Reconnaissance Survey of the
Historical Bridgeport Disposal Site
August 1992

Disposal Area Monitoring System DAMOS

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13. ABSTRACT
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The distribution of relic dredged material at the site was mapped using side-scan sonar. Thirteen REMOTS stations then situated in areas where the side-scan sonar records indicated the presence or absence of dredged material disposal mounds, to assess the areal extent and state of reworking of existing dredged material, to examine present benthic biological conditions at the site, and to incorporate these results into future management plans for other disposal sites.

Results of the side-scan survey indicated that well-defined mounds of dredged material do not exist at the historical Bridgeport Disposal Site; however, relic dredged material is present throughout the site in low relief. Analysis of the REMOTS photographs revealed that the site has experienced some physical and biological disturbances yet, overall, supports a relatively healthy benthic community. This result suggests that the Long Island Sound disposal sites currently in use have encouraging future biologically. Because of the large areal extent of historical dredged material present at the site, however, any future assessment of the biological and chemical state of the historical dredged material should include additional REMOTS photography and sediment sampling for chemical analyses.

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EXECUTIVE SUMMARY

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Results of the side-scan survey indicated that well-defined mounds of dredged material do not exist at the historical Bridgeport Disposal Site; however, relic dredged material is present throughout the site in low relief. Analysis of the REMOTS® photographs revealed that the site has experienced some physical and biological disturbances yet, overall, supports a relatively healthy benthic community. This result suggests that the Long Island Sound disposal sites currently in use have an encouraging future biologically. Because of the large areal extent of historical dredged material present at the site, however, any future assessment of the biological and chemical state of the historical dredged material should include additional REMOTS® photography and sediment sampling for chemical analyses.

1.0 INTRODUCTION

The Bridgeport Disposal Site is an inactive disposal site in Long Island Sound (Figure 1-1). It is located approximately 5 nmi south-southwest of the entrance to Bridgeport Harbor, Connecticut. The disposal site is 2 nmi long and 1 nmi wide (the long axis of which runs east-west) and is centered about 41°04.4′ N latitude and 73°12.6′ W longitude. The site was used frequently for dredged material disposal over a period of twenty-five years from 1953 to 1977. Until now, the site was never monitored under the DAMOS Program. The DAMOS Program began in 1977 around the time that site use was discontinued.

On 4 August 1992, Science Applications International Corporation (SAIC) conducted side-scan sonar and REMOTS® reconnaissance surveys at this historical site to document existing site conditions. The surveys were performed in one day to obtain information concerning onsite physical and biological conditions. The goals of the 1992 survey were

- to search for the existence of relic disposal mounds;
- to assess the current status (i.e., areal extent, topography, amount of reworking, etc.) of relic dredged material;
- to examine present benthic biological conditions at the site; and
- to predict future site conditions at DAMOS disposal sites currently in use.

The side-scan sonar survey was performed first, to identify potential relic disposal mounds 1 to 5 m in elevation. The identification of relic dredged material using side-scan sonar was used to guide the placement of REMOTS® sampling locations. Following field operations, the REMOTS® sediment-profile photographs were analyzed for physical and biological parameters to assess onsite conditions. These data may provide a better understanding of the long-term behavior of dredged material and may be used to predict the future of Long Island Sound disposal sites that are presently in use.

1.1 History of Disposal Activity at the Bridgeport Disposal Site

The Bridgeport Disposal Site was active from 1953 to 1977. In this twenty-five-year period, the disposal site received more than 4.1 million m^3 of material dredged from multiple locations (Table 1-1). The dredged material source areas extended over a 70 mi stretch of coastline from Norwalk Harbor to the Thames River in New London. The majority of the material, 1,987,960 m^3, was dredged from Bridgeport Harbor and Black Rock Harbor and deposited at the disposal site between 1960 and 1963.

Before the mid 1970s, harbor sediments underwent minimal testing prior to dredging and disposal. Moreover, while the Bridgeport Disposal Site was in use, the majority of disposal records do not list the sources of dredged material released at the site. The records do

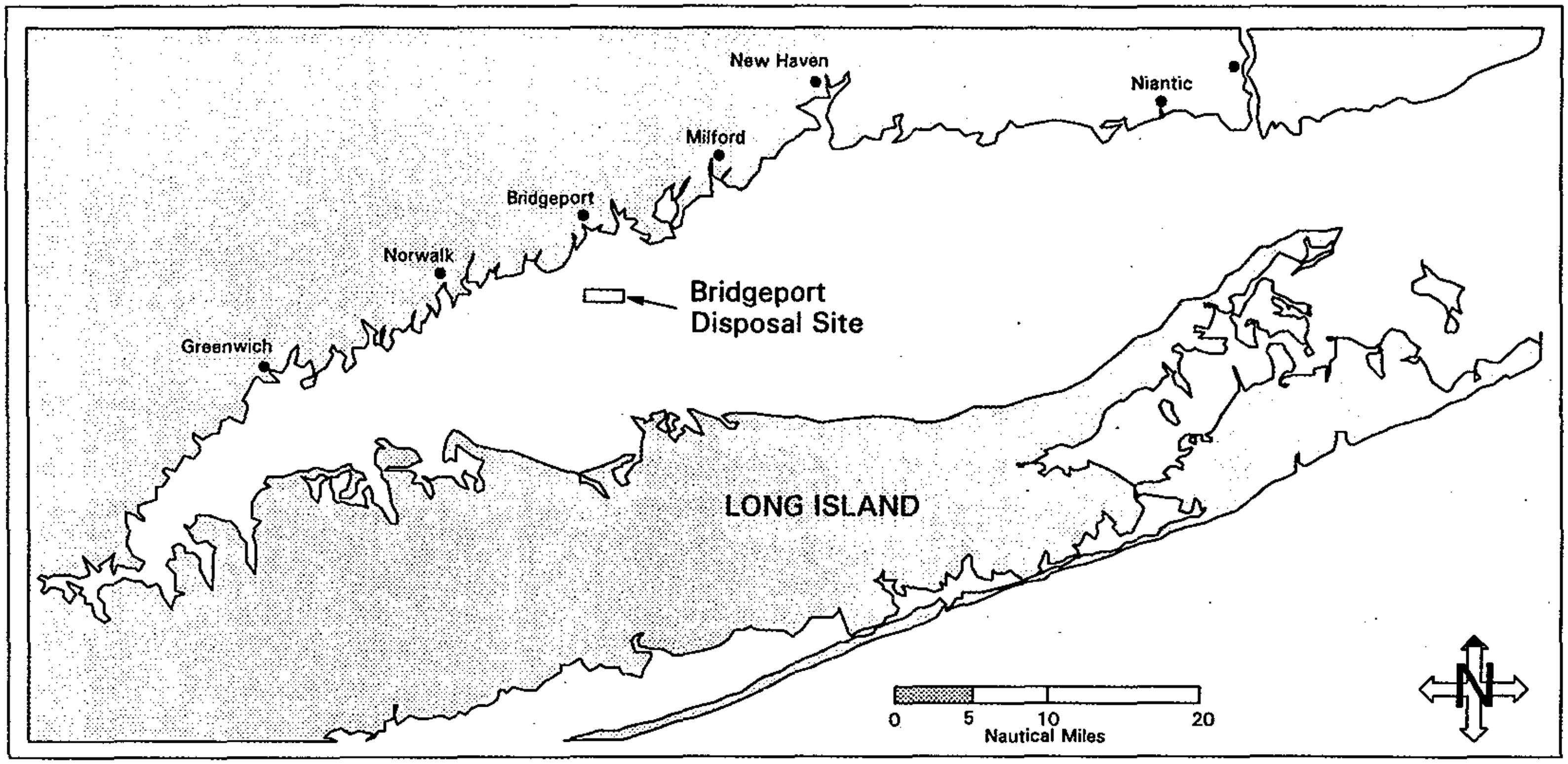


Figure 1-1. Long Island Sound and the historical Bridgeport Disposal Site

Table 1-1

History of Dredged Material Disposal Activity at the Bridgeport Disposal Site

Year	Volume Disposed (m^3)
1953	42,053
1954	44,500
1955	663,565
1956	246,965
1957	9,098
1958	451
1959	301,252
1960	823,914
1961	1,250,121
1962	116,984
1963	18,350
1964	3,303
1965	464,303
1966	24,850
1967	5,505
1968	765
1970	19,650
1971	1,529
1972	0
1973	11,469
1974	24,391
1975	4,404
1976	84,575
1977	23,882
Total	4,185,879

indicate that samples for geophysical testing were taken from various points in Bridgeport Harbor to delineate areas that would require blasting and those that would require dredging. The materials found suitable for dredging were characterized as fine sand.

In the late 1970s, an effort was made to condense the number of disposal sites within Long Island Sound. During this process, the Bridgeport Disposal Site was closed in 1977. The remaining twenty-seven disposal sites were reduced to four regional disposal sites. The current regional sites are the Western Long Island Sound Disposal Site (WLIS), the Central Long Island Sound Disposal Site (CLIS), the New London Disposal Site (NLON), and the Cornfield Shoals Disposal Site (CSDS).

2.0 METHODS

2.1 Navigation

The 4 August 1992 survey was performed onboard the research vessel *R/V UCONN* owned and operated by the University of Connecticut. Positioning and navigation were accomplished using Northstar 800 LORAN-C and Differential Global Positioning System (DGPS) MX4200 receivers interfaced to an integrated navigation system. Positional data were serially routed from the receivers to SAIC's Portable Integrated Navigation and Survey System (PINSS). PINSS consists of an IBM-compatible 386 computer capable of processing data from multiple sensors. A video display of the vessel's position aids the helmsman in navigating to a particular station location or maintaining a specific course. Positional data are recorded on diskette and may be redundantly charted on a plotter. Navigational procedures are discussed in greater detail in SAIC's QA/QC Manual (SAIC 1990a).

2.2 Side-scan Sonar Survey

Side-scan sonar data were acquired using a Klein Model 400 Graphic Sonar Recorder and a Model 422 dual frequency towfish capable of detecting bottom features to a resolution of less than 1 m. The survey was performed using a single 100 kHz frequency transducer. The side-scan recorder was configured to produce an 85 m instrument sweep to optimize the resolution. A 1600 m by 3800 m survey grid centered about the midpoint of the disposal site was established to characterize the entire disposal site. Eight tracklines 200 m apart were situated in an east-west trend to parallel the depth contours in the vicinity of the disposal site.

The speed of the vessel was maintained at 3 knots while the sonar (i.e., towfish) was towed approximately 11 m from the seafloor. During the survey, the navigation system generated a plot of the ship's position with respect to the target survey lanes (Figure 2-1). Time was automatically annotated on the plot every 5 minutes. At the same time, the sonar record was annotated with time so that targets present on the sonar record could be transferred (compensating for cable layback) to the real-time navigation plots following the survey. The resulting mosaic of acoustic targets was used to establish the locations of the REMOTS® stations (Figure 2-2).

2.3 REMOTS® Sediment-Profile Photography

Thirteen REMOTS® stations were visited during the 4 August 1992 survey (Figure 2-1). Twelve of the thirteen stations were clustered in the northeast quadrant of the site where the presence of dredged material was suspected. Two other stations were situated in the western half of the site to characterize areas of suspected dredged material deposits there. Film from the REMOTS® camera was developed on the research vessel to verify that the photographs collected during the one-day sampling effort were usable. Three replicate

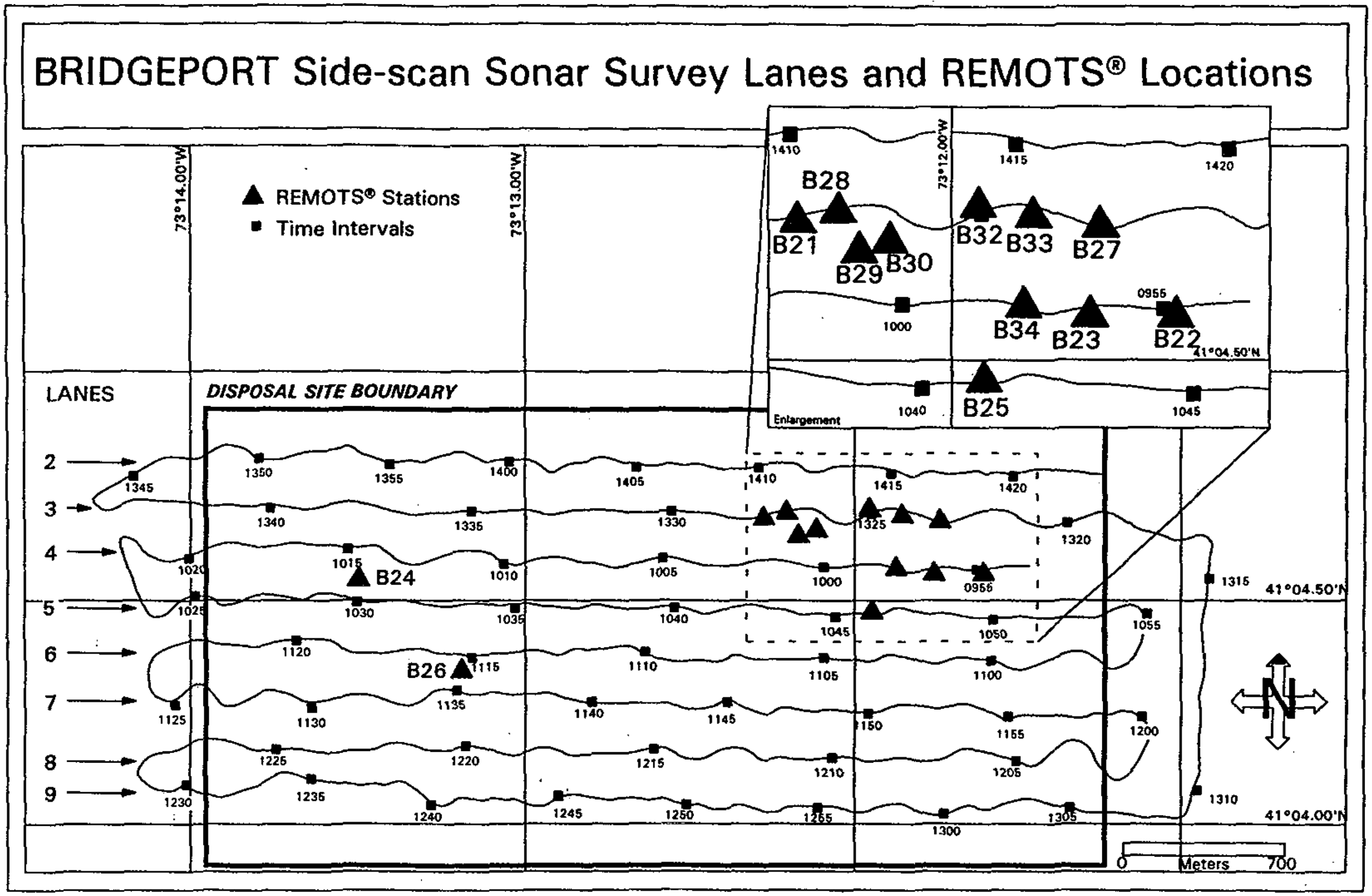


Figure 2-1. Vessel track of the side-scan sonar survey and locations of the selected REMOTS® stations

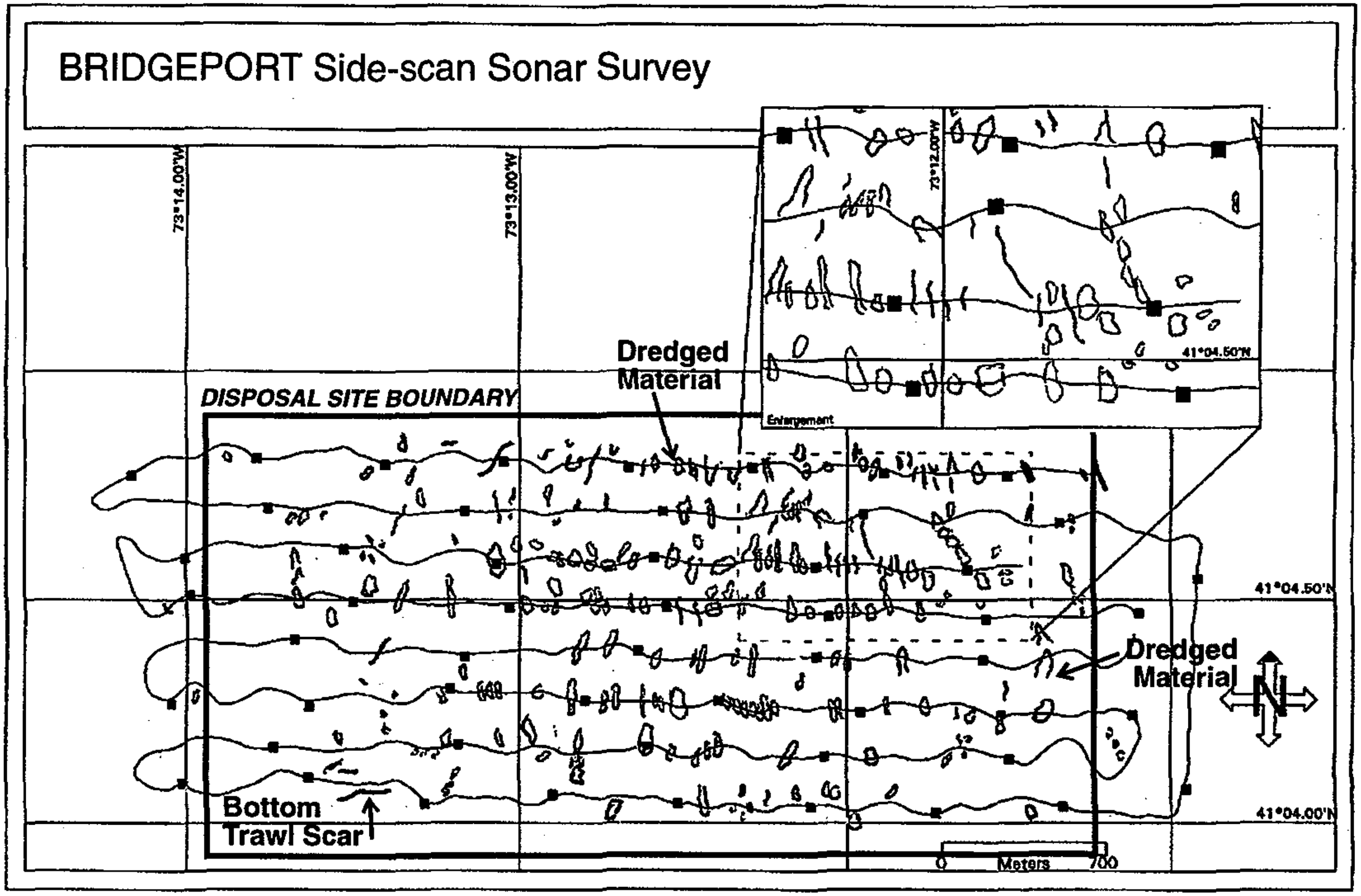


Figure 2-2. Bridgeport Disposal Site side-scan sonar survey mosaic. Annotations are outlines of visible features, as labelled on the example features.

photographs were collected at each of twelve stations, while six replicate photographs were taken at Station B34.

Following field operations, REMOTS® biological and physical parameters were measured directly from color transparencies using a video digitizer and computer image analysis system. Sediment-profile analysis and interpretation are formal and standardized techniques (Rhoads and Germano 1982, 1986). Customized software allows the measurement and storage of data from as many as 21 different variables for each REMOTS® photograph. All data were edited and verified by a senior-level scientist before being approved for final interpretation. REMOTS® parameters measured in this survey included sediment type, prism penetration depth, surface boundary roughness, presence of mud clasts, apparent redox potential discontinuity (RPD) depth, infaunal successional stage, presence of sedimentary methane, organism-sediment index (OSI), and bedforms. REMOTS® data for each photograph are included in the Appendix. A more detailed description of these parameters and the image analysis methods are available in SAIC Report No. 240 (SAIC 1990b).

3.0 RESULTS

3.1 Side-scan Sonar

The historical Bridgeport Disposal Site, based on the results of the side-scan survey, is mottled with relic, low-relief dredged material deposits. The natural or ambient bottom in the western portion of the site exhibits a predominantly smooth, low-reflectance, silty texture (Figure 3-1). Numerous low-relief, high-reflectance features, inferred to be dredged material, are present throughout the disposal area but are concentrated in the central portion of the site (Figure 3-2). The mottled, patchy appearance of these strong acoustic reflectors, or targets, is characteristic of dredged material deposits and is due to alternating patches of high- and low-reflectance materials. Strong reflectance of dredged material deposits relative to the ambient, smooth bottom is a function of increased acoustic backscattering at the surface of the deposit. This backscattering is likely related to increased microtopography and surface roughness (i.e., coarse-grained texture) of dredged material in comparison to smooth, ambient sediments. While storm activity may reduce the topographic relief of dredged material mounds, net deposition in Long Island Sound is slow, approximately 1 mm/yr. Coarse-grained dredged material covered by a thin surface deposit may be sonically detected with side-scan sonar which has a small degree of bottom penetration.

The mottled texture has been observed in other side-scan sonar surveys of dredged material disposal sites on the West Coast and is caused by one or more of the following processes or events (SAIC 1990c, 1990d):

- physical and/or biological reworking of the deposit, producing a smooth, low-reflectance signature;
- disposal of sandy material with some cohesive silts;
- random spacing of individual disposal operations of cohesive silty material; or
- transport and deposition of sediments over the dredged material.

Recently deposited dredged material will typically form a localized, circular high-reflectance pattern in side-scan sonar traces (SAIC 1987, 1990c). The mottled appearance and low relief of dredged material in this survey suggest that the acoustic reflectivity of the material has decayed due to physical or biological reworking of the deposit or that natural deposition over the last fifteen years has covered portions of the relic dredged material.

3.2 REMOTS® Sediment-Profile Photography

The physical and biological parameters discussed in this section pertain to those areas sampled using REMOTS® sediment-vertical profiling. These areas are restricted to the northeastern and southwestern quadrants of the site. For purposes of discussion, the data

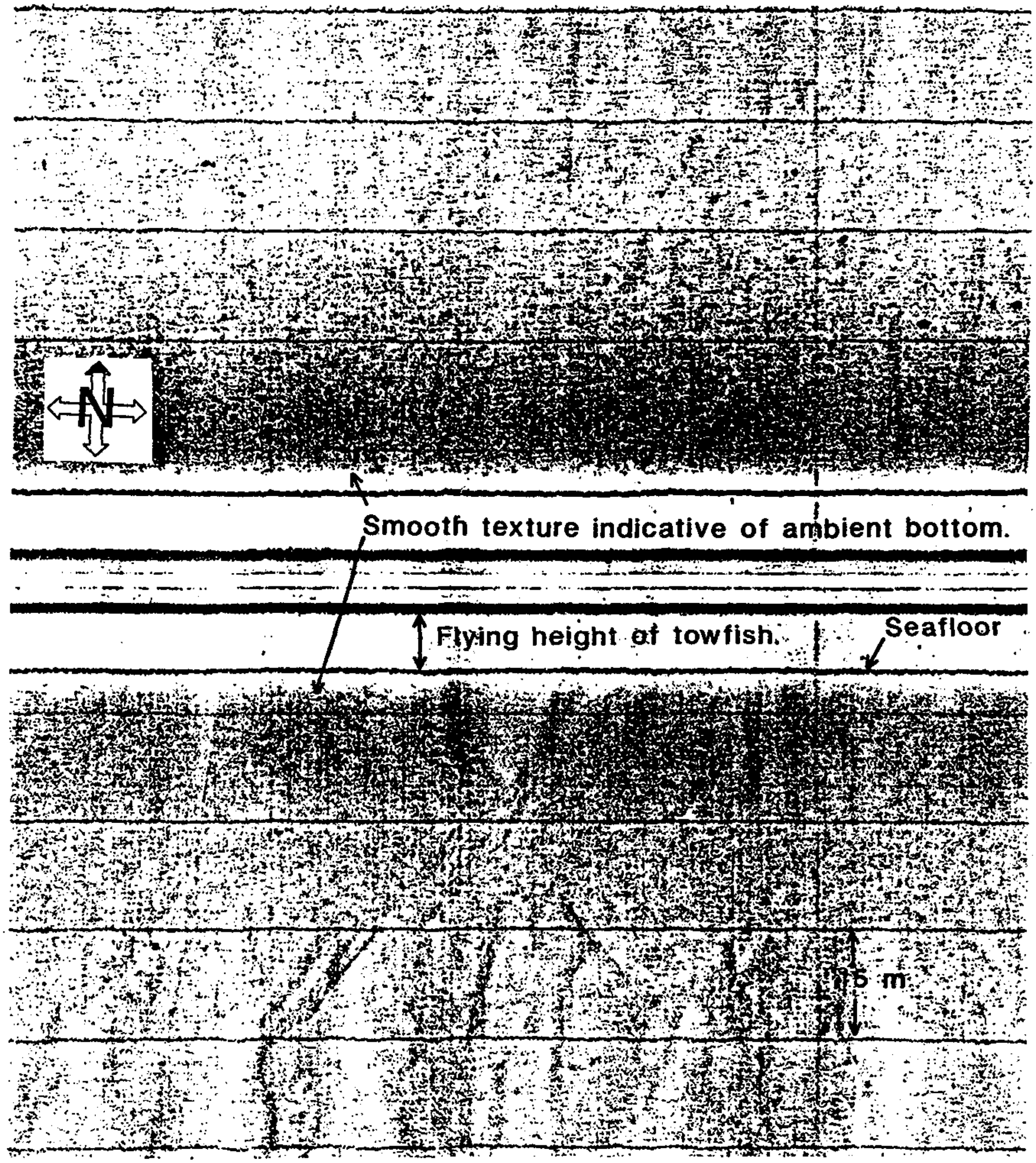


Figure 3-1. Example of a side-scan sonar record from the western portion of lane 2 showing the smooth, featureless image produced by the ambient silt bottom

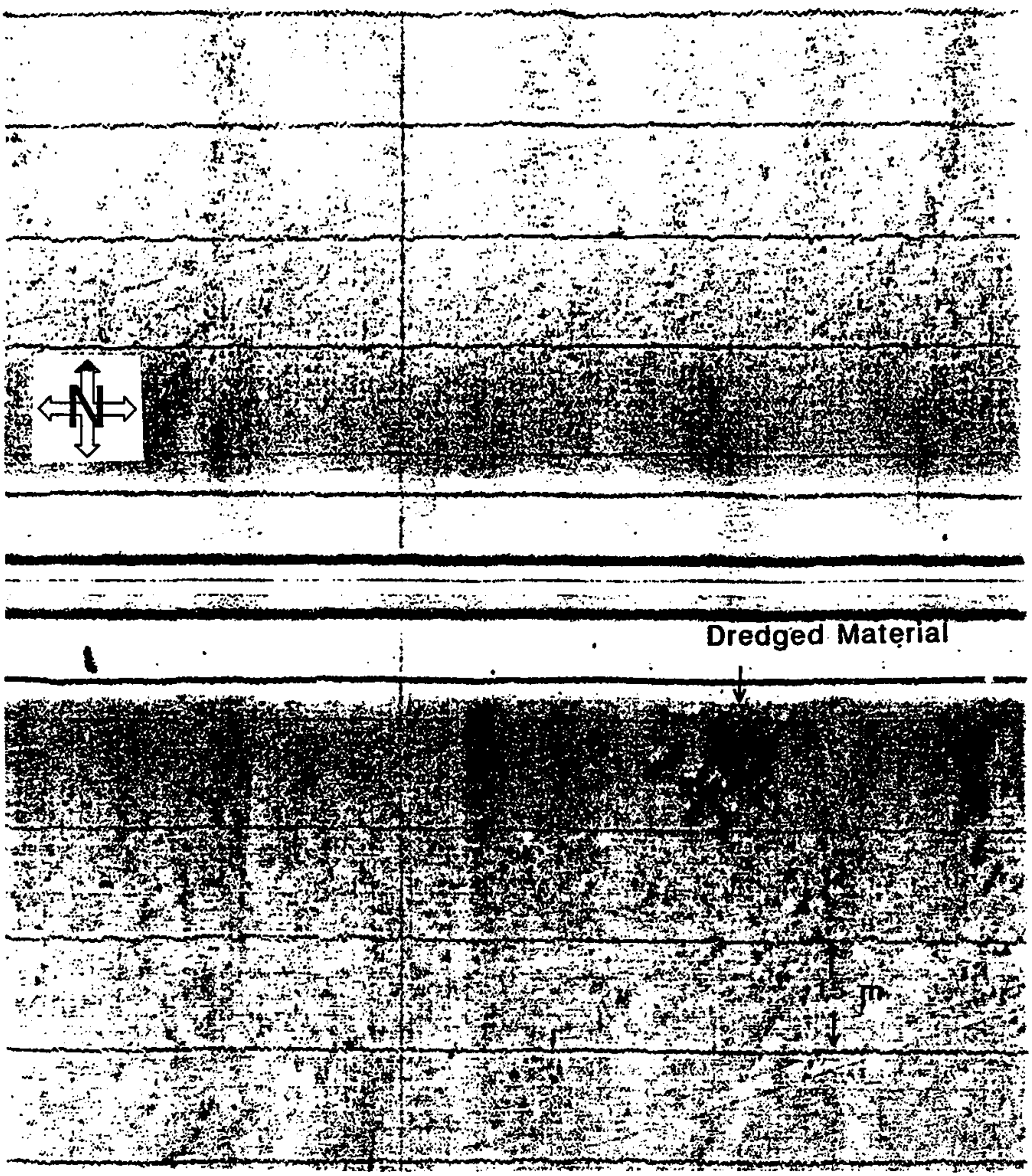


Figure 3-2. Example of a side-scan record from the eastern portion of lane 7 exhibiting mottled texture and low-relief patches of high-reflectance areas on low-reflectance ambient bottom

obtained from the REMOTS® photographs will be applied to the site in general based on the assumed presence of relic dredged material throughout the site (see above). The results of the REMOTS® image analysis are presented in the Appendix.

3.2.1 Sediment Features

Grain size ranges are estimated visually by comparing the sediment image to the Udden-Wentworth size classes. The Udden-Wentworth size class system is a standard grain size measurement ranging from greater than 4 phi (silt/clay) to less than -1 phi (gravel). A major mode (the most common grain size) and the range of grain sizes are estimated.

The Bridgeport Disposal Site is dominated by sediments with a major mode of 1 to >4 phi, i.e., medium sand or finer. Thin surface layers of coarse sand were also observed among three stations: B27, B30, and B32.

Some stations exhibiting relatively high modal grain sizes (1 or less) also contained shell fragments and mudclasts. Shell fragments were present in 25 percent of the Bridgeport photographs, and mudclasts were present in 50 percent of the REMOTS® photographs (Figure 3-3). Mud clasts are typically associated with the reduction of topographic relief due to physical and biological processes. While fine-grained sediment is reworked into ball structures and concentrated in topographic lows, coarse-grained materials, including shell fragments, are concentrated at the crest of the gradually decaying mound (SAIC 1984). Localized disturbances, such as trawling activities, may also disturb relic dredged material and initiate the formation of small mud clasts. Evidence of trawling was noted on the side-scan records (Figure 3-4).

Both oxidized and reduced mudclasts were observed at the Bridgeport Disposal Site. While the presence of reduced mud clasts in an aerobic setting is sometimes indicative of recent origin (Germano 1983), the mud clasts in this survey were well rounded, suggesting the clasts were not recently formed. The clasts may have been generated from underlying reduced sediments that were brought to the surface by relatively recent disturbances. Disturbances could have been physically or biogenically induced.

3.2.2 Surface Boundary Roughness

Boundary roughness is the vertical distance between the highest and lowest points of the sediment-water interface. Boundary roughness values at Bridgeport ranged from 0.17 to 5.46 cm with a mean boundary roughness value of 1.4 cm. The surface relief is both physically induced, reflecting either bottom disturbance (scour depressions, mud clasts) or natural bedforms (sand ripples), and biogenically created, including infaunal burrows or mounds. Physical processes accounted for most of the relief at the historical Bridgeport Disposal Site.

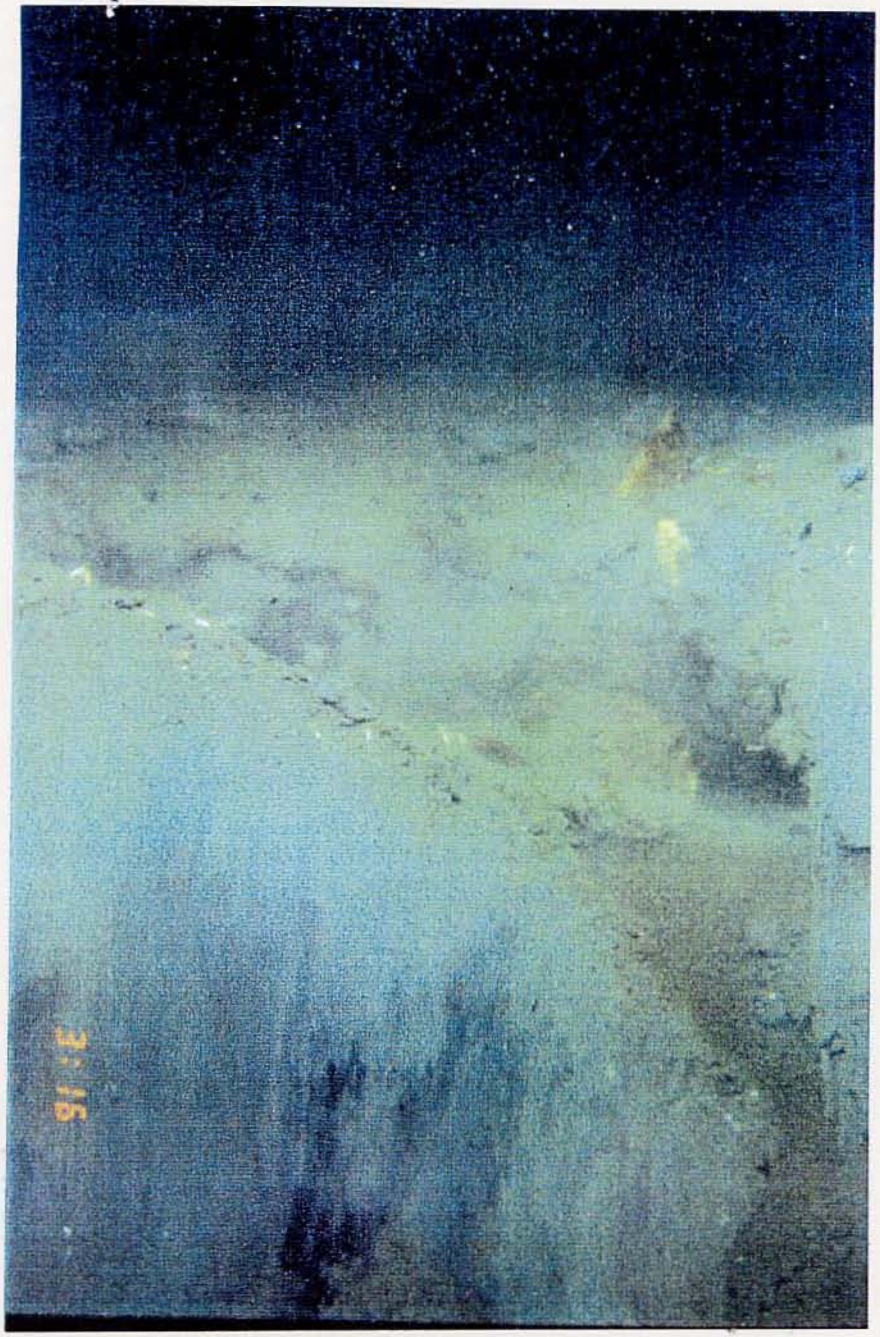


Figure 3-3. Bridgeport Disposal Site REMOTS® photograph from Station B21/C showing surface shell fragments and mud clasts. The large burrow may be that of a lobster. Scale = 1.0×.

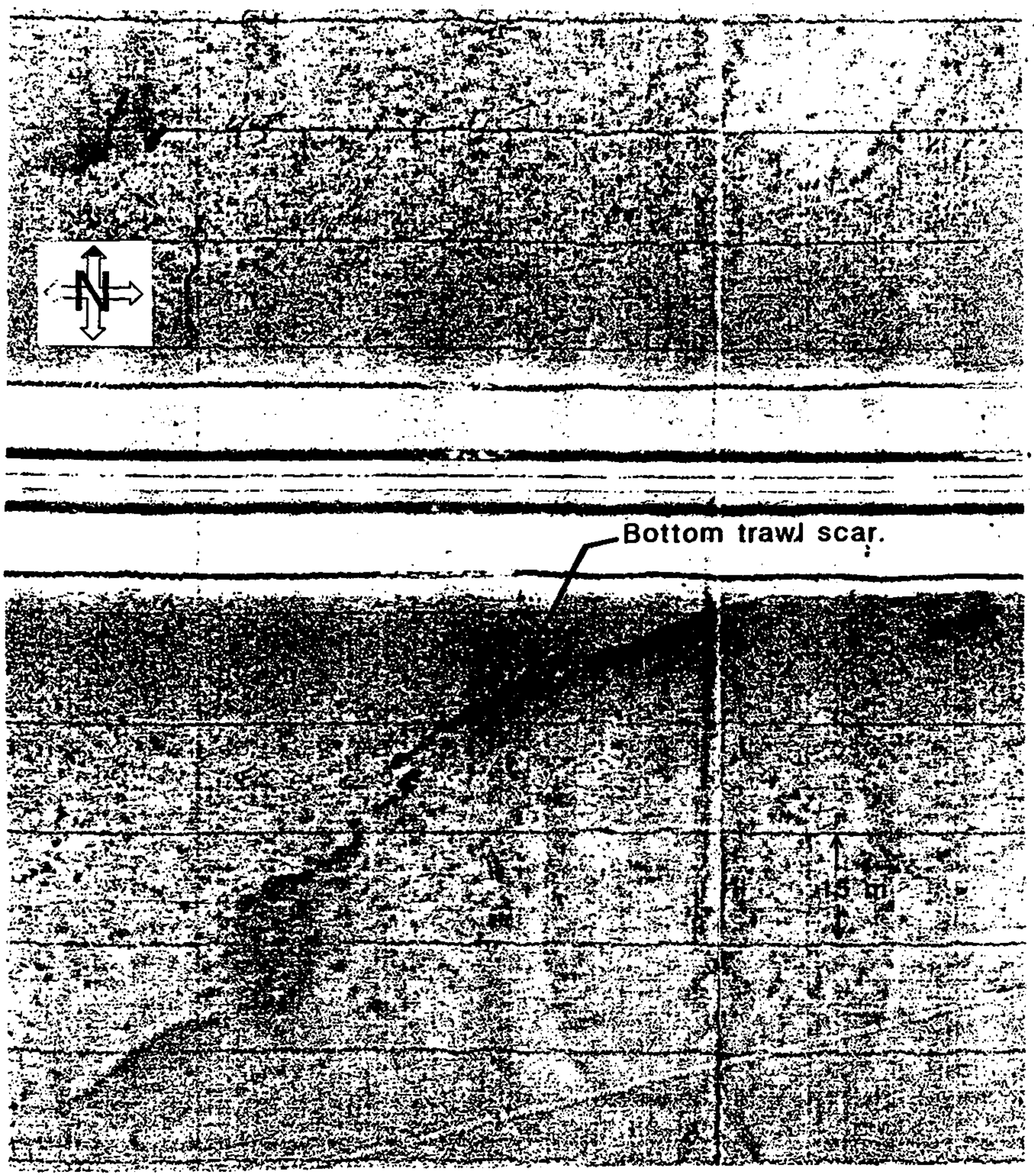


Figure 3-4. Example of a side-scan record (lane 9) showing evidence of bottom trawling

Mud clasts were observed at ten stations, and ripples were noted at six stations. Biological processes accounted for relief measured at only two stations. The majority of replicate photographs, however, demonstrated low surface relief, pointing to the absence of recent disposal activity.

3.2.3 Apparent Redox Potential Discontinuity Depth

The Apparent Redox Potential Discontinuity (RPD) depth is the depth of the upper oxygenated sediment layer. This depth is related to the rate of supply of molecular oxygen into the bottom and the consumption of that oxygen by the sediment and associated microfauna. The boundary between high-reflectance, aerobic sediment and underlying gray to black sediment is termed the apparent RPD.

Mean apparent RPD values ranged from 1.26 to 3.13 cm and were evenly distributed above and below 2.0 cm. There was no obvious spatial pattern in the distribution of RPD values among stations. Shallow RPD depths have been documented under the DAMOS Program in areas affected by past dredged material disposal (e.g., SAIC 1984). RPD values measured at the Mill-Quinnipiac River (MQR) disposal mound located in the Central Long Island Sound Disposal Site ranged from 0.54 to 2.00 cm in August of 1992. Although disposal operations at the MQR mound ceased in 1983, recolonization of the mound by ambient benthos has been relatively slow compared to other disposal mounds within CLIS. The wide range of RPD values measured among stations showing dredged material at the Bridgeport Disposal Site suggests that bioturbation in the area surveyed may have been disrupted by surface disturbance (i.e., trawling).

In addition, the reflectance contrasts across the RPD boundary were typically not distinct and were similar for both ambient sediments and relic dredged material. Low RPD contrasts indicate the lack of relatively high inputs of organic-rich material, such as recently deposited dredged material.

3.2.4 Infaunal Successional Stage

Infaunal successional stages refer to the sequential appearances of benthic infauna assemblages following seafloor disturbances, such as dredged material disposal or a major storm event (Rhoads and Germano 1982, Revelas et al. 1987). The sequence proceeds from the colonization of disturbed areas by Stage I pioneering assemblages (i.e., near-surface, tube-dwelling polychaetes). Stage I organisms are eventually replaced by Stage II infaunal deposit feeders (i.e., shallow-dwelling bivalves or tubicolous amphipods), followed by Stage III head-down deposit feeders. The recolonization sequence generally proceeds to Stage III assemblages as long as the bottom is not redisturbed.

Both Stage I and Stage III infaunal successional stages were observed at the Bridgeport Disposal Site. Stage I infauna were frequently observed in the same photograph as Stage III head-down deposit feeders (as evidenced by feeding voids) (Figure 3-5). At three stations, Stage I benthos were observed exclusively, and two of these stations were interpreted to be ambient. The area, overall, was apparently occupied by Stage III infaunal benthos which typically inhabit low disturbance regimes.

3.2.5 Organism-Sediment Index

The Organism-Sediment Index (OSI) values reflect both the apparent RPD depths and the infaunal successional status of a REMOTS® photograph. OSI values can range from -10 (no apparent macrofaunal life and methane gas present) to 11 (deep apparent RPD, evidence of mature macrofaunal assemblages, and no apparent methane). Based on other studies, SAIC has determined that OSI values less than or equal to +6 are indicative of a "disturbed" benthic environment (i.e., erosion, dredged material disposal, hypoxia, etc.; Rhoads and Germano 1986). OSI values ranged from +2 to +11 for all replicates with a mean value of +7 for all stations. Among stations, there was no apparent pattern of OSI values. Those stations where dredged material was observed displayed mean OSI values ranging from +3.3 to +10. Mean OSI values for apparent ambient sediments ranged from +3.3 to +9.7. In comparison to mean OSI indices measured in the MQR mound in 1992 (+3 to +7), the range of mean OSI values observed in the Bridgeport Disposal Site fell within and slightly above those measured in the MQR mound. These data suggest disturbances within the Bridgeport Disposal Site were heterogeneous in their distribution.

3.2.6 Apparent Relic Dredged Material

Relic dredged material was detected in nine (B21, B28, B32, B33, B27, B29, B30, B34, and B25) of the 13 stations occupied (Figure 3-6). Dredged material was recognized by its coarse-grained, slightly reduced texture (Figure 3-7). Shell fragments were also observed. Relic dredged material did not contrast sharply with ambient sediments in terms of sediment color, reflectance, apparent RPD depth, or infaunal successional stage. Dredged material layers ranged in thickness from 12 to 18 cm and frequently exceeded the camera prism penetration depth. This indicates either that dredged material has remained in layers of this thickness in the area surveyed or that relatively thin dredged material layers have been buried with time by natural sedimentation. Two stations, B22 and B23, were characterized by ambient sediment (Figure 3-6). Both possible relic dredged material and ambient sediment were observed in some, but not all, of the replicate photos collected at the two westernmost stations, B26 and B24.

Figure 3-5. Bridgeport Disposal Site REMOTS® photograph from Station B28/B exhibiting Stage I on III infauna. In this photograph, dredged material is greater than the camera prism penetration depth. Note the backfilled infaunal burrow. Scale = 1.0×.

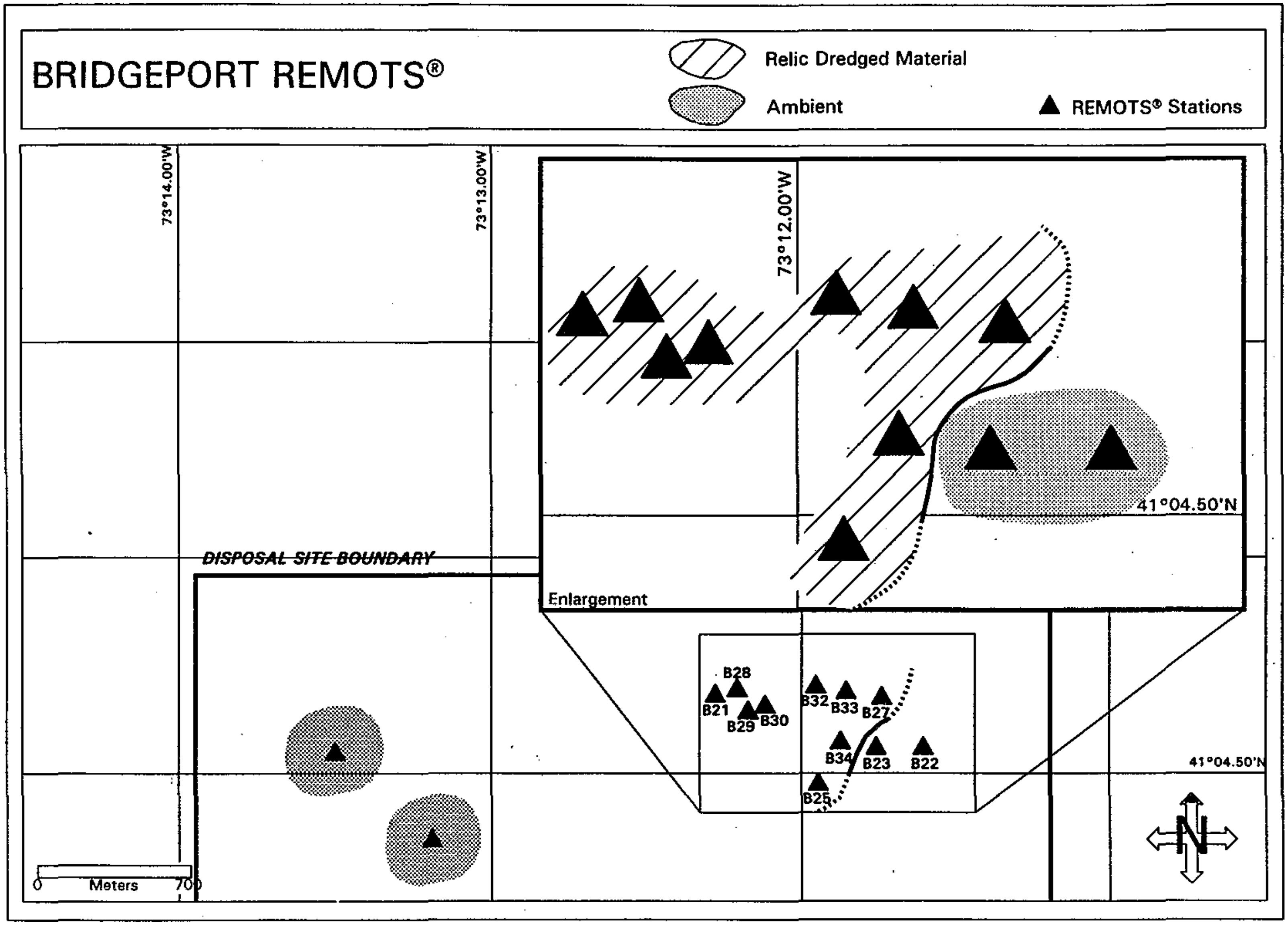
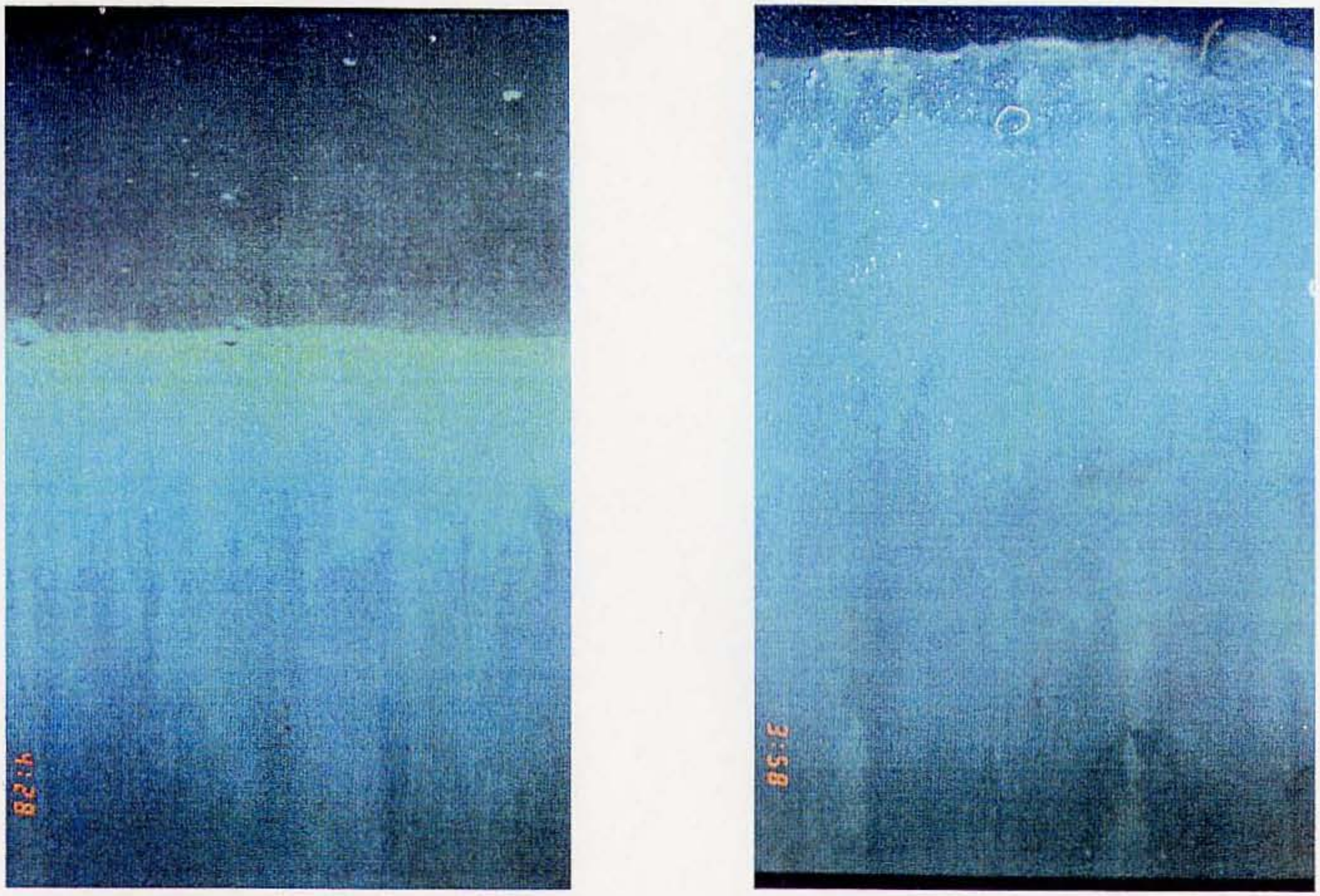


Figure 3-6. Relic dredged material distribution at the Bridgeport Disposal Site



B22/A B25/B

Figure 3-7. Bridgeport Disposal Site REMOTS® photographs from the ambient bottom, Station B22/A, and on dredged material, Station B25/B. The ambient bottom is characterized by biogenically reworked, fine-grained sediments. Dredged material is generally coarser, lower reflectance sediment with some shell fragments. Scale = 0.5×.

3.2.7 General Observations

Neither the presence of methane nor apparent low dissolved oxygen was observed in the REMOTS® photographs. The lack of methane suggests the area surveyed was not affected by organic loading.

4.0 DISCUSSION

Despite the large amount of material (approximately 4.2 million m^3) disposed at the historical Bridgeport Disposal Site prior to 1977, side-scan sonar used during the 1992 survey revealed no dredged material mounds. Rather, numerous low-relief, high-reflectance features, inferred to be dredged material, were present throughout the disposal area. The most plausible cause for the wide distribution of dredged material was the fact that, over a twenty-five-year disposal period, a target disposal buoy was never deployed.

The habitat quality of infaunal benthos within the disposal site was, in general, stable. The average OSI for all stations was +7, and the presence of Stage III deposit-feeding assemblages indicated the benthic environment was relatively healthy. Among the 13 stations analyzed using REMOTS®, however, OSI values were not consistently high, nor were Stage III fauna present at every station. The OSI values at Stations B22, B23, B29, and B30 were less than +6 due to the presence of Stage I fauna only and the relatively low RPD depths (Figure 4-1). Two of these stations (B22 and B23) were stations where no dredged material was present (Figure 3-6), indicating no correlation between the presence of dredged material and OSI. In the remaining stations, the OSI values were high, ranging from +7 to +11, because Stage III organisms were present. High OSI values occurred even though the RPDs for these stations were relatively shallow. Although REMOTS® data indicated a healthy benthic community overall, recolonization was somewhat patchy in the area surveyed. The patchy distribution of Stage III assemblages may be caused by bottom trawling activities that disrupt the sequence of infaunal recolonization, or by long-term impact from contaminated dredged material. Both the scattered pattern of trawl marks and dredged material deposits are evident in the side-scan record at Bridgeport (Figure 2-2).

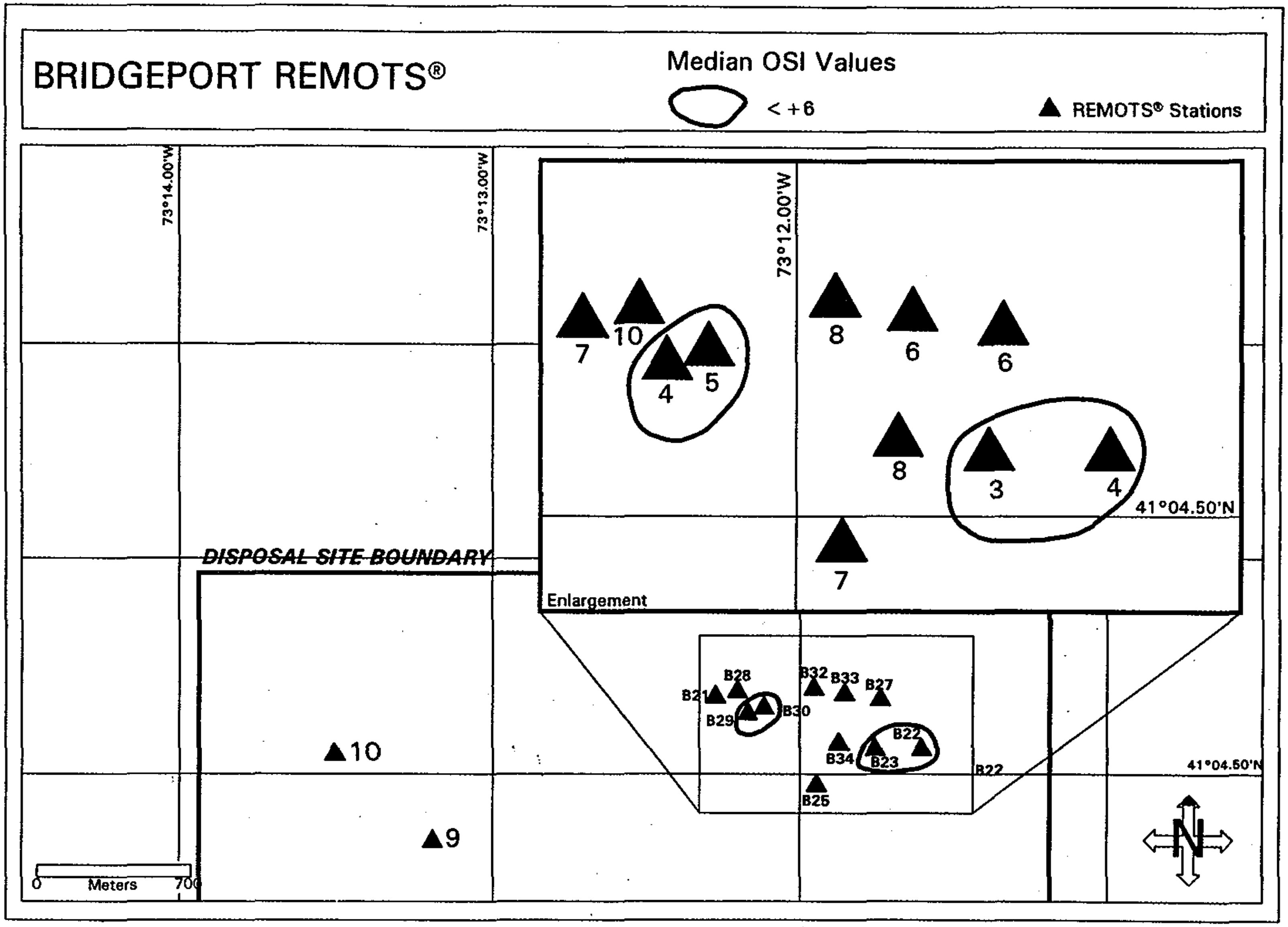


Figure 4-1. Median OSI values at Bridgeport Disposal Site REMOTS® stations

5.0 CONCLUSIONS AND RECOMMENDATIONS

One important goal of the survey was to use the results to predict future site conditions of existing disposal sites within Long Island Sound. The historical Bridgeport Disposal Site is a suitable model for comparison. Like the present sites in Long Island Sound, the Bridgeport Disposal Site received a large amount of dredged material from many sources over a period of two decades and is subjected to the same biological and physical processes experienced by other Long Island Sound disposal sites. Some of the dredged material disposed at the Bridgeport Disposal Site, however, would probably have been deemed unsuitable for unconfined open-water disposal using current standards.

The August 1992 survey of the historical Bridgeport Disposal Site indicated that relic dredged material was distributed throughout the site in low relief. The benthic habitat quality was relatively high despite the fact that materials disposed at the site between 1953 and 1977 were not rigorously screened (and were potentially contaminated) prior to open-water disposal. Currently, active Long Island Sound disposal sites are subject to dredged material characterization screening procedures which are intended to be environmentally protective. Because of these management practices, the future biological health of these sites is likely to be maintained.

The August 1992 reconnaissance survey at the Bridgeport Disposal Site succeeded in providing a cursory look at the physical nature of relic dredged material and the overall quality of the biological conditions at a historical disposal site. While the need for further surveys seems unwarranted, additional surveying would provide a much better assessment of the area's biological status and the location and characteristics of the relic dredged material. Since the dredged material appears to occur over the entire site, a REMOTS® survey using a systematic sampling design (i.e., orthogonal grid or radiating transects) is recommended to provide the needed coverage for a comprehensive site evaluation. In addition, because the distinction between ambient sediment and dredged material was sometimes not clear in the REMOTS® photographs, any future survey should include an off-site reference station for purposes of comparison. Finally, sediment sampling for chemistry analyses would help to better understand the long-term biological response to any existing chemical contamination at the site.

6.0 REFERENCES

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APPENDIX

Historical Bridgeport Disposal Site
REMOTS® Data, August 1992

Loc.	Sta.	/Rep.	Average Pen.	Boundary Roughness	Boundary Roughness type	Grain Size Major Mode	Grain Size Range
BP	B21	/A	15.76	2.07	Physical	> 4	1 to > 4
BP	B21	/B	14.47	2.03	Physical	> 4	1 to > 4
BP	B21	/C	11.02	4.02	Biological	> 4	1 to > 4
BP	B22	/A	12.71	0.21	Indeterminate	> 4	1 to > 4
BP	B22	/B	12.78	0.76	Physical	> 4	2 to > 4
BP	B22	/C	15.53	2.2	Physical	> 4	1 to > 4
BP	B23	/A	13.71	1.18	Physical	> 4	1 to > 4
BP	B23	/B	14.89	0.68	Physical	> 4	1 to > 4
BP	B23	/C	15.23	0.76	Physical	> 4	1 to > 4
BP	B24	/A	12.44	1.18	Physical	> 4	1 to > 4
BP	B24	/B	16.63	0.34	Physical	> 4	1 to > 4
BP	B24	/C	13.79	2.28	Physical	> 4	1 to > 4
BP	B25	/A	15.34	0.55	Physical	> 4	1 to > 4
BP	B25	/B	18.36	0.85	Physical	> 4	1 to > 4
BP	B25	/C	15.02	1.78	Physical	> 4	1 to > 4
BP	B26	/A	15.49	1.44	Physical	> 4	1 to > 4
BP	B26	/B	15.27	0.17	Physical	> 4	1 to > 4
BP	B26	/C	16.65	1.9	Physical	> 4	1 to > 4
BP	B27	/A	13.05	5.46	Physical	> 4	0 to > 4
BP	B27	/B	17.45	0.21	Physical	> 4	0 to > 4
BP	B27	/C	15.34	0.8	Physical	> 4	2 to > 4
BP	B28	/A	16.48	0.63	Physical	> 4	1 to > 4
BP	B28	/B	17.07	0.97	Physical	> 4	1 to > 4
BP	B28	/C	14.45	3.77	Physical	> 4	1 to > 4
BP	B29	/A	14.7	0.21	Physical	> 4	1 to > 4
BP	B29	/B	10.3	4.78	Physical	> 4	1 to > 4
BP	B29	/C	12.54	1.23	Physical	> 4	2 to > 4
BP	B30	/A	14.22	0.68	Physical	> 4	1 to > 4
BP	B30	/B	16.33	0.42	Physical	> 4	0 to > 4
BP	B30	/C	14.39	0.51	Physical	> 4	0 to > 4
BP	B32	/A	17.09	1.27	Physical	> 4	0 to > 4
BP	B32	/B	13.33	0.68	Physical	> 4	1 to > 4
BP	B32	/C	15.57	0.93	Physical	> 4	1 to > 4
BP	B33	/A	13.31	1.06	Physical	> 4	1 to > 4
BP	B33	/B	15.59	1.14	Physical	> 4	1 to > 4
BP	B33	/C	11.59	0.59	Physical	> 4	1 to > 4
BP	B34	/A	13.41	1.44	Physical	> 4	1 to > 4
BP	B34	/B	13.26	2.16	Physical	> 4	1 to > 4
BP	B34	/C	14.09	1.1	Physical	> 4	1 to > 4
BP	B34	/D	12.93	0.97	Biological	> 4	1 to > 4
BP	B34	/E	13.2	0.51	Physical	> 4	2 to > 4
BP	B34	/F	12.99	0.85	Physical	> 4	1 to > 4

Loc.	Sta.	/Rep.	RPD Avg.	Reboun Avg.	Mud Clast Count	Mud Clast Diameter	Mud Clast Status
BP	B21	/A	1.88	0	0	0	x
BP	B21	/B	2.5	0	2	1.48	Oxidized
BP	B21	/C	1.44	0	7	0.34	Oxidized
BP	B22	/A	1.54	0	9	0.36	Both
BP	B22	/B	1.61	0	3	0.34	Oxidized
BP	B22	/C	2.77	0	0	0	x
BP	B23	/A	1.16	0	0	0	x
BP	B23	/B	2.14	0	4	0.17	Both
BP	B23	/C	1.12	0	1	0.25	Reduced
BP	B24	/A	2.71	0	0	0	x
BP	B24	/B	3.22	0	0	0	x
BP	B24	/C	3.26	0	0	0	x
BP	B25	/A	2.28	0	0	0	x
BP	B25	/B	0.47	0	0	0	x
BP	B25	/C	1.04	0	0	0	x
BP	B26	/A	2.28	0	0	0	x
BP	B26	/B	3.77	0	0	0	x
BP	B26	/C	2.64	0	0	0	x
BP	B27	/A	1.52	0	3	0.38	Reduced
BP	B27	/B	1.27	0	0	0	x
BP	B27	/C	3.05	0	0	0	x
BP	B28	/A	3.77	0	0	0	x
BP	B28	/B	2.39	0	2	0.64	Oxidized
BP	B28	/C	3.24	0	3	0.89	Reduced
BP	B29	/A	1.88	0	0	0.42	Oxidized
BP	B29	/B	0.66	0	2	0.42	Reduced
BP	B29	/C	1.54	0	5	0.17	Reduced
BP	B30	/A	1.44	0	3	0.47	Both
BP	B30	/B	2.81	0	0	0	x
BP	B30	/C	1.84	0	1	0.34	Reduced
BP	B32	/A	2.01	0	0	0	x
BP	B32	/B	1.57	0	3	0.72	Both
BP	B32	/C	3.36	0	0	0	x
BP	B33	/A	1.31	0	0	0	x
BP	B33	/B	3.45	0	0	0	x
BP	B33	/C	3.17	0	2	0.26	Both
BP	B34	/A	1.99	0	0	0	x
BP	B34	/B	2.37	0	2	0.38	Reduced
BP	B34	/C	1.9	0	1	0.43	Oxidized
BP	B34	/D	2.01	0	0	0	x
BP	B34	/E	1.21	0	0	0	x
BP	B34	/F	2.64	0	2	0.34	Reduced

Loc.	Sta.	/Rep.	Dredged Material Penetration	Successional Stage	OSI	RPD > Pen.
BP	B21	/A	16.8	Stage I ON Stage III	8	0
BP	B21	/B	15.49	x	99	0
BP	B21	/C	13.03	Stage III	7	0
BP	B22	/A	0	Stage I	4	0
BP	B22	/B	0	Stage I	4	0
BP	B22	/C	0	Stage I	5	0
BP	B23	/A	0	Stage I	3	0
BP	B23	/B	0	Stage I	4	0
BP	B23	/C	0	Stage I	3	0
BP	B24	/A	0	Stage I ON Stage III	9	0
BP	B24	/B	0	Stage I ON Stage III	10	0
BP	B24	/C	0	Stage III	10	0
BP	B25	/A	0	Stage I ON Stage III	9	0
BP	B25	/B	18.79	Stage I ON Stage III	6	0
BP	B25	/C	0	Stage III	7	0
BP	B26	/A	0	Stage I ON Stage III	9	0
BP	B26	/B	0	Stage I ON Stage III	11	0
BP	B26	/C	0	Stage I ON Stage III	9	0
BP	B27	/A	15.78	Stage I ON Stage III	8	0
BP	B27	/B	17.56	Stage I	3	0
BP	B27	/C	15.74	Stage I	6	0
BP	B28	/A	16.8	Stage I ON Stage III	11	0
BP	B28	/B	17.56	Stage I ON Stage III	9	0
BP	B28	/C	16.33	Stage I ON Stage III	10	0
BP	B29	/A	14.81	Stage I	4	0
BP	B29	/B	12.69	Stage I	2	0
BP	B29	/C	13.16	Stage I	4	0
BP	B30	/A	14.55	Stage I	3	0
BP	B30	/B	16.54	Stage I	5	0
BP	B30	/C	14.64	Stage I ON Stage III	8	0
BP	B32	/A	17.73	Stage I ON Stage III	8	0
BP	B32	/B	13.67	Stage I	4	0
BP	B32	/C	16.04	Stage I ON Stage III	10	0
BP	B33	/A	13.84	Stage I	3	0
BP	B33	/B	16.16	Stage III	10	0
BP	B33	/C	11.89	Stage I	6	0
BP	B34	/A	14.13	Stage III	8	0
BP	B34	/B	14.34	Stage III	9	0
BP	B34	/C	0	Stage I	4	0
BP	B34	/D	13.41	Stage III	8	0
BP	B34	/E	0	Stage III	7	0
BP	B34	/F	0	Stage I ON Stage III	9	0

Loc.	Sta.	/Rep.	DM > Pen.	Cobble	Sand/ Mud	Bedforms	Mud/ Sand	Fresh DM
BP	B21	/A	DM > Pe	0	Sand/Mud	Bed Form	0	0
BP	B21	/B	DM > Pe	0	Sand/Mud	0	0	0
BP	B21	/C	DM > Pe	0	Sand/Mud	Bed Form	0	0
BP	B22	/A	0	0	Sand/Mud	0	0	0
BP	B22	/B	0	0	0	0	0	0
BP	B22	/C	0	0	Sand/Mud	Bed Form	0	0
BP	B23	/A	0	0	Sand/Mud	Bed Form	0	0
BP	B23	/B	0	0	Sand/Mud	0	0	0
BP	B23	/C	0	0	Sand/Mud	0	0	0
BP	B24	/A	0	0	0	Bed Form	0	0
BP	B24	/B	0	0	0	0	0	0
BP	B24	/C	0	0	Sand/Mud	0	0	0
BP	B25	/A	0	0	Sand/Mud	0	0	0
BP	B25	/B	DM > Pe	0	0	0	0	0
BP	B25	/C	0	0	Sand/Mud	0	0	0
BP	B26	/A	0	0	0	0	0	0
BP	B26	/B	0	0	0	0	0	0
BP	B26	/C	0	0	Sand/Mud	0	0	0
BP	B27	/A	DM > Pe	0	Sand/Mud	0	0	0
BP	B27	/B	DM > Pe	0	Sand/Mud	0	0	0
BP	B27	/C	DM > Pe	0	Sand/Mud	0	0	0
BP	B28	/A	DM > Pe	0	Sand/Mud	0	0	0
BP	B28	/B	DM > Pe	0	Sand/Mud	0	0	0
BP	B28	/C	DM > Pe	0	0	0	0	0
BP	B29	/A	DM > Pe	0	Sand/Mud	0	0	0
BP	B29	/B	DM > Pe	0	0	0	0	0
BP	B29	/C	DM > Pe	0	Sand/Mud	0	0	0
BP	B30	/A	DM > Pe	0	Sand/Mud	0	0	0
BP	B30	/B	DM > Pe	0	Sand/Mud	0	0	0
BP	B30	/C	DM > Pe	0	Sand/Mud	0	0	0
BP	B32	/A	DM > Pe	0	Sand/Mud	0	0	0
BP	B32	/B	DM > Pe	0	Sand/Mud	0	0	0
BP	B32	/C	DM > Pe	0	Sand/Mud	0	0	0
BP	B33	/A	DM > Pe	0	Sand/Mud	0	0	0
BP	B33	/B	DM > Pe	0	Sand/Mud	0	0	0
BP	B33	/C	DM > Pe	0	0	0	0	0
BP	B34	/A	DM > Pe	0	0	Bed Form	0	0
BP	B34	/B	DM > Pe	0	0	Bed Form	0	0
BP	B34	/C	0	0	Sand/Mud	0	0	0
BP	B34	/D	DM > Pe	0	0	0	0	0
BP	B34	/E	0	0	Sand/Mud	0	0	0
BP	B34	/F	0	0	0	0	0	0

Loc.	Sta.	/Rep.	Poor Sort	Chaotic Fabric	Shell Lag	Mussel Bed	Burrows	Amphipods
BP	B21	/A	0	0	0	0	0	0
BP	B21	/B	0	0	0	0	0	0
BP	B21	/C	0	0	0	0	Burrows	0
BP	B22	/A	0	0	0	0	0	0
BP	B22	/B	0	0	0	0	0	0
BP	B22	/C	0	0	0	0	0	0
BP	B23	/A	0	0	0	0	0	0
BP	B23	/B	0	0	0	0	0	0
BP	B23	/C	0	0	0	0	0	0
BP	B24	/A	0	0	0	0	0	0
BP	B24	/B	0	0	0	0	0	0
BP	B24	/C	0	0	0	0	0	0
BP	B25	/A	0	0	0	0	0	0
BP	B25	/B	0	0	0	0	0	0
BP	B25	/C	0	0	0	0	0	0
BP	B26	/A	0	0	0	0	0	0
BP	B26	/B	0	0	0	0	0	0
BP	B26	/C	0	0	0	0	0	0
BP	B27	/A	0	0	Shell Lag	0	0	0
BP	B27	/B	0	0	0	0	0	0
BP	B27	/C	0	0	0	0	0	0
BP	B28	/A	0	0	0	0	0	0
BP	B28	/B	0	0	0	0	0	0
BP	B28	/C	0	0	0	0	0	0
BP	B29	/A	0	0	0	0	0	0
BP	B29	/B	Poor Sort	0	0	0	0	0
BP	B29	/C	0	0	0	0	0	0
BP	B30	/A	Poor Sort	0	0	0	0	0
BP	B30	/B	0	0	0	0	0	0
BP	B30	/C	0	0	0	0	0	0
BP	B32	/A	0	0	0	0	0	0
BP	B32	/B	0	0	0	0	0	0
BP	B32	/C	0	0	0	0	0	0
BP	B33	/A	0	0	0	0	0	0
BP	B33	/B	0	0	0	0	0	0
BP	B33	/C	0	0	0	0	0	0
BP	B34	/A	0	0	0	0	0	0
BP	B34	/B	0	0	0	0	0	0
BP	B34	/C	0	0	0	0	0	0
BP	B34	/D	0	0	0	0	0	0
BP	B34	/E	0	0	0	0	0	0
BP	B34	/F	0	0	0	0	0	0

Loc.	Sta.	/Rep.	Hydroids	General Comments
BP	B21	/A	0	x
BP	B21	/B	0	cut through ox mudclasts relic dm
BP	B21	/C	0	soft sed small mc shell fragment lobster burrow?
BP	B22	/A	0	numerous small mc on surface looks ambient
BP	B22	/B	0	x
BP	B22	/C	0	looks ambient
BP	B23	/A	0	ambient sand and shell fragments over silt clay
BP	B23	/B	0	ambient some slope
BP	B23	/C	0	rippled ambient? sand shell fragments over silt clay
BP	B24	/A	0	shell fragments rippled
BP	B24	/B	0	looks ambient
BP	B24	/C	0	rippled sand and shell fragments over >4 relic dm?
BP	B25	/A	0	small voids on right
BP	B25	/B	0	patchy rpd layer darker mud on top shell fragments
BP	B25	/C	0	rippled burrowing anemone
BP	B26	/A	0	ambient
BP	B26	/B	0	ambient
BP	B26	/C	0	possible relic dm some slope shell fragments
BP	B27	/A	0	relic dm sloped surface
BP	B27	/B	0	relic dm
BP	B27	/C	0	relic dm or possibly ambient
BP	B28	/A	0	relic dm
BP	B28	/B	0	relic dm large burrow
BP	B28	/C	0	Stage III relic? some slope
BP	B29	/A	0	relic dm relic Stage III? numerous small mc
BP	B29	/B	0	relic dm sloped surface patchy rpd
BP	B29	/C	0	some slope numerous small mc
BP	B30	/A	0	relic dm rippled
BP	B30	/B	0	relic dm relic Stage III shell frags
BP	B30	/C	0	shell fragments on surface burrowing anemone
BP	B32	/A	0	rippled shell fragments on surface
BP	B32	/B	0	sloped surface relic dm
BP	B32	/C	0	some slope
BP	B33	/A	0	relic dm and relic Stage III some slope
BP	B33	/B	0	rippled relic DM?
BP	B33	/C	0	relic dm rippled surface some shell frags
BP	B34	/A	0	layer of surface organic matter relic dm
BP	B34	/B	0	relic dm
BP	B34	/C	0	relic dm?
BP	B34	/D	0	organic matter layer on surface due to burrowing excavation
BP	B34	/E	0	some slope polychaete visible
BP	B34	/F	0	some slope