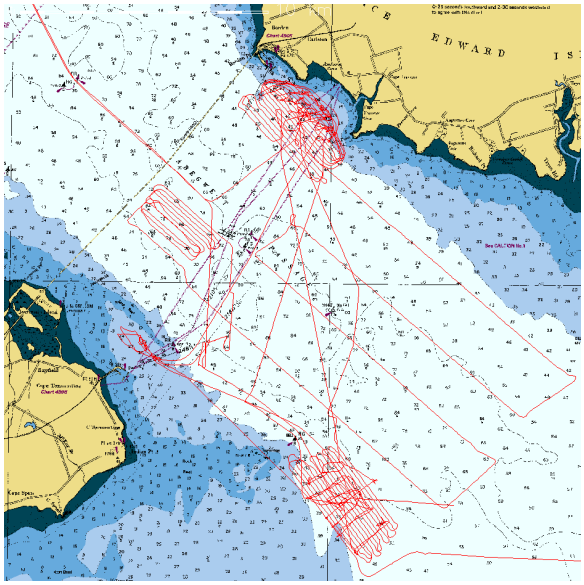
GEOLOGICAL SURVEY OF CANADA
OPEN FILE 4982

Cruise Matthew 2001065
Geophysical Surveys and Sampling Operations in the Northumberland Strait and Saint John NB
23 October – 7 November 2001



D. R. Parrott

2010

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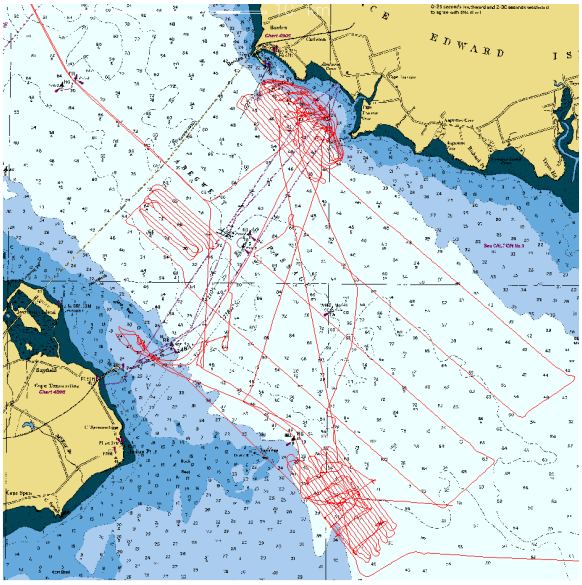

D.R. Parrott

2010

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Background

Survey *Matthew* 2001065 was conducted from 21-29 October 2001 southeast of Confederation Bridge in the Northumberland Strait. Geophysical data, seafloor samples, and seafloor photographs and videos were collected from the CCGS *Matthew* (Fig. 1a). These data were used to provide information on the character and distribution of seafloor sediments, and the geological and oceanographic processes which have affected the seafloor over marine disposal sites at Amherst Cove, PEI, Cape Jourimain, NB and near Cape Tourmentine NB. Multibeam bathymetry data were collected with a Simrad EM3000 system, mounted in the survey launch Plover (Fig. 1b), at these three offshore disposal sites in the Northumberland Strait, and along the Confederation Bridge.

a)

b)

Figure 1. The geophysical survey and seafloor sampling program were performed using (a) the CCGS *Matthew*. Multibeam bathymetry was conducted using the survey launch Plover (b) equipped with a Simrad EM3000 multibeam bathymetry system.

Geophysical equipment used during the survey consisted of a Simrad MS992 dual frequency (120 and 330 kHz) sidescan sonar system, an IKB Seistec sub-bottom profiler, and a QTCView seafloor classification system. Sediment samples were collected with a VanVeen grab sampler and a small gravity corer, and bottom photographs were taken along transects through the survey area. Video transects were made at the three disposal sites using a small hand deployed video camera. A track plot showing lines where geophysical data and samples were collected, and transit between stations, in the Northumberland Strait during survey *Matthew* 2001065 is shown in Figure 2.

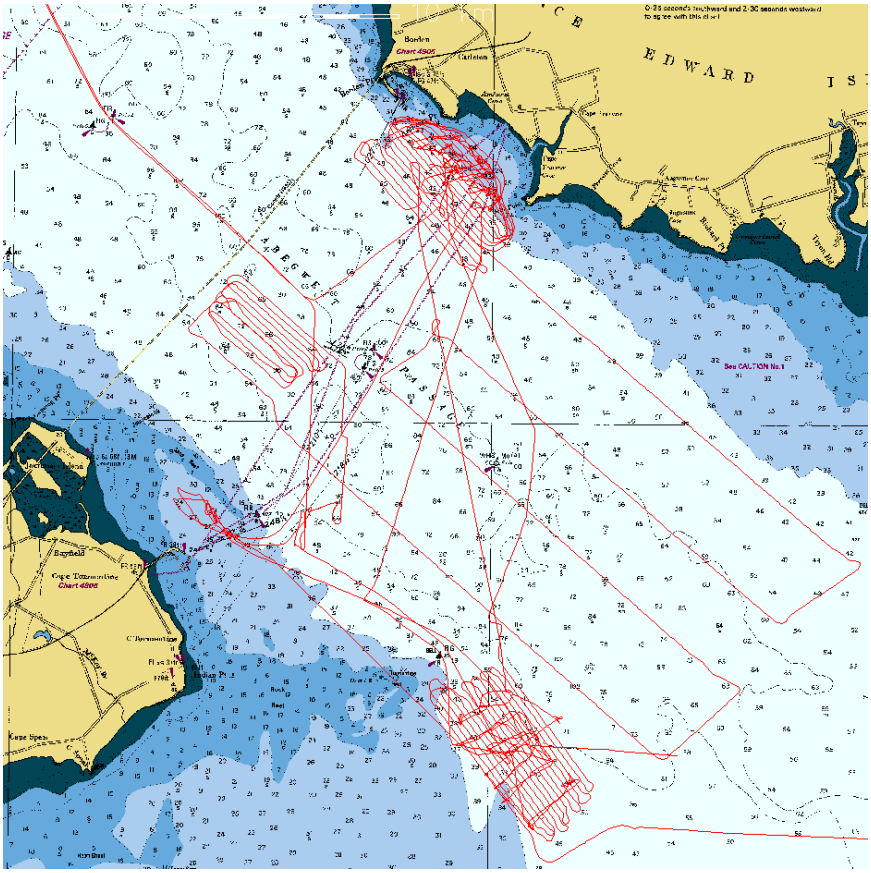

Figure 2. Trackplot showing lines where geophysical data and samples were collected, and transit between stations, in the Northumberland Strait during survey Matthew 2001065.

After completion of the multibeam bathymetry survey work in the Northumberland Strait, the hydrographic survey launch Plover was transported by truck to Saint John, NB. A multibeam bathymetry survey of the Black Point offshore disposal site in the approaches to Saint John Harbour, NB was performed from 30 October to 7 November 2001.

Previous Work

Survey *Matthew* 2001065 collected data over sites originally surveyed by Dr. Carl Amos of the Geological Survey of Canada in 1995. Survey Hart 95140 collected geophysical, photographic and sample data at offshore disposal sites in the Northumberland Strait as shown in Figure 3. Amos also conducted a survey near the site of the proposed Confederation Bridge to provide background geological and benthic information on the seafloor prior to construction of the bridge. Details of the previous survey are provided in Amos et al, 1995.

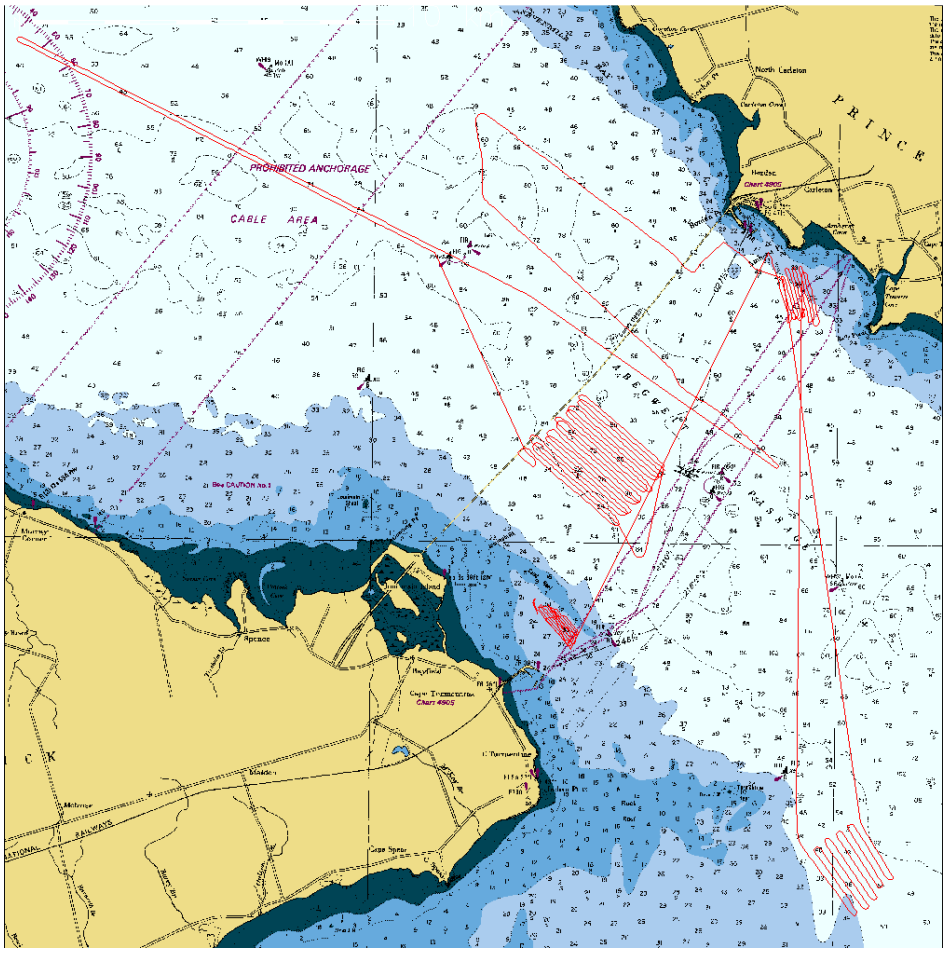

Figure 3. Trackplot showing lines where geophysical data were collected in the Northumberland Strait during survey Hart 95140.

Data Acquisition and Processing

The following geophysical and sampling equipment was used during survey *Matthew* 2001065:

- Simrad MS992 sidescan sonar system in a neutrally-buoyant tow configuration
- IKB Seistec high resolution sub-bottom profiler
- AGCDIG 4 channel digital geophysical data acquisition system
- ORE TrackPoint II ultra short baseline towfish positioning system
- Regulus survey navigation package with input from differential GPS
- Simrad EM3000 multibeam bathymetry system
- Linux workstations running GRASS with GSCA extensions
- Caris HIPS multibeam bathymetry data cleaning software running on Windows NT
- GSCA icehole camera
- Hand deployed video camera
- VanVeen grab sampler
- Small gravity corer

Sidescan sonar

High-resolution, acoustic images of the seabed were produced with a Simrad MS992 dual frequency (120 and 330 kHz) sidescan sonar system mounted in a neutrally-buoyant towbody and deployed 13 metres behind a dead weight depressor (a 120 kg. iron blister weight on a swivel) as shown in Figure 4. The towfish was deployed about 50 metres behind the vessel. This configuration was chosen to reduce artifacts seen on the sidescan sonar records due to vessel-induced heave, and thereby improve resolution. The sidescan sonar system was capable of resolving objects down to a size of about 0.15 m. An ORE TrackPoint II acoustic position system was used to position the towfish. A hardcopy graphic record of the 330 kHz portion of the sidescan sonar data was produced on an Alden 9315CTP thermal recorder set for a fixed speed of 1.7 knots. This produced records with a 2 to 1 aspect ratio at the slowest survey speeds of 3.5 knots. A hardcopy graphic record of the 120 khz portion of the sidescan sonar data was produced on an EPC Labs GSP1086-2 thermal recorder.

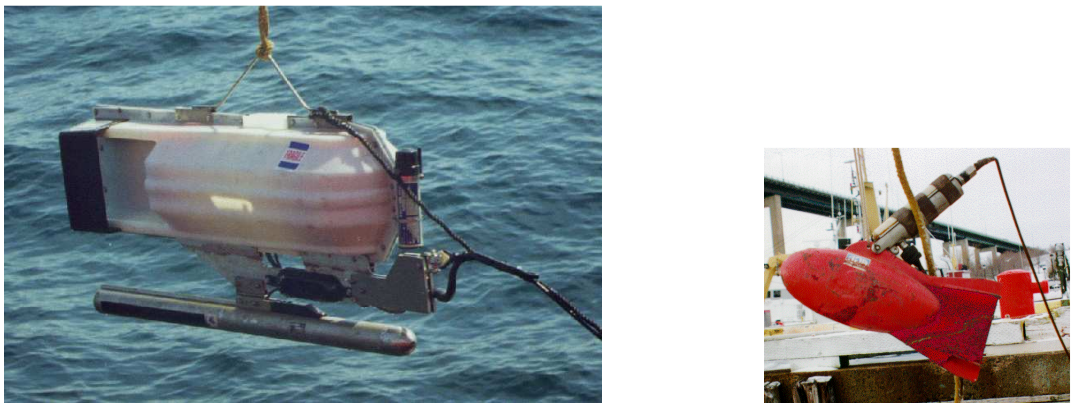

Figure 4 Neutrally buoyant sidescan sonar towfish (shown on the left) and deadweight depressor used by GSCA. The towfish was towed about 13 metres behind the deadweight depressor. The TrackPoint II beacon is visible on the front of the towfish.

The sidescan sonar data were collected at 100 metre range for lines near the disposal sites and at 200 metre range for lines outside the primary disposal sites. This provided swaths of 200 and 400 metres respectively. Lines run at the 100 m range were typically 75 or 100 metres apart, with a 300 metre spacing used for the 200 metre range lines.

Sidescan sonar data from survey *Matthew* 2001065 (both 120 and 330 kHz) were collected digitally using an AGCDIG digitizer with version 2.3 software. A sample interval of 80 microseconds was used. 3400 samples per ping were collected at 200 metre range and 1700 samples at the nominal 100 metre range setting. Digital gain settings for the sidescan sonar system and digitizers were logged on field sheets. During the survey, data were imported into a Linux workstation at a resolution of 0.35 metres (across track). The seafloor was detected and slant range and beam corrections were applied to the raw data to remove geometric distortions present in sidescan sonar data. The data were integrated with navigation and imported into the GRASS GIS system at 0.5 metre resolution for data near the disposal site and 1.0 metre resolution for regional data. The sidescan sonar data from adjacent survey lines were integrated to produce a sidescan sonar mosaic. A variable layback, based on towfish positions from the TrackPoint II positioning system, was applied to the sidescan sonar data.

IKB Technologies Seistec Sub-bottom profiler

An IKB Technologies Seistec high-resolution, sub-bottom profiler system was used to map the thickness and structure of materials on the sea floor and provide information on the genesis of the sediments. The system uses an electrodynamic (boomer) source to produce a repeatable impulse-like output which provides vertical resolution of 0.25 metre or better. The Seistec system was equipped with an internal line-and-cone array and an external streamer. The boomer and line-and-cone array are contained in a small catamaran as shown in Figure 5. The external streamer was attached to the front of the catamaran, so that the lead-in section of the streamer was positioned under the boomer and line-and-cone array with the receiving elements trailing behind the catamaran. The catamaran was deployed by crane on the starboard side of the vessel and towed on the port side at the surface. The system was fired 2 times per second, or faster, and graphic records were displayed on a thermal graphic recorder. The power supply to the boomer was operated at a nominal setting of 175 Joules. Graphic records were printed on an EPC9800 recorder set for 125 millisecond scans in two channel mode. Data were sampled at a 38 microsecond interval for 124 milliseconds to provide 3845 samples per channel. Bandpass filtered signals were recordered. External steamer data were filtered at 1000 to 7000 hertz.

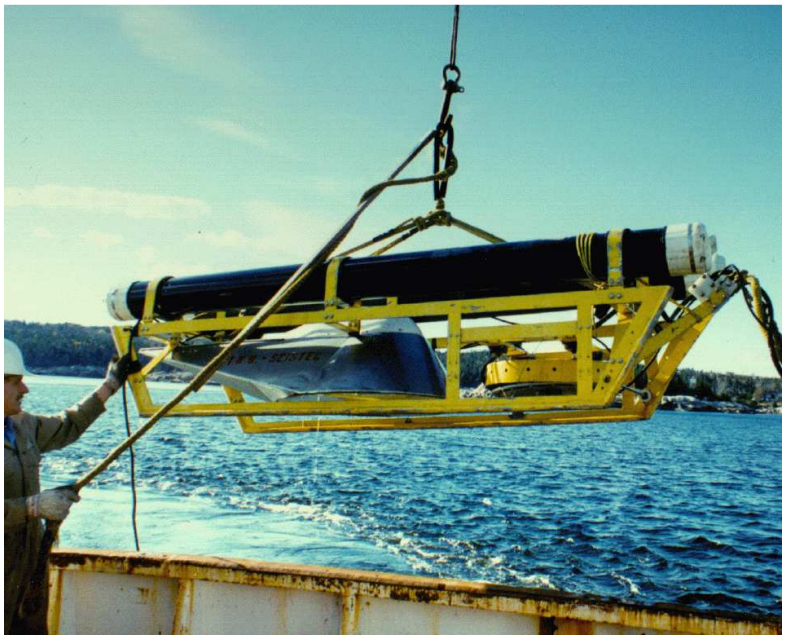

Figure 5. Seistec sub-bottom profiler showing the catamaran used to tow the boomer and line-and-cone array at the surface. Power and signals are contained in the tow cable bundle on the front of the catamaran.

Digital data acquisition

The sidescan sonar and sub-bottom profiler data were digitized and logged on an AGCDIG digital data recorder, developed by the Geological Survey of Canada (Atlantic), running version 2.3 software. The clock in the AGCDIG was synchronized to the GPS time signal. No gains or corrections were applied by the digitizer to the raw logged data. Channel configurations for the logged data were:

Sidescan sonar - 80 microseconds sample interval

Channel	Use
0	120 kHz port
1	120 kHz starboard
2	330 kHz port
3	330 kHz starboard

Sub-bottom profiler – IKB Seistec - 38 microseconds sample interval

Channel	Use
0	STB Seistec line cone receiver
1	STB GF10/15P streamer hydrophone

Navigation
Navigation was provided by a Global Positioning System utilizing differential corrections broadcast by the Canadian Coast Guard station at Western Head. Accuracy of the navigation was approximately 4 m. Tracks and survey lines were run with the Regulus navigation package by ICAN Limited, Mount Pearl, NF.

Multibeam Bathymetry
Multibeam bathymetric data were collected using a Simrad EM3000 multibeam bathymetry system mounted in the hydrographic survey launch Plover (Figure 2b). The EM3000 system uses a 300kHz transducer with 127 beams with a beamwidth of 1.5^o x 1.5^o. The system provides a depth resolution of 1 cm with an accuracy of 5 cm RMS. Each beam insonifies an area of approximately 1.35 m^2 at 50 metres water depth.

The Plover used an Applied Analytics Corporation POS-MV 320 attitude sensing system with integrated differential GPS navigation system to determine the position and attitude. The systems integrate data from an inertial measurement unit and differential GPS signals. A positional accuracy 0.5 to 4 metres can be obtained using the phase differential of the GPS carrier frequency when using DGPS, and of 0.02-0.10 metres when using an RTK source. This survey was performed using DGPS data for an accuracy of 0.5 to 4 metres. A heading aiding accuracy of 0.1^o - 0.5^o can be obtained from the raw GPS data. A Kalman filter is used to improve the heading estimate to 0.05^o - 0.1^o. Vessel attitude is measured using an inertial measurement unit to provide an accuracy of 0.0003^o for pitch, roll and heading. More information on this system can be found at www.applanix.com.

Survey lines were run at a various spacing throughout the survey area to provide 200 percent coverage of the seafloor in water depths greater than about 20 metres. During the survey, data were processed using version 5.0 of the HIPS data cleaning program (CARIS by Universal Systems Limited, Fredericton, NB) on a Windows NT workstation to remove spurious soundings and navigation data and to correct for tidal variations. Data were also imported into a Linux based workstation and processed using the MBTools software developed by the Lamont-Doherty Institute. The processed data were imported into the GRASS GIS system where shaded-colour relief images were generated and overlaid on scanned bathymetry maps of the area. After the survey, the data from the Saint John harbour survey were reprocessed by the Ocean Mapping Group of the University of New Brunswick to remove residual tidal and refraction errors, for comparison with previous high-resolution multibeam bathymetry sureys.

Tidal corrections were made using predicted tides for Point Borden and measured tides from the tide gauge in Port Borden PEI provided by the Canadian Hydrographic service.

Multibeam backscatter
The strength of an echo from the seafloor is known as the acoustic backscatter intensity. Acoustic backscatter intensity values are controlled by the physical properties of the seafloor sediments such as the velocity of sound, the density and roughness of the sediment. Backscatter generally increases as the sediments on the seafloor become denser and less porous, and increase in grain size. Mapping the distribution of backscatter provides valuable information on the character and distribution of sediments within an area.

Seafloor Photographs
Photographs were taken at 47 camera stations off Saint John Harbour (about 300 photographs in total) with the “Icehole” camera developed by GSCA (shown in Figure 6). Images were obtained on transects through the disposal site and surrounding area using 200 ASA colour print film. The

photographs were processed, digitized, and stored on CD-ROM. Locations for all camera stations are shown in Figure 7, and provided in Appendix IV. The photographs are shown in Appendix VI.

Figure 6. GSCA “Icehole” camera showing the flash on the left of the frame, the pinger in the centre and the camera case on the right of the frame. The cable for the bottom contact trigger weight is hanging from the left end of the camera case.

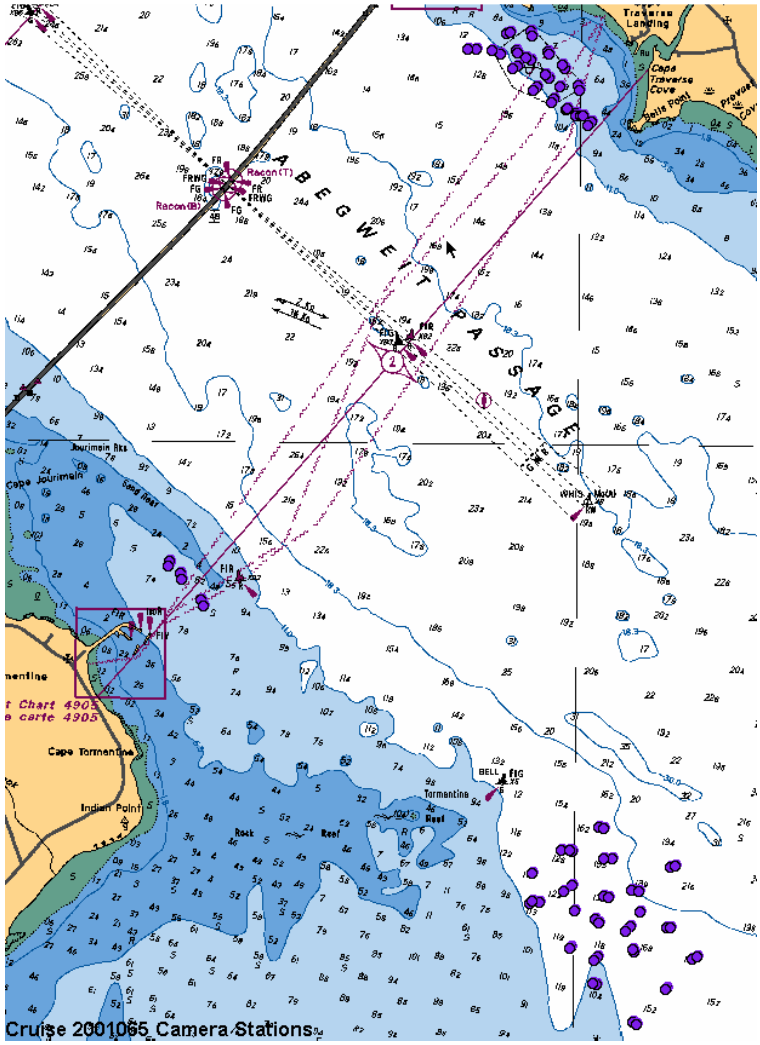

Figure 7. Location of seafloor photographs (shown by the purple dots) taken during survey Matthew 2001065 in October 2001. The positions are provided in Appendix IV.

Video transects

Video transects were performed using the a small hand deployed video camera which consisted of a small underwater video system with a pan and tilt system, and an underwater light assembled in a lightweight aluminum frame (Figure 8). A vane was used to align the frame with the currents. Data were recorded on a standard video cassette recorder. The camera was hand deployed from the port side of the CCGS *Matthew* and the length of cable adjusted to keep the camera within 0.5 metres of the seafloor. Transects were made in Amherst Cove, near Cape Jourimain and Cape Tormentine.

Figure 8. Video camera showing the protective cage and vane used to keep the camera aligned with the current. The system was hand deployed near the seafloor in depths to about 25 metres – as shown in the image to the right.

Seafloor Grab Samples

A 0.1 cubic metre VanVeen grab sampler was used to collect 44 sediment samples in the survey area. The sample locations are shown in Figure 9and are provided in Appendix IV. Digital images were taken of most of the grabs and are contained as 'hotlinks' in an ArcView GIS data base. Low resolution copies of all available grab sample images are presented in this report in Appendix V.

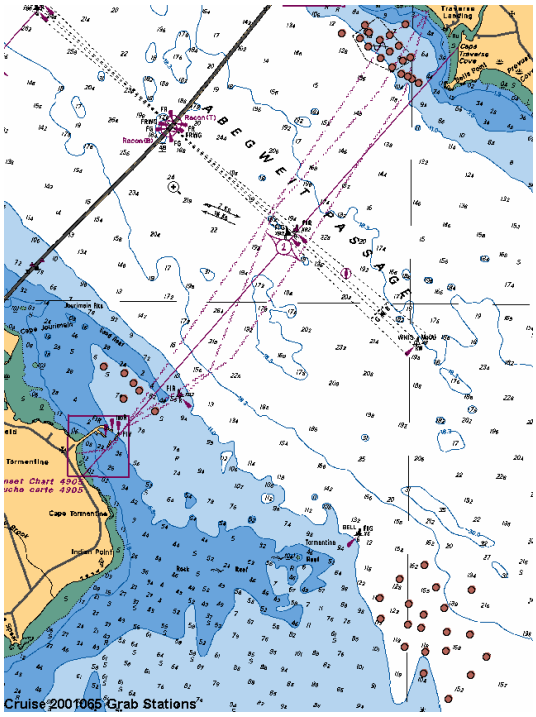

Figure 9. Location of grab samples (shown by the red dots) taken during survey Matthew 2001065 in October 2001.

Tides and Currents

During the survey, tides and currents for the survey area were calculated using the program Tides and Currents Pro by Nautical Software Inc. As shown in Figures 10 and 11, a tidal range of about 2 metres was predicted for Cape Tormentine during the survey, with currents of about 0.7 knots predicted for Abegweit Passage.

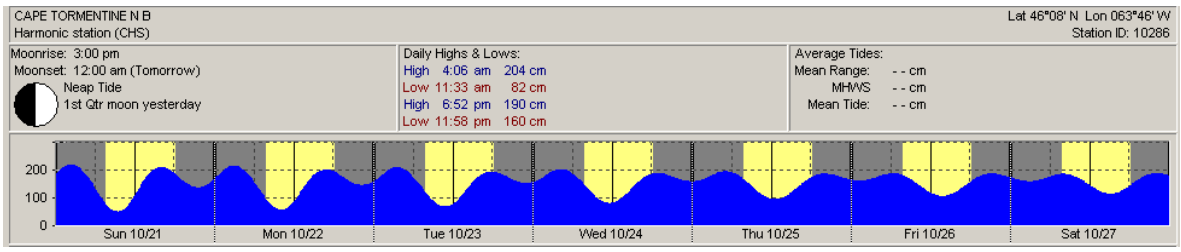

Figure 10. Predicted tides for Cape Tormentine during October 2001.

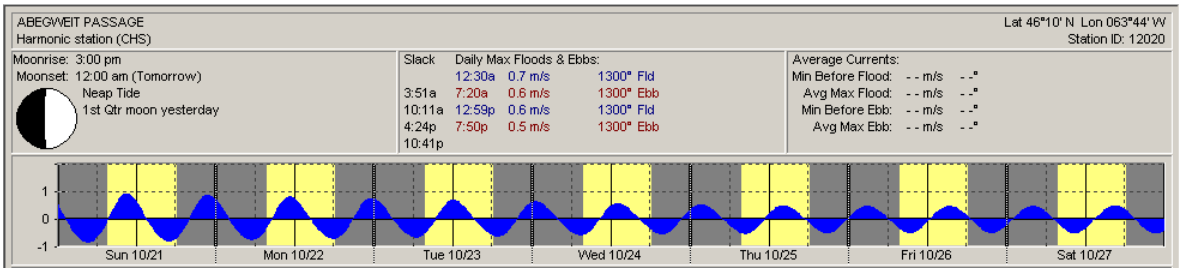

Figure 11. Predicted currents for Abegweit Passage area during the Matthew 2001065 survey.

Tidal data for the period 23-30 October 2001 were downloaded from the Canadian Hydrographic Service (CHS) tide gauge in Cape Borden PEI. The tide gauge data, shown in Figure 12, were used to correct the multibeam bathymetry data.

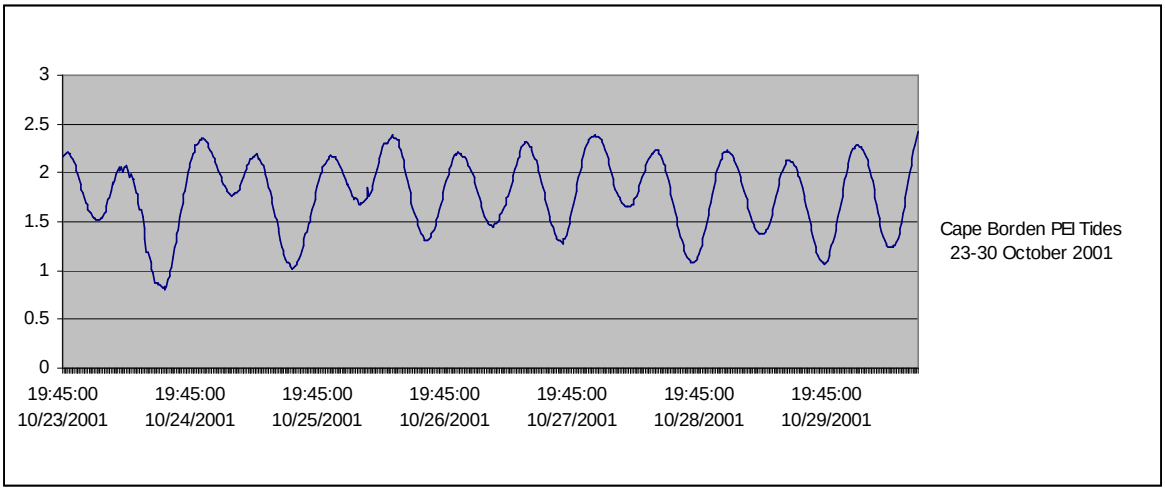

Figure 12. Measured tides 23-30 October 2001 from gauge at Cape Borden PEI.

Preliminary Results

Amherst Cove, PEI

A suite of data consisting of sidescan sonar, multibeam bathymetry, sub-bottom profiler, seafloor photographs, underwater video, and grab samples were collected in the area around Amherst Cove, PEI. A shaded, colour-relief image generated from the multibeam bathymetry data shows numerous dredge spoils from the construction of the Confederation Bridge (Figure 13) which were dumped in an approved offshore disposal site in Amherst Cove. An area of sandwaves can also be seen in the lower right portion of the image.

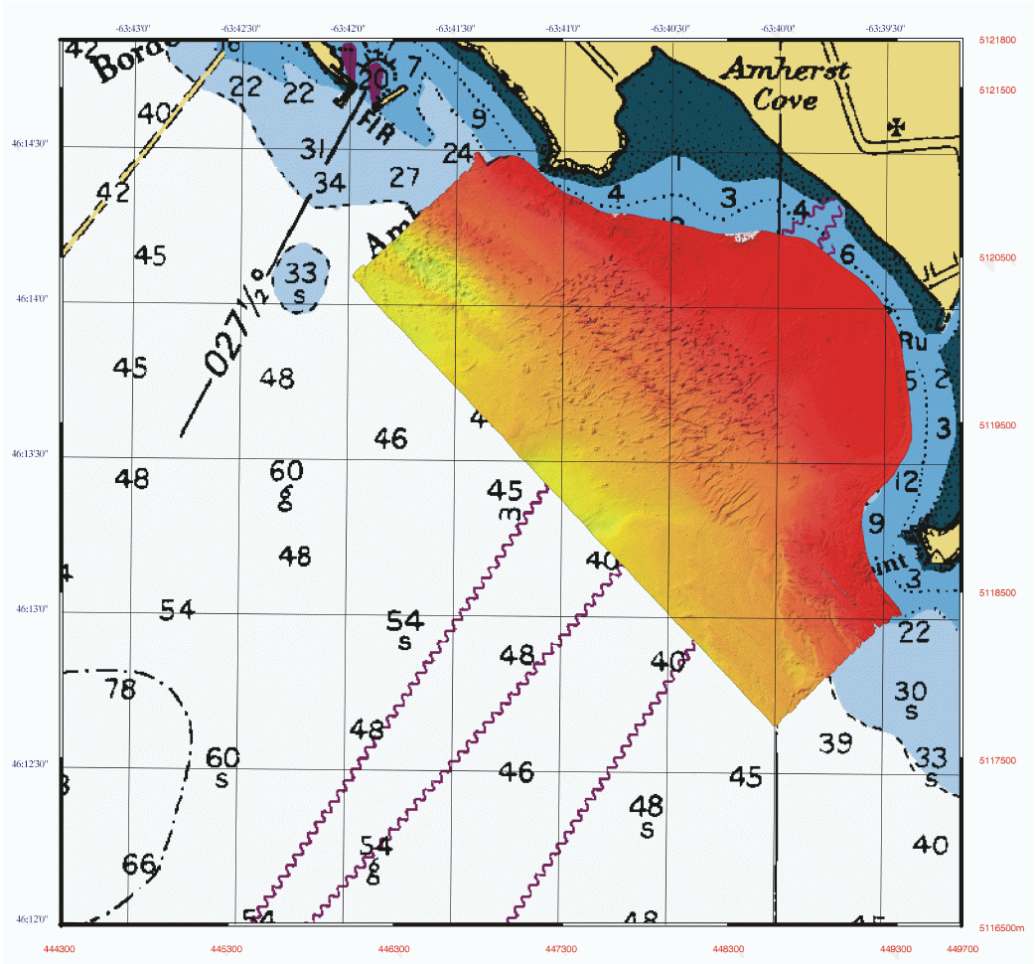

Figure 13. Coloured shaded relief image generated from multibeam bathymetry data collected in Amherst Cove in October 2001 on survey Matthew 2001065.

Multibeam bathymetry data collected in the area, were processed to extract backscatter intensity values and used to generate a mosaic (Figure 14). The dredge spoils are visible in the central portion of the mosaic.

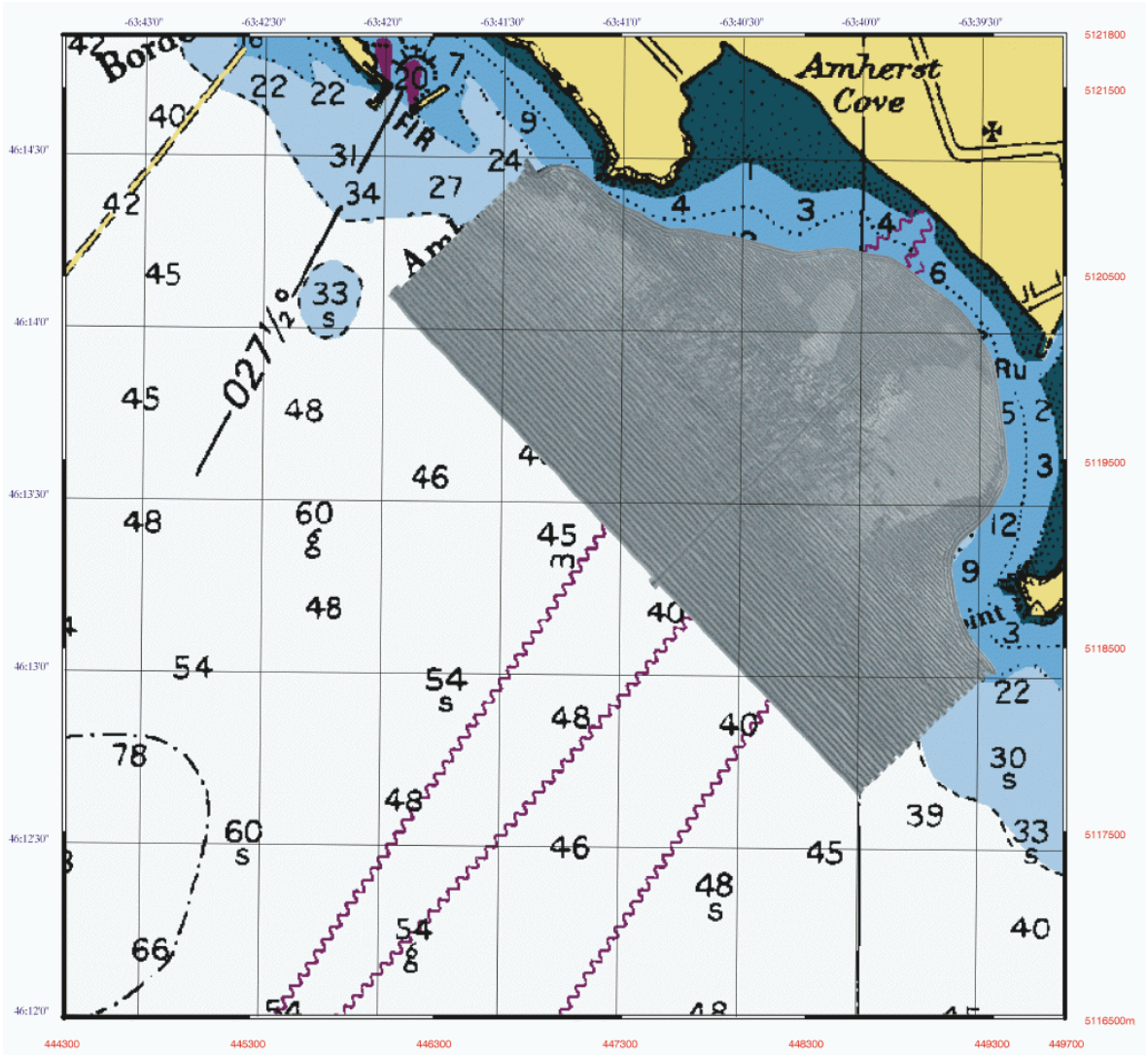

Figure 14. Backscatter intensity calculated from multibeam bathymetry collected in Amherst Cove PEI during survey Matthew 2001065.

Sidescan sonar data collected in the area, were processed and used to generate a mosaic (Figure 15). The dredge spoils are visible in the upper right portion of the mosaic.

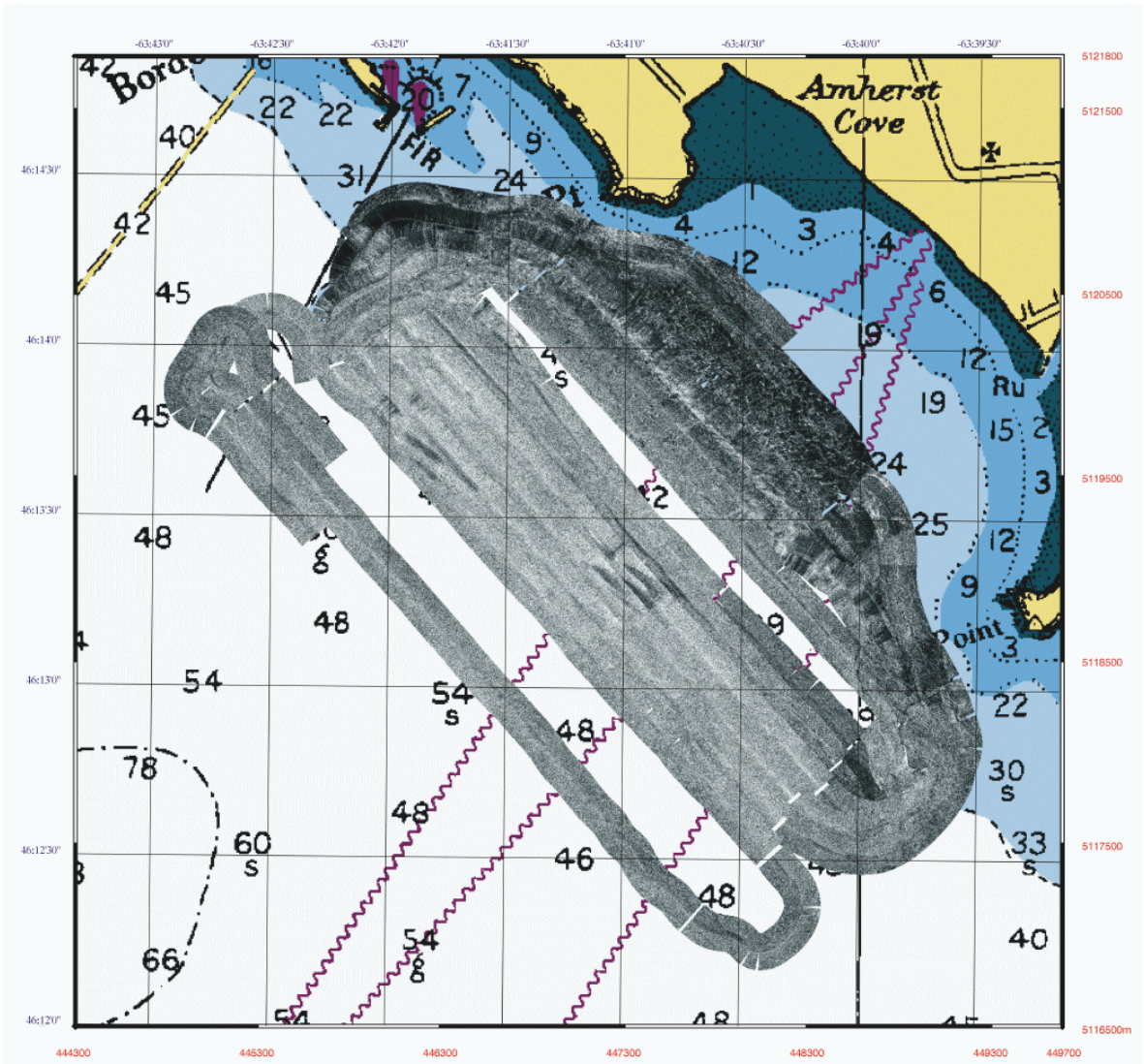

Figure 15. Sidescan sonar mosaic of data collected in Amherst Cove PEI during survey Matthew 2001065.

Sidescan sonar data collected in the area by Amos in 1995 were processed and used to generate a mosaic (Figure 16). These data will be used to provide background information on the area before disposal activities commenced.

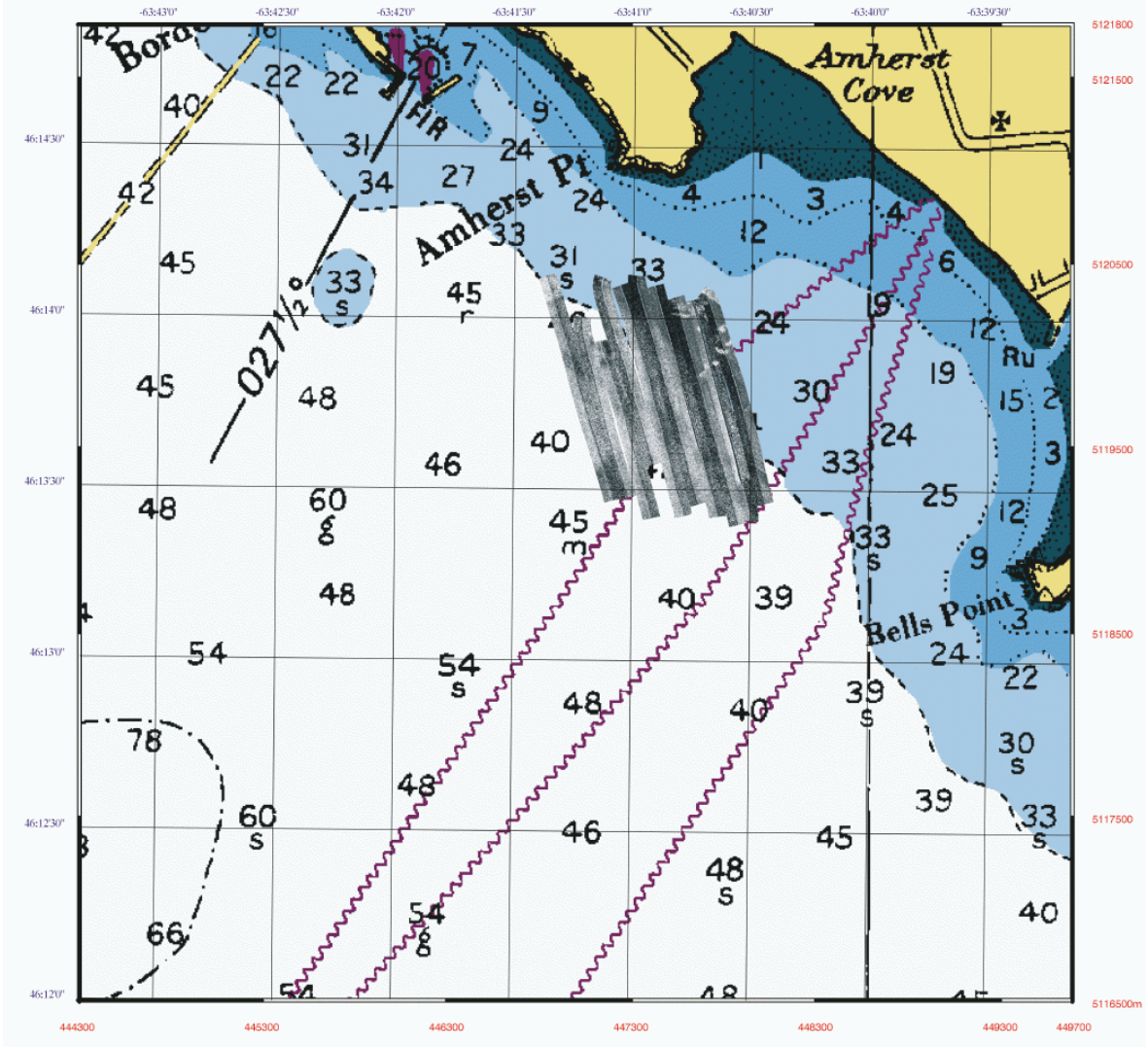

Figure 16. Sidescan sonar mosaic of data collected in Amherst Cove PEI during survey Hart 95140.

Seafloor photographs and samples were taken in Amherst Cove to provide information on the nature and distribution of sediments on the seafloor. These locations are shown in Figures 17 and 18. Photographs of the seafloor and samples are contained in Appendix V and VI, and the locations are provided in Appendix IV.

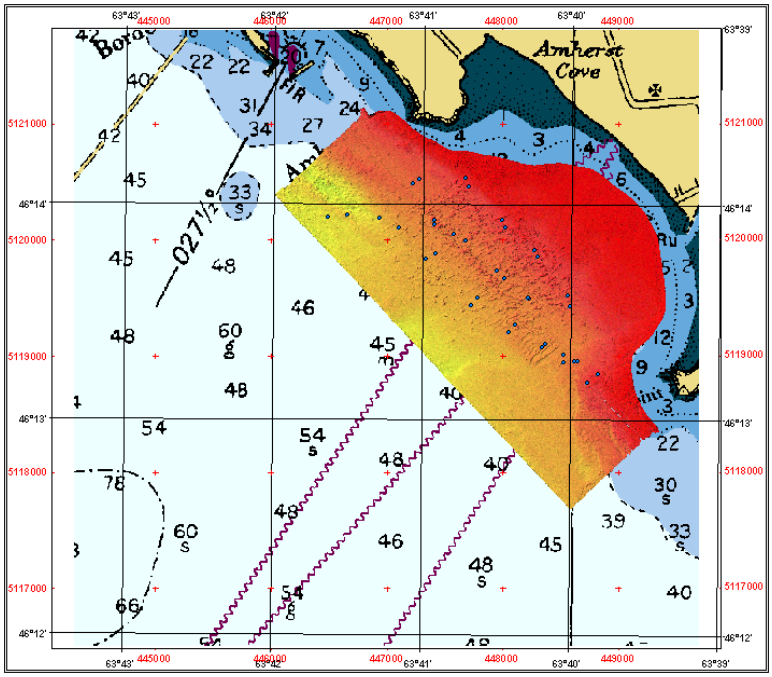

Figure 17. Locations of camera stations in Amherst Cove during cruise Matthew 2001065.

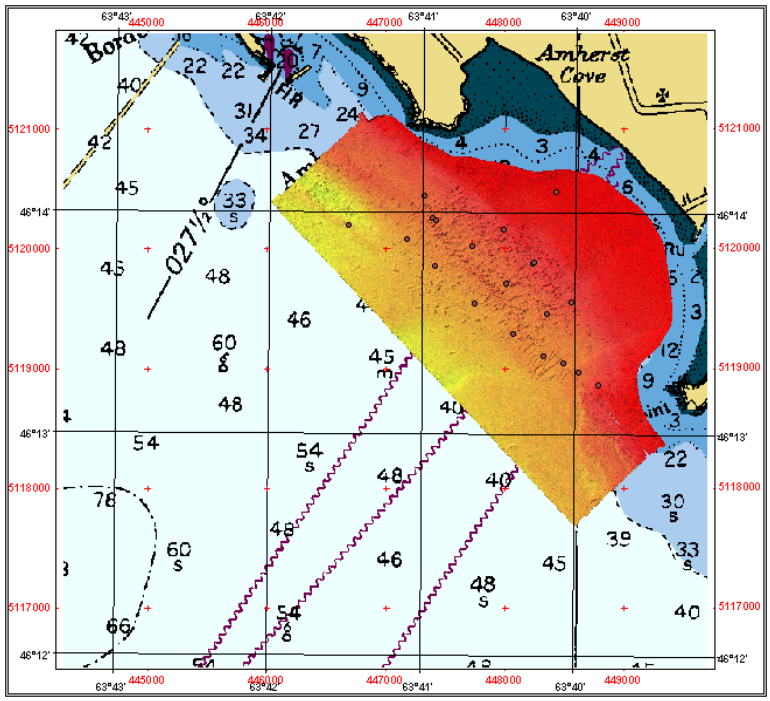

Figure 18. Locations of grab sample stations in Amherst Cove during cruise Matthew 2001065.

Cape Tormentine

A suite of data consisting of sidescan sonar, multibeam bathymetry, sub-bottom profiler, seafloor photographs, underwater video, and grab samples were collected in the area around an unused offshore disposal site near Cape Tormentine, NB. A shaded, colour-relief image generated from the multibeam bathymetry data shows a relatively smooth seafloor with zones of sand ripples (Figure 19).

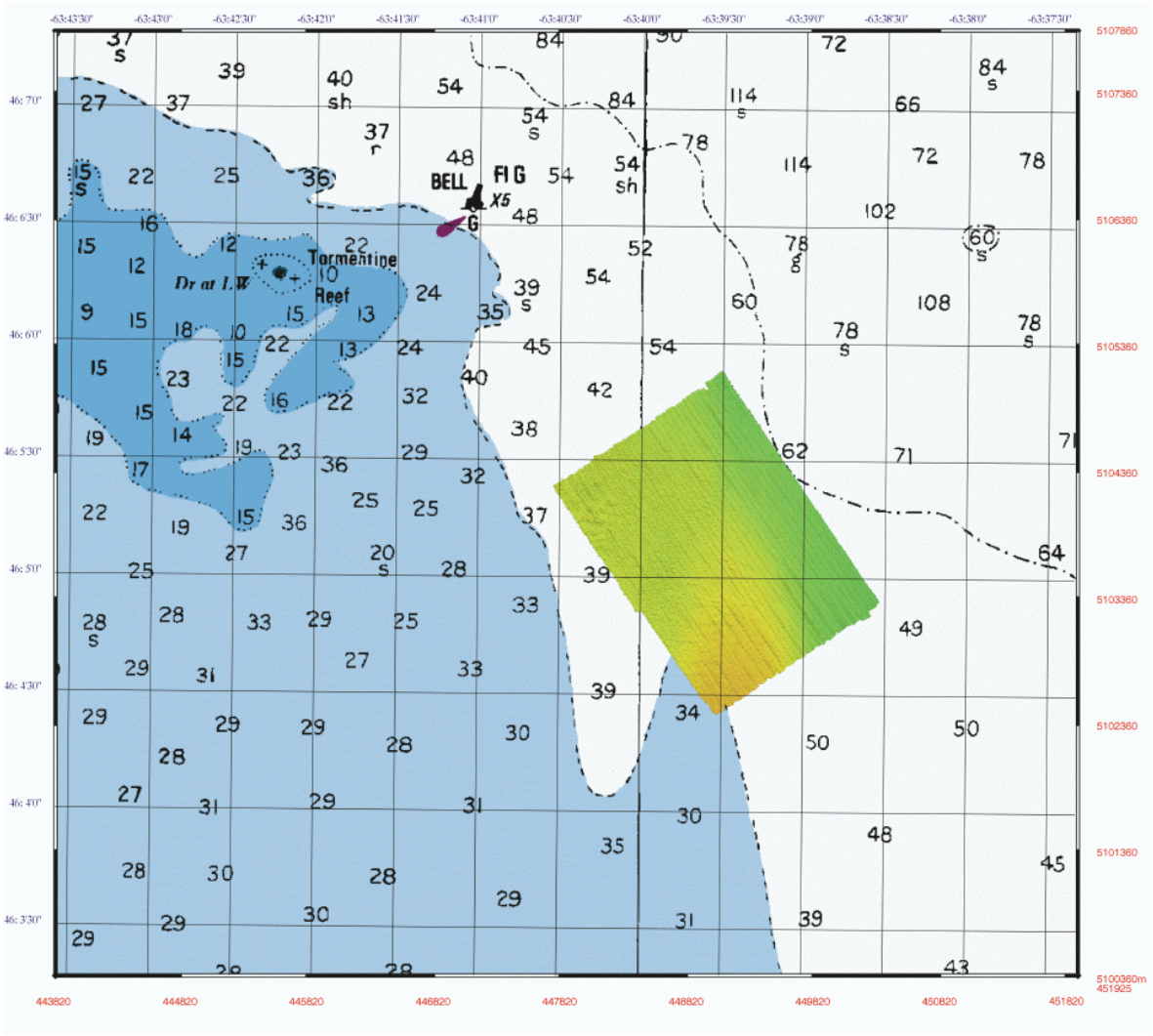

Figure 19. Coloured shaded-relief image generated from multibeam bathymetry data collected near Cape Tormentine during survey Matthew 2001065.

Multibeam bathymetry data collected in the area were processed to extract backscatter intensity values and used to generate a mosaic (Figure 20).

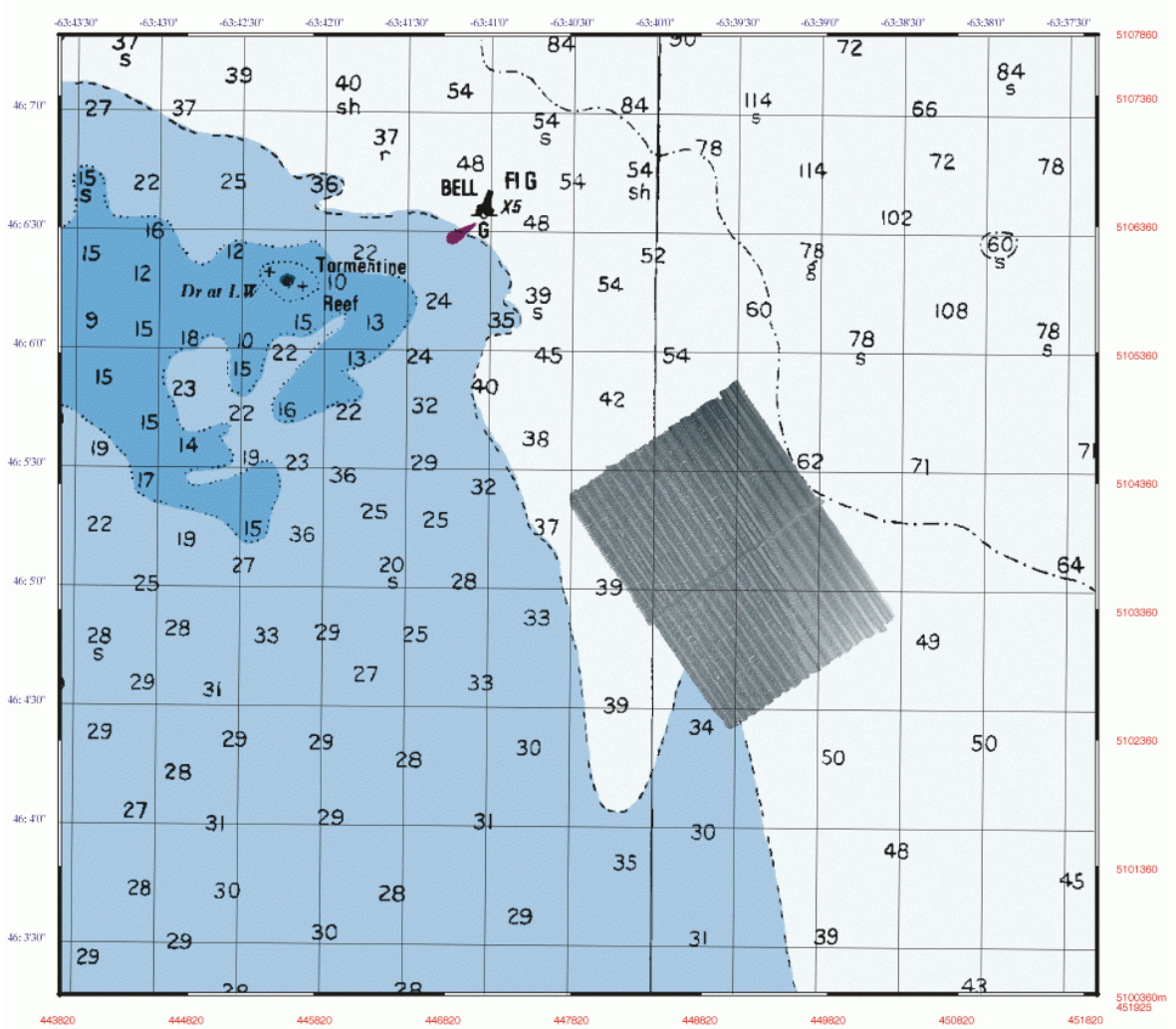

Figure 20. Backscatter intensity calculated from multibeam bathymetry collected near Cape Tormentine during survey Matthew 2001065.

Sidescan sonar data collected in the area were processed and used to generate a mosaic (Figure 21).

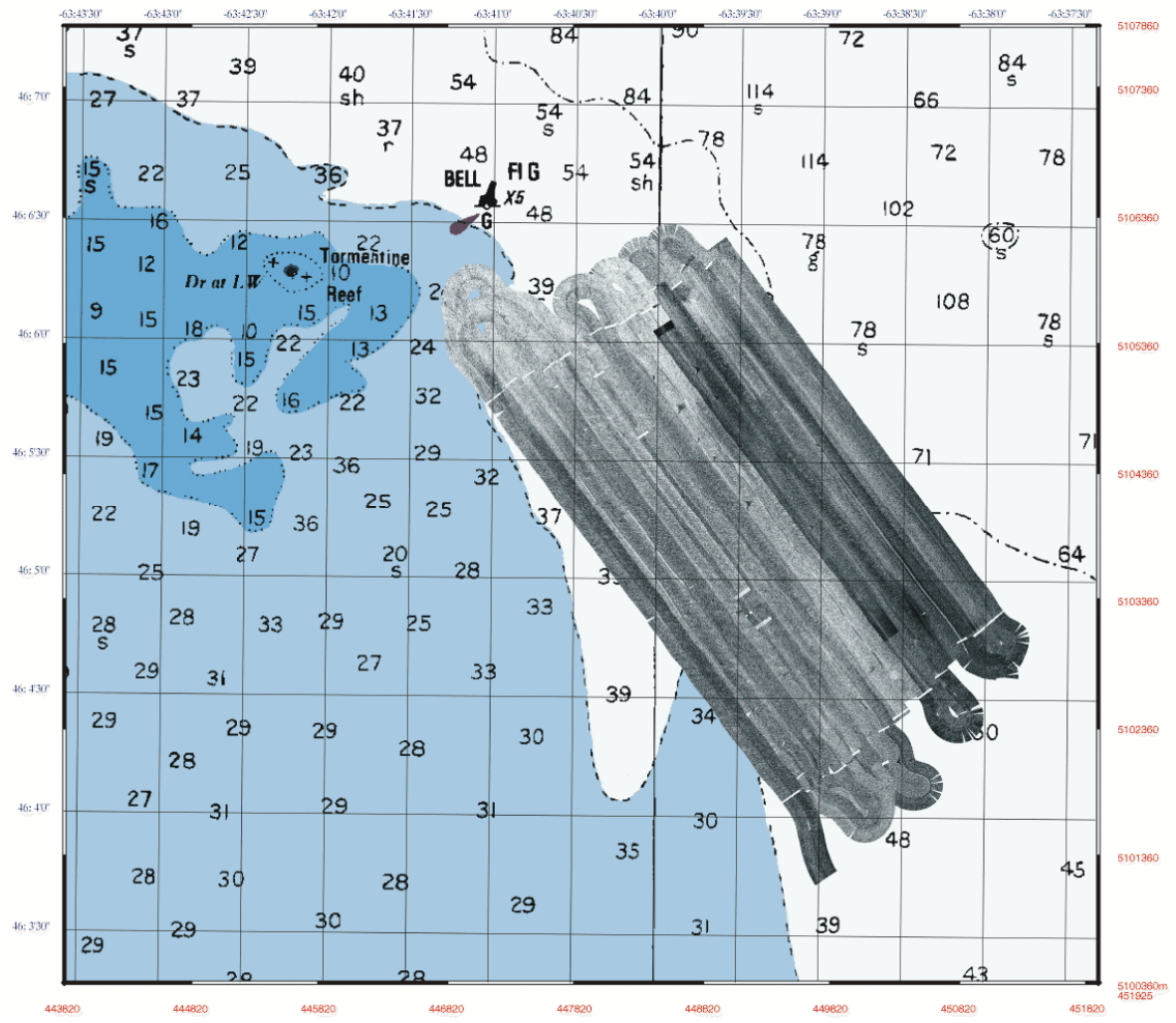

Figure 21. Sidescan sonar mosaic of data collected near Cape Tormentine during survey Matthew 2001065.

Seafloor photographs and samples were taken in the site survey near Cape Tormentine to provide information on the nature and distribution of sediments on the seafloor. These locations are shown in Figures 22 and 23. Photographs of the seafloor and samples are contained in Appendix V and VI, and the locations are provided in Appendix IV.

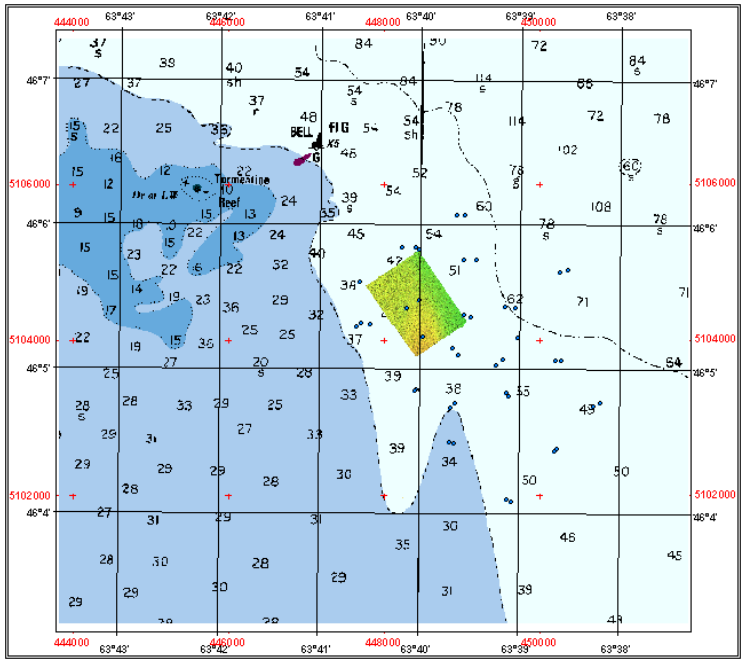

Figure 22. Locations of camera stations taken near Cape Tormentine during survey Matthew 2001065.

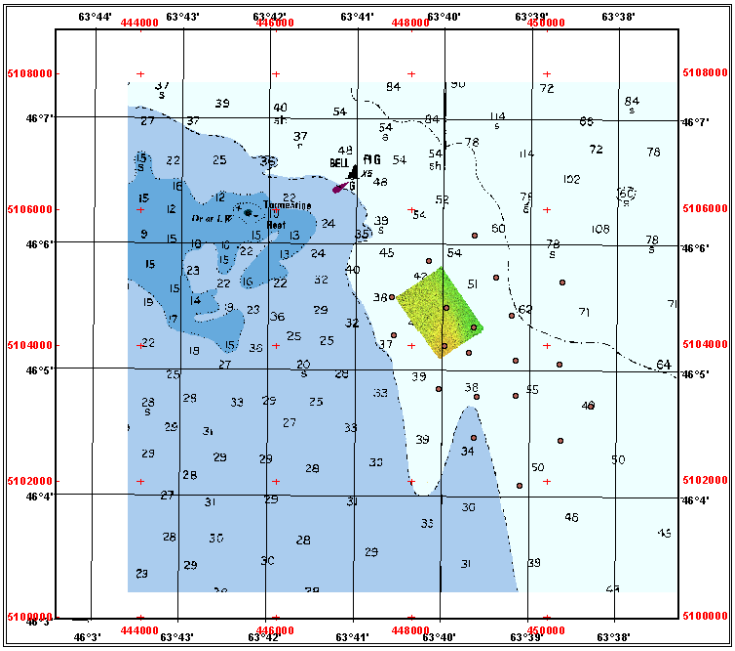

Figure 23. Locations of grab sample stations taken near Cape Tormentine during survey Matthew 2001065.

Cape Jourimain

A suite of data consisting of multibeam bathymetry, seafloor photographs, underwater video, and grab samples were collected in the area around Cape Jourimain, NB. A shaded, colour-relief image generated from the multibeam bathymetry data shows a relatively smooth seafloor with large zones of sand ripples and old dredge spoils (Figure 24).

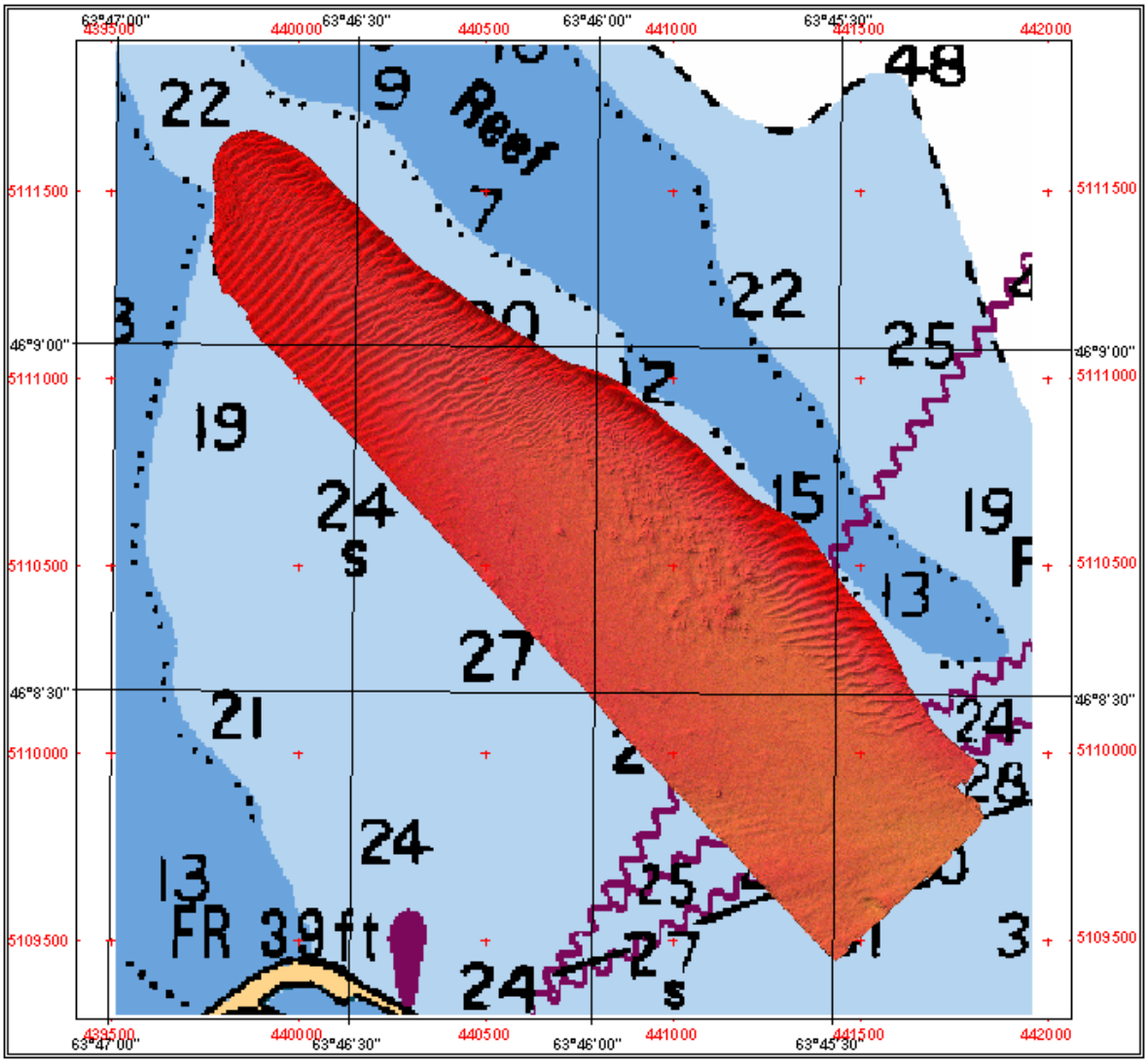

Figure 24. Shaded relief image generated from multibeam bathymetry data collected near Cape Jourimain during Matthew 2001065.

Multibeam bathymetry data collected in the area were processed to extract backscatter intensity values and used to generate a mosaic (Figure 25). Sand ripples and old dredge spoils are visible.

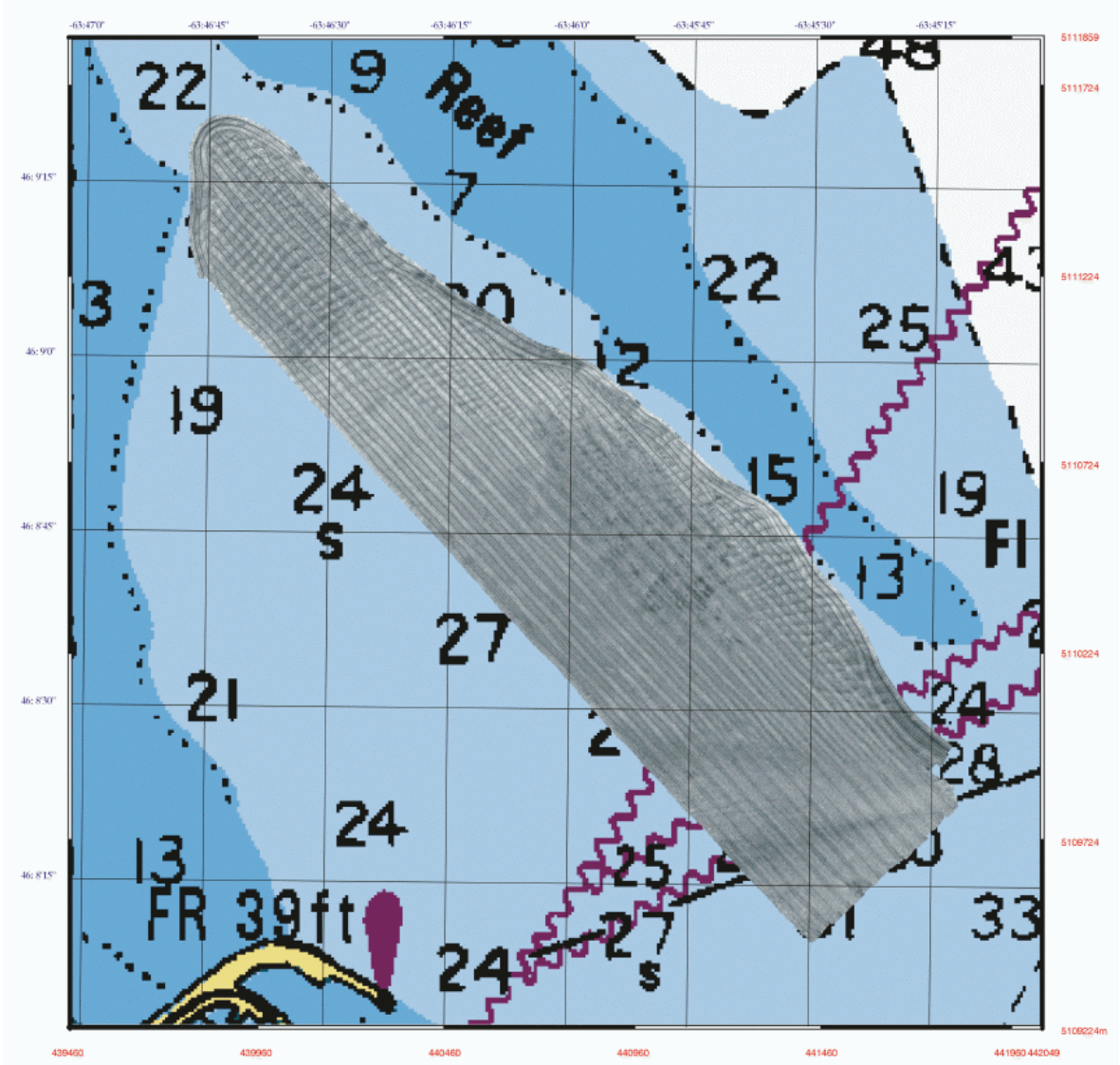

Figure 25. Backscatter intensity calculated from multibeam bathymetry collected near Cape Jourimain during survey Matthew 2001065.

Seafloor photographs and samples were taken near Cape Jourimain to provide information on the nature and distribution of sediments on the seafloor. These locations are shown in Figures 26 and 27. Photographs of the seafloor and samples are contained in Appendix V and VI, and the locations are provided in Appendix IV.

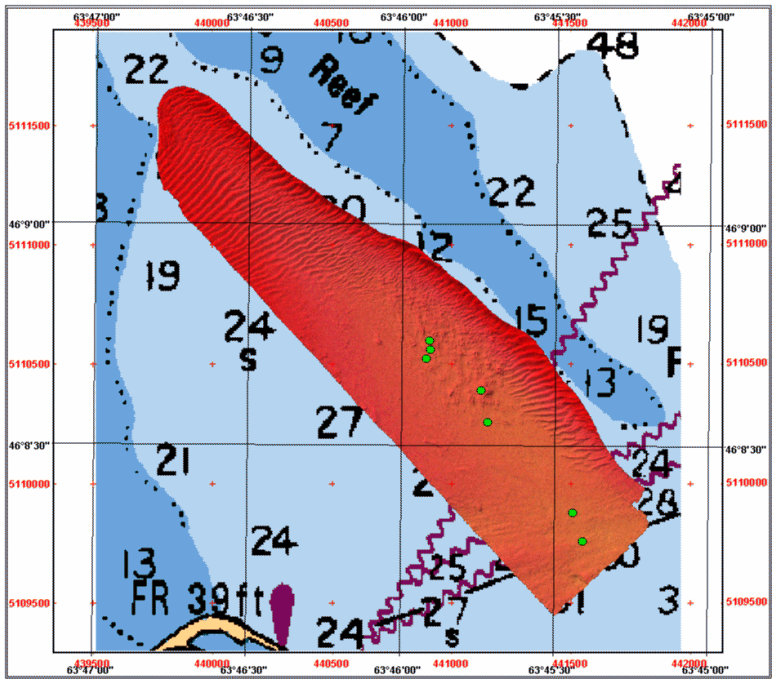

Figure 26. Seafloor camera stations taken near Cape Jourimain.

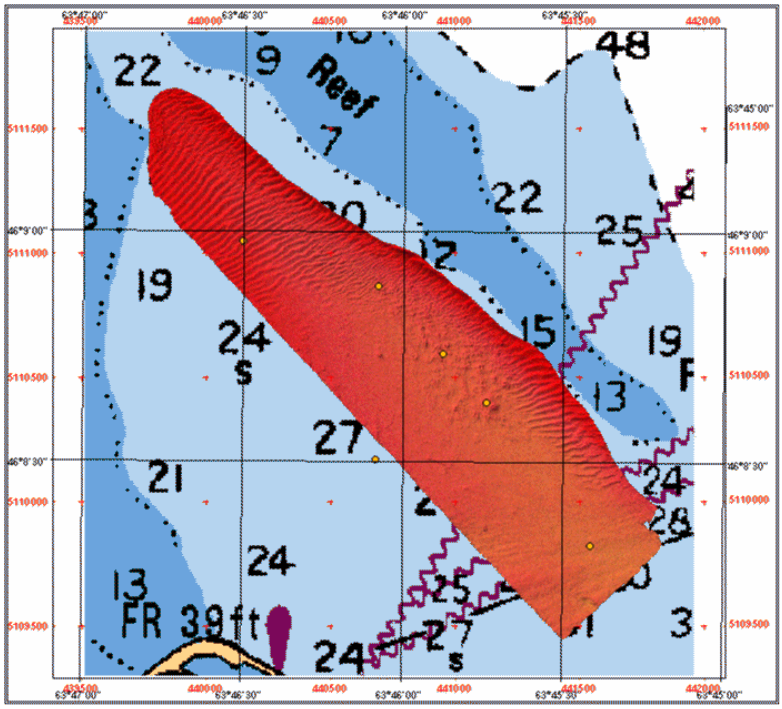

Figure 27. Seafloor grab sample stations taken near Cape Jourimain.

Benthic Impact Site

During survey Hart 95140, sidescan sonar data were collected over a site to provide background information on the seafloor before construction activities on the Confederation Bridge commenced (Amos et al., 1995). This area was re-surveyed during 2001065 and a mosaic generated from the data (Figure 28) The sidescan sonar data collected by Amos in 1995 were also processed and used to generate a mosaic (shown in Figure 29). These data will be used to determine if significant changes have occurred in the character of the seafloor.

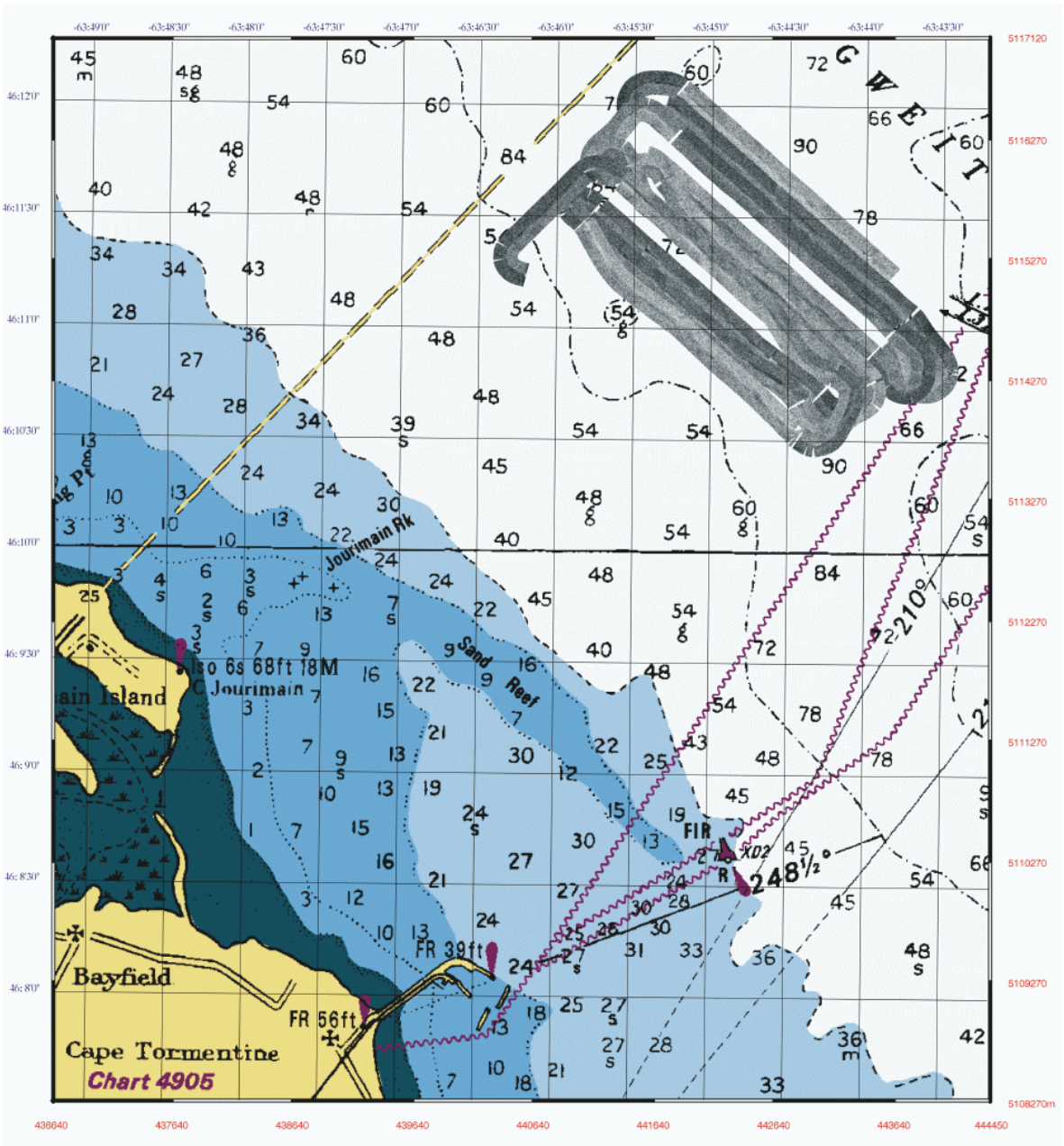

Figure 28. Sidescan sonar mosaic of data collected near Cape Tormentine during survey Matthew 2001065.

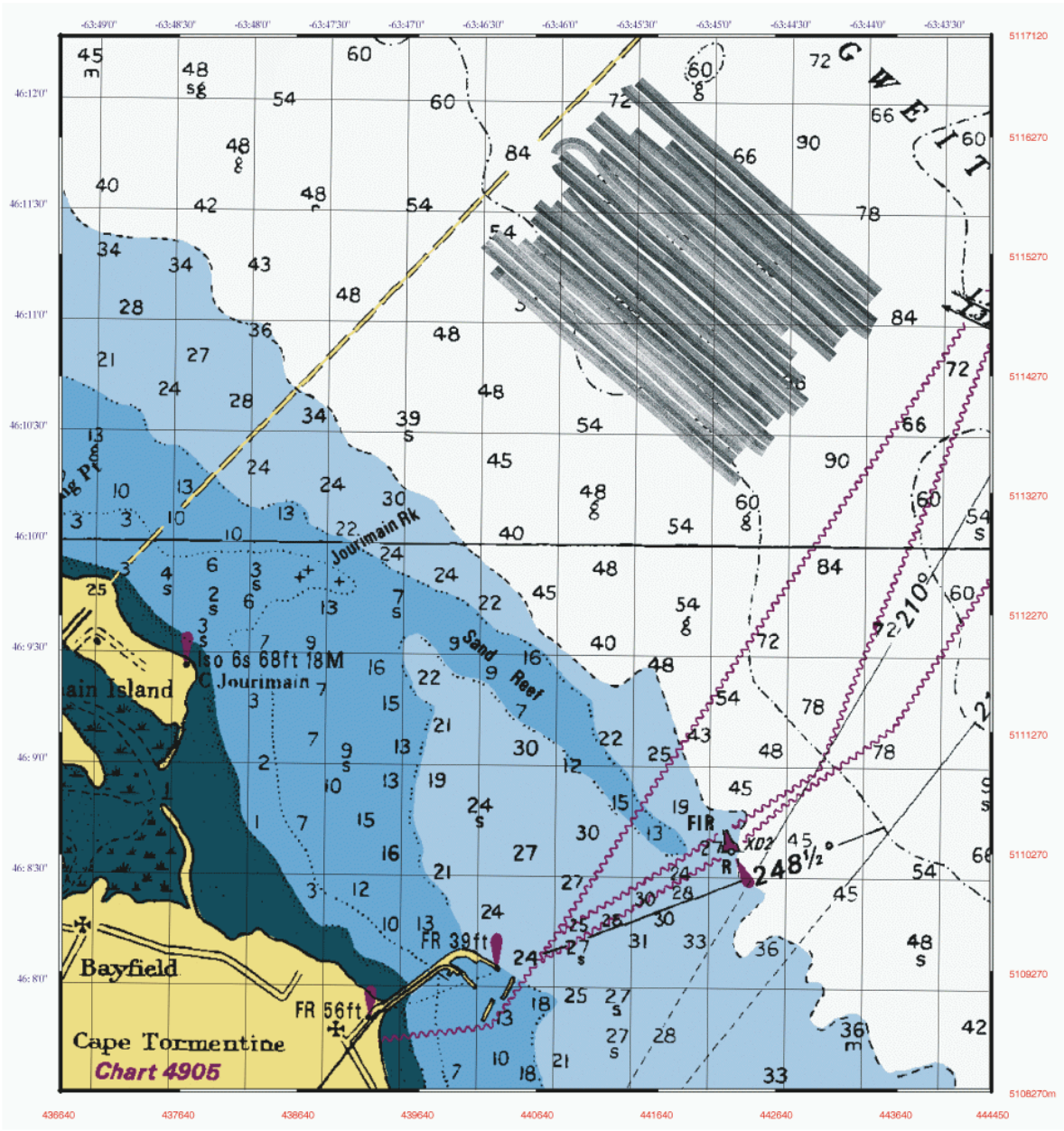

Figure 29. Sidescan sonar mosaic of data collected near Cape Tormentine during survey Matthew 2001065.

Regional Geophysical Lines

A series of regional geophysical line were run during the evenings and at night to provide an overview of the character of the seafloor in Abegweit Passage, southeast of the Confederation bridge. Sub-bottom profiler and sidescan sonar data were collected simultaneously. These lines were run with a range of 200 metres each side, for a total swath of 400 metres on the sidescan sonar system. A mosaic generated from the sidescan sonar data is shown in Figure 30.

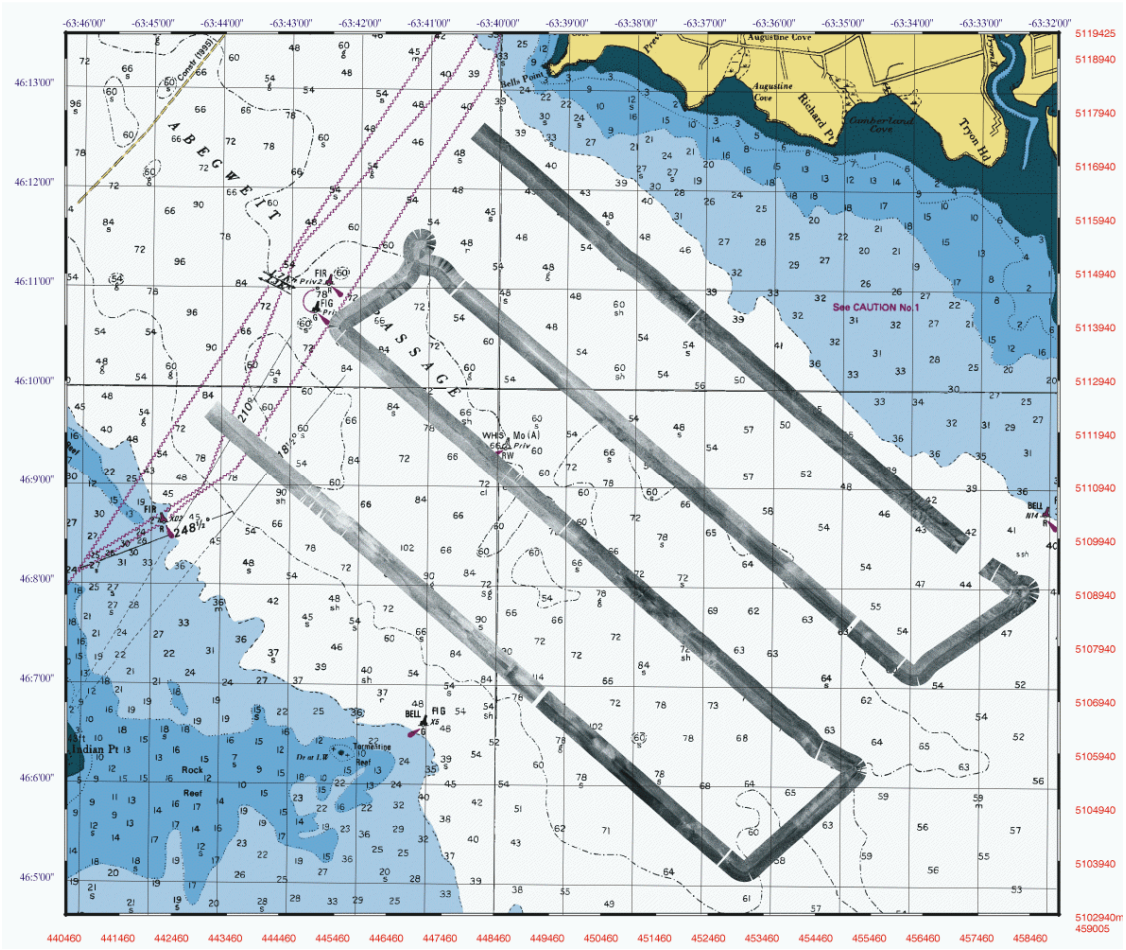

Figure 30. Sidescan sonar mosaic of data collected on regional line in Abegweit Passage during survey Matthew 2001065.

Saint John, NB

Multibeam bathymetry and acoustic backscatter data were collected as part of a series of repetitive surveys of the Black Point offshore disposal site and a nearby sand wave field. In addition, data were collected near Cape Spencer to expand on previous survey coverage. A shaded, colour-relief image generated from the multibeam bathymetry data is shown in Figure 31. A slump associated with the disposal site, and several sand wave fields are visible.

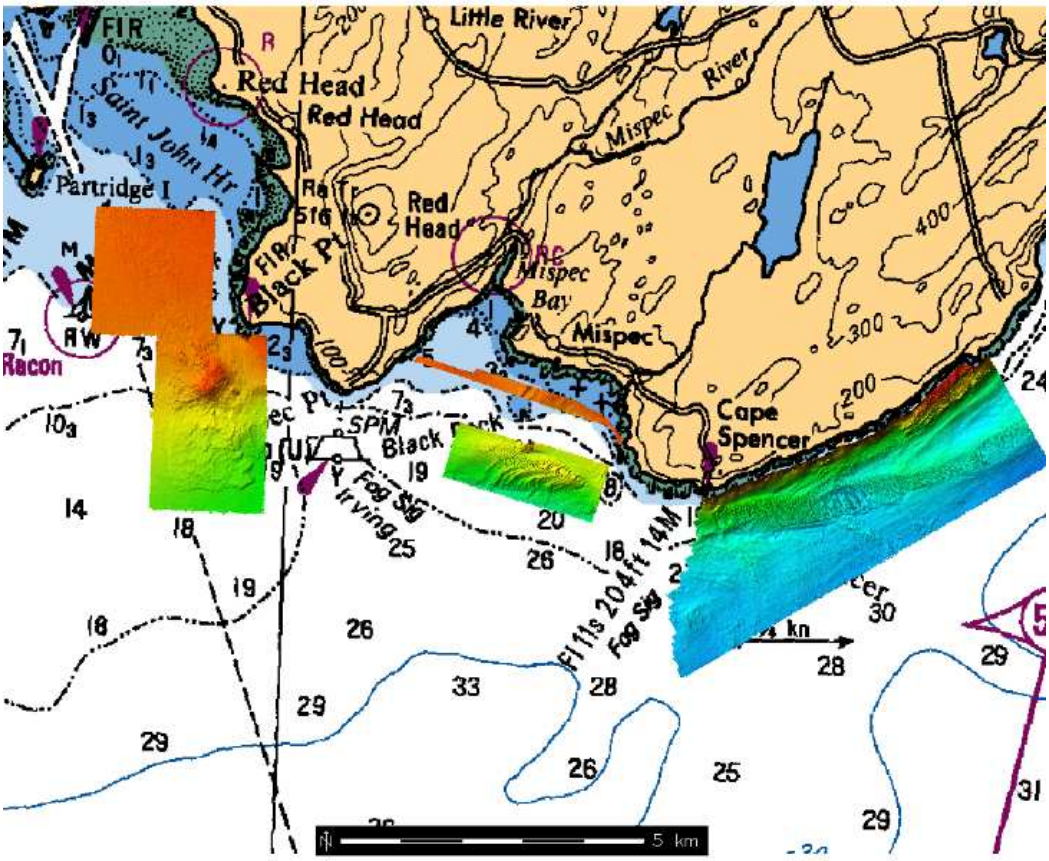

Figure 31. Coloured shaded-relief image generated from multibeam bathymetry data collected near Saint John, NB during survey Matthew 2001065.

Access to Data and Samples

The sidescan sonar, sub-bottom profiler, multibeam bathymetry, photographs, and grab samples collected during this survey are archived at the Geological Survey of Canada - Atlantic, in Dartmouth Nova Scotia. For access to the geophysical data and samples contact the senior scientist for the survey, Russell Parrott (902-426-7059) or Susan Merchant of the GSCA. Digitally processed sidescan sonar mosaics, ExaByte tapes containing the sidescan sonar data in SEG-Y format, CD-ROMs containing the sidescan sonar and sub-bottom profiler data in SEG-Y format, and ExaBytes tapes of the raw data are available for viewing.

Acknowledgements

We would like to thank the officers, crew onboard the CCGS *Matthew* for their assistance in the various surveys and in collecting and delivering the sediment samples.

References

Amos, C.L., Ivaldi, R., and E. Gomez, J.L.Hart Cruise (95-140) Northumberland Strait, N.B., 23 May – 6 June 1995. GSC Open File Report # 3176. Internal Cruise Report 25 September 1995.

Nautical Software Inc, Tides and Currents 4.2, http://www.tides.com

Appendices

Appendix I Survey Particulars

Name of Vessel:	CCGS *Matthew*
Vessel captain:	William Bogue
Dates of Survey:	23-31 October 2001
Area of Operation:	Northumberland Strait, New Brunswick
Senior Scientist:	Russell Parrott, GSC

Appendix II Survey Personnel

Geological Survey of Canada Atlantic

Russell Parrott	Senior Scientist
Anthony Atkinson	Electronics Technologist
Robert Murphy	Sampling/photography
Darrel Beaver	Multibeam bathymetry data collection/multibeam data processing
Paul Girouard	Navigation/database entry/computers

Others

Walli Rainey	Geophysical watckkeeping and record keeping
Lori Cook	Geophysical watckkeeping and record keeping

Appendix III - Summary of Activities (all times in GMT)

Day 296 – Tuesday 23 October 2001 – Transit to survey site

11:30 CCGS *Matthew* departs BIO en route to Charlottetown, PEI.

Day 297 – Wednesday 24 October 2001 – Mobilization and start surveys

11:00 GSC personnel depart BIO en route to Charlottetown, PEI.
12:00 CCGS *Matthew* arrives CCG Base Charlottetown, PEI.
16:00 GSC personnel arrive CCG Base Charlottetown and join CCGS *Matthew.*
18:00 CCGS *Matthew* departs CCG Base Charlottetown for survey site.
22:20 Deploy sidescan sonar, Seistec sub-bottom profiler and TrackPoint system and run a series of lines on site 3, near Cape Tourmentine. 100 metre range (each side), 150 metre line spacing.

Day 298 – Thursday 25 October 2001 – Survey and sampling

00:01 Continuing with sidescan sonar and sub-bottom profiler survey.
10:00 Recover geophysical gear.
10:45 Deploy multibeam launch for survey of disposal site 3.
11:00 Prepare camera and grab and steam to Site 1 in Amherst Cove PEI.
Commence seafloor photographs at 18 stations at Site 1 in Amherst Cove PEI.
16:50 Commence grab samples at Site 1. Digital pictures taken at selected sites.
20:15 Recover multibeam launch.
21:00 Winds increasing. Proceed to Summerside PEI and tie up at CCG Base Summerside.

Day 299 – Friday 26 October 2001 – Survey and sampling

12:00 Depart CCG Base Summerside and proceed to site 2 at Cape Jourimain NB.
15:14 Deploy multibeam launch for survey of site 2 at Cape Jourimain NB.
15:46 Commence camera and grab sample stations at site 3 near Cape Tourmentine.
20:05 End sampling program and transit to Cape Jourimain to recover survey launch.
20:15 Recover multibeam launch.
21:30 Deploy sidescan sonar and Seistec for survey of disposal site 1, Amherst Cove PEI.

Day 300 – Saturday 27 October 2001 – Survey and sampling

00:01 Continuing with sidescan sonar and sub-bottom profiler survey.
09:37 Recover sidescan sonar, Seistec.
10:40 Deploy multibeam launch to complete for survey of site 1 at Amherst Cove, PEI and site 2 at Cape Jourimain NB. Lines run along bridge footings to check for signs of sediment transport.
11:37 Continue sampling program in sites 2 and 3.
19:20 Sampling program finished for the day.
20:54 Recover survey launch Plover.
21:24 Deploy sidescan sonar and Seistec for re-survey of impact study mosaic performed by Amos in 1995.
21:50 Regulus navigation system reset clocks for end of daylight savings time – system was display GMT at time and completely confused everyone.

Day 301 - Sunday 28 October 2001 – Survey and sampling

00:01 Continuing with sidescan sonar survey.
11:17 Recover survey gear – Lobster trap (?) buoys seen near stern.
11:59 Deploy multibeam launch for survey of nearshore portions of Amherst Cove.
12:10 Start transects with Freddy's video camera in Amherst Cove.
16:24 Start transects with Freddy's video camera in Cape Jourimain.

17:35 Start transects with Freddy's video camera in Cape Tourmentine.
18:46 Recover launch Plover.
18:58 Continue transects with Freddy's video camera in Cape Tourmentine.
19:22 End of video transects.
22:00 Return to CCG Base Charlottetown to take personnel with bad back to hospital.

Day 302 – Monday 29 October 2001 – Repairs and Survey

08:00 Injured seaman to airport.
13:00 Divers inspect propellors and rudder to determine if buoys present and to check for damage. No bouys present, some indications of polishing of shaft due to presence of buoys.
14:00 Several calls to Bruce Wile to arrange for crane to offload multibeam launch and truck to transport to Saint John NB.
17:00 Depart CCG Base Charlottetown.
20:20 Deploy launch Plover for survey of site 3 near Cape Tourmentine.
20:30 Deploy sidescan sonar and Seistec to complete re-survey of impact study mosaic performed by Amos in 1995.

Day 303 – Tuesday 30 October 2001 – Survey and sampling

00:01 Continuing with sidescan sonar and multibeam bathymetry surveys.
02:30 End of sidescan sonar and sub-bottom profiler surveys – winds increasing.
02:38 Recover multibeam launch Plover.
02:48 Recover sidescan sonar and sub-bottom profiler.
02:50 Commence transit to CCG Base Charlottetown to offload launch.
11:00 Arrive CCG Base Charlottetown and start demobilization of equipment.
12:00 Murphy and Beaver downloading tide data.
12:30 Transport truck departs BIO for Charlottetown. Anticipate arrival at about 17:30. Launch Plover will be loaded unto truck using the large crane on the CCGS Earl Grey. The CCGS Earl Grey is due Charlottetown at approximately 16:30.
18:00 Load launch unto truck.
19:00 GSC personnel depart CCG Base Saint John. D. Beaver and A. Corkum (coxswain from CCGS *Matthew*) travel to Saint John NB. Remainder of personnel travel to BIO.
23:00 Arrive BIO.

Day 304 – Wednesday 31 October 2001 – Multibeam Bathymetry Survey, Saint John, NB

12:00 Truck with survey launch Plover arrives at CCG base Saint John.
12:30 Launch in water. Had to use straps from CCG Saint John. Lifting cable supplied by BIO quite long and beyond the reach of the crane. In water, setup antennas and equipment.
14:00 Depart base, head for dump site.
14:58 Start survey after svp cast. Sunny, winds from the northwest at 15-20k, 1m chop (white caps).
20:06 End of survey. Return to CCGB Saint John.
21:00 Secure at wharf .
Lines completed 100 – 120 (Dump site).

Day 305 – Thursday 1 November 2001 – Multibeam Bathymetry Survey, Saint John, NB

10:00 Depart wharf for multibeam bathymetry survey of Black Point offshore disposal site.
10:58 Start survey at Black Point offshore disposal site.
17:12 Complete re-survey of disposal site.
17:24 Start survey of new site proposed for offshore disposal by local fishers group. Barges in area en-route to Black Point.
20:15 Return to CCGB Saint John for fuel.

2045 Arrive base for fuel.
2110 Finish taking on fuel (375.9 liters).
Lines completed 121 – 160 (Dump site)
200 – 232 (Proposed dump site).

Day 306 – Friday 2 November 2001 – Multibeam Bathymetry Survey, Saint John, NB

1000 Depart base for Mispec Bay (Dune field).
1100 Foggy, wind and swell from the southwest, winds 25+, swell 2-3m, cancel survey, return to base.
17:00 Depart CCGB Saint John for multibeam bathymetry re-survey of Mispec Bay dune field.
17:51 Start survey. 1-2 metre swells.
20:32 Return to wharf due to weather.
21:20 Secure at wharf.
Lines completed 300 – 314 (Mispec dune field).

Day 307 – Saturday 3 November 2001 – Multibeam Bathymetry Survey, Saint John, NB

10:00 Depart wharf for multibeam bathymetry survey of Mispec Bay dune field.
10:49 Arrive svp site.
10:59 Commence survey. Foggy, winds from the southwest at 15-20, 1-2m swell from the southwest.
16:16 Complete survey of Mispec Bay dune field.
16:41 Arrive svp site at the dump site.
16:51 Start survey (fill in lines between existing and proposed disposal sites near Black Point also north of the proposed disposal site). Thick fog.
20:02 Return to CCGB Saint John for fuel.
20:30 Arrive base, take on fuel (357.8 liters).
Lines completed 400 – 461 (Mispec Bay)
500 – 559 (Proposed dump site).

Day 308 – Sunday 4 November 2001 – Multibeam Bathymetry Survey, Saint John, NB

10:00 Depart CCGB Saint John for multibeam bathymetry survey of Cape Spencer.
10:58 Arrive svp site.
11:12 Start survey. Overcast, winds 15-20, seas 0-.5m.
19:52 Finish survey and return to CCGB.
20:50 Arrive base.
Lines completed 600 – 635 (East of Cape Spencer).

Day 309 – Monday 5 November 2001 – Multibeam Bathymetry Survey, Saint John, NB

10:00 Depart base for Cape Spencer.
11:10 Arrive svp site.
11:27 Start survey. Overcast, winds from the northwest at 15-20 and building, 0-1m chop, some white caps.
14:10 End Cape Spencer survey, seas building 1-2 m. Head back to base for fuel.
15:15 Arrive base, take on fuel (402.7 liters).
15:30 Depart base for proposed dump site.
15:50 Arrive svp site.
16:01 Start survey at proposed dump site. Rain, foggy, winds northwest at 20.
18:39 End of survey for day.
19:15 Secure at wharf.
Lines completed 636 – 643 (East of Cape Spencer)
700 – 718 (West of proposed dump site).

Day 310 – Tuesday 6 November 2001 – Multibeam Bathymetry Survey, Saint John, NB

10:00 Depart base for multibeam bathymetry survey of Courtney Bay. Dredging operations underway.
10:39 Arrive svp site. Very rough, winds 30+, 1-3m chop. Head for Courtenay Bay.
11:17 Start survey. Could not complete all of Courtenay Bay due to dredges.
14:30 End of Dump01_Fall survey.
15:15 Arrive base, Take down antennas, prepare launch for transport.
Lines completed 800 – 825 (Courtenay Bay).

Day 311 – Wednesday 7 November 2001 – High winds. Prepare launch for transport from Saint John, NB

12:30 Truck arrives to transport launch to St. Peters, NS.
14:00 Beaver and Corkum depart Saint John, NB for transit to BIO.

Appendix IV Sample and Camera Station Locations

Station	Type	Day / Time	Latitude	Longitude	Depth
1	Camera	298 / 1120	46.13985	-63.4092	7.5
2	Camera	298 / 1134	46.13946	-63.4116	10.1
3	Camera	298 / 1149	46.14004	-63.4151	10
4	Camera	298 / 1209	46.14155	-63.4107	7.5
5	Camera	298 / 1224	46.14183	-63.4071	5.9
6	Camera	298 / 1239	46.13985	-63.4047	6.5
7	Camera	298 / 1311	46.13816	-63.4022	6.3
8	Camera	298 / 1331	46.13637	-63.4002	6
9	Camera	298 / 1345	46.13621	-63.4028	7.7
10	Camera	298 / 1354	46.13717	-63.4045	7.8
11	Camera	298 / 1406	46.13889	-63.4071	7.8
12	Camera	298 / 1417	46.13827	-63.4091	10
13	Camera	298 / 1517	46.13622	-63.4063	9.3
14	Camera	298 / 1531	46.13502	-63.4037	8.2
15	Camera	298 / 1542	46.13398	-63.4019	8.5
16	Camera	298 / 1554	46.1336	-63.4005	8.1
17	Camera	298 / 1606	46.13333	-63.4097	7.4
18	Camera	298 / 1618	46.13274	-63.3982	5.1
37	Camera	299 / 1546	46.05198	-63.3967	11.5
38	Camera	299 / 1603	46.0528	-63.3997	11.3
39	Camera	299 / 1618	46.05429	-63.3955	12.5
40	Camera	299 / 1635	46.05493	-63.3915	15.8
41	Camera	299 / 1642	46.05122	-63.3917	12.8
42	Camera	299 / 1655	46.05828	-63.3964	10.4
55	Camera	299 / 1902	46.04539	-63.3964	9.9
56	Camera	299 / 1913	46.04867	-63.3911	12.7
57	Camera	299 / 1924	46.05119	-63.3963	17.4
58	Camera	299 / 1939	46.05816	-63.3944	16.5
59	Camera	299 / 1949	46.05473	-63.4013	12.1
60	Camera	299 / 2005	46.05367	-63.4049	11.5
61	Camera	300 / 1137	46.06125	-63.3964	16.6
62	Camera	300 / 1201	46.05885	-63.4001	13.8
63	Camera	300 / 1211	46.05659	-63.406	11.9
68	Camera	300 / 1314	46.05735	-63.3859	18
69	Camera	300 / 1338	46.04911	-63.4003	11.7
74	Camera	300 / 1520	46.04802	-63.3826	17.6
75	Camera	300 / 1534	46.04508	-63.3862	15.4
76	Camera	300 / 1549	46.04158	-63.3912	9
77	Camera	300 / 1745	46.08396	-63.4544	7.5
78	Camera	300 / 1756	46.08672	-63.4574	9.9
79	Camera	300 / 1828	46.08784	-63.4591	7
86	Camera	301 / 0012	46.14736	-63.4125	11.3
87	Camera	301 / 1350	46.1347	-63.4106	12.8
88	Camera	301 / 1458	46.13336	-63.4044	10.5
89	Camera	301 / 1624	46.08843	-63.4662	4.4
90	Camera	301 / 1737	46.05174	-63.4015	10.9
91	Camera	301 / 1858	46.05502	-63.4003	11.3

Station	Type	Day / Time	Latitude	Longitude	Depth
19	Grab	298 / 1650	46.13277	-63.3984	5.3
20	Grab	298 / 1659	46.13332	-63.3998	7.6
21	Grab	298 / 1705	46.13376	-63.4008	8.8
22	Grab	298 / 1711	46.1341	-63.4021	8.7
23	Grab	298 / 1717	46.13509	-63.404	9.1
24	Grab	298 / 1728	46.13599	-63.4019	8.2
25	Grab	298 / 1736	46.13651	-63.4003	6.9
26	Grab	298 / 1744	46.13828	-63.4027	6.8
27	Grab	298 / 1802	46.13975	-63.4047	6.4
28	Grab	298 / 1827	46.14127	-63.4099	7.6
29	Grab	298 / 1833	46.14148	-63.4013	8.2
30	Grab	298 / 1842	46.13994	-63.4148	11.7
31	Grab	298 / 1853	46.13929	-63.411	9.4
32	Grab	298 / 1908	46.14018	-63.4091	8.2
33	Grab	298 / 1920	46.13901	-63.4067	8.3
34	Grab	298 / 1928	46.1381	-63.4092	9.9
35	Grab	298 / 1939	46.13642	-63.4066	10.2
36	Grab	298 / 1948	46.13732	-63.4046	8.6
43	Grab	299 / 1717	46.04844	-63.396	10.3
44	Grab	299 / 1724	46.05139	-63.3915	13.8
45	Grab	299 / 1733	46.05497	-63.3921	14.9
46	Grab	299 / 1740	46.05395	-63.3964	11.8
47	Grab	299 / 1746	46.05251	-63.3997	11.6
48	Grab	299 / 1754	46.05197	-63.3969	11.7
49	Grab	299 / 1811	46.05333	-63.4056	11
50	Grab	299 / 1820	46.05549	-63.3996	12.2
51	Grab	299 / 1827	46.05795	-63.3938	16.2
52	Grab	299 / 1837	46.05108	-63.3966	16.8
53	Grab	299 / 1845	46.04856	-63.3915	11.4
54	Grab	299 / 1851	46.04521	-63.3963	9.8
64	Grab	300 / 1224	46.05636	-63.4058	12
65	Grab	300 / 1235	46.05924	-63.4015	13.5
66	Grab	300 / 1245	46.06128	-63.3964	16.5
67	Grab	300 / 1304	46.05764	-63.3863	18
70	Grab	300 / 1346	46.04909	-63.4004	11.6
71	Grab	300 / 1404	46.04144	-63.391	9.4
72	Grab	300 / 1417	46.04504	-63.3863	15.8
73	Grab	300 / 1424	46.04777	-63.3829	18
80	Grab	300 / 1840	46.08782	-63.4587	6.6
81	Grab	300 / 1845	46.08929	-63.4607	6.4
82	Grab	300 / 1852	46.09023	-63.465	4.9
83	Grab	300 / 1859	46.08552	-63.4608	6.2
84	Grab	300 / 1907	46.08676	-63.4574	6.9
85	Grab	300 / 1914	46.08369	-63.4541	7.9

Appendix V Grab Sample Photos

Matthew 2001065 Grab Sample Photos


Grab24.png


Grab25.png


Grab26.png


Grab27.png


Grab28.png


Grab29.png


Grab30.png


Grab31.png


Grab32.png


Grab43.png


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Grab53.png

Matthew 2001065 Grab Sample Photos

Grab54.png

Grab64.png

Grab65.png

Grab66.png

Grab67.png

Grab70.png

Grab70a.png

Grab71.png

Grab72.png

Grab73.png

Grab80.png

Grab80a.png

Grab81.png

Grab82.png

Grab83.png

Grab83a.png

Grab84.png

Grab84a.png

Grab85.png

Appendix VI Seafloor Photographs