER:
SURVEY NUMBER: H-10163 1/3
DATUM:

CHARTING NAME	DESCRIPTION (Record reason for deletion of landmark or aid to navigation. Show triangulation station names, where applicable, in parentheses)	POSITION LATITUDE ° ′	LATITUDE // D.M. Meters	POSITION LONGITUDE ° ′	LONGITUDE // D.P. Meters	METHOD AND DATE OF LOCATION (See instructions on reverse side) OFFICE	FIELD	CHARTS AFFECTED
STACK	(Two Harbors Power & Light Co. Stack 1952).	47 01	06.710	91 39	35.787		F-3-6-V SEPT. 84	14966
CUPOLA	Courthouse Dome, Cupola, 1984	47 01	19.840	91 40	16.380		F-3-6-L SEPT. 84	14966
CUPOLA	Cupola on Fog Horn Building at Two Harbors Light. Two Harbors Cupola, 1984	47 00	49.685	91 39	50.466		F-3-6-L SEPT. 84	14966
TANK FR	N. Two Harbors Water Tank (Silver) Fixed red light, top center.	47 02	08.048	91 40	21.937		F-3-6-L SEPT. 84	14966
R RELAY MAST	(Two Harbors Radio Mast 1977) Two vertical lights - fixed red	47 00	45.259	91 41	13.274		F-3-6-L SEPT. 84	14966
TANK FR	N. Two Harbors Water Tank (Green) Fixed red light, top center.	47 02	25.388	91 41	25.033		F-3-4-6-L SEPT. 84	14966
	Lights checked: 3 Sept 84							

L-553(67) NC L-46(87) L-669(67) nc L-46(87)

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NOAA FORM 76-40 (8-74)
Replaces C&GS Form 567.

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NONFLOATING AIDS [redacted]

ORIGINATING ACTIVITY
- [X] HYDROGRAPHIC PARTY
- [ ] GEODETIC PARTY
- [ ] PHOTO FIELD PARTY
- [ ] COMPILATION ACTIVITY
- [ ] FINAL REVIEWER
- [ ] QUALITY CONTROL & REVIEW GRP.
- [ ] COAST PILOT BRANCH

(See reverse for responsible personnel)

- [XX] TO BE CHARTED
- [ ] TO BE REVISED
- [ ] TO BE DELETED

REPORTING UNIT (Field Party, Ship or Office): OCEANPROBE, INC.
STATE: MINNESOTA
LOCALITY: Lake Superior
Knife River Harbor, and
Two Harbors
DATE: 1 Oct 84

The following objects HAVE [X] HAVE NOT [ ] been inspected from seaward to determine their value as landmarks.

OPR PROJECT NO.: 2137
JOB NUMBER:
SURVEY NUMBER: H-10153 2/3
DATUM:

CHARTING NAME	DESCRIPTION (Record reason for deletion of landmark or aid to navigation. Show triangulation station names, where applicable, in parentheses)	POSITION LATITUDE ° ′	LATITUDE ″ D.M. Meters	POSITION LONGITUDE ° ′	LONGITUDE ″ D.P. Meters	METHOD AND DATE OF LOCATION (See instructions on reverse side) OFFICE	METHOD AND DATE OF LOCATION FIELD	CHARTS AFFECTED
	KNIFE RIVER HARBOR							
LT.	GRANITE POINT LIGHT FL 4 SEC.	46 56	37.157′	91 46	43.178′		F-2-6-L SEPT. 84	14966
	TWO HARBORS							
E.BKW. LT.	EAST BREAKWATER LIGHT FL R 6 SEC.	47 00	38.399′	91 40	09.528′		F-3-6-L SEPT. 84	14966
W.BKW. LT.	WEST BREAKWATER LIGHT FL 4 SEC.	47 00	43.372′	91 39	29.631′		F-3-6-L SEPT. 84	14966
TWO HARBORS LT.	(TWO HARBORS LIGHTHOUSE 1952) GP FL (2) 20 SEC.	47 00	50.488′	91 39	49.274′		F-3-6-V SEPT. 84	14966
LT.	DOCK 6 LIGHT FR	47 00	48.110′	91 40	25.935′		F-3-6-L SEPT. 84	14966
	RADIO BEACON MAST	47 00	49.297′	91 39	50.336′		F-3-6-L SEPT. 84	14966
	Lights checked: 5 Sept 84							

NC 14668(87)

NC 14668(87)

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RESPONSIBLE PERSONNEL		
TYPE OF ACTION	NAME	ORIGINATOR
OBJECTS INSPECTED FROM SEAWARD	JOHN HUDSON KENNETH A. MACDONALD	☐ PHOTO FIELD PARTY ☒ HYDROGRAPHIC PARTY ☐ GEODETIC PARTY ☐ OTHER *(Specify)*
POSITIONS DETERMINED AND/OR VERIFIED	KENNETH A. MACDONALD	FIELD ACTIVITY REPRESENTATIVE
		OFFICE ACTIVITY REPRESENTATIVE
FORMS ORIGINATED BY QUALITY CONTROL AND REVIEW GROUP AND FINAL REVIEW ACTIVITIES		☐ REVIEWER ☐ QUALITY CONTROL AND REVIEW GROUP REPRESENTATIVE

INSTRUCTIONS FOR ENTRIES UNDER 'METHOD AND DATE OF LOCATION'

(Consult Photogrammetric Instructions No. 64,

OFFICE

I. OFFICE IDENTIFIED AND LOCATED OBJECTS

Enter the number and date (including month, day, and year) of the photograph used to identify and locate the object.

EXAMPLE: 75E(C)6042
8-12-75

FIELD

I. NEW POSITION DETERMINED OR VERIFIED

Enter the applicable data by symbols as follows:

F - Field	P - Photogrammetric
L - Located	Vis - Visually
V - Verified	
1 - Triangulation	5 - Field identified
2 - Traverse	6 - Theodolite
3 - Intersection	7 - Planetable
4 - Resection	8 - Sextant

A. Field positions* require entry of method of location and date of field work.

EXAMPLE: F-2-6-L
8-12-75

*FIELD POSITIONS are determined by field observations based entirely upon ground survey methods.

FIELD (Cont'd)

B. Photogrammetric field positions** require entry of method of location or verification, date of field work and number of the photograph used to locate or identify the object.

EXAMPLE: P-8-V
8-12-75
74L(C)2982

II. TRIANGULATION STATION RECOVERED

When a landmark or aid which is also a triangulation station is recovered, enter 'Triang. Rec.' with date of recovery.

EXAMPLE: Triang. Rec.
8-12-75

III. POSITION VERIFIED VISUALLY ON PHOTOGRAPH

Enter 'V-Vis.' and date.

EXAMPLE: V-Vis.
8-12-75

**PHOTOGRAMMETRIC FIELD POSITIONS are dependent entirely, or in part, upon control established by photogrammetric methods.

NOAA FORM 76-40 (8-74)

SUPERSEDES NOAA FORM 76-40 (2-71) WHICH IS OBSOLETE, AND EXISTING STOCK SHOULD BE DESTROYED UPON RECEIPT OF REVISION.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1974-665-073/1030 Region 6

NOAA FORM 76-40
(8-74)

Replaces C&GS Form 567.

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

[redacted] LANDMARKS FOR CHARTS

ORIGINATING ACTIVITY
- [X] HYDROGRAPHIC PARTY
- [ ] GEODETIC PARTY
- [ ] PHOTO FIELD PARTY
- [ ] COMPILATION ACTIVITY
- [ ] FINAL REVIEWER
- [ ] QUALITY CONTROL & REVIEW GRP.
- [ ] COAST PILOT BRANCH

(See reverse for responsible personnel)

[ ] TO BE CHARTED [ ] TO BE REVISED [X] TO BE DELETED	REPORTING UNIT (Field Party, Ship or Office)	STATE	LOCALITY	DATE
	OCEANPROBE INC.	MINNESOTA	TWO HARBORS	1 OCT. 84

The following objects HAVE [ ] HAVE NOT [ ] been inspected from seaward to determine their value as landmarks.

OPR PROJECT NO.	JOB NUMBER	SURVEY NUMBER	DATUM
2137		H-10153 3/3	NA 1927

CHARTING NAME	DESCRIPTION (Record reason for deletion of landmark or aid to navigation. Show triangulation station names, where applicable, in parentheses)	POSITION LATITUDE ° ′	LATITUDE ″ D.M. Meters	LONGITUDE ° ′	LONGITUDE ″ D.P. Meters	METHOD AND DATE OF LOCATION (See instructions on reverse side) OFFICE	FIELD	CHARTS AFFECTED
STACK	DESTROYED	47 01	08.0	91 40	12.1			14966
	NC-L46(87)							

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
ATLANTIC MARINE CENTER
439 West York Street
Norfolk, VA 23510-1114

N/MOA2321:RHW

JAN 22 1987

Commander (OAN)
Ninth Coast Guard District
1240 East 9th Street
Cleveland, OH 44199

Dear Sir:

During office processing of hydrographic survey H-10153, Minnesota, Lake Superior, Two Harbors, an obstruction with depths of 30 to 32 feet was found in the turning basin of Agate Bay where surrounding depths are 45 to 56 feet. The obstruction was found to be ruins of the old east breakwater and is considered a potential danger to navigation.

The following text is recommended for inclusion in the Local Notice to Mariners:

An obstruction with a least depth of 30 feet at Low Water Datum is located in the turning basin of Agate Bay in Latitude 47°00'45.32"N, Longitude 91°40'09.37"W.

Questions concerning the survey may be directed to Mr. Richard H. Whitfield, Evaluation and Analysis Group, telephone (804) 441-6268 (FTS 827-6268).

The affected NOAA Chart is 14966.

Sincerely,

David B. MacFarland, Jr.
Commander, NOAA
Chief, Hydrographic Surveys Branch

cc:
N/CG222

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE

ATLANTIC MARINE CENTER

July 26, 1984 N/MOA23:DBM

TO: N/CG24x5 - David H. Peterson

FROM: N/MOA23 - David B. MacFarland, Jr.

SUBJECT: Request for Data

Requested data is listed below.

Vessel Identification Numbers
8000
8001

Station Name	POSITION LATITUDE	LONGITUDE
FLOOD 1982	47°02'29.39868"	91°38'09.52385"
WICK 1981	47°07'31.51490"	91°28'54.04840"
STONEY PT. 1983	46°55'26.4408"	91°49'02.1535"

These are field computed positions only.

Attachments

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF CHARTING AND GEODETIC SERVICES
ROCKVILLE, MARYLAND 20852

September 11, 1984

Mr. Paul Kronfield
President, Oceanprobe, Inc.
Two Harbors, MN 55616

Ref: Gardline Surveys letter dated 29 August 1984

Dear Mr. Kronfield:

With respect to the question raised by your subcontractor in the above referenced letter, I have been advised by the Atlantic Marine Center that corrected depths are acceptable on the Master Hydrographic Data File, provided that:

1) a hard copy record of the raw depth data is furnished with the survey records;

2) the required corrector tapes containing the positioning correctors, etc. are also furnished as specified in the contract.

Direct communication between your subcontractor and AMC regarding tape formatting questions continues to be authorized as before. If you have any questions, do not hesitate to consult with me.

Sincerely,

David H. Peterson
Lt. Cdr., NOAA
COTR

Received Gardline 15 Sept

GARDLINE SURVEYS, INC.
Hydrographic and Geophysical Surveys

(713) 568-3881
WX 910-881-2710 "GHS HOU"

10849 Kinghurst • Suite 150 • Houston, Texas 77099

August 29, 1984

LCDR Dave Peterson, NOAA
COTR

Reference: Lake Superior Hydrographic Survey

In planning the hydrographic data reduction and digital tape production at our Houston office, we have encountered a potential problem, betweem our data reduction/editing program, and the SOW.

The SOW states that raw hydrographic data on the Master data file shall not be manipulated (3.4.2.8). An earlier paragraph specifically mentions position ranges and angles (3.4.2.2) as the raw data which NOAA requires as Harris/7 input.

1. Our proposal (pages 54-55 and 82) stated that the recorded sounding would be subject to amendment, and deletion, and insertion of additional soundings. Gardline will not manipulate or correct position ranges and angles.

2. The NTM 2 instructions describe the use of Corrector Files and Master Files. We understand that NOAA's software uses the corrector file short record to amend or delete digital soundings already on the Master File, or to insert additional soundings into the computer for plotting. We further understand that the observed digital soundings on the Master File punch paper tape are preserved and can be reviewed at any stage of processing.

3. We point out that the editing process used by Gardline will alter some of the digitized soundings on the Master File. Our edit command"AMEND" will cause a corrected sounding value to be written onto the output tape. (The original digitized sounding is preserved, unaltered, on the raw data tape, however.)

4. In order to comply with SOW 3.4.2.8, we propose to do the following:

   a. Make a hardcopy printout of the data contained on the raw data cartridges. (This annotated hardcopy will be delivered along with the other daily survey records, to AMC.)

Gt. Yarmouth
Norfolk (U.K.)
(0493) 50723
TLX 975296

Aberdeen
Scotland
(0224) 573241
TLX 73535

The Hague
Netherlands
070 634946
TLX 32656

Kuala Lumpur
Malaysia
482305
TLX MA 31070

Singapore
2532622
TLX RS 36214

4. b. Preserve the raw data until the IBM tape has been examined by NOAA and the smooth sheet plotted. (This raw data will be held at Gardline, Houston office.)

Are 4a. and 4b. acceptable to NOAA for the purpose of preserving the original digital sounding data?

Phone call 9/10/84 to D. Peterson COTR

1) cannot eliminate corrector tapes

2) OK to correct the raw sndg on the output tape.

Respectfully,

Arthur Sibold
Supervising Hydrographer

GARDLINE SURVEYS, INC.

AS/mk

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

WATER LEVEL NOTE FOR HYDROGRAPHIC SHEET

Processing Division: Atlantic Marine Center: MOA231

Hourly heights are approved for

Water Level Station Used: Two Harbors, Minnesota (909-9070)

Period: August 22, 1984 to October 1, 1984

HYDROGRAPHIC SHEET: H-10153 (Area B)

OPR- Z 137-OP-84

Locality: Lake Superior

Plane of reference: Low Water Datum (IGLD 1955: 600.0 Feet)

Remarks:

Zoning not required, data from other gages on Lake Superior indicates no unusual water level movement during the survey period.

Harry A. Lippincott

Chief, Great Lakes Acquisition Unit

NOAA FORM 77-28
(11-72)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HYDROGRAPHIC TITLE SHEET

REGISTER NO.

H-10153

INSTRUCTIONS - The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

FIELD NO.

OP-5-1-84

State MINNESOTA

General locality LAKE SUPERIOR

Locality TWO HARBORS

Scale 1:5000 Date of survey October ~~1 to 7~~ 6, 1985

Instructions dated _____ Project No. Z137-OP-84

Vessel M/V HEYBOY (VESSEL NO. 8003)

Chief of party P. H. KRONFIELD

Surveyed by Paul Kronfield, Don Baecker, Ken MacDonald

Soundings taken by echo sounder, ~~hand lead, pole~~ DE719; IT412

Graphic record scaled by _____

Graphic record checked by _____

Protracted by N/A Automated plot by ~~HYPERANGE~~ KYNETICS 1201 Plotter (AMC)

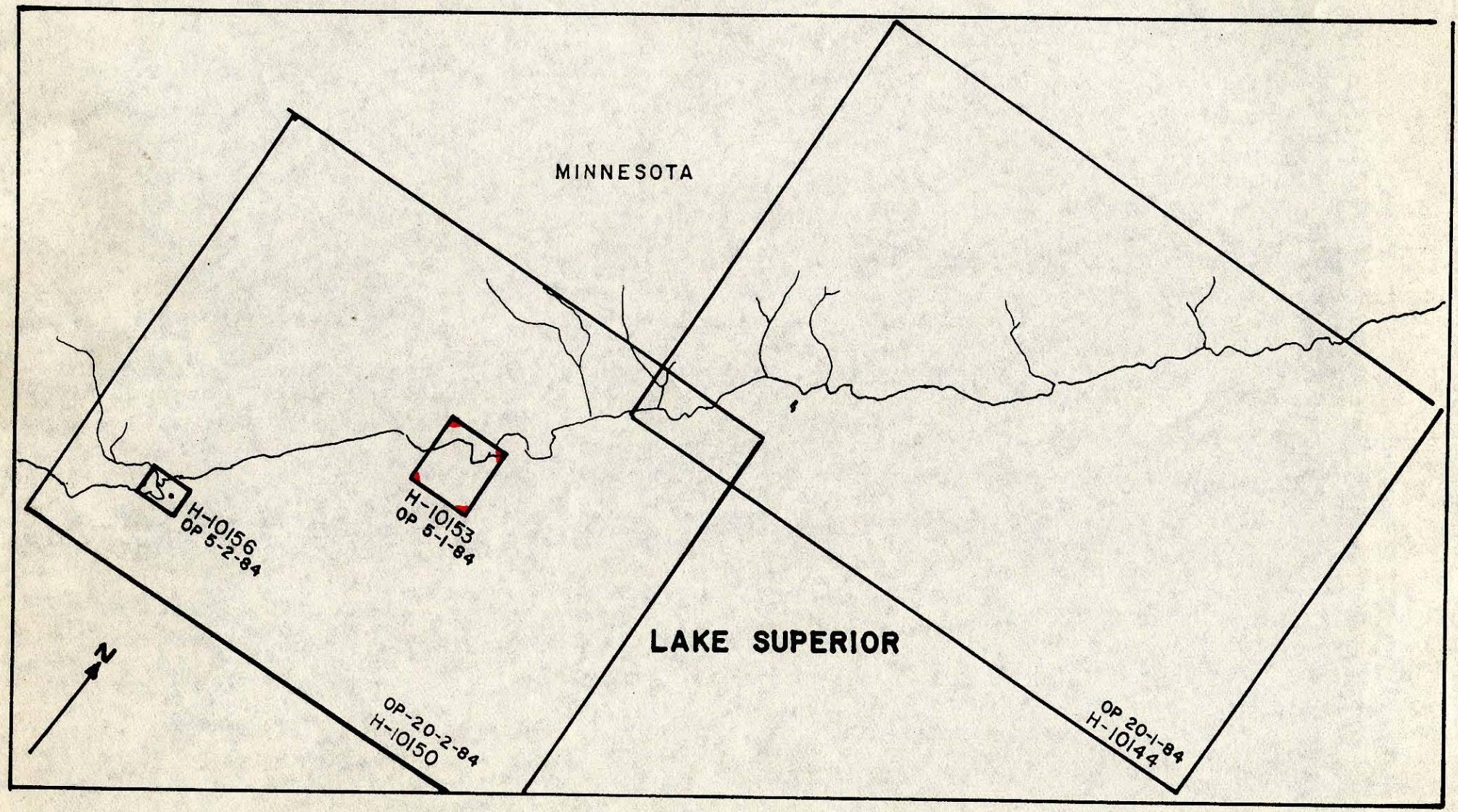
Verification by D.V. Mason

Soundings in ~~fathoms~~ feet at MLW ~~MLLW~~ ~~Great Lakes Datum = 600.0 ft. MSL~~ (IGLD 1955: 600 Ft)

REMARKS:

NOAA FORM 77-28 SUPERSEDES FORM C&GS-937.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1976—605-061/1222 REGION NO. 6


MINNESOTA
H-10156
OP 5-2-84
H-10153
OP 5-1-84
LAKE SUPERIOR
N
OP-20-2-84
H-10150
OP 20-1-84
H-10144

OCEANPROBE

TABLE OF CONTENTS

OCEANPROBE

APPENDICES

* Filed with original field data.

DESCRIPTIVE REPORT

to accompany

HYDROGRAPHIC SURVEY H-10153 HOLIDAY SURVEY 1985

OP-5-1-84

Surveyed By: Oceanprobe, Inc.

Subcontractor: Kenneth A. MacDonald

Hydrographer: Kenneth A. MacDonald

A. PROJECT

This survey was accomplished as an addition to Project instructions OPR-Z-137-OP-84.

The survey was to obtain basic hydrographic data, in order to update the Two Harbors inset (1:10,000) on nautical chart 14966.

Oceanprobe, Inc. and Kenneth A. MacDonald conducted the field work.

B. AREA SURVEYED

The area surveyed is Two Harbors, Minnesota, on the western shore of Lake Superior, about twenty miles northeast of Duluth. The area surveyed is a narrow holiday between sheets H-10153 and H-10150, approximately 0.1 nautical mile wide in E-W direction, by 1.26 nautical mile long N-S.

Soundings were obtained in this holiday area with sufficient overlap in sheets H-10153 and H-10150 to verify an adequate tie with the previous year's work.

Field work was started on October 1, 1985. Soundings were accomplished on October 6, 1985. The last day of field work was October 7, 1985.

C. SOUNDING VESSEL

All echo soundings on this survey were collected by:

HEYBOY (VESNO 8003): 33 Ft. Chris-Craft

HEYBOY is a vee-bottom, 33-ft. Chris-Craft vessel, outfitted as diving platform and sonar search vessel. This vessel is of standard Chris-Craft wooden construction, powered by an inboard engine. Propulsion is a single-shaft screw. Steerage is by rudder positioned aft of the screw and over the skeg. The echosounder transducer was mounted on the port side just forward of the breaks on a stainless steel bracket screwed into the side. The transducer was stayed forward, aft, and abaft by nylon line. The electronic positioning system receiver/transmitter antenna was mounted on a pole directly over the transducer.

The graphic recorder, HYPERANGE data acquisition system, and Miniranger Falcon-484 range processor were mounted on a large wood table in the main cabin on the starboard side. The CRT guidance display was installed on the port side at the helm, and was easily viewed by all in the cabin.

The hydrographic team consisted of four persons:

1) Hydrographer - Ken MacDonald observed the hydrographic operations and made notations in the sounding volume

2) HYPERANGE operator - entered guidance data into the system and controlled line changes

3) Hydrographic Technician - operated the DE-719, IT-412, and Falcon-484 system, and annotated the DE-719 records

4) Helmsman - steered the vessel during hydrography

An ONAN 6.5 KVA gasoline generator located in the vessel bilge supplied all necessary power.

D. SOUNDING EQUIPMENT

D.1 Equipment - HEYBOY

Vessel: 8003 (M/V HEYBOY)

A Raytheon DE-719B echo sounder was installed aboard this vessel on October 5. This echo sounder was used for all echo sounding on October 6, 1985.

	Model	Unit	S/N
Analog Depths:	Raytheon DE-719B	Transceiver/ Recorder	4805
Digital Depths:	Innerspace 412	Depth Digi-tizer	0009

D.2 Installation - HEYBOY

A standard 208 KHz transducer was installed against the port side of the vessel, in a custom-designed and constructed stainless steel bracket, with 1" screws. The transducer was clamped to the end of a stainless steel pipe, and the pipe was able to slide up and down inside the bracket. During hydrography, the pipe was extended and clamped at its extreme lower reach. The transducer was stayed fore, aft, and abaft with nylon line to prevent damaging forces or vibrations.

The start/stop signal from the DE-719B was routed to a depth digitizer via standard shielded cabling. The digitized depth was then supplied to the data acquisition interface of the HYPERANGE data acquisition and guidance system. The HYPERANGE system operates on 100 msec. interrupts which enables it to log data at that time interval. The DE-719B transmit pulses are also based on 100 msec. intervals. For this survey, Oceanprobe has logged each individual sounding on 9-track magnetic tape.

D.3 Operation

The holiday area depths varied from 80 to 400 feet. The DE-719 was generally run on the following scales:

Depth Range
0 to 55 Feet
50 to 105 Feet
100 to 155 Feet
150 to 205 Feet

Between 200 and 400 foot depths, the DE-719B was operated at the X2 scale mode. This mode doubled the depth ranges selected.

The IT-412 was operated at a maximum sounding update rate of 10 soundings per second. (100 millisecond updates).

The DE-719B and IT-412 operated as independent units - start/stop signals were separated. The DE-719 activated the transducer pulse and this pulse was transmitted to the depth digitizer as the "start" pulse. The returning acoustic pulse burned the graphic record and

also was transmitted to the digitizer as the "stop" pulse. An oscillator circuit determined the elapsed time and displayed it as a digital value converted to feet.

In practice, depths which are scaled from the analog record are subject to errors from:

1. Stylus belt rotation speed (cal.zero and speed of sound controls)

2. Initial setting (tide & draft control)

Digital soundings are subject to errors from:

1. Speed of sound oscillator circuit frequency (sound velocity control)

2. Digital draft setting (draft control)

It should be noted that improper adjustment or setup of one instrument does not adversely affect the operation of the other instrument. If the DE-719 is incorrectly adjusted, it will not alter the reading of the digital depth; if the depth digitizer is out of adjustment, this will not change the analog depth which is being recorded.

Prior to this survey, Oceanprobe installed a switch on the back of the IT-412. This double throw- double pole switch had two positions: "NORMAL" and "NOAA". In the normal position, the IT-412 circuits and controls were unaltered. In the "NOAA" position, two IT-412 functions were altered:

1. Draft setting. The switch removed a capacitor from a timing board, and inserted a much smaller capacitor in its place. This substitution had the effect

of holding the draft value to zero. Any manipulation of the draft setting on the front panel of the IT-412 would have no effect.

2. Sound velocity. The "NOAA" position disabled the variable oscillator circuit from the sound velocity determination function. In its place a crystal-controlled oscillator provided a constant 24 KHz to the circuit which translated exactly to 4800 feet per second sound velocity. Any manipulation of the sound velocity setting on the front panel of the IT-412 would have no effect.

D.4 Static Draft - HEYBOY

The static draft was measured by Ken MacDonald using a steel surveyor's tape on 5 October, 1985 as 1.60 feet. This static draft was added to the observed analog and digital depths, when completing the direct comparison log. The bar check abstracts therefore include static draft.

D.5 Settlement & Squat - HEYBOY

A settlement and squat determination was performed on the M/V HEYBOY on JD279 (October 6, 1985), from the boat ramp at the head of Burlington Bay. Ken MacDonald operated a Topcon GTS-2B total station from ashore, while Paul Kronfield held a Philadelphia-type rod on the back deck of HEYBOY. The vessel approached Capt. MacDonald's position at a constant engine speed of 1300 RPM. This speed was the only speed used on the survey. A height of 10.35 feet was observed at this speed, observed on two runs. After these observations, HEYBOY

came dead in the water, and another reading was made by Captain MacDonald. A height of 10.30 feet was observed. We therefore indicate a -0.1 foot settlement and squat corrector for our hydrography.

This method of determining settlement and squat is as described in HM 4.9.4.2 (level instrument and rod readings).

D.6 Direct Comparisons

For our hydrography, two bar checks were obtained - once prior to hydrography on JD279, and immediately upon completion of hydrography on JD280. Our bar check was performed to a depth of 50 feet, and although we had no soundings in these shallow depths, we felt the bar checks were valuable and necessary to check the continuity of proper operation of echosounder and digitizer, to check the analog-digital differences, and to check the results of our XBT drop data.

For this bar check the identical check bar used for the 1984 hydrography was deployed. This check bar was a 2-foot diameter circular aluminum plate with numerous holes drilled to allow some passage of water, and weighted with three lead diver weights. This circular plate was raised and lowered by a single steel cable connected to three short 2-foot length steel cables from which the plate was suspended.

The check bar line was marked at 5 foot intervals, to 80 feet. On JD277 (4 October 1985), Captain Ken MacDonald and Paul Kronfield measured this line with a Lufkin steel surveyor's tape on a flat surface at the Edna G. dock in Two Harbors' Agate Bay. Our measurments were from the top of the plate to the center of taped markings.

Our findings were as follows:

Line Marking (Ft)	Taped (Ft)
5	4.98
10	10.00
15	15.02
20	20.02
25	25.05
30	30.02
35	35.02
40	40.02
45	45.01
50	50.06
55	55.05
60	60.06
65	65.04

During our two bar checks, one man lowered and raised the check bar plate at 5-foot intervals. Paul Kronfield observed and recorded the digital depths - the analog depths were scaled later in the processing center. A frequency meter was used to monitor the oscillator frequency of the "NOAA" position option. The frequency was maintained within ± 0.5 Hertz of 24 KHz by this crystal controlled circuit. This circuit maintained the speed of sound setting at exactly 4800 feet per second.

D.7 Other Instrument Corrections

Digital Draft. The IT-412 depth digitizer minimum draft setting is 0.2 feet. Our field change with a smaller value capacitor in the draft circuit sets, and holds, this value to 0.0 feet. There was no major difference noticed between analog and digital readings during this survey bar checks. No other instrument corrections were noticed or applied.

D.8 Depth Digitzer

Innerspace Technology Model 412 "Autotrack" s/n 009.

This depth digitizer independently receives the "start" and "stop" signals from the DE-719B and coverts the elapsed time to depth.

Two controls normally affect the digital result:

1. DRAFT Control

Normally, a potentiometer allows the hydrographer to set a value of draft into the depth display, which corresponds to the static draft. By NOAA practice, this value must be set to zero. The value can be checked at any time by turning a display switch. Ordinarily, in order to set any desired draft value, the pot is turned until the desired draft value is displayed. At this point the pot is locked so it cannot be turned accidentally. Our addition of a field change allowing constant, unaltered zero setting was utilized for this project.

2. SOUND VELOCITY Control

Normally, a potentiometer allow the hydrographer to adjust the timing circuit oscillator so that it produces a frequency corresponding to a known or measured sound velocity. This potentiometer knob is a ten-turn marked knob.

Standard NOAA practice directs the hydrographer to set all sound velocities to a constant 4800 feet per second and for soundings to be later corrected for ambient sound velocities in processing. The

IT-412 digitizer timing circuit must be maintained at 24 Khz, corresponding to a two-way travel time of 4800 feet/second. Our field change previously described introduced a stable, crystal-controlled frequency of 24 Khz directly to the sound velocity circuit. This frequency was constantly monitored by the Fluke frequency meter, and drift was observed at less than ± 0.5 Hz.

D.9 Not Applicable

D.10 Not Applicable

D.11 Not Applicable

D.12 Not Applicable

D.13 Instrument Correction

Per HM and AMC OPORDER 84, instrument correction was applied to analog insert soundings and to missed digital depths.

D.14 Velocity of Sound Determinations

As the survey area was extremely small, and water depths were relatively deep, the deeper sound velocity determinations were critical. In addition, the lake turnover of water column could be in progress, further making an accurate determination of sound velocities in the deeper portions of the survey area very important.

For this task, Oceanprobe deployed our in-house Sippican MK-9 XBT (s/n 840210) instrument interfaced with our HP-85 computer. The ground connection at the rear of the MK-9 was attached to a braided grounding strap and trailed over the side.

On JD277 (October 4, 1985), a test XBT (T-10 probe) drop was performed in 150 feet of water in Burlington Bay. This was a test probe to assure the Sippican MK-9 instrument was operating properly. The test was successful, and the data was saved as backup data should it be required.

On JD279 (6 October 1985), at 16.14 UTC an XBT cast was attempted in 400 feet of water off Burlington Bay in the holiday area. The position of the drop was:

Lat. : 46° 59' 16.26" N
Long.: 91° 39' 14.81" W

This drop failed. It was discovered the grounding strap was not in contact with the water. Another attempt was made with our last probe. This drop was successful. The drop was labelled position number 3004 at 16:24:42 UTC in 331 feet of water in the holiday area near Burlington Bay at position:

Lat. : 46° 59' 33.07" N
Long.: 91° 39' 14.75" W

The probe identifier for this drop on the HP-85 data tape was 3. A quick scrutiny of the data indicated a sharp positive thermocline in the top meter of water column with a slight negative gradient developing from 5 meters depth to 50 meters. Thereafter the water column appeared isothermal. Temperature variations in the upper layers indicated some turnover of the water column. Maximum variation in temperature from 5 meters depth to the bottom was less than 1 degree Celcius.

D.15 Corrections to Echo Soundings

AMC OPORDER 84, plus HM 4.9.1, 4.9.4, and 4.9.5 were used as guidelines in developing and abstracting the various correctors. Workpapers of Paul Kronfield in developing the velocity correctors are included in the data delivery.

E. HYDROGRAPHIC SHEETS

Track plot sheets and preliminary field data sheets were plotted at the Houston processing office by the IDSI HYPERANGE data acquisition system. The HYPERANGE-recorded data were downloaded to the Oceanprobe HP-1000 Fortran-based computer on the 9-track reel-to-reel tape drive, and plotted on paper using our 36-inch Houston Instruments drum plotter. Working charts were plotted at the same scale used for the field sheet.

HYPERANGE calculates and plots data on the geoid. All data input and output of the HYPERANGE system are in terms of latitude and longitude.

HEYBOY mainscheme hydrography and electronic control stations are plotted on the field sheet.

F. CONTROL STATIONS *See sections 2 of the Evaluation Report*

Most hydrographic control stations were established specifically for this project on a 1984 traverse which was run along the shoreline by Seaway Engineering Company of Duluth. The 1984 traverse was closed and adjusted between existing NGS stations (JERN, SPLIT, SPLIT ROCK, LIND BACKMAN, and PION). Based upon field review of data, this traverse meets third-order, class 1 standards.

For this holiday survey of 1985, an additional horizontal control point was cut in by Capt. MacDonald. Station WAGNER 1985 was set, and field observations were completed 2 October 1985. WAGNER was intersected from stations CHURCH 1984, and COON 1984, and the distances, CHURCH-WAGNER, and COON-WAGNER, were measured with a Topcon Geodetic total station, GTS-2B.

The coordinates of WAGNER 1985 were computed using the line CHURCH-WAGNER. A description for WAGNER 1985 is submitted, and recovery notes are submitted for CHURCH 1984, COON 1984, DART 1984, and ALDER 1984. Zenith distances were observed to WAGNER 1985 from CHURCH 1984 and COON 1984. Abstracts are submitted.

For this holiday survey, Oceanprobe proposed, and was given permission for, controlling the hydrography by range-range methods using Miniranger Falcon-484 system, provided Oceanprobe provide at least 3, and preferably 4 shore stations in good angle. In addition, due to the fact that the scale of survey was specified to be 1:5,000, Oceanprobe was required to ensure that any positions determined having range residuals exceeding 2 meters, would be discarded. On this survey very few residuals exceeded 2 meters. In fact, the majority of the residuals computed, were less than one meter.

It was decided to survey an additional horizontal control point at the head of Burlington Bay in order to facilitate the optimum angle of intersecting LOP's.

G. HYDROGRAPHIC POSITIONING CONTROL *See section 2. of the Evaluation Report.*

The launch HEYBOY was positioned and controlled by the range-range method. Ranges were supplied by a Motorola Falcon 484.

Further details are in the Project Report: Electronic Position-Fixing, a copy of which can be found in Appendix D.

H. SHORELINE *See section 2.b. of the Evaluation Report*

Not applicable for this holiday survey.

I. CROSSLINES *See section 3.a. of the Evaluation Report.*

For this holiday survey, crosslines were chosen to agree in spacing with those of the 1984 mainscheme hydrography. The intersecting angle was altered slightly for the 1985 work in order to: 1) not obscure the previous year's crosslines when overlayed, and 2) to parallel the depth contours more closely. Agreement was outstanding, both in this 1985 holiday survey, and with the 1984 mainscheme hydrography.

J. JUNCTIONS *See section 5. of the Evaluation Report.*

This holiday survey was required to join the hydrography of H-10150 (1:20,000) (1984) on the east, with H-10153 (1:10,000) (1984) on the west. Mainscheme lines on H-10150 ran fully through the holiday area, which further substantiated our data.

K. COMPARISON WITH PRIOR SURVEYS *See section 6. of the Evaluation Report.*

As documented in section J (above) comparisons were made with mainscheme hydrography accomplished by Oceanprobe on sheets H-10150 and H-10153 in 1984. There was excellent agreement with all soundings.

L. COMPARISON WITH THE CHART *See section 7. of the Evaluation Report.*

The 1985 holiday survey was compared to Chart 14966 (19th Edition / Jan. 83). This chart is 1:10,000 inset of Two Harbors.

In general, the chart compares poorly outside the breakwater. The chart soundings represent almost all the prior survey soundings available. Thus, the chart does not adequately depict the depth contours outside the harbor.

Recommendation

It is recommended that the Two Harbors inset be revised totally, to reflect the 1984 and 1985 survey results. In addition, in 1985 it was observed that structures and features in the northwestern and western areas of Agate Bay have been totally altered and/or demolished since 1984. The nearshore soundings, detached positions, shoreline verification, and PSR items in this area no longer apply and should not be considered as accurate for the new addition of the chart. We feel that a two-man field party should be able to update these areas in 7 days for an accurate addition of the new chart addition.

M. ADEQUACY OF SURVEY

The holiday survey is sufficiently complete and adequate to complete the junction between H-10150 (1984) and H-10153 (1984).

N. AIDS TO NAVIGATION *See section 7.b. of the Evaluation Report*

Not applicable for this 1985 holiday survey.

O. STATISTICS

Total number of positions	345
Lineal n.m. of mainscheme hydrography	7.56
Lineal n.m. of development hydrography	0.00
Lineal n.m. of crosslines	1.95
Number of bottom sample stations	0

Water level stations	1
XBT casts	2
Bar checks	2

P. MISCELLANEOUS

This work was undertaken very late in the season, and weather was a factor in the execution of the survey, and in the quality of the data. There was some heave evident in the records, but never exceeded the guidelines specified in the Statement of Work and the Hydrographic Manual. Missed traces were also noted by the hydrographer, but these occasions were on hydrographic lines used to overlap with the previous year's hydrography, thus for the purpose of checking our 1985 hydrography with that of 1984, and for effecting a junction, the data quality was sufficiently good.

Q. RECOMMENDATIONS

We recommend additional field work prior to the production of the new edition of Chart 14966. Sheet H-10153, an important inset of the Agate Bay / Two Harbors port is no longer accurate in the turning basin area shoreline as port construction has dramatically altered the shoreline features and depths. The shoreline verification work done in this area in 1984 is no longer valid. At the time we were performing the 1985 holiday survey, we noticed a large crane was removing all structures on the western shore of the harbor, and the small boat ramp was likewise removed. As this harbor is likely the most important item on the Chart insofar as large shipping, we recommend a two-man hydrographic party be sent to Two Harbors for approximately one week to document the changes to the harbor for inclusion in the new edition of the Chart.

R. AUTOMATED DATA PROCESSING

R.1 Automated Data Processing

Sounding data was collected by M/V HEYBOY, using the HYPERANGE integrated navigation and data acquisition system. The HYPERANGE recorded raw sounding and positioning data on 9-track magnetic tape, as it was received. Raw data was logged every 100 milliseconds and was time-tagged.

Please refer to Project Report Electronic Positioning System (Appendix D) for a more detailed description of the HYPERANGE system hardware and software.

R.2 Hydrographic Data Acquisition - HEYBOY

The sequence of our hydrographic activity on October 6 is outlined below, in order to acquaint NOAA processors and verifiers with the particulars of this survey.

M/V HEYBOY was rigged on the evening of October 5 at Knife River Marina by Paul Kronfield, Donald Baecker, and Captain Ken MacDonald. Captain MacDonald drilled holes in the side of HEYBOY and mounted the transducer bracket using screws. Kronfield and Baecker loaded the equipment aboard and ran cables. The following were installed aboard:

Raytheon DE-719B Echo Sounder
Innerspace IT-412 Digitizer
Integrated Data Systems HYPERANGE multi-processor unit
Teletype keyboard control unit and printer
CRT monitor for helmsman
Motorola Miniranger Falcon-484 Range Processor
Falcon-484 CDU
Sippican MK-9 XBT
Hewlett-Packard HP-85
Hewlett-Packard HP-41CV with survey pac

Survey prism assembly
Philadephia rod
"Dry" diving suit
Check bar and measured line

The Miniranger receiver/transmitter unit was installed on a pipe rigged from the roof of the HEYBOY cabin, directly over the position of the transducer.

On October 6, 1985 Kronfield and Baecker boarded HEYBOY and the vessel was underway at 07.13 hrs. All electronic equipment was warmed up enroute. Captain MacDonald was connecting batteries at our four chosen horizontal control Miniranger stations: ALDER 1984, COON 1984, WAGNER 1985, and CHURCH 1984. Captain MacDonald also set up the TOPCON total station at an offset location from CHURCH 1984.

At 08.53 HEYBOY arrived at Burlington Bay and anchored in 59 feet of water off CHURCH 1984 location. There was a brisk wind blowing from the south, with heavy chop and swell. A bar check was executed, and data quality was poor due to vessel motion and the relatively shallow water.

From 09.16 to 09.20 an electronic positioning systems calibration check was conducted. We performed this check by holding a surveying prism assembly against the pipe supporting the Miniranger R/T unit. The prism was directly beneith the R/T, and pointed at Captain MacDonald ashore, who shot the prism with the Topcon total station. By radio, Captain MacDonald signalled when he had an accurate fix and the HYPERANGE system executed an event at this signal, also the mirrors were turned away from the TOPCON, thus freezing the range display on the total station. Captain MacDonald radioed the distance and bearing to Kronfield aboard HEYBOY.

Kronfield utilized the survey pac and the HP-41CV to compute the X-Y state plane coordinates of the vessel from the distance-bearing data relayed from ashore. The Traverse program was used for this calculation, and the vessel was treated as a sideshot. Once X-Y data was computed, Kronfield again used an HP-41CV program to convert from Minnesota state plane to geographic coordinates. These computed geographic coordinates were compared with those computed by the HYPERANGE from the Miniranger 3-way fix solution.

The results of this check verified accurate calibration of the Falcon-484 system:

Position Number	Total Station	HYPERANGE
3001	47-01-22.19 91-38-39.11	47-01-22.22 91-38-39.05
3002	47-01-22.30 91-38-39.32	47-01-22.26 91-38-39.32
3003	47-01-22.20 91-38-39.13	47-01-22.18 91-38-39.13

The anchor was retrieved while Capt. MacDonald broke down the EDM total station. HEYBOY proceeded to the boat launching ramp and dock to pick up Captain MacDonald, then headed for deep water in the holiday area. At 10.14 hrs. in 400 feet of water an XBT attempt was made. This probe failed when the MK-9 grounding strap was not in contact with the water. At 16.23 hrs. our last XBT probe was deployed and was successful in 330 feet of water.

Prior to commencement of hydrography, the end-points or "waypoints" of the intended lines were entered into the system, and the waypoints were selected. The CRT monitor then displayed the line number, present real-time latitude/longitude, distance along line, distance off line, azimuth, depth, and real-time computed speed.

The helmsman steered for zero distance off line. The teletype unit printed events selected at 20 seconds, in a line containing Julian day, UCT time, latitude, longitude, speed, track, range 1, residual 1, range 2, residual 2, range 3, residual 3, range 4, residual 4, event (position) number, depth, and engine rpm.

Just before the vessel reached the starting point of the line, the HYPERANGE system initiated six line-up events spaced at 25 meters to assist the helmsman in achieving proper and accurate steering. The line-up events also are evident on the analog record. All hydrographic and positioning data was entered serially on a data bus, at 100 millisecond intervals, and during the 20-second event period, the 9-track tape wrote all data existing on the bus.

Paul Kronfield operated the echo-sounder, including changing scales, annotating event marks with position number, and adjusting the gain. Kronfield also operated the IT-412 and the Falcon-484 system. Don Baecker operated the HYPERANGE, deleted station ALDER 1984 just prior to losing signal around the Burlington Bay headland, and entered new waypoint coordinates. Ken MacDonald annotated in the Sounding Volume and observed the operation.

Throughout most of the hydrography, the swell was heavy from the southeast. We quickly found out the best direction for running the hydrographic lines was with a following sea. We attempted one hydrographic line into the sea, and experienced heavy heave on the record and heavy rolling. In addition, this line was not held on the line as we wished. This line was resurveyed in the opposite direction with good results.

At this point we intended to survey additional short lines at the northern portion of the holiday in an east-west direction. The echo-sounder failed, however, at 15.09 hrs. This was most disappointing as the wind had dropped and the sea was laying down nicely. Captain MacDonald reviewed the hydrographic data gathered so far and judged the holiday was adequately covered with good junctions to the 1984 hydrography. It was imperative that the echosounder be repaired so that a good bar check could be achieved. Therefore, it was decided to conduct settlement and squat tests, perform an electronic positioning systems calibration check, and then attempt to repair the Raytheon for a bar check. Captain MacDonald was dropped off at the dock and settlement and squat determinations were conducted with the total station and the Philadelphia rod as described previously. Upon completion of this Capt. MacDonald returned to CHURCH 1984 and set up the total station for the calibration check.

At 16.15 the calibration check commenced. HEYBOY was adrift near CHURCH 1984 for this check. The results showed excellent agreement:

Position Number	Total Station	HYPERANGE
3344	47-01-28.65 91-38-40.84	47-01-28.64 91-38-40.84
3345	47-01-29.34 91-38-42.34	47-01-29.36 91-38-42.40
3346	47-01-30.25 91-38-43.09	47-01-30.35 91-38-43.14

After this successful check, Captain MacDonald broke down the total station and drove to our cabins at Castle Danger for our oscilliscope for troubleshooting the Raytheon. The oscilliscope revealed the transmitter circuits were providing the transducer with proper pulses, and the transducer cable had no obvious de

fects. We then discovered a cold solder joint on the transducer plug. After re-soldering the plug the unit worked excellently.

While there remained some daylight it was decided to dismantle the Miniranger Universal Reference station at WAGNER 1985. This site is very isolated required a difficult Ø.5 mile hike on a rugged rocky and pebbly beach. In order to save Captain MacDonald the trouble of packing out one hundred pounds of batteries, and the tripod with the Miniranger station, Kronfield donned his dry suit and swam ashore, towing a small skiff, while HEYBOY stood off a short distance. Kronfield loaded the skiff with the batteries, cables, tripod and reference stations. He held the skiff with one hand and a line to the HEYBOY with his other. Personnel aboard HEYBOY then pulled Kronfield back to the launch and assisted in unloading the skiff.

After nightfall, at 19.ØØ hrs. HEYBOY arrived at an appropriate location in the holiday area with 128 feet of water under the keel. A bar check was conducted - the data quality of this bar check was outstanding.

HEYBOY was underway from Burlington Bay at 19.46 hrs. for its Knife River Marina berth. The vessel was derigged by 22.ØØ hrs. and personnel returned to Castle Danger for the evening.

R.3 Automated Data Reduction

The 9-track magnetic tape recorded on board HEYBOY in Lake Superior was returned to the Houston processing center and mounted on the HP-1ØØØ tape drive. A fortran program was compiled to extract the raw data as an

ASCII dump. This printout was used for editing of the data for accuracy and completeness. Another fortran program extracted the raw data and restructured it in the desired NOAA format.

The analog echogram, trackplot, teletype printout, and sounding volumes were used to reduce and edit the hydrographic data, and then produce the field sheet and final data tape.

R.4 Tape Records

Oceanprobe followed the procedures described below for correcting soundings:

1. Soundings associated with bad positioning data were deleted. These deletions included those few times when range residuals exceeded 2 meters.

2. Incorrectly digitized soundings were corrected.

These procedures were done and approved in the 1984-5 processing sequence of the 1984 data. The authorization letter was included in the 1984 descriptive reports.

The result was a master digital file containing:

Time
Raw Positioning Data
Geographic Locations of signals
Raw Soundings
Analog Soundings not initially recorded online

S. REFERRAL TO REPORTS

The following Project Reports with supporting field notes and records were submitting to Atlantic Marine Center.

1. Horizontal Control
2. Electronic Position-Fixing
3. Automated Data Processing (HYPERANGE)

Personnel from Oceanprobe, Inc. performed the hydrographic and geodetic field work. Data processing, reduction, editing and production of the field sheet and report were accomplished by Oceanprobe, Inc.

This report was written, and is respecfully submitted by:

Paul H. Kronfield
Oceanprobe, Inc.
Chief of Party

Dated: October 31, 1985

OCEANPROBE

APPROVAL SHEET

Oceanprobe completed delivery of processed data on Sheet H-10150 to AMC by December 3, 1984. Initial data processing was carried out by a subcontractor. In February of 1985, AMC determined that data did not meet Government specifications and returned it to Oceanprobe. Oceanprobe took final delivery of all data on Feb. 26, 1985. The data was corrected by Oceanprobe through the assistance of Integrated Data Systems Inc. and delivered corrected data to AMC on April 1, 1985. In September, 1985, NOAA determined that all data would be acceptable if Oceanprobe would return to the field and fill a small holiday area 0.1 n.m. wide. This holiday was caused by the negligence of a subcontractor, whose contract with Oceanprobe was subsequently terminated. On October 4, 1985, Oceanprobe deployed a hydrographic survey team to Lake Superior.

A new horizontal control station was monumented and surveyed. Oceanprobe utilized a range-range system for survey on this sheet, a procedure that deviated from ordinary NOAA practice - this method was approved in advance by NOAA. Hydrography was accomplished on October 6, 1985.

Data processing was accomplished at Integrated Data Systems Inc. in Houston, Texas.

I was involved on a full time basis on this survey from the initial work throughout 1984, and in particular, on this 1985 holiday survey. I personally reduced and processed all data on this holiday, and I certify that it is highly accurate and complies with NOAA hydrographic specifications, International Hydrographic specifications, and the specifications delineated in the Oceanprobe contract with the Government.

OCEANFROM

I strongly recommend that a survey party resurvey the shoreline in Agate Bay prior to updating the nautical chart of this area as extensive construction work has changed all shoreline verification in this area.

I approve of this field sheet and all accompanying records for completeness and accuracy in accordance with the Statement of Work.

Paul H. Kronfield
Chief of Party

OCEANPROBE

SIGNAL LIST

NUM	STA.NAME	YEAR	LATITUDE	LONGITUDE	ELEV	
001	ALDER	1984	46-59-48.9027	91-42-57.0328	185.6	3.0
002	COON	1984	47-00-54.9803	91-39-37.4380	186.2	3.0
003	WAGNER	1985	47-01-42.5310	91-39-23.3040	186.4	4.0
004	CHURCH	1984	47-01-33.3602	91-38-44.4379	185.0	2.0

The following established horizontal control stations were recovered for this 1985 holiday survey.

Station Name	Year Established	Signal List
ALDER	1984	Yes
COON	1984	Yes
CHURCH	1984	Yes

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

WATER LEVEL NOTE FOR HYDROGRAPHIC SHEET

Processing Division: Atlantic Marine Center : N/MOA231

Hourly heights are approved for: Two Harbors, MN (909-9070)
Water Level Station

Period: October 6, 1985

HYDROGRAPHIC SHEET: H-10153

OPR- Z137-OP-85

Locality: Lake Superior

Plane of reference: Low Water Datum (IGLD 1955 600.0 Feet)

Remarks:

Zoning not required, data from other gages on Lake Superior indicates no unusual water level movement during the survey period.

Harry A. Lippincott
Chief, Great Lakes Acquisition Unit

NOAA FORM 76-155
(11-72)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

GEOGRAPHIC NAMES

SURVEY NUMBER

H-10153

Name on Survey	A ON CHART NO. 14966	B ON PREVIOUS SURVEY NO.	C ON U.S. QUADRANGLE MAPS	D FROM LOCAL INFORMATION	E ON LOCAL MAPS	F P.O. GUIDE OR MAP	G RAND MCNALLY ATLAS	H U.S. LIGHT LIST	K	
AGATE BAY										1
LAKE SUPERIOR										2
MINNESOTA (title)										3
TWO HARBORS										4
BURLINGTON BAY										5
										6
										7
										8
										9
										10
										11
										12
										13
										14
										15
										16
					Approved:					17
					Charles E. Harrington					18
					Chief Geographer - N/CG2x5					19
										20
					DEC 16 1986					21
										22
										23
										24
										25

NOAA FORM 76-155 SUPERSEDES C&GS 197

HYDROGRAPHIC SURVEY STATISTICS
REGISTRY NO.: H-10153

Number of positions	1841
Number of soundings	9329
Number of control stations	21

	TIME-HOURS	DATE COMPLETED
Preprocessing Examination	37	01/11/86
Verification of Field Data	454	09/24/86
Quality Control Checks	157	
Evaluation and Analysis	153	03/16/87
Final Inspection	61	03/10/87
TOTAL TIME	862	
Marine Center Approval		03/17/87

Transmittal letter of survey and survey records will be included in the Descriptive Report to identify the records accompanying the survey.

ATLANTIC MARINE CENTER
EVALUATION REPORT

SURVEY NO.: H-10153 FIELD NO.: OP-5-1-84

Minnesota, Lake Superior, Two Harbors

SURVEYED: 22 August through 1 October 1984 and 6 October 1985

SCALE: 1:5,000 PROJECT NO.: OPR-Z137-OP-84

SOUNDINGS: RAYTHEON DE 719B Fathometer and Pole Soundings

CONTROL: FALCON 484 and Target Digital Transit (Range/Azimuth), FALCON 484 (Range/Range), and LEITZ DSM3E Total Station (Shoreline)

Chief of Party.....P. H. Kronfield

Surveyed by.....D. Baeker
.....K. MacDonald
.....R. Zaunere
.....J. Hudson
.....R. Frost
.....C. Erni
.....A. Sibold

Automated Plot by.....XYNETICS 1201 Plotter (AMC)

1. INTRODUCTION

a. A holiday existed on the eastern side of the 1984 survey work resulting in insufficient overlap for an adequate junction with H-10150 (1984). Hydrography was completed in October 1985, and an adequate junction was made along the eastern side. A separate Descriptive Report is included under one cover.

b. No unusual problems were encountered during verification.

c. Notes in the Descriptive Report were made in red during office processing.

2. CONTROL AND SHORELINE

a. The control is adequately discussed in sections F., G., S., and Appendices D. and E. of the 1984 and 1985 Descriptive Reports. Appendices D. and E. are included with the original field data.

b. The shoreline originates with the 1:5,000 scale enlargement of class III final reviewed photogrammetric shoreline manuscript TP-00082 of 1982. A part of the shoreline on the eastern side of Agate Bay in the vicinity of Latitude 47°00'56"N, Longitude 91°39'56"W was revised during office processing using notes and drawings from the hydrographer's Sounding Log (Vol 2, page 11). The revisions are shown in red on the present survey. There are no additional shoreline changes shown on the present survey.

3. HYDROGRAPHY

a. Soundings at crossings agree within the criteria stated in sections 4.6.1. and 6.3.4.3. of the HYDROGRAPHIC MANUAL, and section 3.3.1.6.3. of the Statement of Work (SOW).

b. The standard depth curves could not be drawn in their entirety. The zero (0) and six (6) foot curves could not be delineated because of their proximity to shore and vessel safety. The charted 24-foot supplemental depth curve was also drawn. Dashed and brown curves were added to better show bottom topography.

c. Development of bottom configuration and determination of least depths is considered adequate with the following exceptions:

1) Line spacing in Agate Bay in the vicinity of Latitude 47°00'55"N, Longitude 91°40'06"W should have been reduced from the standard spacing of 50 meters to 25 meters to better delineate the 30-foot curve.

2) Additional hydrography should have been conducted in the vicinity of Latitude 47°00'45"N, Longitude 91°39'25"W where a holiday exists on the present survey. A mainscheme line was run, but the hydrographer did not change scales on the fathometer, and the trace was not recorded on the fathogram in this area.

4. CONDITION OF SURVEY

The smooth sheet, accompanying overlays, hydrographic records, and reports are adequate and conform to the requirements of the HYDROGRAPHIC MANUAL with the following exceptions:

a. A negative report on dangers to navigation was not included in section L. of the Descriptive Report as required by section 3.3.1.13. of the SOW. A danger to navigation was found on the present survey, and was forwarded to the appropriate Coast Guard District and National Ocean Service offices. A copy is appended to the Descriptive Report. See also section 6.f. of this report.

b. The velocity tables submitted were not properly scaled. New velocity graphs and tables were constructed, and filed with the data package during office processing.

c. TC/TI correctors were submitted in error. Instrument error was determined at 80 feet. The instrument error should have been determined at 20 feet. This was corrected during office processing.

d. The hydrographer did not verify or locate numerous charted items. These items and charting recommendations are discussed in sections 6. and 7.a. of this report.

e. It would have been desirable for bottom samples to be taken on shoal features as required by section 4.5.9.2. of the HYDROGRAPHIC MANUAL.

f. The hydrographer's statements in section D.14., paragraphs three and four on page 19 of the Descriptive Report may not constitute a valid departure, re: sections 1.4. and 1.5. of the SOW. No documented confirmation from NOAA was apparent with the survey records submitted. Bar checks alone to 80 feet should have been supplemented by oceanographic observations to determine corrections to depths surveyed. See section 3.3.1.7.2. of the SOW.

g. The hydrographer did not obtain a position for the least depth on the wreck "ELY".

h. It would have been desirable for the hydrographer to have described the three wrecks located by the field unit during the development of AWOIS Item #3062.

i. Lines perpendicular to the depth curves should have been run in the vicinity of Latitude 47°00'55"N, Longitude 91°40'32"W to provide a better delineation of the depth curves between the piers.

5. JUNCTIONS

H-10150 (1984) to the east, south and west

Changes have been made to the present survey depth curves during the evaluation and inspection phases of office processing. These changes are not shown on survey H-10150 (1984). The smooth sheet for survey H-10150 (1984) is archived at headquarters in Rockville, Maryland, and a standard junction could not be made. In this case, the note "ADJOINS" has been shown on the present survey smooth sheet. The chart compiler should be cognizant of this situation and resolve the differences during the chart compilation process.

There is a holiday approximately 600 meters by 300 meters between the present survey and H-10150 (1984) in the vicinity of Latitude 47°01'15"N, Longitude 91°39'15"W. This area is not considered adequately developed by the present survey. A crossline was run during development of H-10150 (1984), but the hydrographer did not change scales on the fathometer, and the trace was not recorded on the fathogram in this area. A smaller holiday also exists between the western side of the present survey and H-10150 (1984) in the vicinity of Latitude 47°00'31"N, Longitude 91°40'52"W. With these exceptions, an excellent junction was effected between the present survey and H-10150 (1984).

6. COMPARISON WITH PRIOR SURVEYS

LS-254 (1861) 1:16,000
LS-1754 (1938) 1:15,000
LS-1765 (1941) 1:5,000
LS-2049 (1954) 1:5,000

Prior survey LS-254 (1861) has no grid, and many of the soundings are not legible because of the condition of the prior survey and the quality of reproduction. Considerable cultural change has occurred since the prior survey was conducted. Considering the time between surveys and the cultural changes, a comparison between the prior survey and the present survey was not practical.

Prior survey LS-1765 (1941) was completed shortly after prior survey LS-1754 (1938). Soundings and cultural features inside the breakwater on LS-1765 (1941) originate with a 1941 instrumental survey. Soundings outside the breakwater originate from a photographic enlargement of chart 968, edition of February, 1914. Soundings on LS-1765 compare well with the present survey with soundings inside Agate Bay agreeing within plus or minus (+/-) five feet. In the area noted as 26 feet Project Depth, present survey soundings are now 28 to 50 feet. Present survey soundings adjacent to piers 1 and 2 are three (3) to six (6) feet deeper than the prior survey, and soundings adjacent to pier 6 are one (1) to eight (8) feet shoaler. Present survey soundings outside of Agate Bay are 10 to 20 feet shoaler than the prior survey soundings.

In addition the following should be noted:

a. Two charted depths of 17-ft and 18-ft in the vicinity of Latitude 47°00'54.2"N, Longitude 91°40'29.0"W and Latitude 47°00'53.7"N, Longitude 91°40'26.0"W originate with prior survey LS-1765 (1941) and were neither verified nor disproved by the present survey. The two depths were brought forward from the prior survey to supplement the present survey. It is recommended that the charted depths of 17-ft and 18-ft be retained as charted.

b. The charted foul limits in the vicinity of Latitude 47°00'54.5"N, Longitude 91°40'39.5"W originate with LS-1765 (1941) as pier ruins. The area was verified by the hydrographer as foul(pier ruins) baring 2 feet above LWD. It is recommended that the charted foul limits be revised and charted as shown on the present survey.

c. The charted five piles centered in the vicinity of Latitude 47°01'03"N, Longitude 91°40'32"W originating with LS-1765 (1941) were located, and the area developed by the hydrographer. It is recommended that the charted five piles be revised to foul and charted as shown on the present survey.

d. The group of piles shown on prior survey LS-1765 (1941) along the north shore of Agate Bay in the vicinity of Latitude 47°01'02"N, Longitude 91°40'23"W was not discussed by the hydrographer. The shoreline has accreted in the area, and the hydrographer mentions that the shoreline in this area is riprap. Charted shoreline in this area agrees well with the present survey. No change in charting status is recommended.

e. AWOIS Item #3063 is an obstruction, charted as a row of visible piles 50 meters long in the vicinity of Latitude 47°00'57"N, Longitude 91°40'00"W. The obstruction originates with prior survey LS-1765 (1941) as a pier 130 meters long. A diver investigation was conducted, and one line of hydrography was run in the area with negative results. The hydrographer states that during the investigation of AWOIS Item #3062, a submerged crib, two of three shipwrecks serving as crib foundations for piers were located, and that one in Latitude 47°00'57.32"N, Longitude 91°39'59.98"W is part of AWOIS Item #3063. This is in the same area as the offshore end of the charted row of piles. It is recommended that the charted row of piles be revised to submerged piles as shown on the present survey. The remaining offshore end of the pier (80 meters) shown on the prior survey was not brought forward to the present survey because the area has been dredged by the Corps of Engineers. Prior survey depths of 16 to 21 feet are now 29 to 31 feet as shown on the present survey. See also section 7.a.12) of this report for discussion and recommendation of AWOIS Item #3062.

f. An uncharted submerged obstruction in the vicinity of Latitude 47°00'46.0"N, Longitude 91°40'09.5"W was located and developed by the hydrographer and found to be the submerged ruins of a portion of the old east breakwater shown on prior survey LS-1765 (1941). An echosounder least depth of 30 feet was obtained over the obstruction in Latitude 47°00'45.32"N, Longitude 91°40'09.37"W. The limits were extended on the present survey during office processing because hydrography

indicates the remains extend further north than the hydrographer shows on the final field sheet. It is recommended that an obstruction (breakwater) with the legend LD 30 feet and limits be charted as shown on the present survey.

Prior survey LS-2049 (1954) has no soundings within the common area. Cultural features and shoreline within the area originate with a 1954 instrumental survey, LS-1765 (1941), and a 1944 instrumental survey.

The present survey is considered adequate to supersede the above listed prior surveys except as noted in this report.

7. COMPARISON WITH CHART 14966 (19th Ed., Jan. 15/83)

a. Hydrography

The charted hydrography originates with the previously discussed prior surveys which need no further consideration and miscellaneous sources.

In addition, the following information is directed to the attention of the chart compiler on charted items not adequately addressed by the hydrographer.

1) Numerous natural features outside the high water line were located by the hydrographer during the survey. It is recommended that these features be charted as shown on the present survey.

2) AWOIS Item #2391 is an obstruction (two submerged piles with a least depth of 5 feet charted in the vicinity of Latitude 47°00'41.5"N, Longitude 91°40'42.0"W. The piles originate with a 1963 revisory survey and first appeared on chart 14966 in 1964. The hydrographer states that the two charted submerged piles are part of the wreck "ELY" and in the next paragraph of the Descriptive Report states that nothing was found (See page 29 of the Descriptive Report). The hydrographer also states in the Diver Report that two large twin bits located on the port bow of the wreck could be mistaken for submerged piles. It is recommended that the two submerged piles, LD 5 feet be deleted from the chart. Discussion and charting recommendations for the wreck "ELY" are in sections 7.a.4) and 7.a.5) of this report.

3) AWOIS Item #3057 is a charted visible pile in Latitude 47°00'41.5"N, Longitude 91°40'40.5"W originating with an unknown source. The item first appeared on the 17th edition of chart 14966 in 1976 and is believed to have been charted in error. The hydrographer conducted a visual search

with negative results. It is recommended that the visible pile be removed from the chart.

4) An uncharted dangerous submerged wreck was located and developed by the hydrographer in the vicinity of Latitude 47°00'42.5"N, Longitude 91°40'40.5"W. Local divers confirmed this to be the three masted schooner "ELY". The bow and stern were located by the hydrographer in Latitude 47°00'42.95"N, Longitude 91°40'41.55"W, and Latitude 47°00'42.03"N, Longitude 91°40'38.70"W, respectively. A least depth of 5 feet at LWD was obtained on the wreck. It is recommended a dangerous submerged wreck that covers 5 feet at LWD be charted as shown on the present survey.

5) The hydrographer located uncharted wreckage in Latitude 47°00'43.72"N, Longitude 91°40'43.56"W which was identified as a portion of the schooner "ELY". It is recommended that a visible wreck be charted in the position shown on the present survey. The hydrographer determined an elevation of 2 feet above LWD on the wreckage.

6) The charted area uncovering in the vicinity of Latitude 47°00'56"N, Longitude 91°40'38"W was not discussed by the hydrographer. Present survey depths of 6 to 18 feet are in this area. It is recommended that the charted area uncovering be removed from the chart, and present survey depths be charted.

7) AWOIS Item #3058 is a wreck charted in Latitude 47°01'01.6"N, Longitude 91°40'22.5"W originating with aerial photographs (BP105637 of May 1978). Local information describes the wreck as an old barge that was removed in 1980. The wreck is not presently charted on the latest edition of chart 14966 (19th Ed., Jan 15/83). No change in charting status is recommended.

8) The charted Overhead Cable in the vicinity of Latitude 47°01'01.6"N, Longitude 91°40'21.2"W was neither verified nor disproved by the hydrographer. The overhead cable is not shown on Shoreline Manuscript TP-00082. It is recommended that the Overhead Cable be retained as charted unless other information supports the authority for its removal.

9) The thirteen (13) charted piles along the north shore of Agate Bay from Longitude 91°40'16"W to Longitude 91°40'29"W are dolphins originating with prior survey LS-2049 (1954). The hydrographer located ten (10) of the piles, and these are shown on the present survey. It is recommended that the piles be charted as dolphins in the positions shown on the present survey.

One (1) charted dolphin in Latitude 47°01'01.1"N, Longitude 91°40'22.8"W originating with LS-2049 (1954) was neither verified nor disproved by the hydrographer. The dolphin was brought forward from the prior survey to the present survey as a submerged dolphin. It is recommended that the charted dolphin be revised to a submerged dolphin and charted as shown on the present survey unless other charting information supports the authority for its removal.

The two (2) charted dolphins in in the vicinity of Latitude 47°01'01.5"N, Longitude 91°40'24.5"W nearest the shoreline, originate with an unknown source and were neither verified nor disproved by the hydrographer. It is recommended that the two (2) charted dolphins be revised to submerged dolphins.

10) AWOIS Item #3059 an obstruction, pier in ruins charted in the vicinity of Latitude 47°00'59.7"N, Longitude 91°40'10.0"W originates with aerial photography of May 1978. The item was located by the hydrographer and determined to be submerged pier ruins. The entire pier is now submerged pier ruins. A depth of 5 feet at LWD was obtained on the pier ruins in Latitude 47°01'00.01"N, Longitude 91°40'10.01"W. It is recommended that the charted pier and pier ruins be revised to submerged pier ruins and charted as shown on the present survey.

11) The charted area uncovering in the vicinity of Latitude 47°00'59"N, Longitude 91°40'04"W was not discussed by the hydrographer. Present survey depths of 9 to 11 feet are in this area. It is recommended that the area uncovering be removed from the chart and present survey depths be charted.

12) AWOIS Item #3062 is an obstruction (submerged crib) charted in Latitude 47°00'58.4"N, Longitude 91°40'00.6"W that originates with a 1963 revisory survey and first appeared on the 1964 edition of chart 14966. A visual search was conducted, and two lines of hydrography 75 feet apart were run with negative results. The hydrographer also stated that no "exposed structure" was seen during a visual inspection of the shoreline by the diver. This investigation is inadequate, and it is recommended that the submerged crib be retained as charted.

During the search for AWOIS Item #3062 the hydrographer located two of three uncharted submerged shipwrecks in a line serving as foundations for piers. A least depth of 3 feet was obtained on two of the wrecks in Latitude 47°00'57.32"N, Longitude 91°39'59.98"W and Latitude 47°00'57.75"N, Longitude 91°40'00.58"W. These are 36 meters and 20 meters, respectively, south, southeast of the the charted submerged crib (AWOIS Item #3062). It is believed

the third wreck that the hydrographer did not locate is possibly the charted submerged crib. It is recommended that the two wrecks located by the hydrographer be charted as obstructions with a depth of 3 feet at LWD as shown on the present survey. Limits were also drawn around the wreckage during office processing. It is recommended that the foul limits be charted as (wreckage) as shown on the present survey.

13) Two of the three charted rocks in the vicinity of Latitude 47°00'56.0"N, Longitude 91°39'57.5"W were located by the hydrographer in Latitude 47°00'56.29"N, Longitude 91°39'57.16""W and Latitude 47°00'56.07"N, Longitude 91°39'56.72"W. The northernmost rock charted in the vicinity of Latitude 47°00'56.8"N, Longitude 91°39'57.6"W was neither verified nor disproved by the hydrographer. It is recommended the two charted rocks located by the hydrographer be revised to the position shown on the present survey and the third rock be retained as charted.

14) It is recommended that the charted piers along the eastern shore of Agate Bay from Latitude 47°00'58"N, Longitude 91°39'58"W to Latitude 47°00'54"N, Longitude 91°39'57"W be revised and charted as shown on the present survey.

15) The charted foul limit in the vicinity of Latitude 47°00'52"N, Longitude 91°39'57"W was not discussed or investigated by the hydrographer. Two rocks baring two (2) feet at LWD were located within the foul area in Latitude 47°00'52.26"N, Longitude 91°39'57.19"W and Latitude 47°00'52.09"N, Longitude 91°39'57.41"W. It is recommended that the charted foul limits be deleted from the chart and the two rocks located by the hydrographer be charted as shown on the present survey.

16) The charted dolphins at the end of pier No. 2, in Latitude 47°00'53.5"N, Longitude 91°40'16.5"W, were neither verified nor disproved by the hydrographer. It is recommended that the dolphins be retained as charted.

17) The two charted dashed limits in the vicinity of Latitude 47°00'47.9"N, Longitude 91°39'55.8"W and Latitude 47°00'47.6"N, Longitude 91°39'55.0"W on the shore end of the east breakwater were neither verified, nor disproved by the hydrographer. These limits delineate an area of submerged rubble. Present survey depths within the limit lines are 4 to 14 feet inside the breakwater, and 8 to 12 feet outside the breakwater. It is recommended that the dashed limits be retained as charted unless other charting information supports the authority for their removal

18) The present survey shows 85 meters of the shore end of the east breakwater as rubble. Construction in this area has been completed with the breakwater now entirely concrete. This was confirmed during a telephone conversation with Mr. Keith Baribeau of the U. S. Army Corps of Engineers in Duluth, Minnesota [Tel. (218) 720-5260]. A charting resolution is deferred to the chart compiler. It is recommended that the "as built drawings" be referred to for the correct delineation of the east breakwater.

19) The two (2) rocks charted in the vicinity of Latitude 47°00'47.3"N, Longitude 91°39'51.8"W were neither verified nor disproved by the hydrographer. A rock originating with TP-00082 in Latitude 47°00'47.6"N, Longitude 91°39'51.7"W is in agreement with the northernmost of the two charted rocks. It is recommended that the position of the most northerly rock be revised to correspond to the position shown on the present survey and that the southerly rock be retained as charted.

20) AWOIS Item #3064, a charted PWI with a legend Depth over Crib 30-ft in Latitude 47°01'07.2"N, Longitude 91°39'30.4"W, originates with a 1972 revisory survey. The hydrographer's position of the crib on the smooth field sheet is approximately 50 meters northwest of the charted position, and is apparently in error. During office processing, fathometer traces were reexamined for indications of the pipeline to the crib. It was determined that the direction of the pipeline was in agreement with the charted pipeline. It was also found that the observed angle to the crib was misread by one degree (1°). With this correction, fathogram traces, and information provided by the hydrographer, a corrected position of Latitude 47°01'07.11"N, Longitude 91°39'31.28"W was determined for the crib. An echosounder least depth of 17 feet was obtained over the crib. It is recommended that the position of the charted PWI be revised to the position found by the present survey, and the legend be revised to LD 17 ft.

21) AWOIS Item #3065, a charted PWI with a legend LD 60 ft. in Latitude 47°01'02.7"N, Longitude 91°39'28.3"W, originates with a 1966 revisory survey. The hydrographer located the crib in Latitude 47°01'04.14"N, Longitude 91°39'27.15"W, 50 meters northeast of the charted position. An echosounder least depth of 42 feet was obtained over the crib. It is recommended that the position of the charted PWI be revised to the position found by the present survey, and the legend be revised to LD 42 ft.

Except as noted above, the present survey is adequate to supersede the charted hydrography in the common area.

b. Aids to Navigation

There are four (4) fixed, and three (3) floating aids to navigation on the survey smooth sheet. These aids appear adequate to serve their intended purposes.

8. COMPLIANCE WITH INSTRUCTIONS

This survey adequately complies with the Project Instructions except as noted elsewhere in this report.

9. ADDITIONAL FIELD WORK

This is an adequate basic survey. Additional work is recommended based on statements made by the hydrographer in sections L. and Q. of the 1985 Descriptive Report.

for Leroy G. Cram

Douglas V. Mason
Cartographic Technician
Verification of Field Data

Richard H. Whitfield

Richard H. Whitfield
Cartographer
Evaluation and Analysis

Robert R. Hill

Robert R. Hill
Senior Cartographic Technician
Verification Check

ADDENDUM TO ACCOMPANY SURVEY H-10153

The average values for shifting surveyed NAD 1927 positions to NAD 1983 positions for this survey are as follows:

Position shifts (NAD 1983 minus NAD 1927):
Average latitude shift = -0.222 seconds = -6.9 meters
Average longitude shift = 0.640 seconds = 13.5 meters

INSPECTION REPORT
H-10153

The completed survey has been inspected with regard to survey coverage, delineation of depth curves, development of critical depths, cartographic symbolization, and verification or disproval of charted data. The digital data have been completed and all revisions and additions made to the smooth sheet during survey processing have been entered in the magnetic tape record for this survey. Final control, position, and sounding printouts of the survey have been made. The survey complies with National Ocean Service requirements except as noted in the Evaluation Report. The survey records comply with NOS requirements except where noted in the Evaluation Report.

Inspected

R. G. Roberson
Chief, Evaluation and Analysis Group
Hydrographic Surveys Branch

for R. W. Sanoski
David B. MacFarland, Jr., CDR, NOAA
Chief, Hydrographic Surveys Branch

Approved: 17 March 1987

Ray E. Moses, RADM, NOAA
Director, Atlantic Marine Center

Number	Hydrographer	Scale	Date
9960	F.P. Rossi	10,000	1981
10024	D.E.Nortrup, W.S.Simmons	20,000	1982
10036	W.S. Simmons	50,000	1982
10043	" " "	20,000	1982
10096	" " "	20,000	1983
10100	" " "	20,000	1983
10103	" " "	20,000	1983
10094	" " "	50,000	1983
[illegible]95	" " "	20,000	1983
[illegible]53	F. P. Rossi	5,000	1981
10141	R.W. Jones	5,000	1984
9979	F. P. Rossi	20,000	1981
10152	R.W. Jones, K.W. Perrin	10,000	1985-86
10144	P.H. Kronfield	20,000	1984
10150	" " "	20,000	1984
10156	" " "	5,000	1984
10147	D.L. Suloff	5,000	1984
10148	" "	10,000	1984
10153	P.H. Kronfield	5,000	1984-85

CAUTION

Due to periodic high water conditions in the Great Lakes, some features charted as visible at Low Water Datum may be submerged, particularly in the near shore areas. Mariners should proceed with caution.

LORAN LINEAR INTERPOLATOR

MICROSECONDS

FEET

YARDS

METERS

STATUTE MILES

Latitude and Longitude Plotting Interpo

LS-9

NOAA FORM 75-96
(10-83)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

MARINE CHART BRANCH

RECORD OF APPLICATION TO CHARTS

FILE WITH DESCRIPTIVE REPORT OF SURVEY NO. H-10153

INSTRUCTIONS

A basic hydrographic or topographic survey supersedes all information of like nature on the uncorrected chart.

1. Letter all information.
2. In "Remarks" column cross out words that do not apply.
3. Give reasons for deviations, if any, from recommendations made under "Comparison with Charts" in the Review.

CHART	DATE	CARTOGRAPHER	REMARKS
14960	6-11-90	Ed Martin	Full ~~Part Before~~ After Marine Center Approval Signed Via
			Drawing No. 6
14961	6-11-90	Ed Martin	Full ~~Part Before~~ After Marine Center Approval Signed Via
			Drawing No. 6
14966	9-23-93	C. STANWARD	Full ~~Part Before~~ After Marine Center Approval Signed Via
			Drawing No. 6
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
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			Full Part Before After Marine Center Approval Signed Via
			Drawing No.

SUPERSEDES C&GS FORM 8352 WHICH MAY BE USED.

app'd to STDs 10-5-87 [illegible]