DAMOS

DISPOSAL AREA MONITORING SYSTEM

Summary of Program Results
1981-1984

Volume III
Part A
Section I

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I. Western Long Island Sound Disposal Area

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VOLUME III

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I. WESTERN LONG ISLAND SOUND DISPOSAL AREA

1.0 INTRODUCTION

As a result of requirements for dredging of small harbors in the western portions of Long Island Sound, a dredged material disposal site was designated by the New England Division of the U.S. Army Corps of Engineers (40°59.34'N, 73°29.21'W, Fig. I-1-1) to help reduce barging costs. This point and the surrounding area, known as the Western Long Island Sound III (WLIS III) disposal site was studied extensively during preparation of an Environmental Impact Statement.

The WLIS III site (Fig. I-1-2) is located 2.5 nautical miles north of Lloyd Point between two previously used disposal sites designated as the Stamford and Eaton's Neck dumping grounds. The depth in the center of the site is approximately 32 meters and the sediments are known to consist primarily of fine silts and clays. The smooth bottom topography of the site contrasts with the rougher topography of the surrounding area which results primarily from previous disposal operations.

Currents in the area are known to flow generally in an east-west direction with maximum tidal velocities on the order of 25 cm/sec. The wave climate at the site is controlled primarily by the fetch distance, which is only significant in an easterly direction.

Prime lobster fishing grounds are located east and west of the site at the previously used disposal sites, in the vicinity of Cable and Anchor Reef, and in a deep east-west trending channel farther to the east. Benthic macrofaunal assemblages were composed of polychaete worms, bivalves, etc. which are generally associated with mud and fine-grained sediment types.

The disposal point was marked with a taut-wire moored buoy in March 1982 and has since been used for disposal of sediment from several projects including those shown in Table I-1-1. Two major periods of disposal have occurred, the first from March through May 1982, and the second from December 1982 through the winter of 1982-83.

An interim survey was made during April 1982 to insure that operational procedures were effective in developing a mound at the disposal site. A more detailed survey of the area, using precision navigation control, was made in August 1982, which included replication of the baseline hydrographic and sediment chemistry surveys as well as diver observations of the disposed dredged material surface conditions. A similar survey was conducted in January 1983, however, the diver observations of the disposal mound were replaced by a REMOTS camera survey which photographed the sediment-water interface.

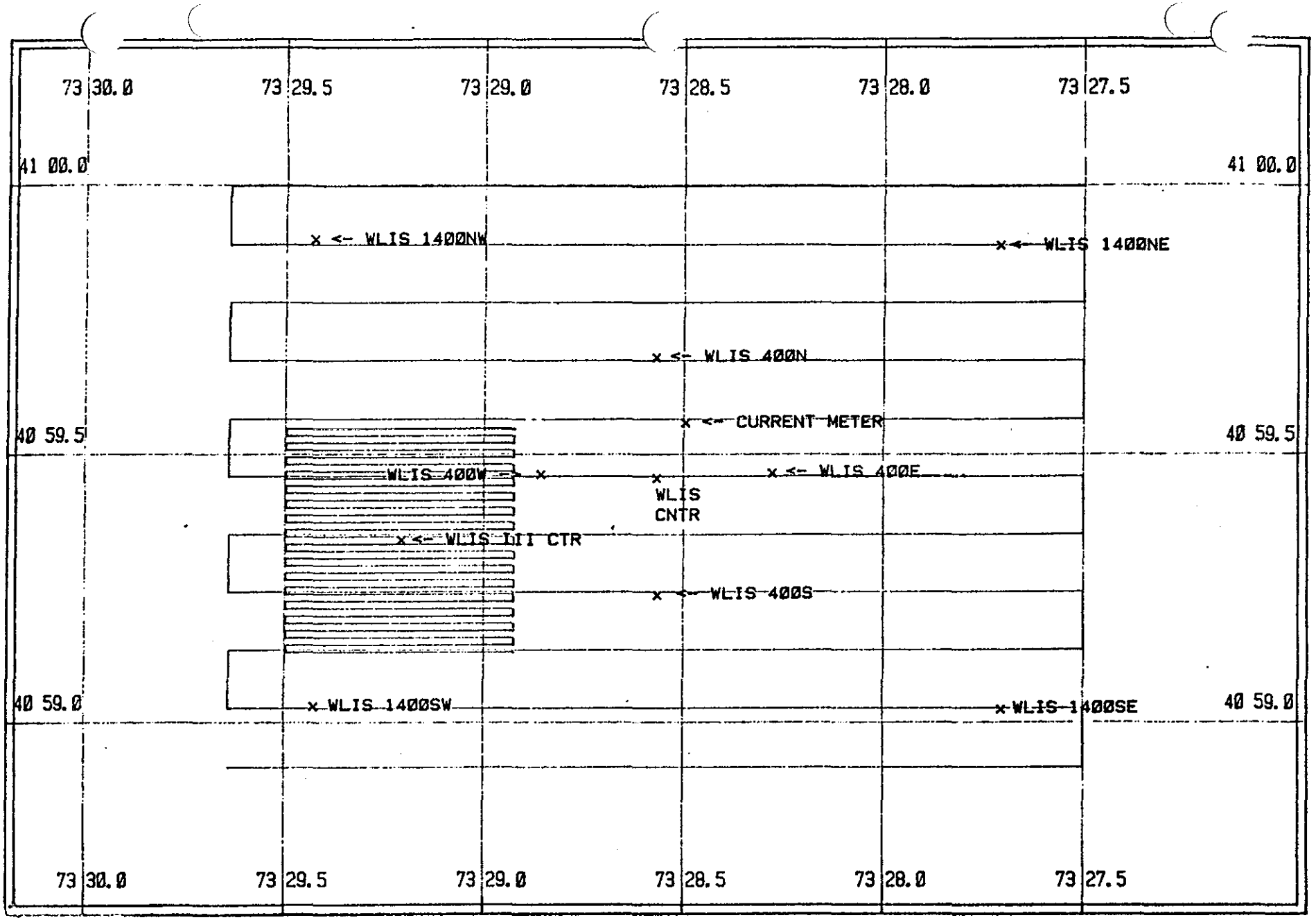

FIGURE I-1-1. Western Long Island Sound designated disposal site.

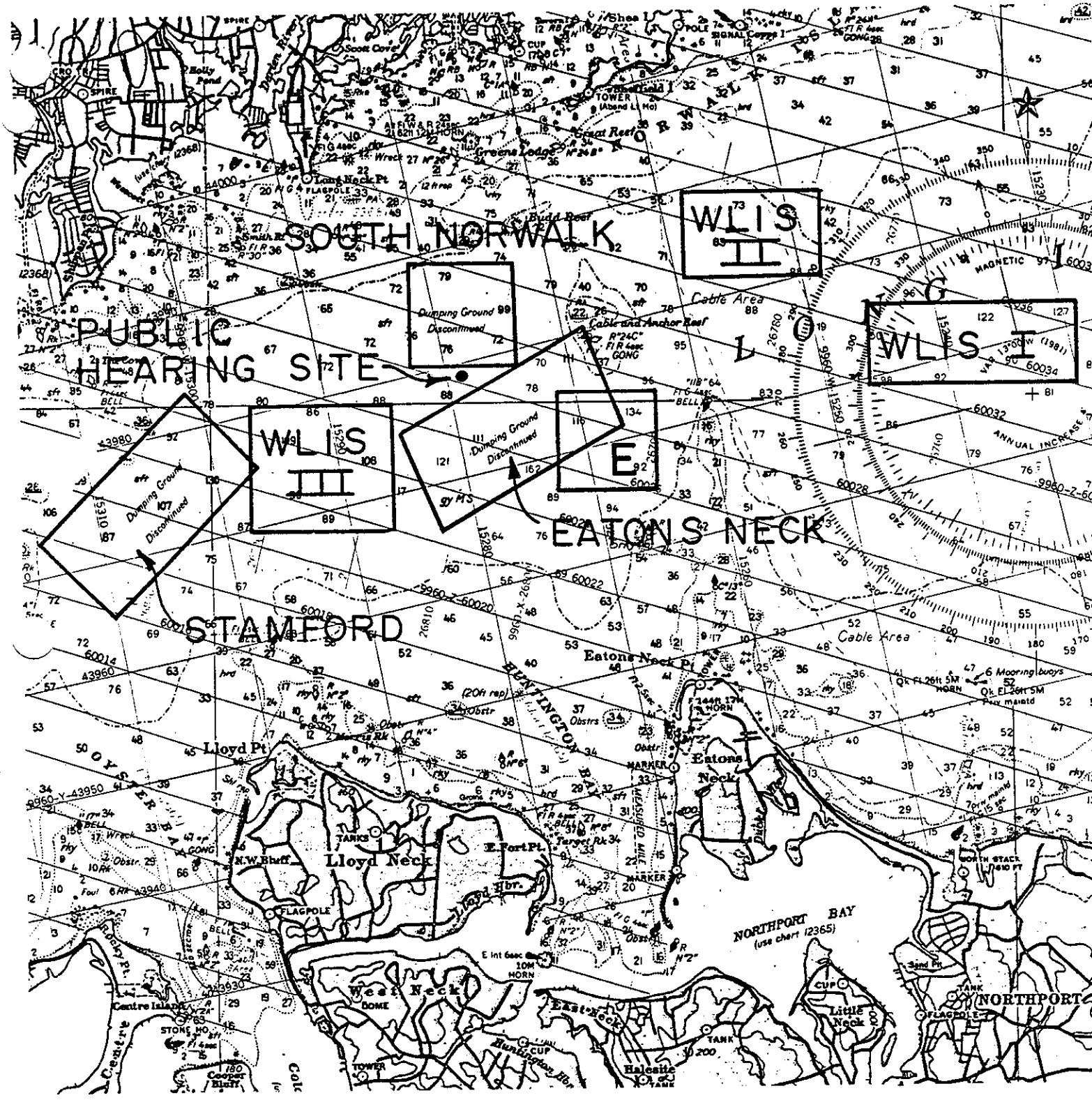

Figure I-1-2. Historic and proposed dredged material disposal site.

TABLE I-1-1

Disposal Operations at the WLIS III Disposal Site

Source	Dates	Volume (yds^3)	Volume (m^3)
Mamaroneck	March-April, 1982	22,180	16,967
Shore Acres Pt.	March-April, 1982	20,600	15,759
Post Road Boat Yard	April, 1982	1,900	1,453
Crescent	May, 1982	4,350	3,327
Various Permits	April, 1982	4,050	3,098
		53,080	40,606
		August 1982 Survey	
Rex Marina	Dec 1982-Jan 1983	5,850	4,475
F. Ludwig	Dec, 1982	2,695	2,061
Beach Pt. Club	Jan, 1983	6,700	5,126
		15,245	11,662
		January 1983 Survey	
Nichols Yacht Yd.	Jan-Feb, 1983	19,850	15,185
Beach Pt. Club	Feb, 1983	550	421
Rex Marina	Feb, 1983	550	421
Darien Boat Club	Feb-March, 1983	6,500	4,973
Mamaroneck	Feb-April, 1983	9,050	6,923
American YC	Feb-March, 1983	26,800	20,502
Cove Marina	March-April, 1983	10,350	7,918
H. Govziska	March, 1983	4,050	3,098
		77,700	59,441
		Post Survey	
Milton Harbor	April-June, 1984	96,678	73,800
		1984 Survey	

In August and September 1983, a detailed bathymetric survey of the disposal area was again conducted along with a REMOTS survey and diver observations. The information collected on these surveys were compared to the bathymetric and REMOTS survey data collected in January 1983.

In March 1984, a new disposal point was designated in the Western Long Island Sound III (WLIS III) disposal site. This disposal point was designated WLIS III "B" and was located west of the still active WLIS III "A" disposal point. On 14 March 1984, the WLIS III "A" buoy was serviced with fresh lead acid batteries and any burned out lamps were replaced. The buoy was then towed to 40°59.35'N, 73°29.55'W.

On 22 March, the survey team was informed that due to its close proximity to the western boundary of the WLIS III disposal area, it would be necessary to move the WLIS III "B" disposal buoy approximately 250 meters to the east. Consequently, the buoy was moved to 40°59.36'N, 73°29.41'W. At this time, it was noted by the diving team that the buoy and its associated mooring were in satisfactory condition and not in need of immediate repair.

From mid-April to mid-June, approximately 73,800 m^3 of material was disposed at the WLIS III "B" disposal point. More than 90% of the material was dredged from Milton Harbor.

2.0 BATHYMETRIC AND SIDE SCAN SURVEYS

Bathymetric surveys of the Western Long Island Sound disposal area (WLIS III) were conducted using the SAIC Navigation and Data Acquisition System, interfaced to a Del Norte Trisponder positioning unit and an Edo-Western 24 kHz fathometer. This system, described in detail in Volume II of this report, was also used to obtain precise positioning for all other sampling.

In January 1982, a survey grid consisting of eleven east-west oriented lanes, 3000 meters long and spaced 200 meters apart, were established over the proposed disposal site (Fig. I-2-1). A Klein Side Scan Sonar System was towed over this grid using a 100 meter sweep to provide nearly complete coverage of the entire area.

Simultaneous with the side scan survey, a bathymetric survey was obtained. A contour chart generated from that data is presented in Figure I-2-2 and a three dimensional view of the site from a north-east perspective is presented in Figure I-2-3. The area surveyed is an east-west trending trough that deepens to a maximum depth of 34.7 meters in the southwestern portion of the area. Both the north and south slopes into the trough are fairly uniform, although there are some topographic features in the northeast portion of the chart in depths less than 28 meters and a small promontory about 300 meters wide occurs on the south slope. The bottom of the trough flattens toward the west so that a natural basin with topographic relief of less than one meter

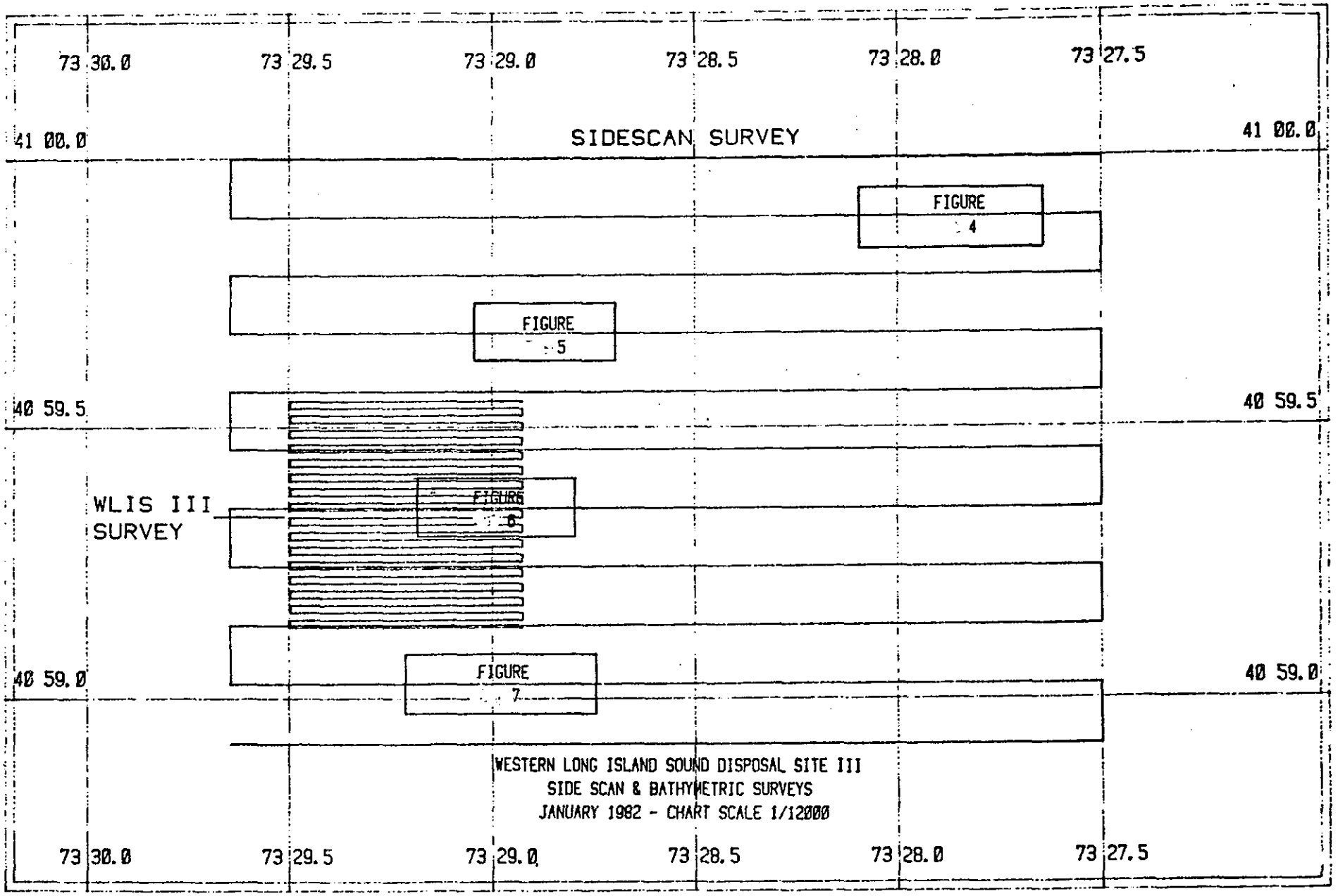

FIGURE I-2-1. Side scan survey at WLIS, January 1982.

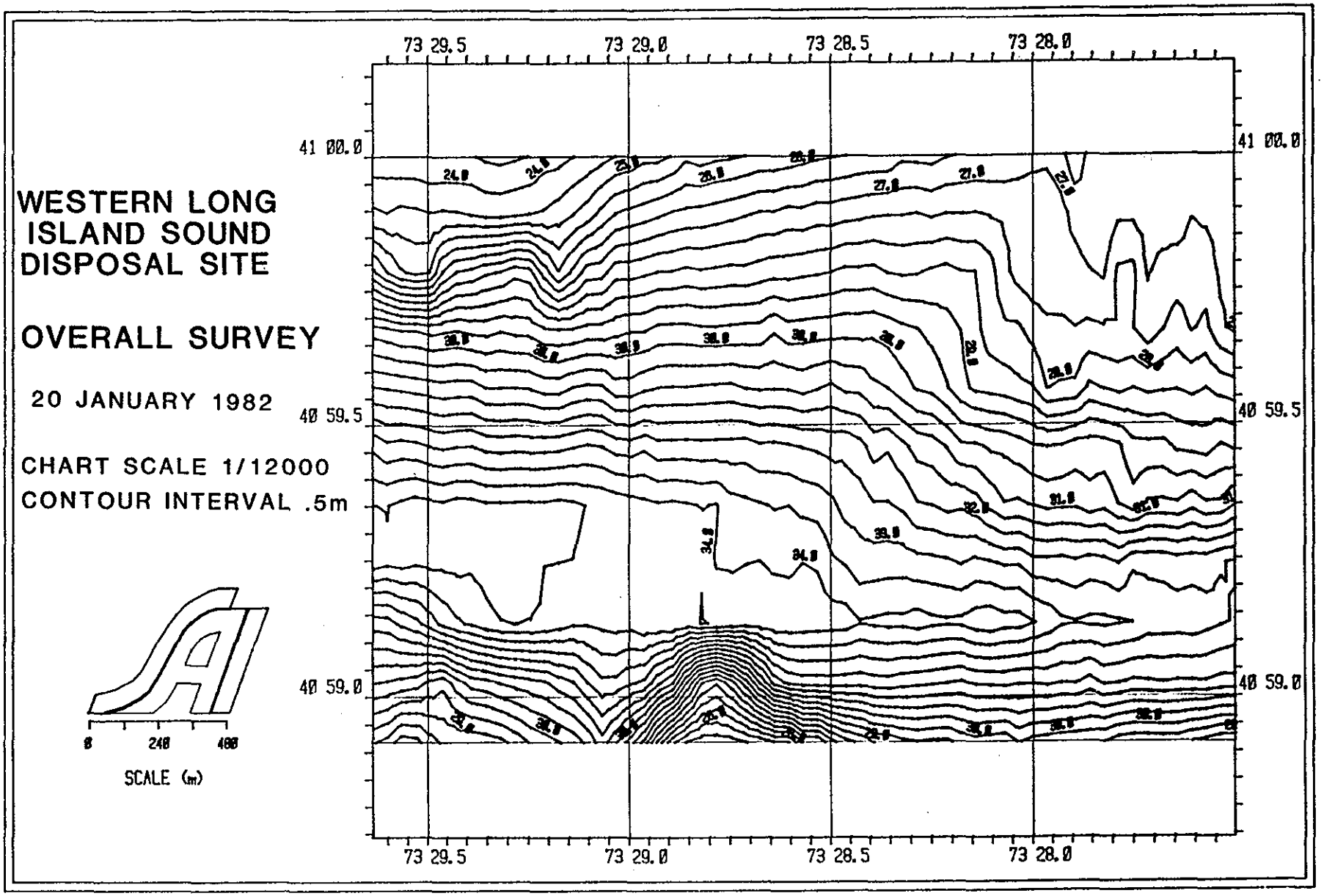

FIGURE I-2-2. Western Long Island Sound Disposal Site, Overall Survey, January 1982.

WESTERN LONG ISLAND SOUND DISPOSAL SITE

20 JANUARY 1982
VERTICAL EXAGGERATION: 50X

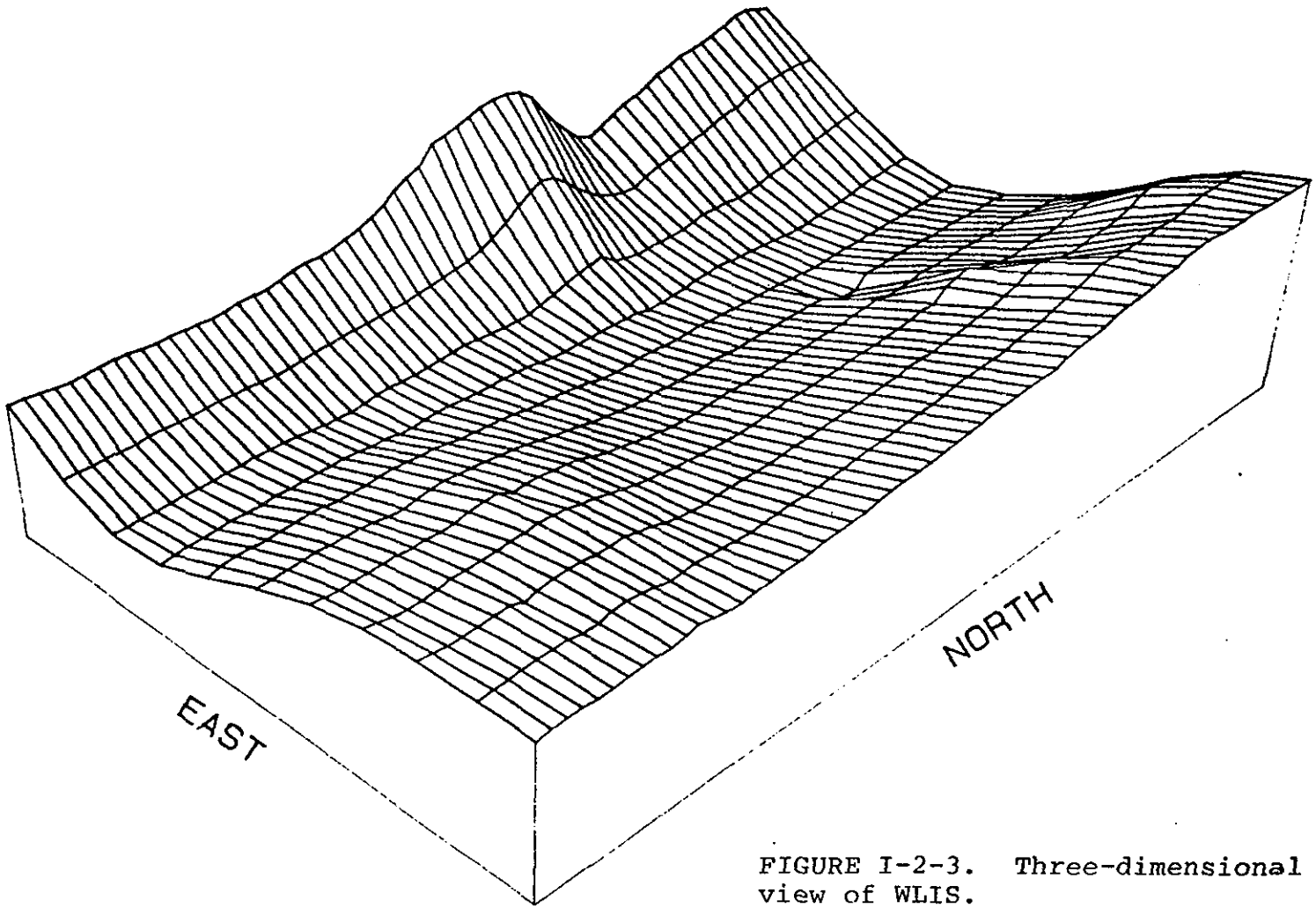

FIGURE I-2-3. Three-dimensional view of WLIS.

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covers a rectangular area of 500 x 1500 meters oriented in an east-west direction. Such a basin would make an excellent disposal site assuming the sediment and current conditions indicated a low-energy, depositional regime that would act as a containment site.

The first step in evaluation of the sediment characteristics (see next section) is an analysis of the side scan data. Representative sections of the side scan records are presented in Figures I-2-4 through I-2-7 from the respective locations shown in Figure I-2-1. Most of the northeast and east sections of the survey site had bottom characteristics similar to Figure I-2-4, which shows a rough microtopography characteristic of a relatively coarse bottom. Sediment samples taken from the area revealed a coarse shell hash covering the sediment-water interface.

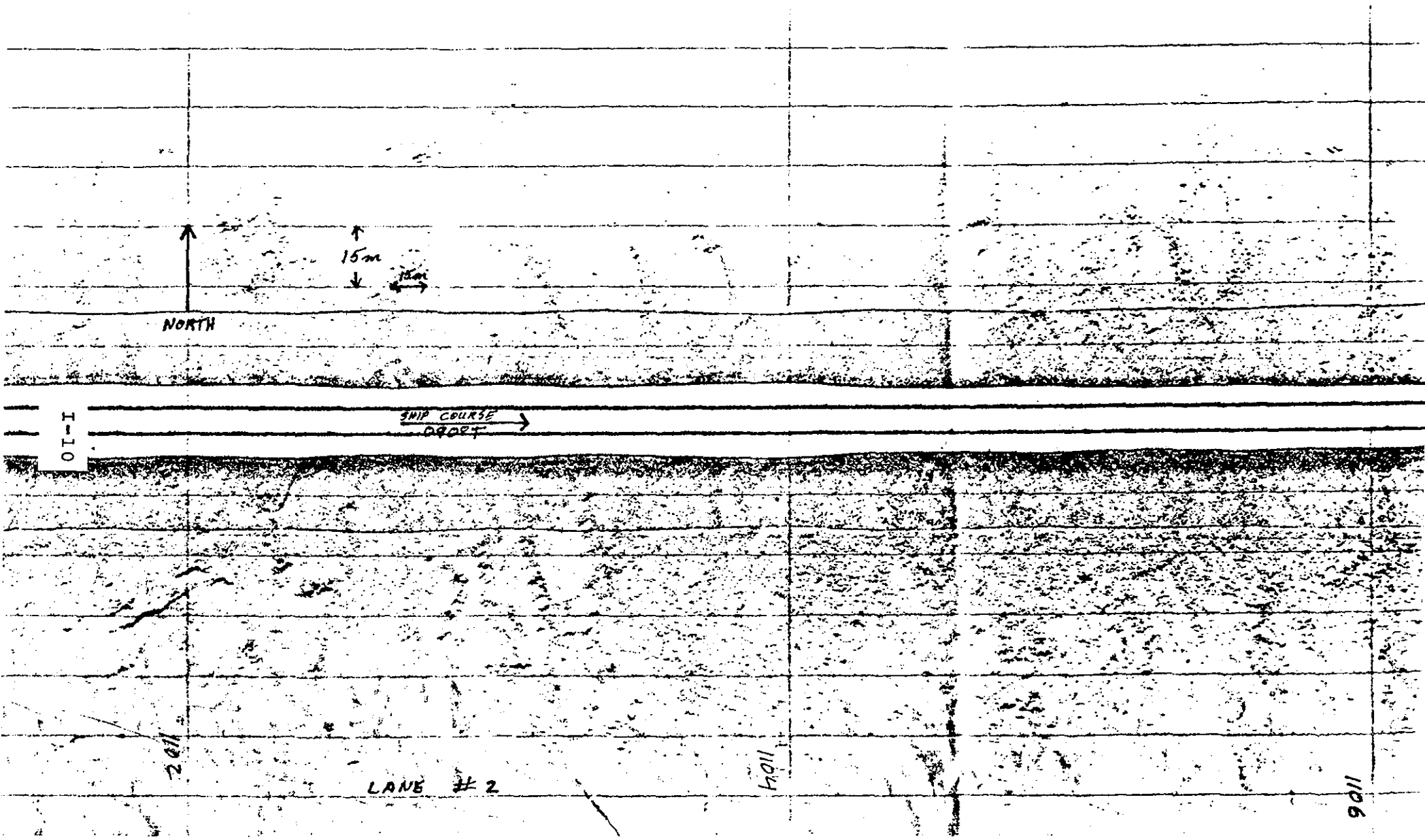
Moving towards the north central portion of the area (Fig. I-2-5), the sediments become finer and the bottom return from the side scan indicates a much smoother surface with occasional outcrops of coarser material. A large (350m long) scour mark, most likely from an otter trawl, indicates some bottom fishing may occur in this softer sediment.

Figure I-2-6, taken from the bottom of the east-west trough at approximately 34 meters depth, shows an extremely flat bottom with no microtopographic features. A side scan record such as this is indicative of a soft muddy bottom which would be constant in depth and composition over a relatively large area.

The southern slope of the trough (Fig. I-2-7), like the north and east portion of the survey area, has mottled surface expression indicative of coarser sediment. Characteristic features of the side scan records from this area are elliptical rings with high returns surrounding a low return area. These rings are generally aligned in a southwest to northeast direction and vary in return strength. The source of these features is unknown, however, they may be the result of lobster pot trawls. Should designation of this site occur, these features would be examined by divers during a subsequent monitoring cruise.

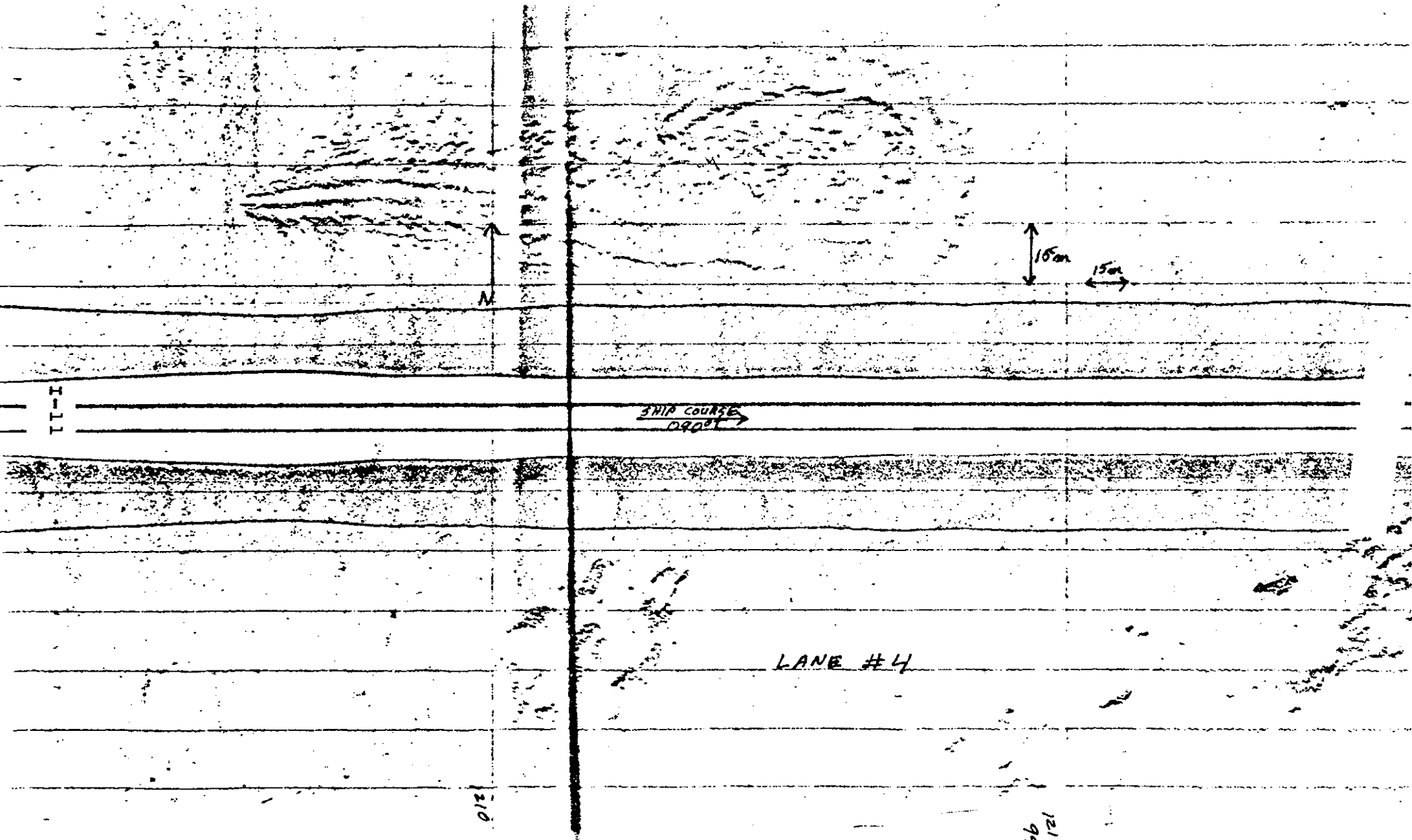
The side scan records indicate that the trough located in the southwest corner of the WLIS III area would be a suitable disposal site. The sediments in that location are fine grained muds and the bottom is smooth and featureless. The lack of topography suggests that lobster habitat in this region would be negligible and one would expect a relatively low diversity and population density of benthic organisms. Finally, the continuity in the bottom conditions provides a good background for monitoring of disposal operations, since variability in measured environmental parameters would be small.

Based on these results, the deep portion of the east-west trough was selected as the location for potential disposal of dredged material within WLIS III. To provide a more



WLIS III SIDE SCAN SURVEY
LANE #2
REPRESENTATIVE BOTTOM RETURN

FIGURE I-2-4



WLIS III SIDE SCAN SURVEY
LANE #4
REPRESENTATIVE BOTTOM RETURN

FIGURE I-2-5

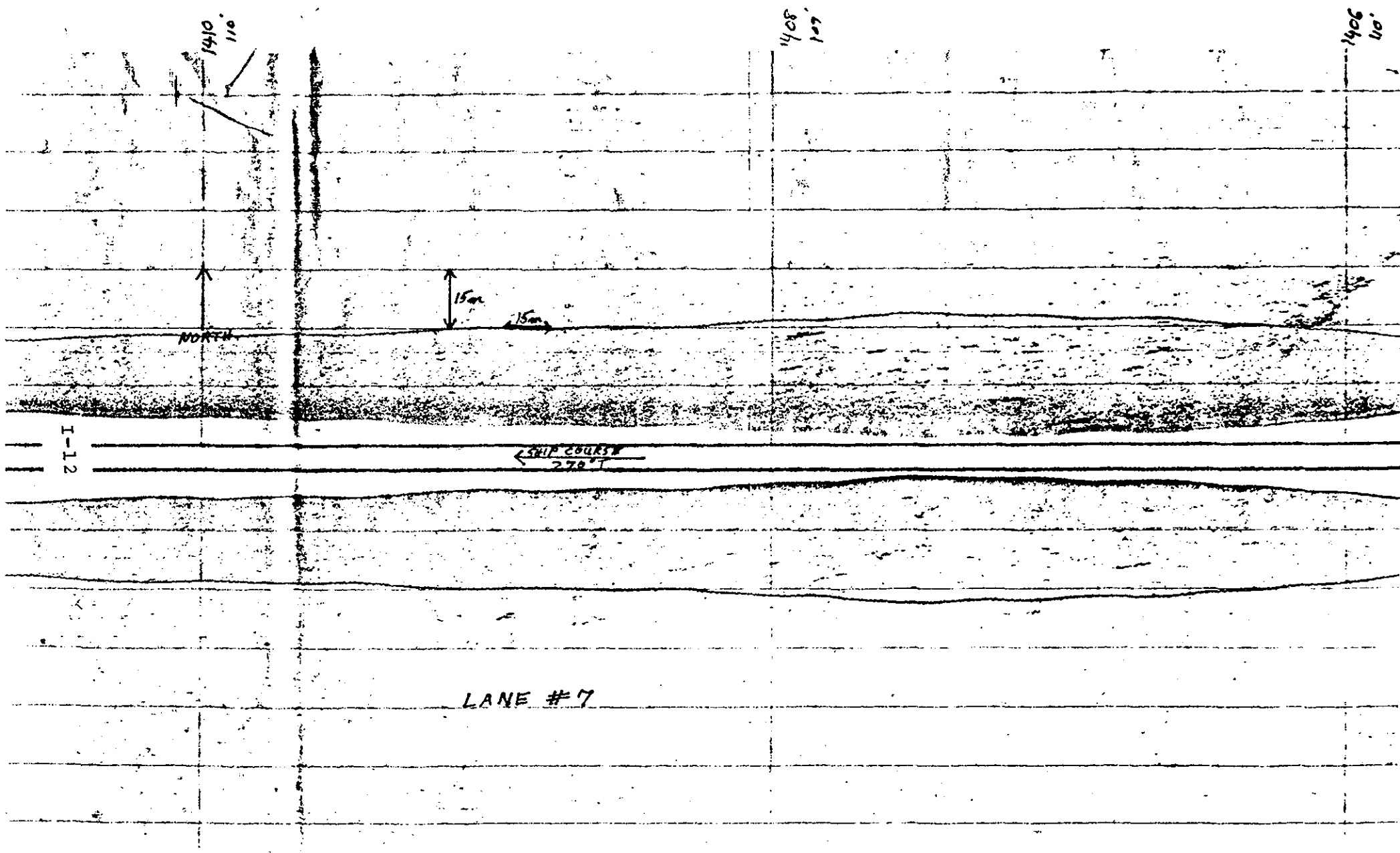


FIGURE I-2-6

WLIS III SIDE SCAN SURVEY
LANE #7
REPRESENTATIVE BOTTOM RETURN

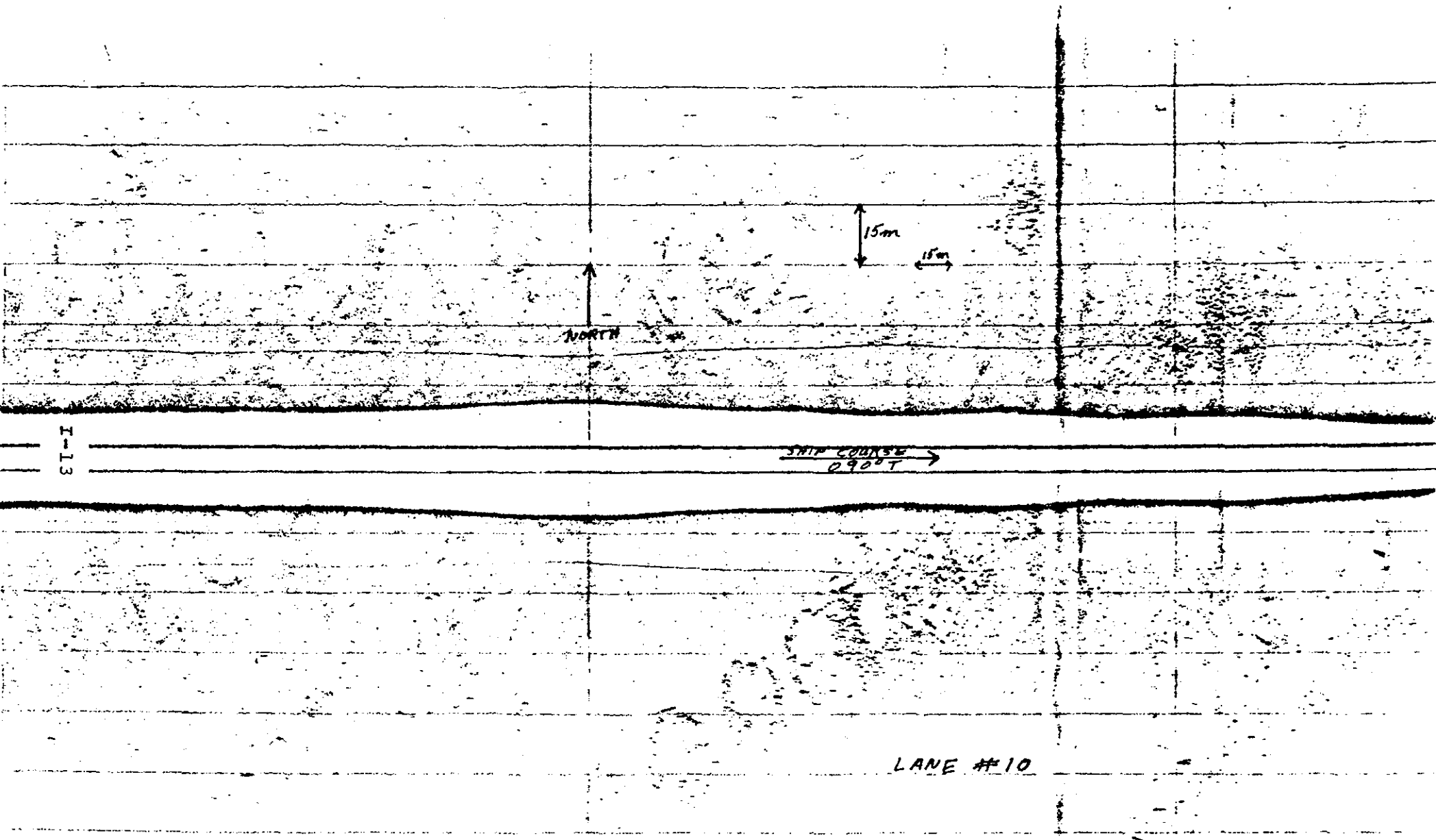


FIGURE I-2-7

WLSS III SIDE SCAN SURVEY
LANE #10
REPRESENTATIVE BOTTOM RETURN

detailed evaluation of this site, a smaller survey was established which was centered at 40°59.34'N, 73°29.21'W. From experience with disposal at Central Long Island Sound, an 800 meter square grid was established consisting of 32 east-west lanes, spaced 25 meters apart. A bathymetric survey of the grid was run on 26 January 1982, the results of which are presented as a contour chart in Figure I-2-8 and in three-dimensional perspective from the northeast in Figure I-2-9.

Close examination of the contour chart indicates that the topography in the survey site is oriented in an east-west direction and that the relief is quite small. The total depth range within the survey is only 1.5 meters from 33.5 to 35 meters in the center of the site. Vertical profiles immediately south of the center (Fig. I-2-10) show very little topography and nearly constant depth at 35 meters. In summary, the survey obtained here provides an excellent baseline for future monitoring of dredged material disposal once such operations occur.

On 23 April 1982, a series of vertical depth profiles were made in the vicinity of the disposal buoy consisting of five east-west transects and two north-south transects as shown in Figure I-2-11. Navigation control was provided by calibrated Loran-C. The transects ranged approximately 400 meters east and west of the disposal buoy at distances north and south of the buoy as follows:

Profile	1	50m north
	2	20m north
	3	10m south
	4	20m south
	5	75m south

The two north-south profiles were made 10 meters west and 70 meters east of the buoy.

Results of the profile measurements are presented in Figures I-2-12 through I-2-17. In general, the data indicate that the dredged material has formed a distinct mound immediately south and east of the disposal buoy with maximum thickness approaching 4 meters on profile 3. The mound has a radius of approximately 100 meters in the east-west direction, and somewhat less than 50 meters in the north-south direction.

This topography closely resembles the features created by point dumping at the Central Long Island Sound (CLIS) Disposal Site and indicates that the disposal operation has been successful in controlling the spread of material. Creation of a mound such as shown in these profiles reduces the amount of sediment exposed to the biota and water column and the area of the bottom impacted by the dumping operation. Furthermore, the formation of a mound indicates that the sediments being dredged are cohesive and consequently should be more resistant to erosion and dispersion.

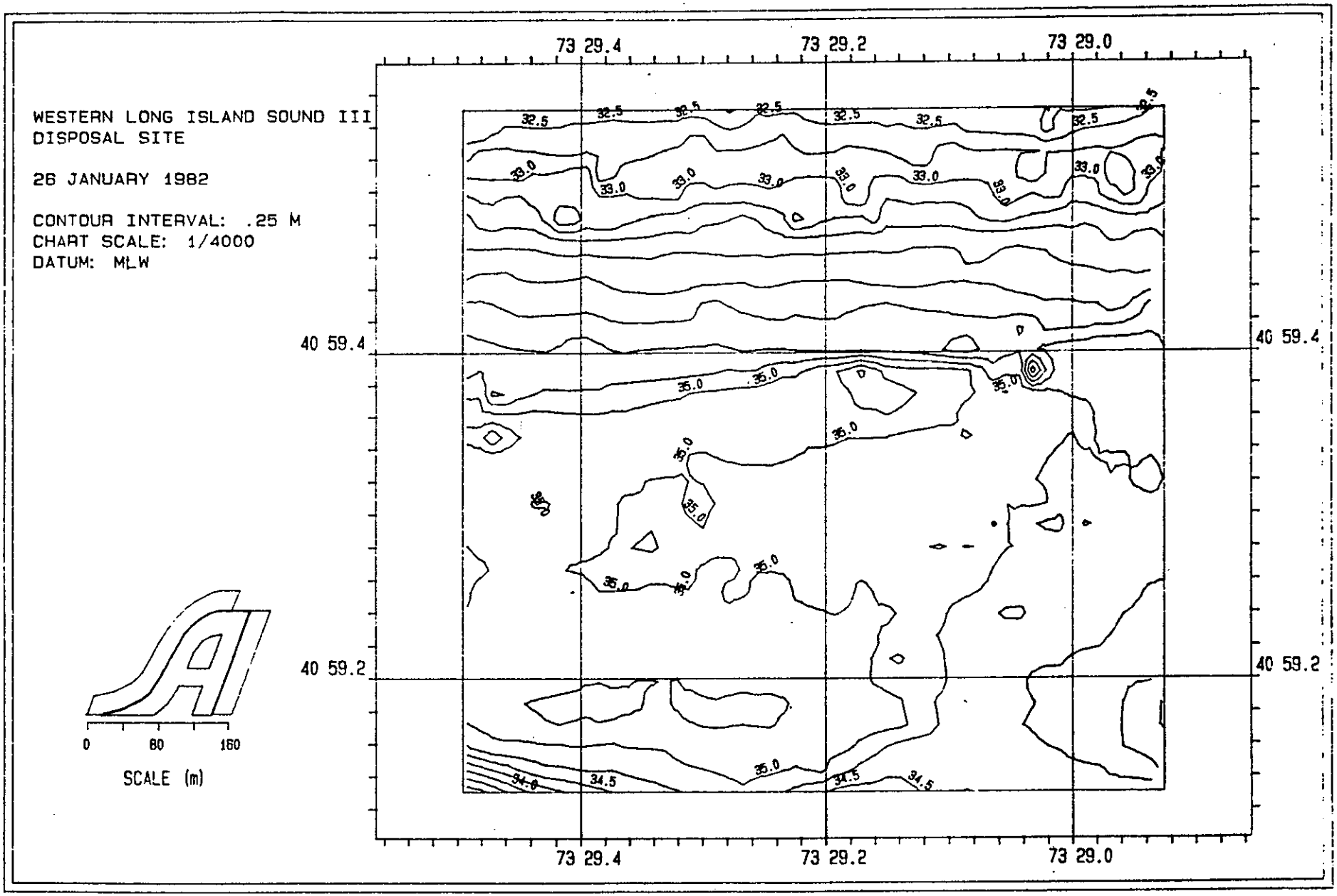


FIGURE I-2-8. Contour chart of WLIS III, January 1982.

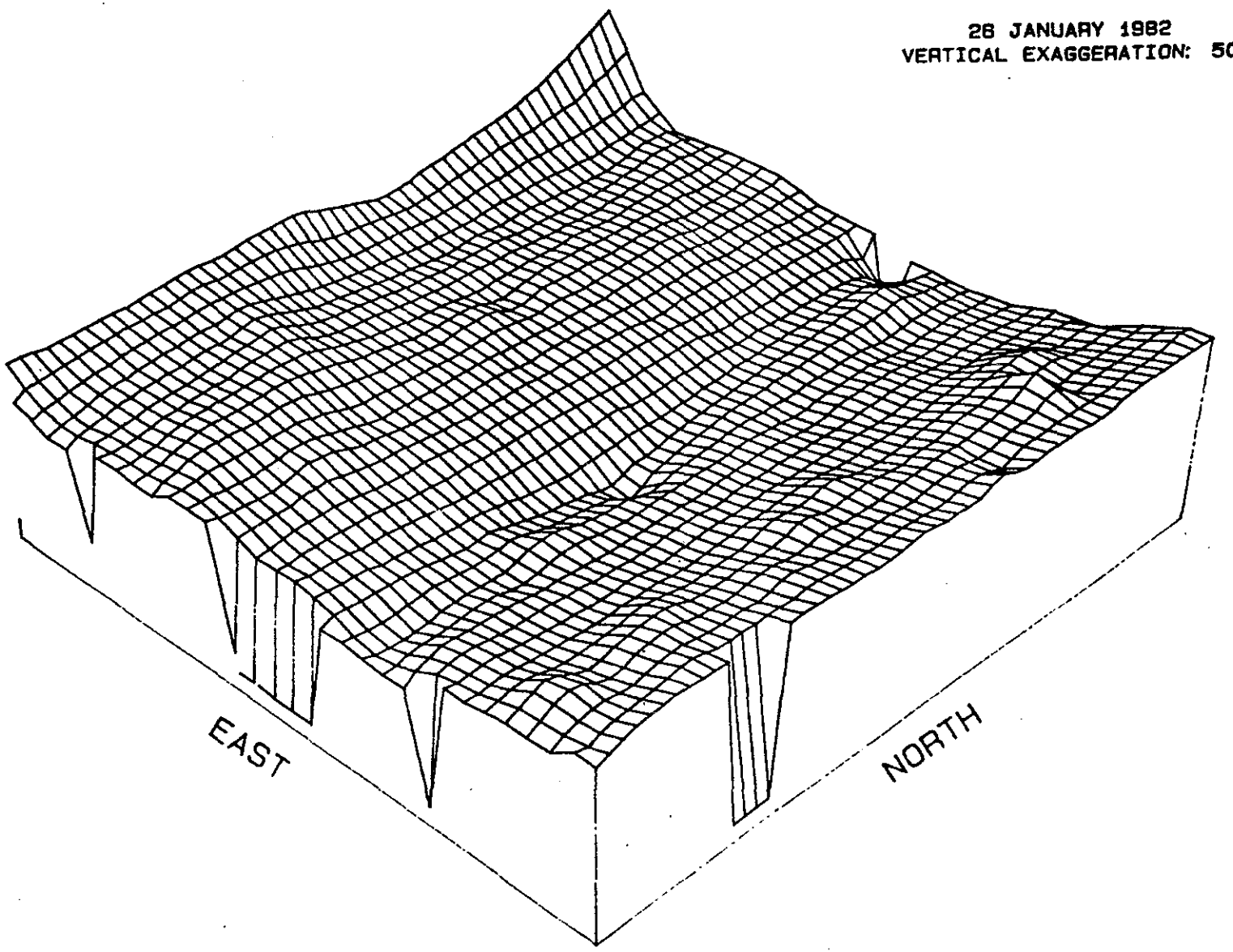


FIGURE I-2- 9 Three-dimensional view of WLIS III, January 1982.

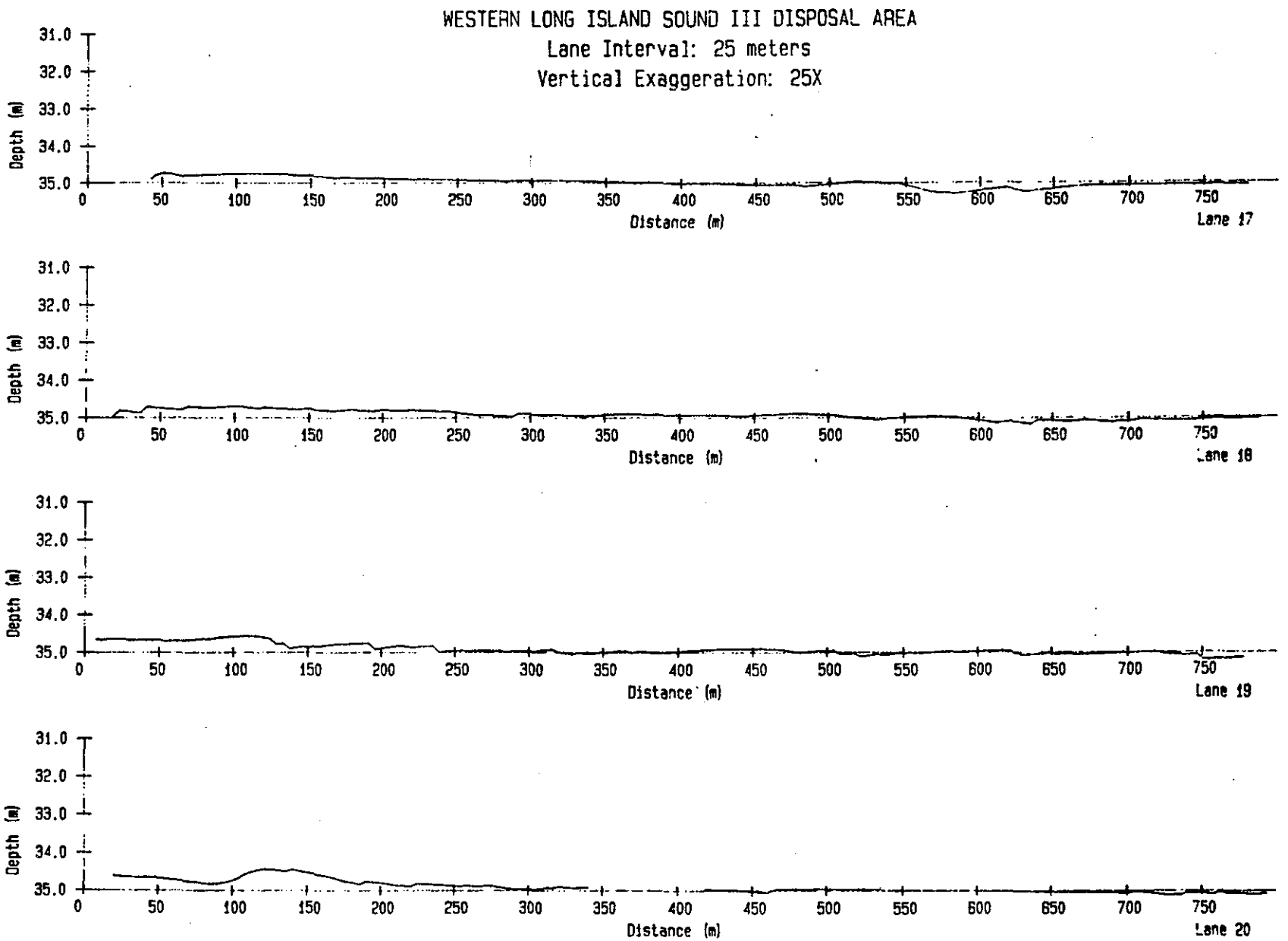


FIGURE I-2-10. Bathymetric profiles of WLIS III, lanes 17-20, January 1982.

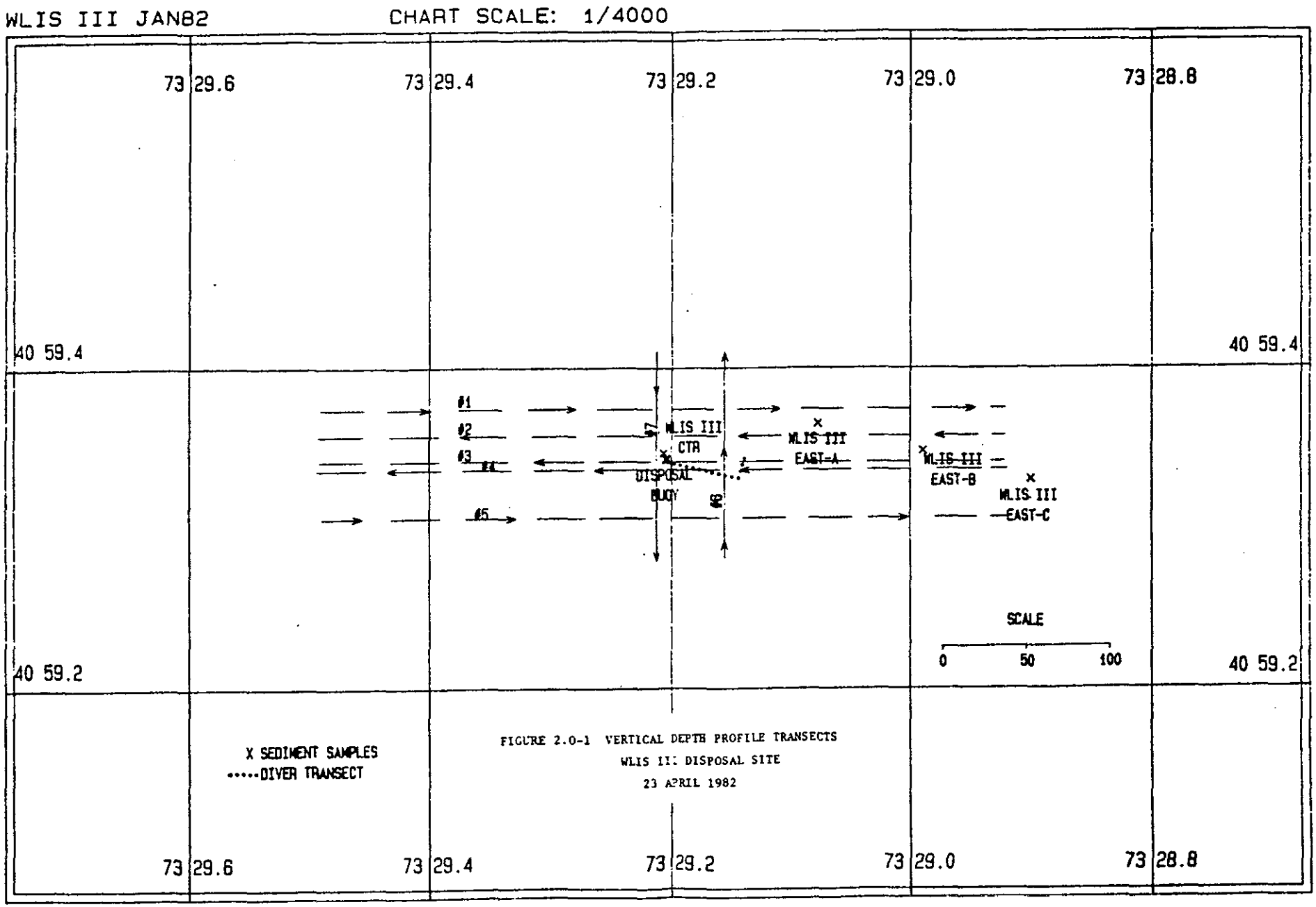


FIGURE I-2-11. Vertical depth profile transects, WLIS III, April 1982.

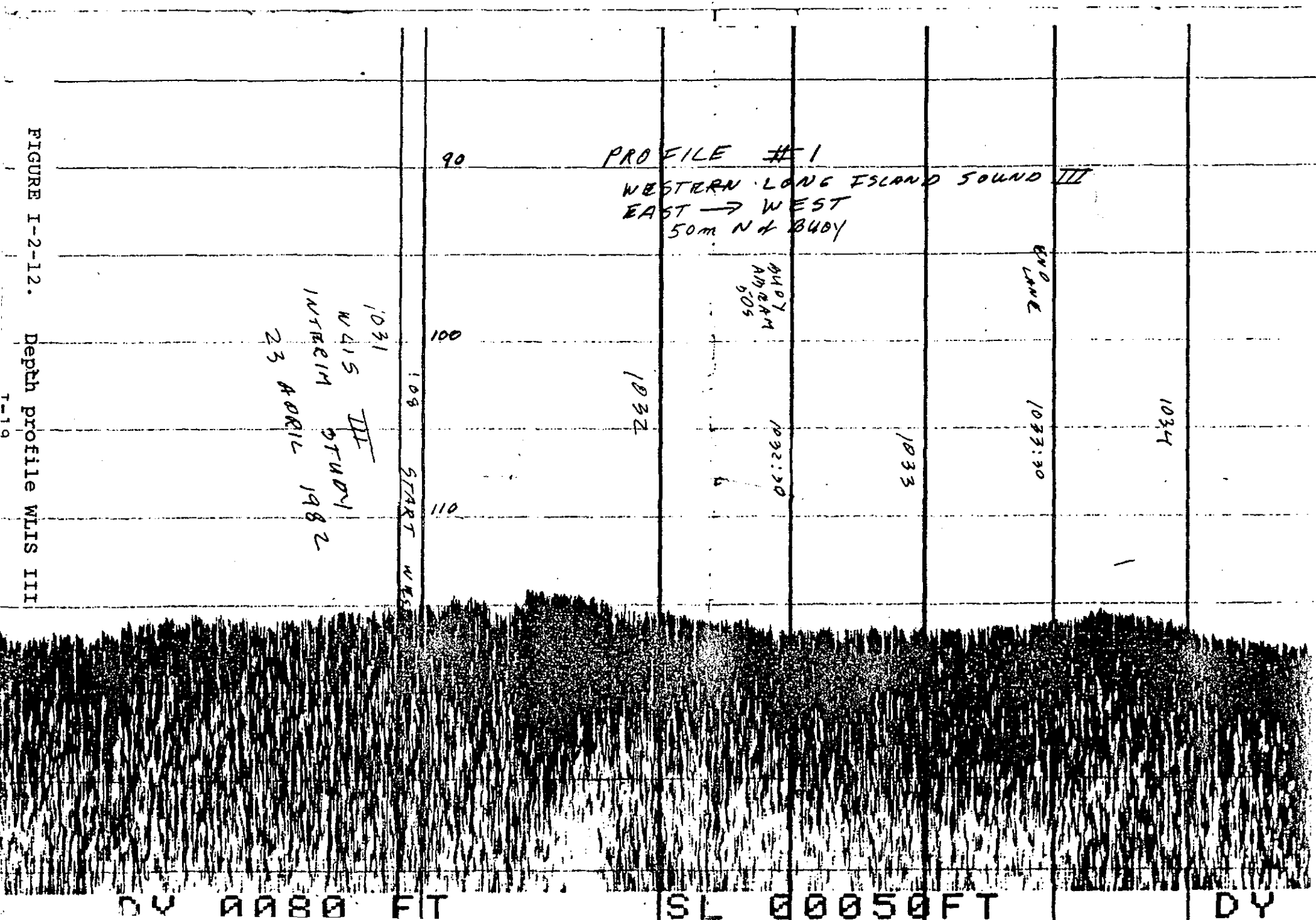


FIGURE I-2-12. Depth profile WLIS III

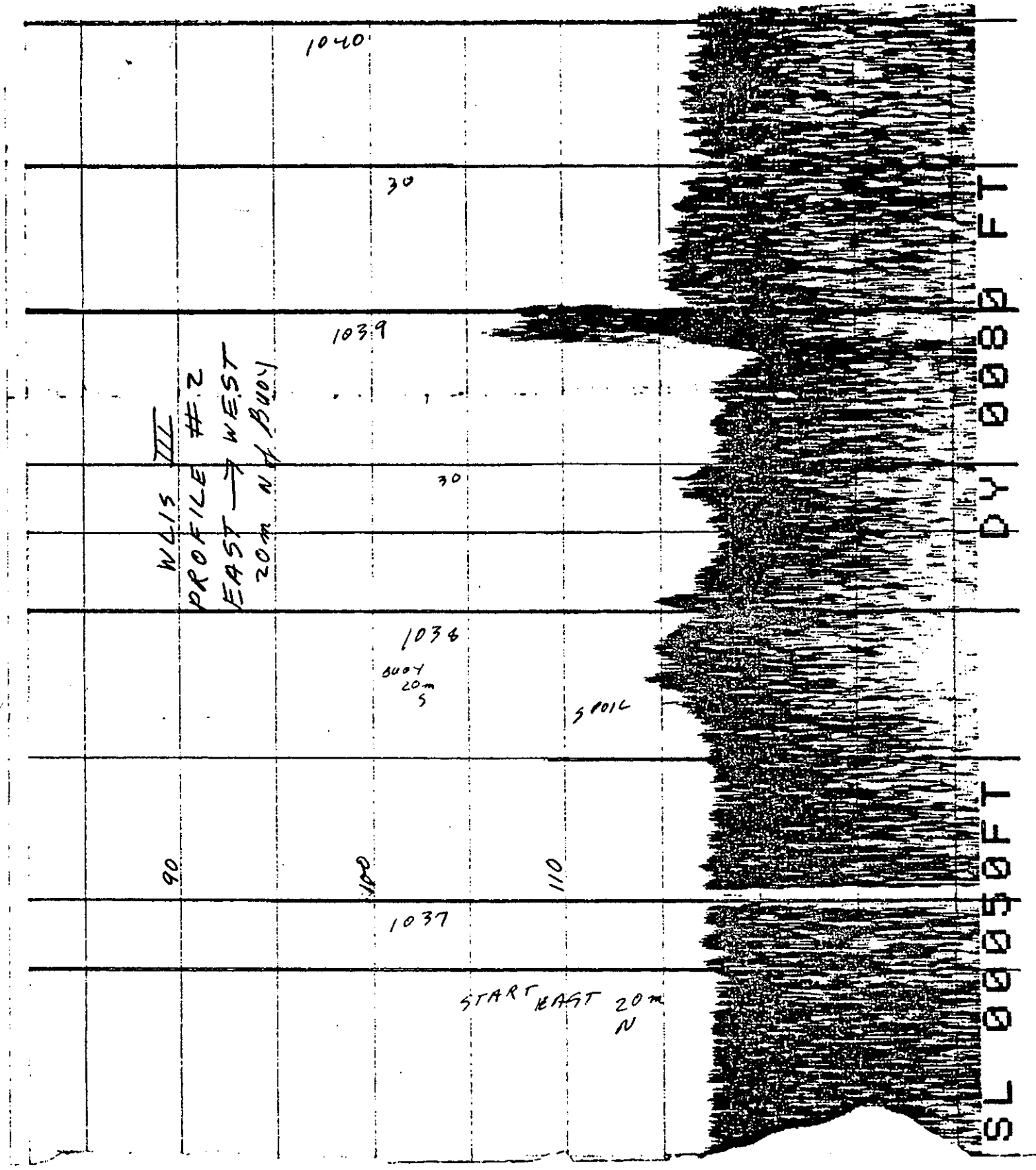


FIGURE I-2-13. Depth profile WLIS III
23 April 1982.

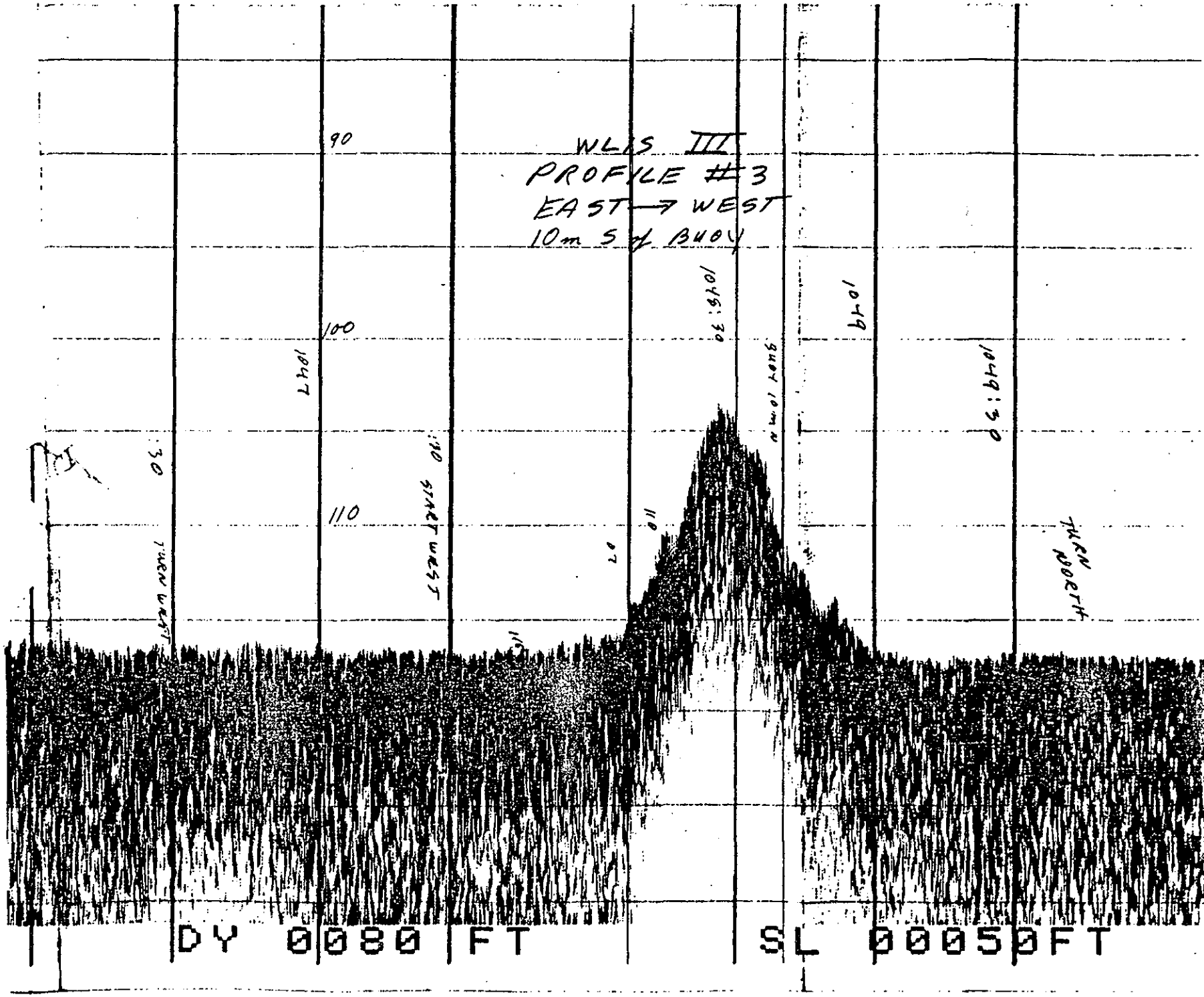


FIGURE I-2-14. Depth profile WLIS III
23 April 1982.

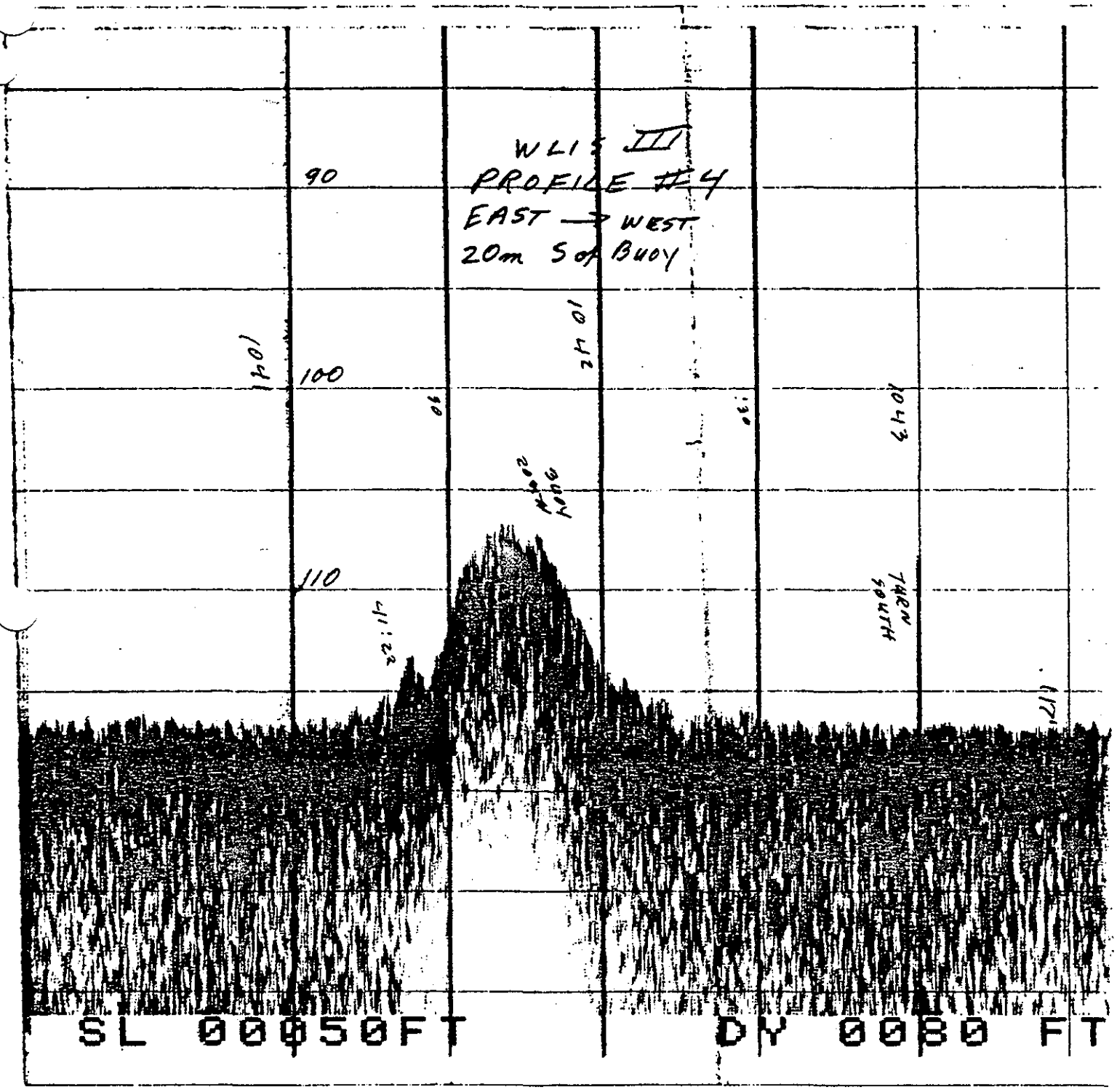


Figure I-2-15. Depth profile WLIS III

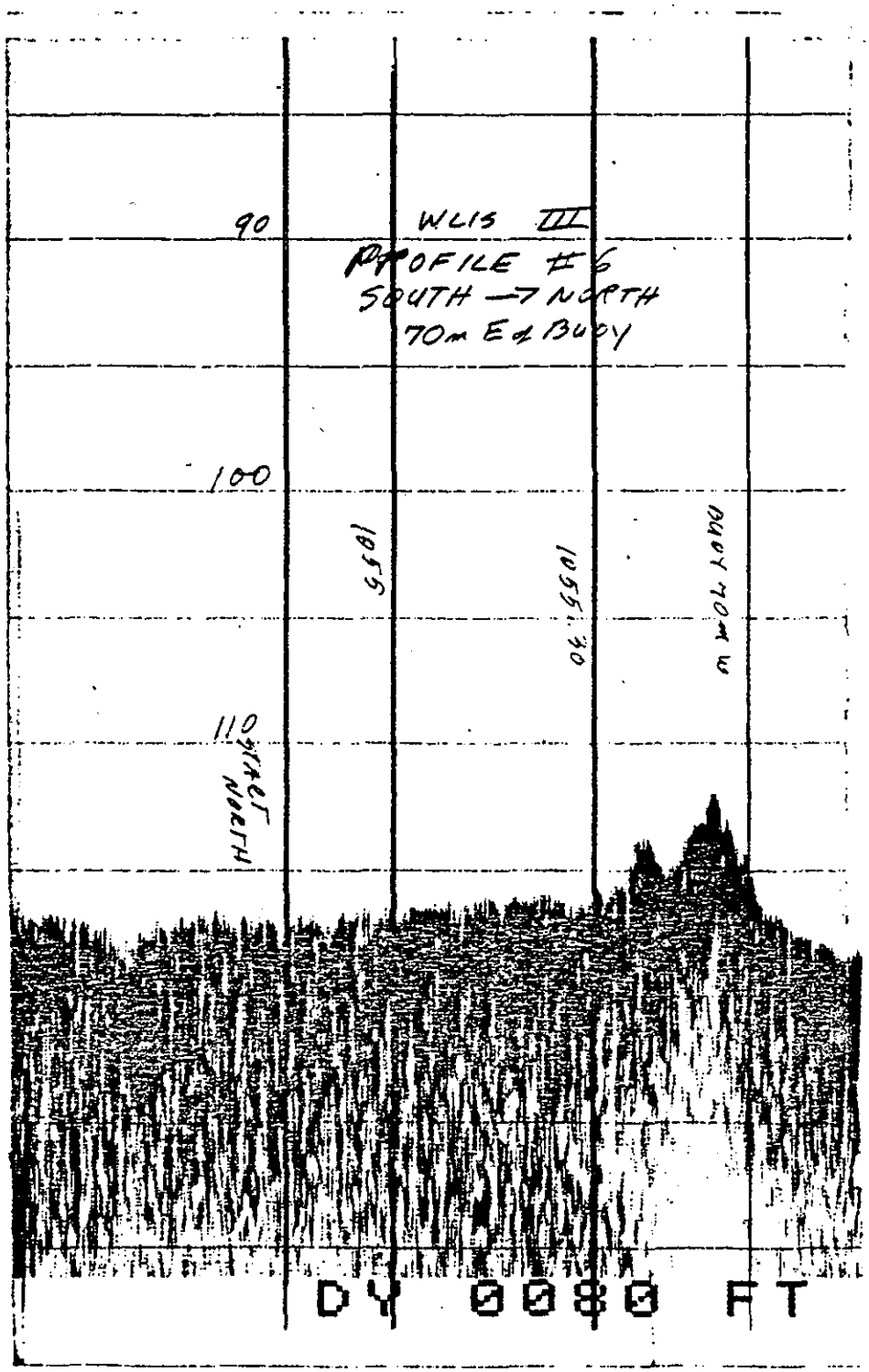


FIGURE I-2-16. Depth profile WLIS III
23 April 1982.

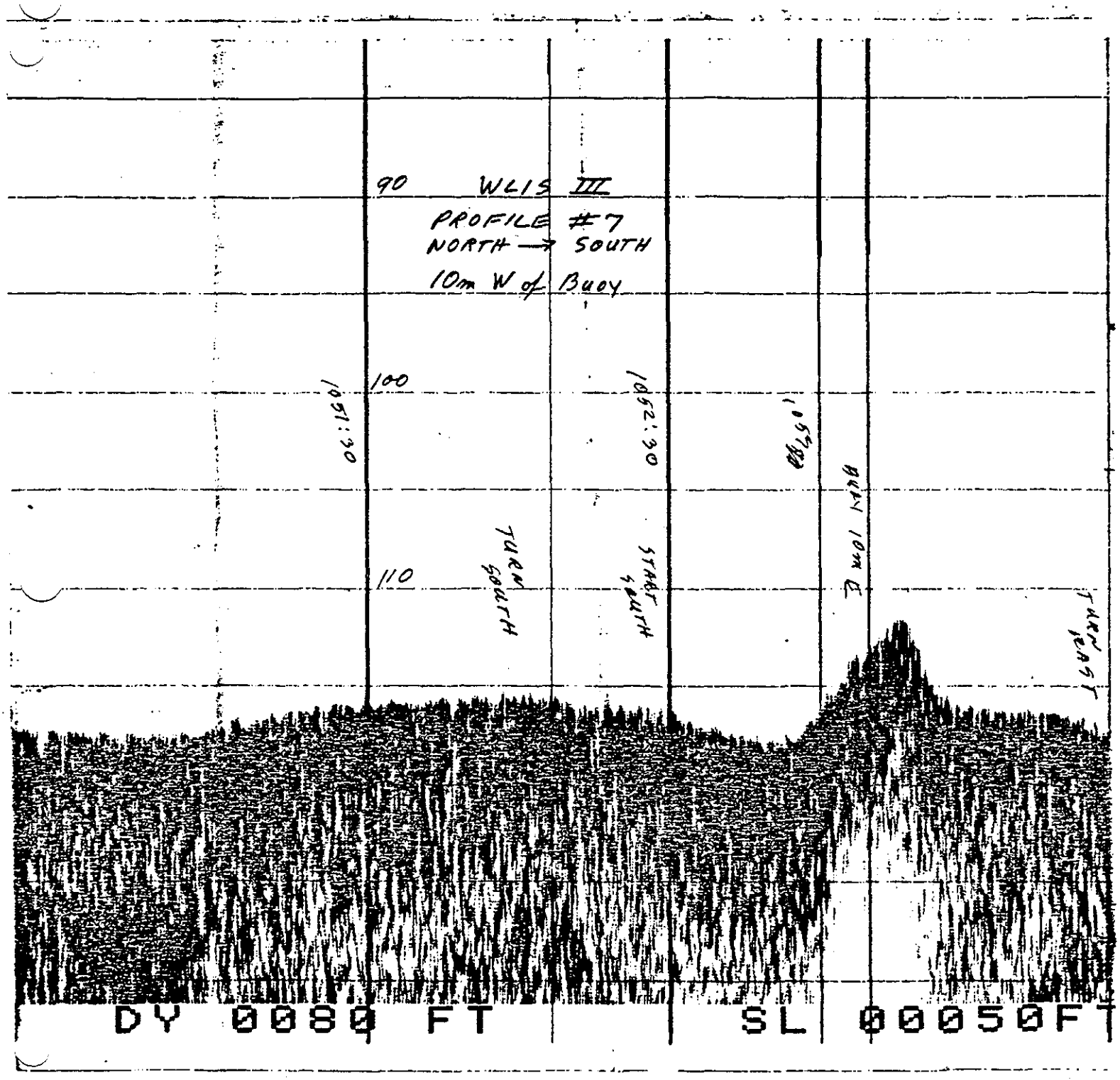


FIGURE I-2-17. Depth profile WLIS III
23 April 1982.

An interesting feature was observed in Profile 2 (Fig. I-2-13) approximately 200m east of the buoy. This feature is approximately 5 meters high, but shows vertical sides indicating it may be a wreck or other man-made object.

A survey grid identical to that used to conduct the baseline survey, consisting of 33 east-west lanes spaced 25 meters apart, was used for subsequent surveys in August 1982 and January 1983.

Figure I-2-18 is a contour chart of the 18 August survey conducted after approximately 40,000 m^3 of material had been disposed at the site between March and May 1982. Based on this chart, it is readily apparent that a successful dumping operation has been accomplished which has restricted the majority of dredged material to a small area in a mound with a radius of approximately 80 meters and a maximum thickness of almost 3 meters. Figures I-2-19a and b provide a comparison of vertical depth profiles from transects crossing the mound area which indicate where dredged material has been deposited.

Through point by point comparison of the January and August depth contours, a contour difference chart was generated (Fig. I-2-20) which more accurately displays the distribution of dredged material. Using this technique, shoaling due to the presence of dredged material can be observed as far as 100 m from the disposal point as a thin layer of material.

Using the baseline survey as a datum, the total volume of material present in the mound can be calculated by summing the depth difference for each grid point in the survey after correction for errors due to tide, sound velocity and ship motion. This procedure, using a least squares analysis to account for measurement errors, has been described in detail by Morton (1983). The results of the volume difference calculation for each lane and the summation over all lanes is presented in Figure I-2-21. The total volume of 25000 m^3 is significantly less than the estimated volume of 40,606 m^3 removed from the various dredge sites, however, since the survey was not conducted until several months after disposal, consolidating and reworking of the mound should have occurred.

A survey was conducted on 19 January 1983 over the same survey grid after approximately 11,662 m^3 of additional material were added to the site during December 1982 and early January 1983. The contour chart of that survey is presented in Figure I-2-22 and the vertical depth profiles for the same transects over the site are shown in Figure I-2-23. The additional material deposited at the site between August and January is readily apparent as an increase in the thickness of material on the mound. The contour difference chart (Fig. I-2-24) indicates only slight changes to the shape of the mound with a general increase in overall thickness, but no significant expansion of the margins as would be expected, since turbidity flows from material dumped at the same point would not extend further than the original disposal operation until substantially

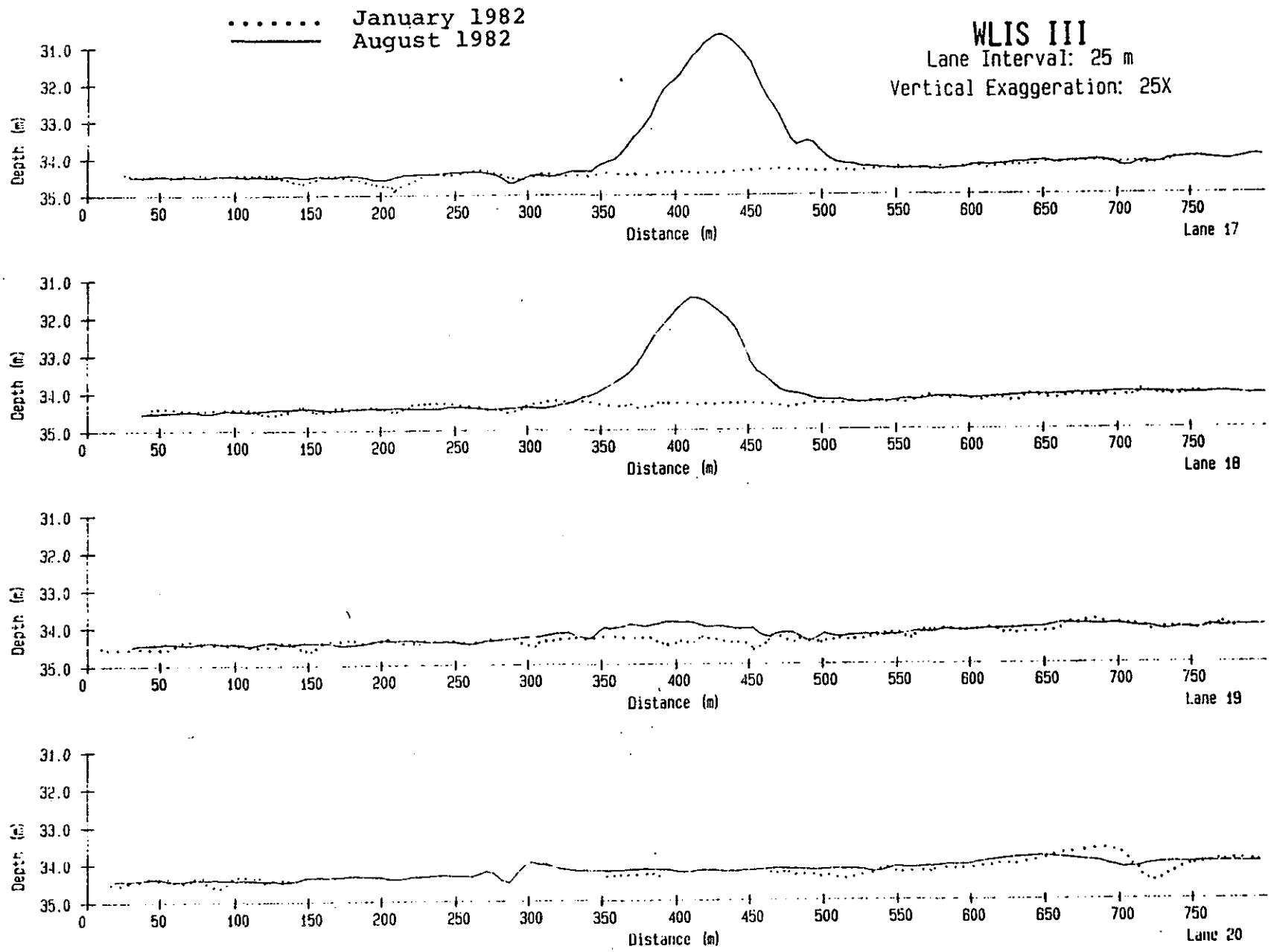


FIGURE I-2-10b

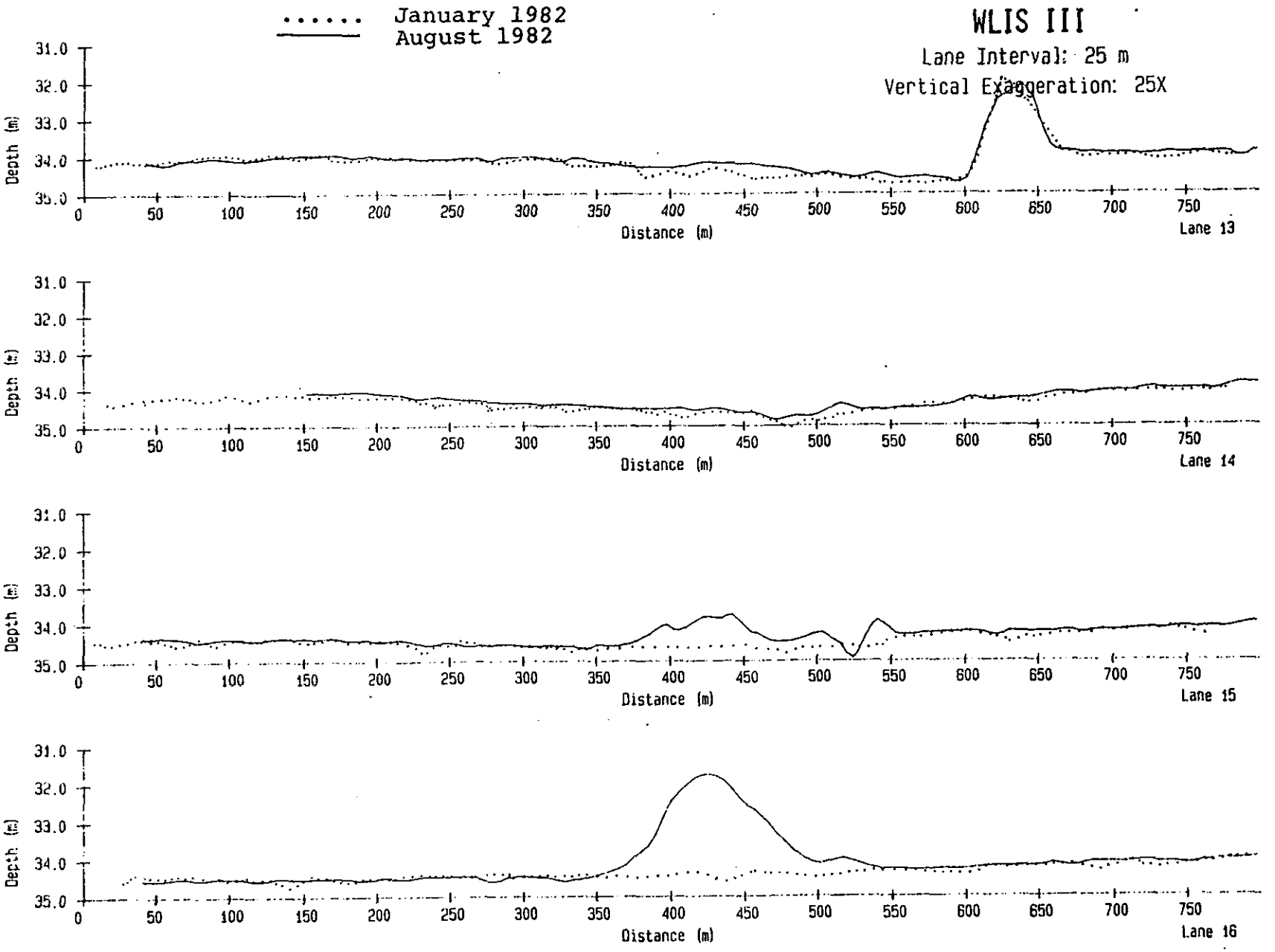


FIGURE I-2-19a. Bathymetric profiles of WLIS III, January and August 1982.

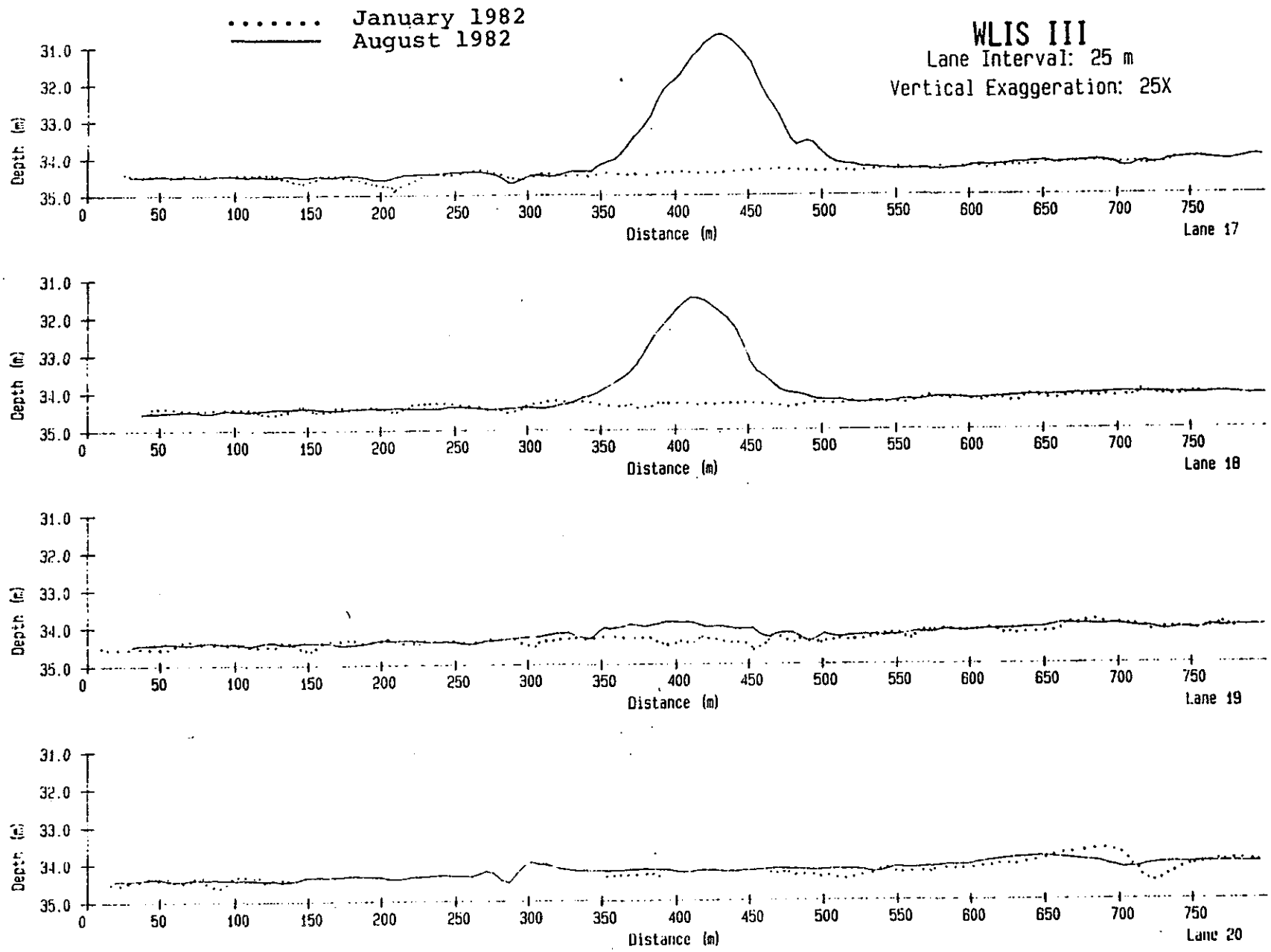
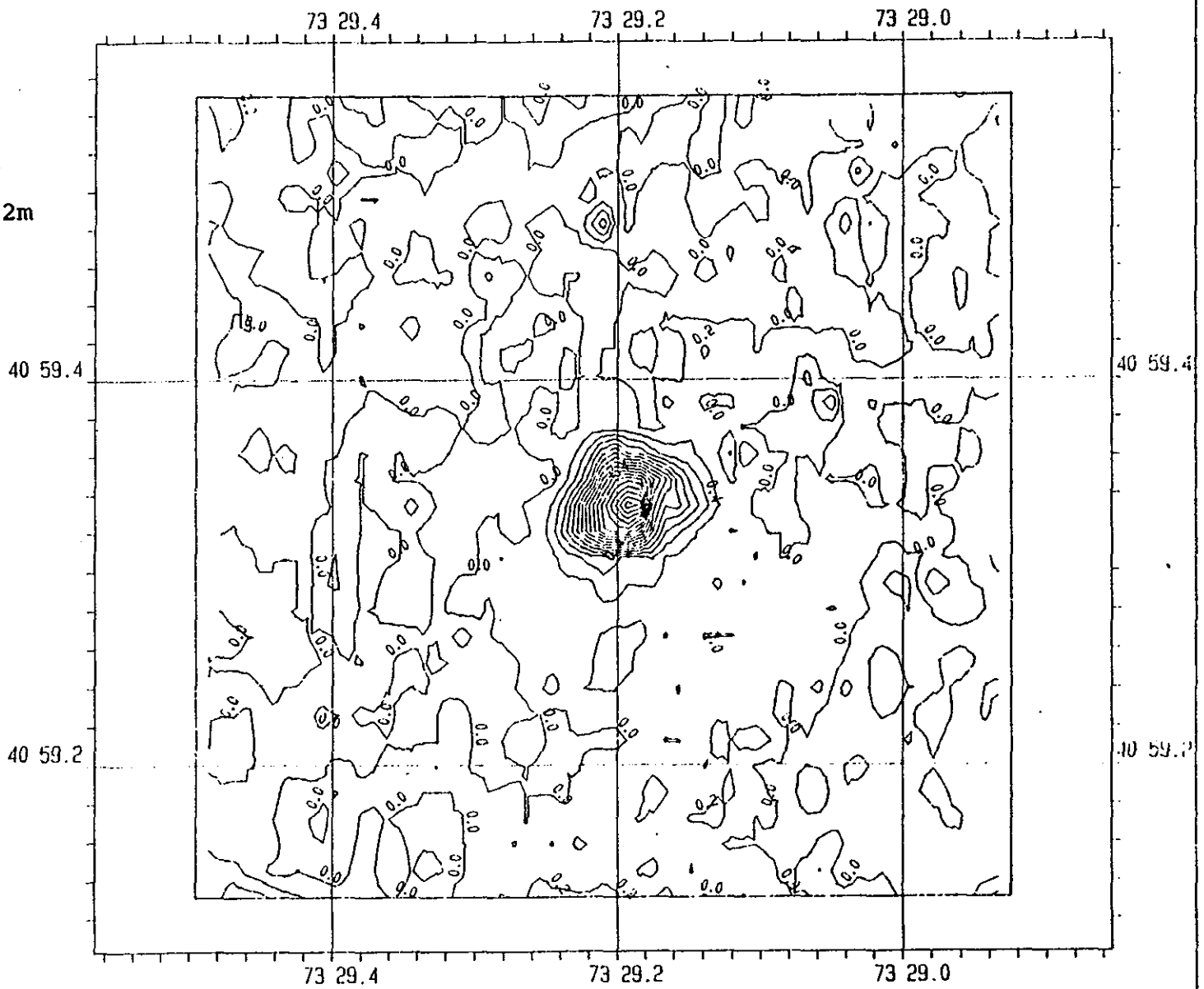


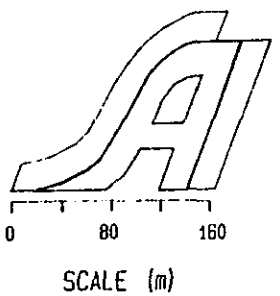
FIGURE I-2-10b

WLIS III

Contour Difference
Aug 82 - Jan 82
Contour Interval .2m
Grid Resolution
12.5 X 25
Datum MLW

FIGURE I-2-20





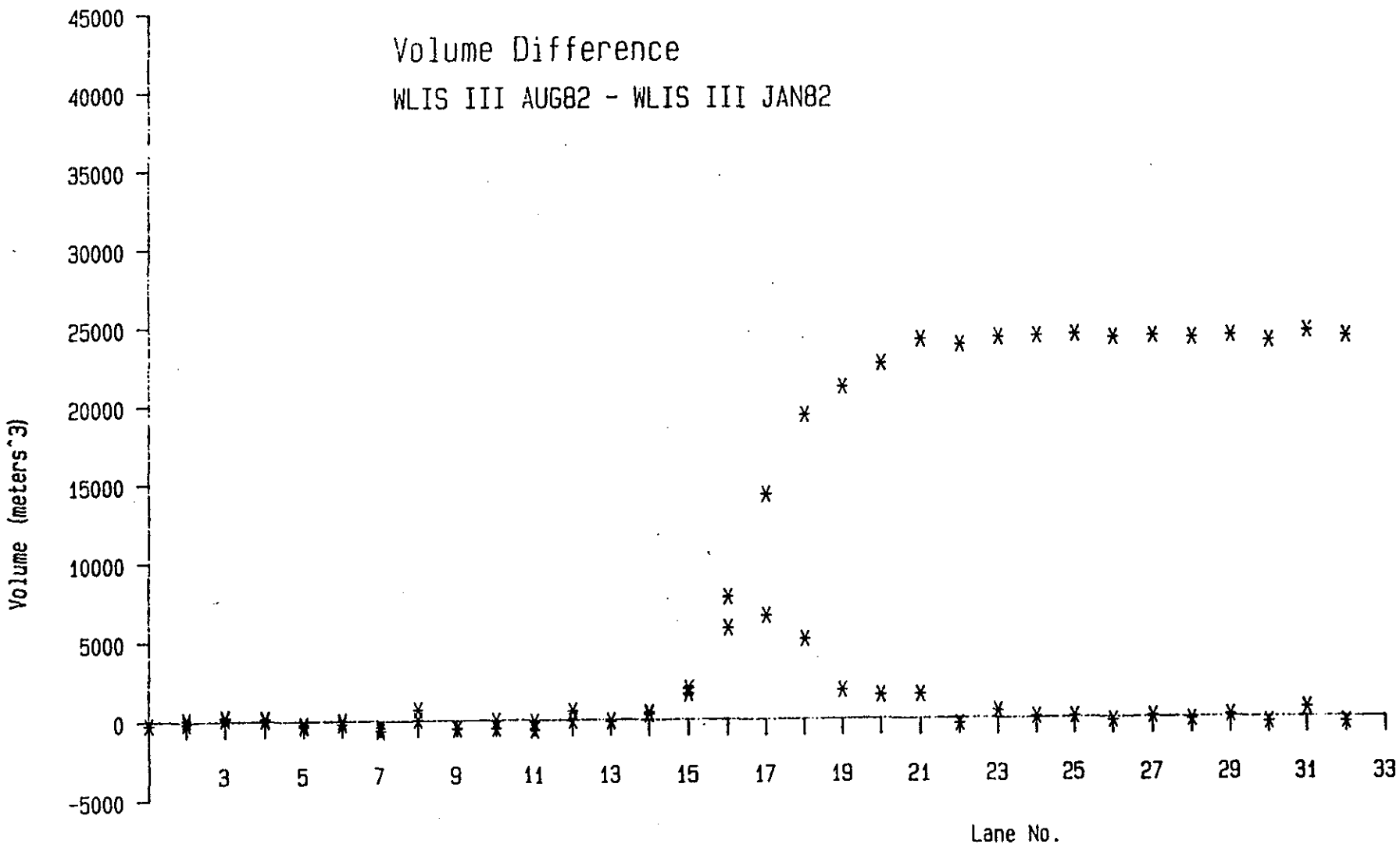
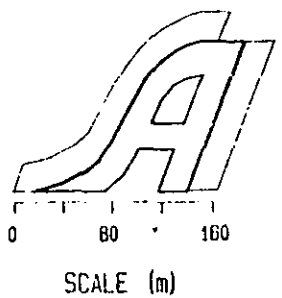


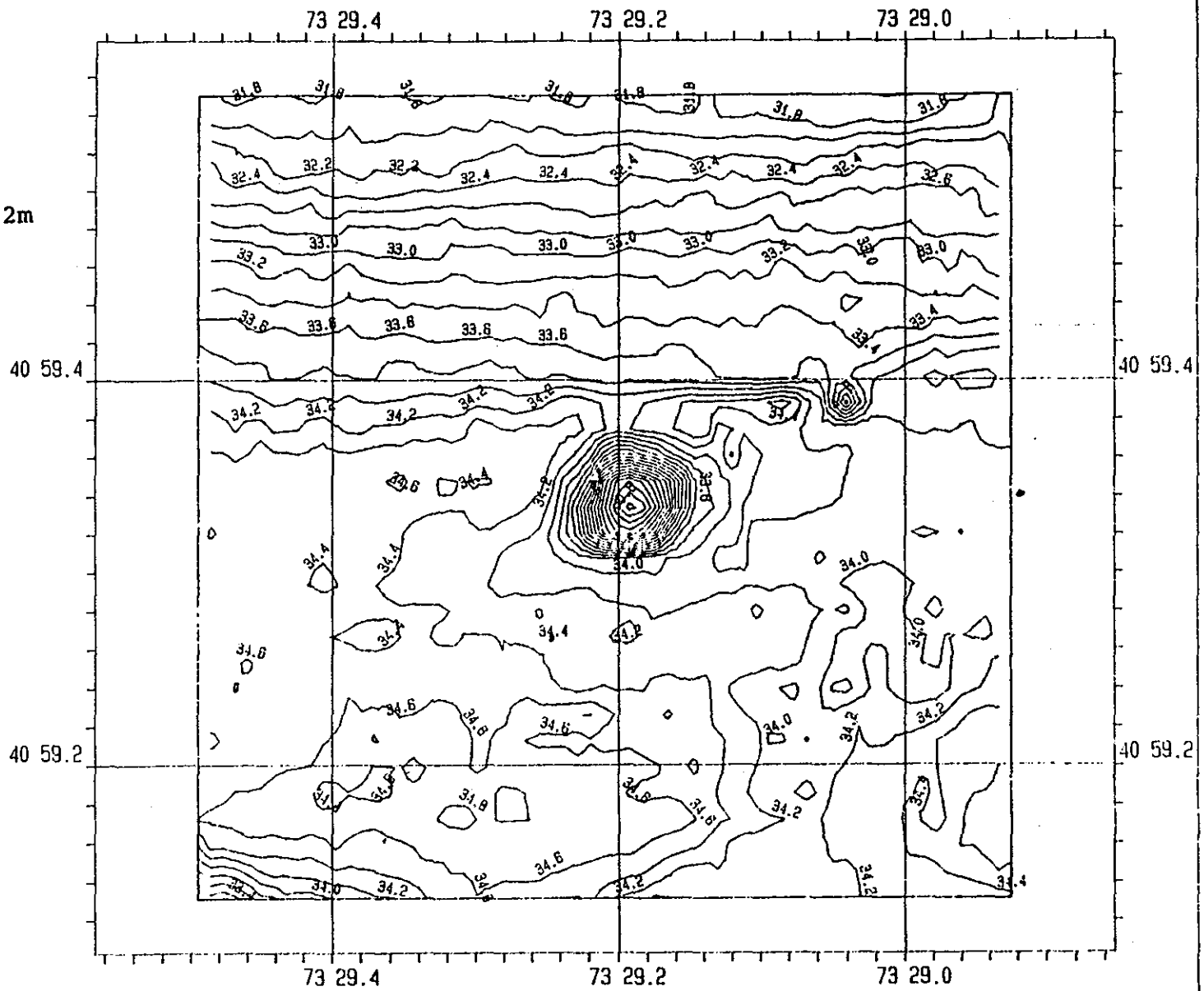
FIGURE I-2-21. Volume difference at WLIS III, January-August 1982.

WLIS III

January 1983
Contour Interval .2m
Grid Resolution
12.5 X 25
Datum MLW

FIGURE I-2-22





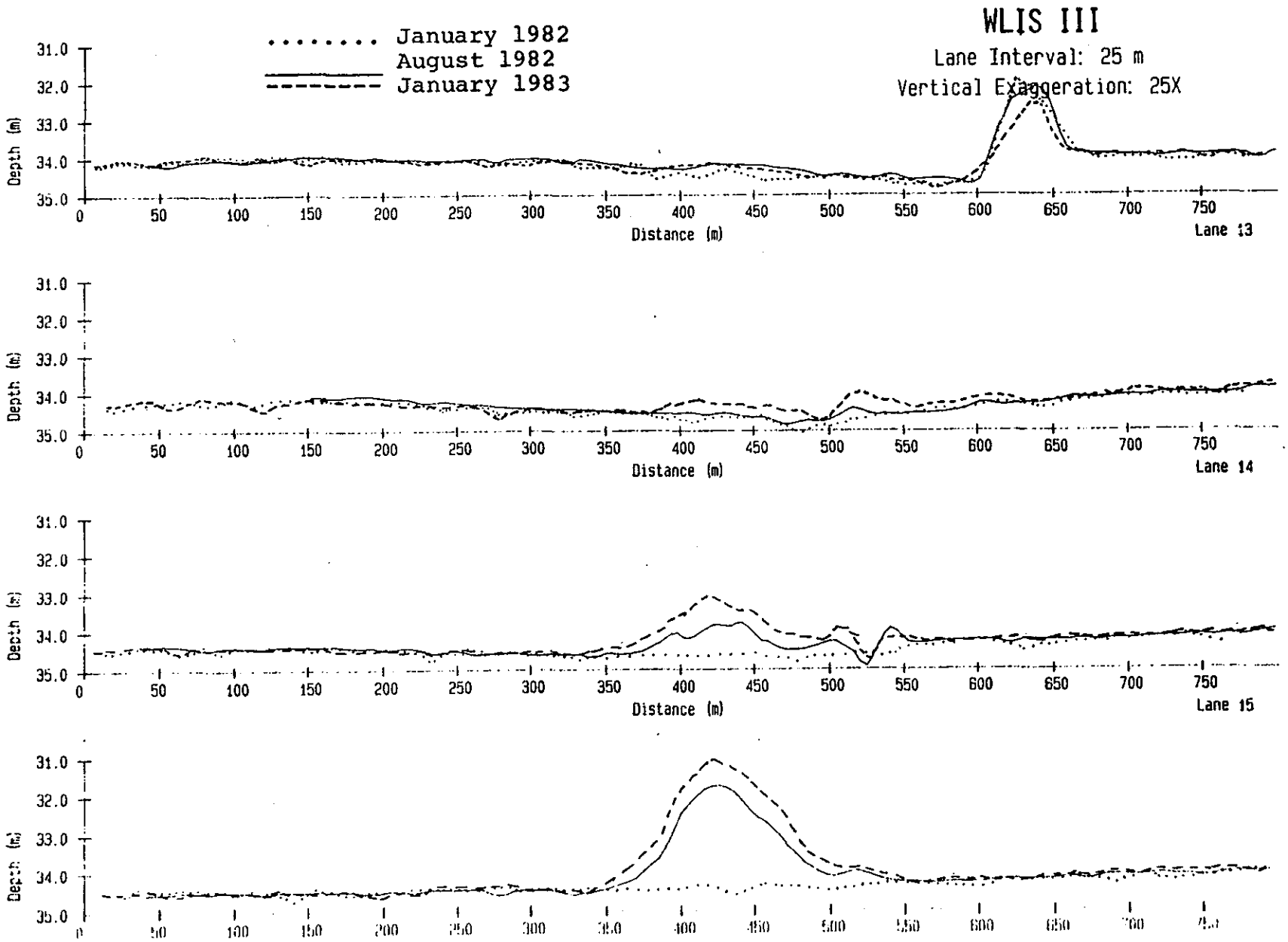


FIGURE I-2-23a

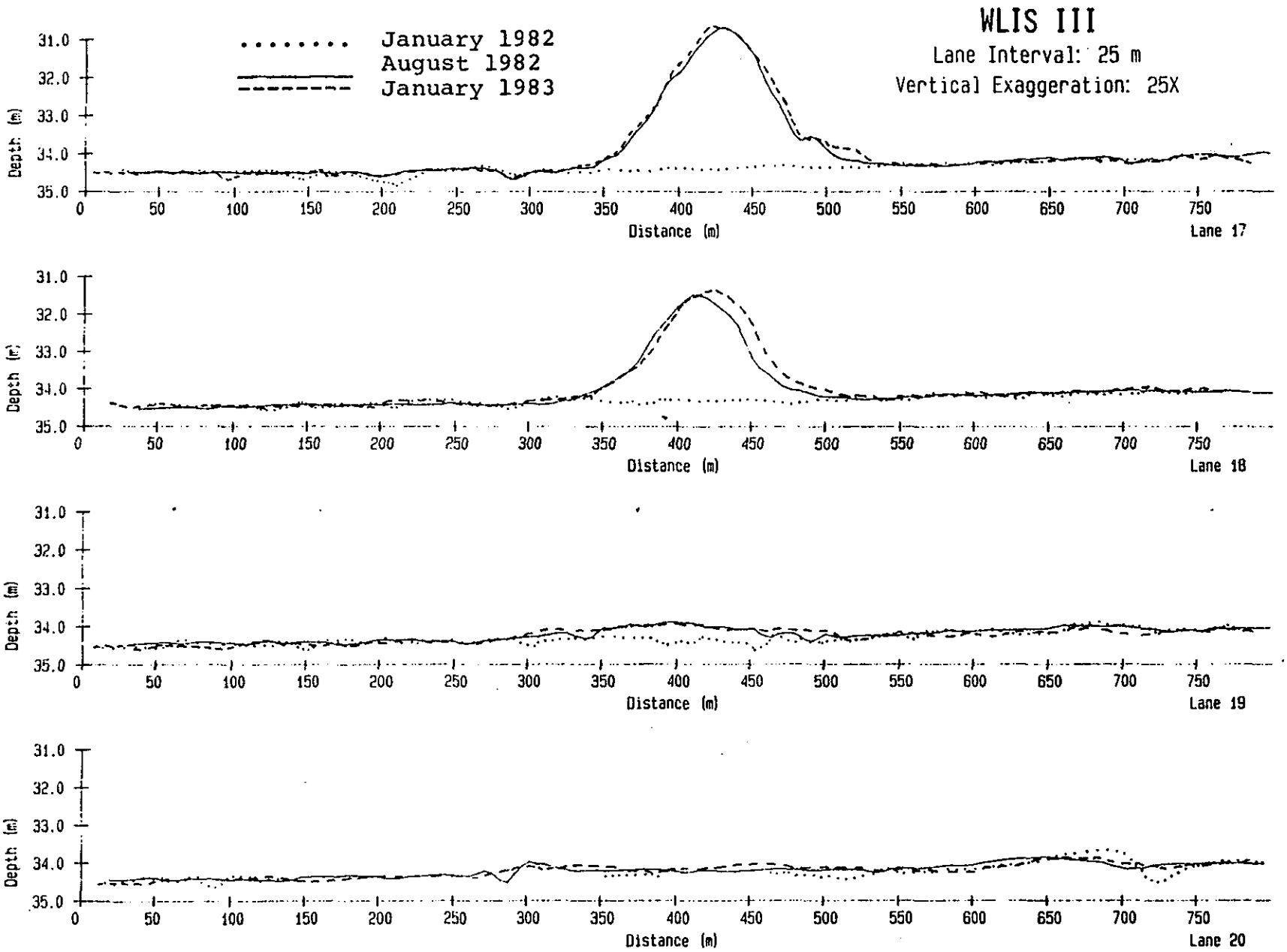
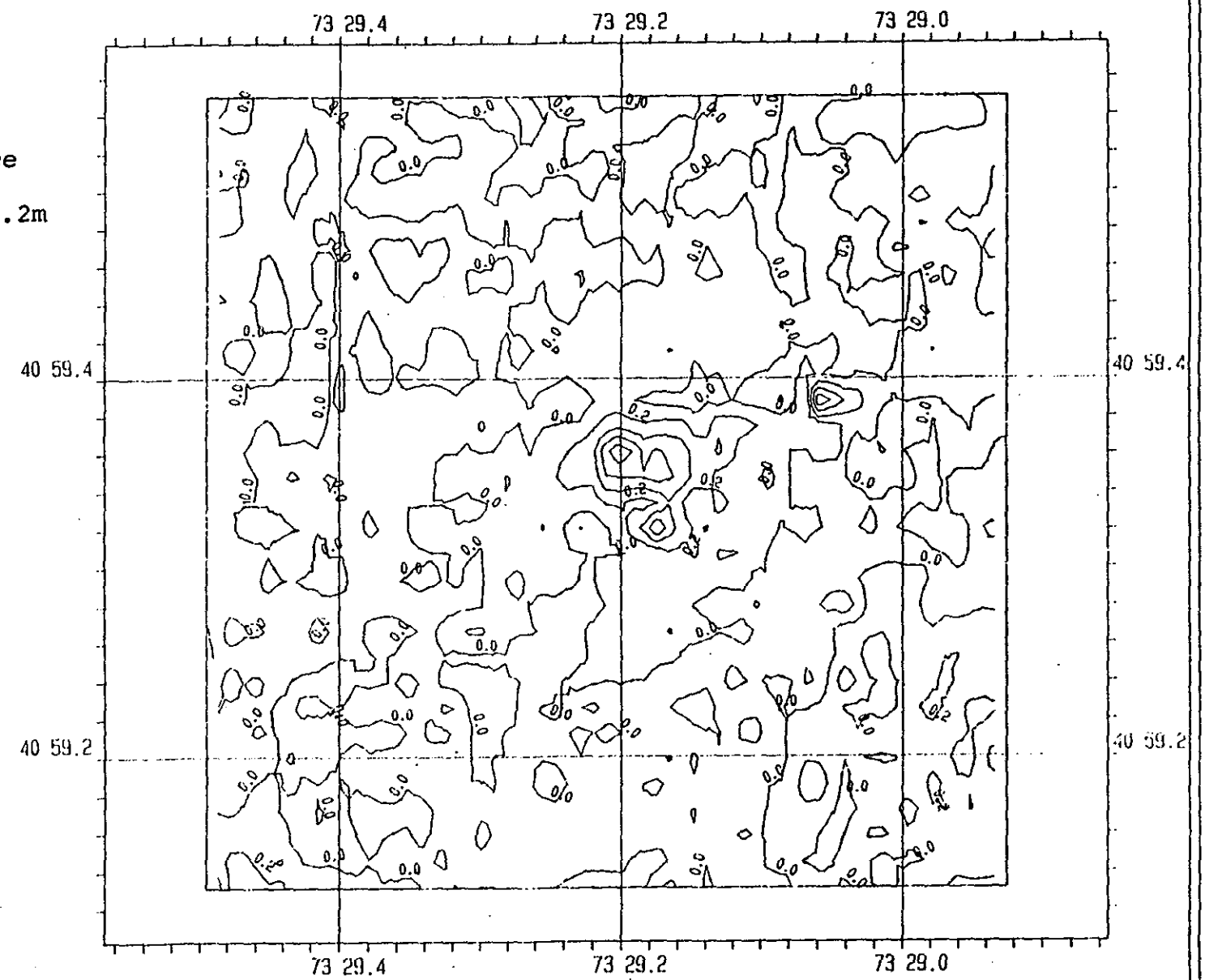


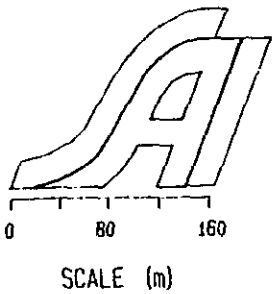
FIGURE I-2-23b

WLIS III

Contour Difference
Jan 83 - Aug 82
Contour Interval .2m
Grid Resolution
12.5 X 25
Datum MLW

FIGURE I-2-24





more sediment is available. The volume calculation for the difference between the January and August surveys (Fig. I-2-25) shows an additional 10,000 m^3 of material present at the site which compares favorably with the 11,662 m^3 estimated from scow loads.

The volume difference between January 1983 and the baseline survey (Figs. I-2-26 and 27) indicates a total of 35,000 m^3 of dredged material is present at the site in a relatively compact mound formation. These numbers are all consistent and indicate that no detectable amount of material was lost from the disposal mound between August and December 1982 when the new disposal operations began.

It is not possible to assess how much of the difference between dredged volume estimates and the August survey volume can be accounted for by compaction of the mound during the 2 1/2 months between disposal and measurement. However, experience at the CLIS disposal site has shown that most of the changes due to compaction occur immediately after disposal. The good agreement between the August-January survey volume and the disposed volume estimates indicate that some of this difference must be due to compaction and that the mound was not susceptible to significant erosion during the summer and fall months.

Figures I-2-28 and 29 represent the depth contour charts generated from the bathymetric surveys of January and August 1983, respectively. It is evident that there has been a substantial deposition of material at this disposal site during the intervening 8 months. The disposal mound is obviously larger in all directions. This is further substantiated in Figures I-2-30 and 31, which depict the depth profiles of the eight survey lanes which cover the mound. A volume difference calculation presented in Figure I-2-32 shows a deposition of new material in excess of 41,000 cubic meters between January and August 1983. Figure I-2-33 represents a contour difference plot that shows a deposition of an additional 2 meters of new material since January 1983.

The March 1984 baseline bathymetric surveys for the WLIS III points "A" and "B" are shown in Figures I-2-34 and 35, with the WLIS III "B" disposal buoy shown on each chart. The bottom in the area of the buoy is essentially flat and is located in a trough that is oriented in an east-west direction, approximately one nautical mile in length by 1/4 mile in width. Depth contours across the WLIS III "A" mound are shown in Figures I-2-36 and 37, also indicating a flat bottom to the west.

A post-disposal survey of the "B" disposal point was conducted on 25 June 1984 and indicated that most of the disposal took place, as directed, to the east of the buoy (Fig. I-2-38). The depth contours over the center of the disposal area (Figs. I-2-39 and 40) showed a mound of Milton Harbor dredged material on the west flank of the WLIS III "A" pile, with a maximum height of approximately 1.6 meters. The contour difference chart for the point "B" disposal is shown in Figure I-2-41, which clearly

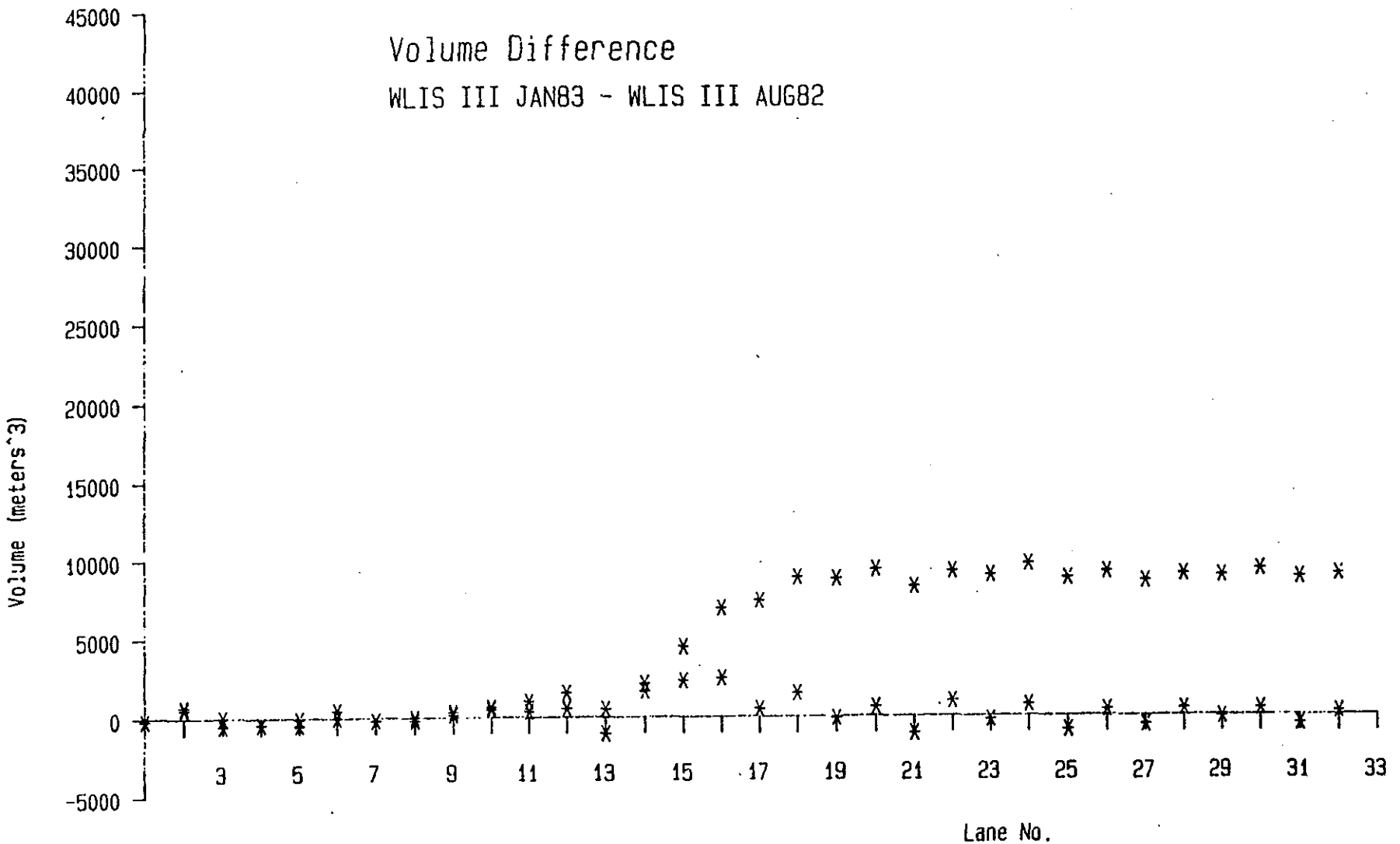
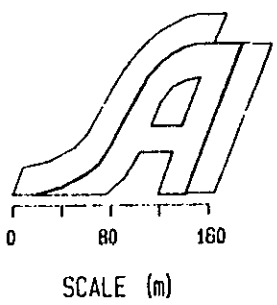


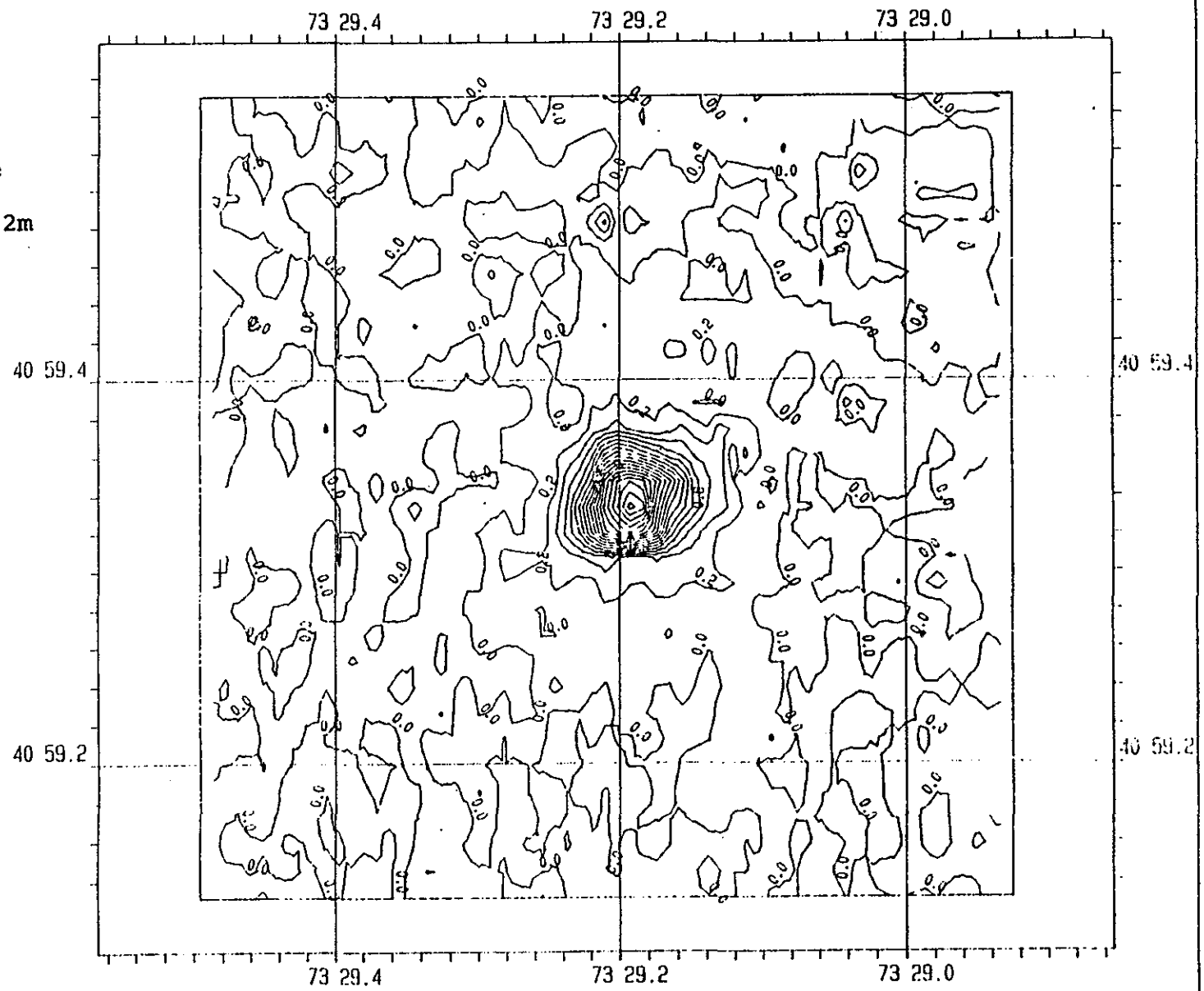
FIGURE I-2-25. Volume Difference at WLIS III, January 1983-August 1982.

WLIS III

Contour Difference
Jan 83 - Jan 82
Contour Interval .2m
Grid Resolution
12.5 X 25
Datum MLW

FIGURE I-2-26





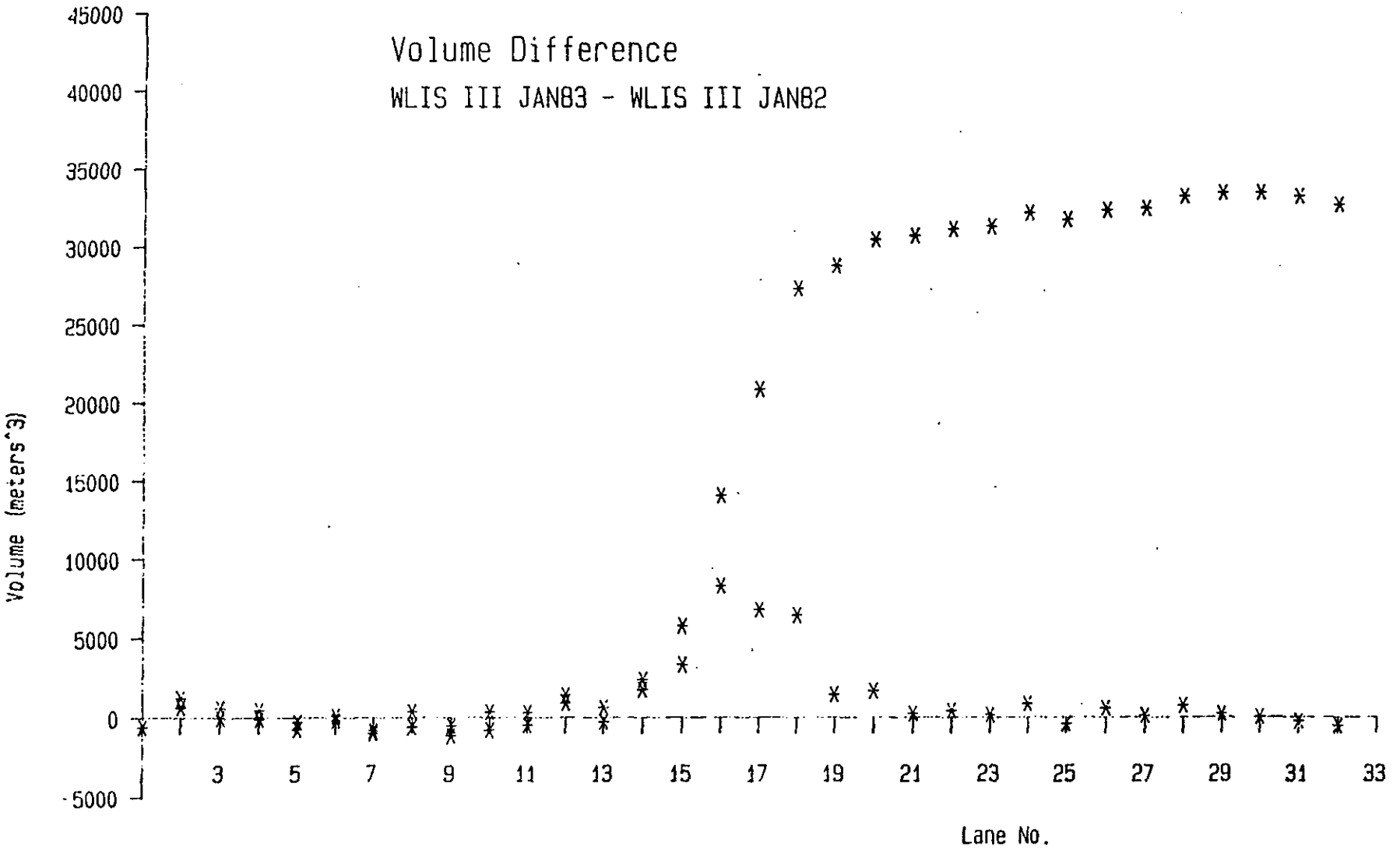


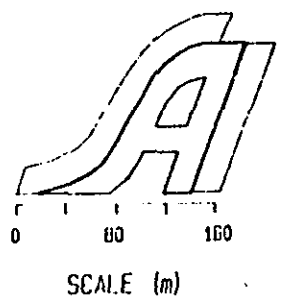
FIGURE I-2-27. Volume Difference at WLIS III, January 1982 - January 1983.

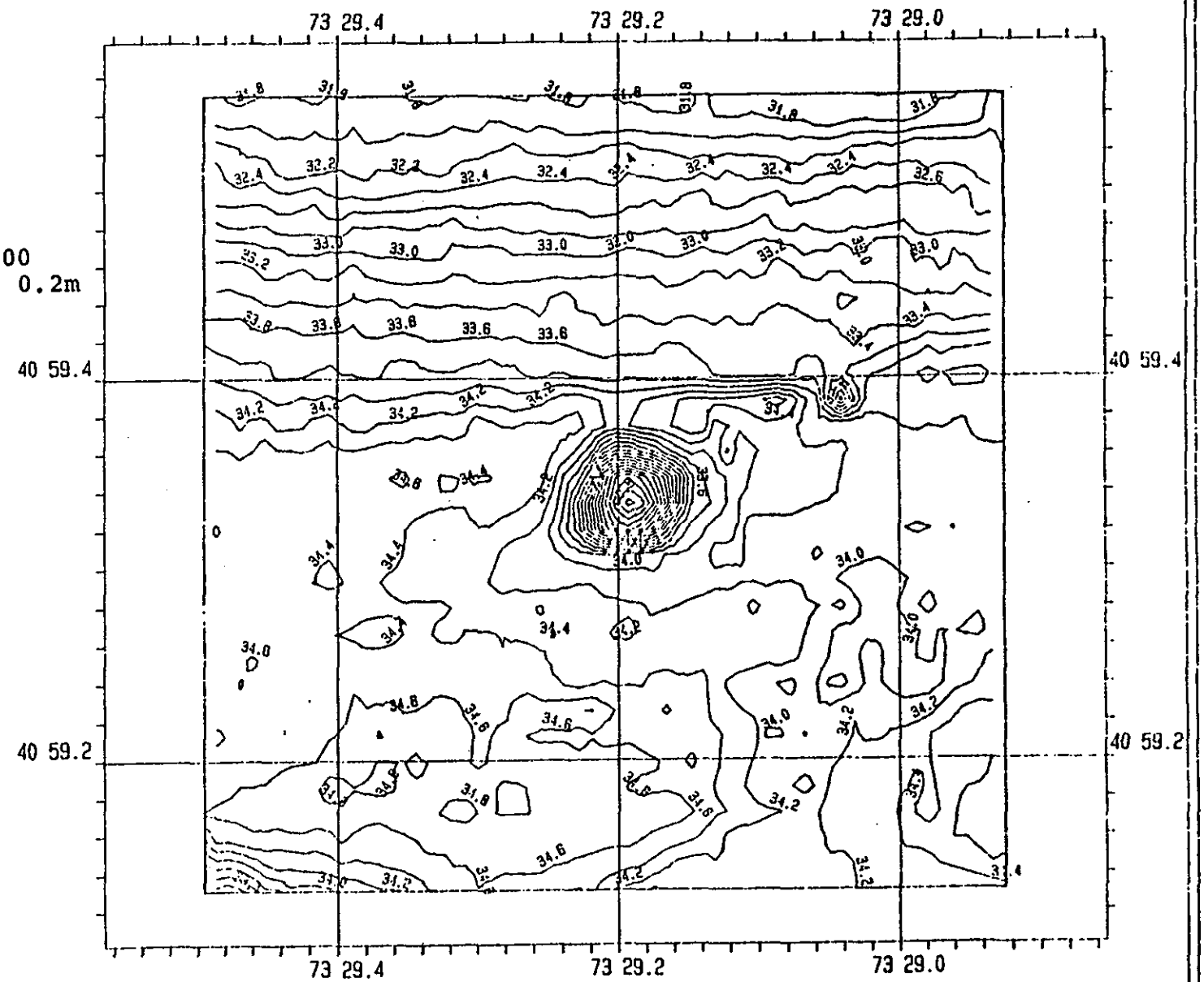
WLIS III

19 January 1983
Chart Scale: 1/4000
Contour Interval: 0.2m
Datum: MLW

Preliminary

FIGURE I-2-28



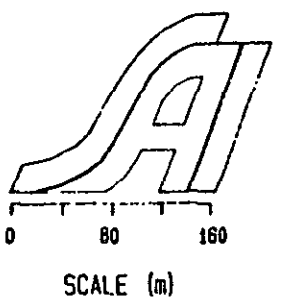


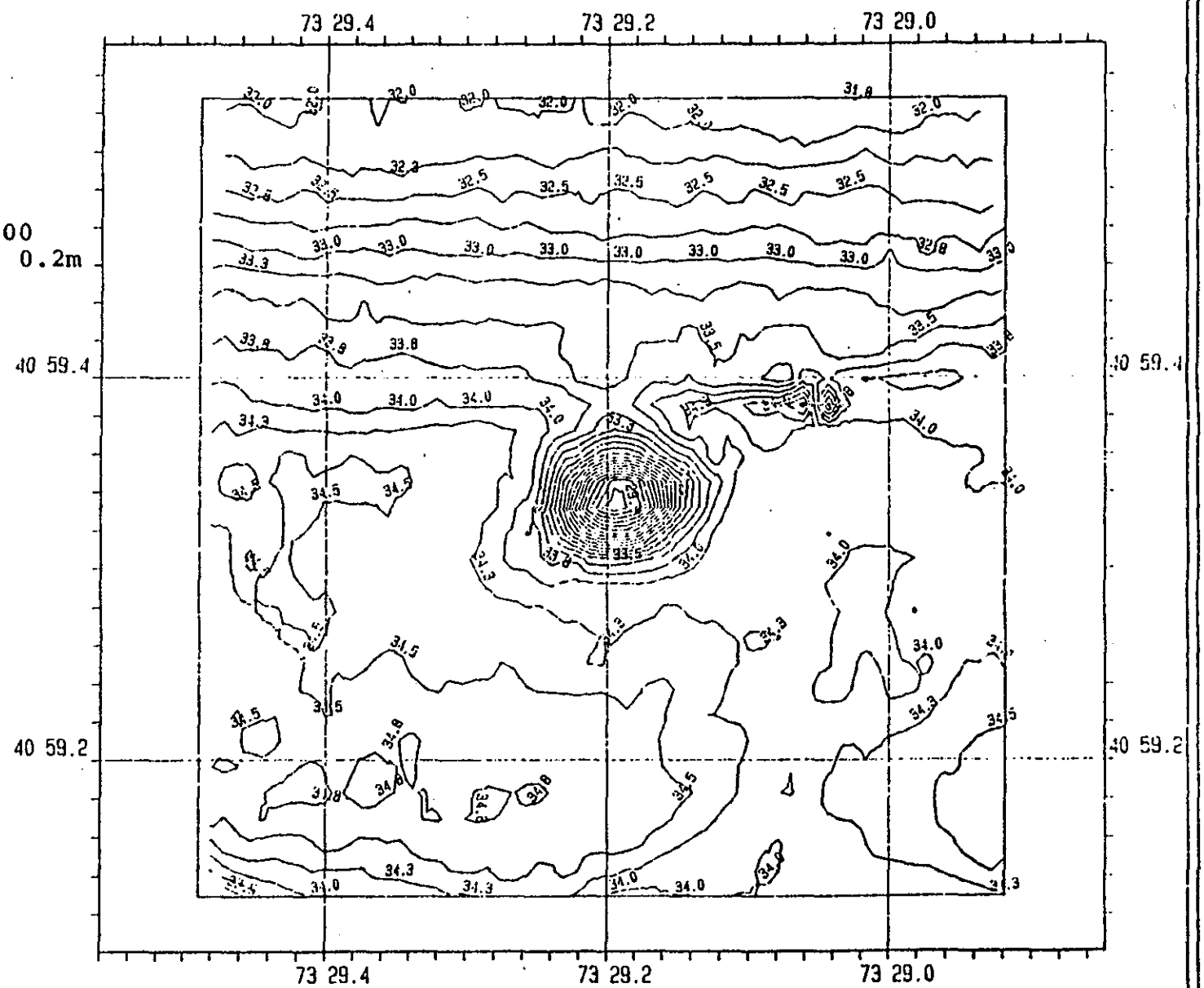
WLIS III

24 August 1983
Chart Scale: 1/4000
Contour Interval: 0.2m
Datum; MLW

Preliminary

FIGURE I-2-29





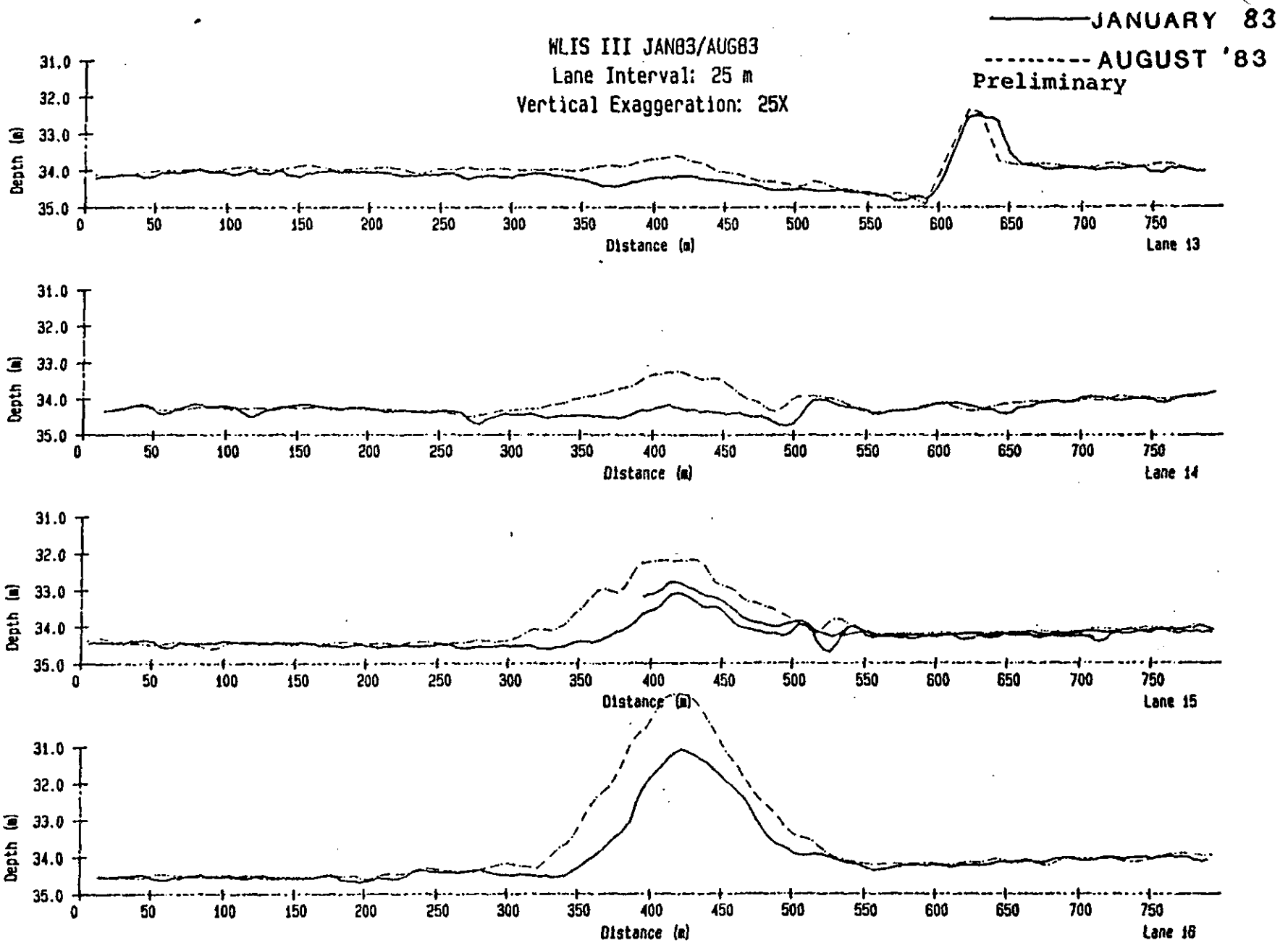


FIGURE I-2-30. Bathymetric profiles at WLIS III, January and August 1983, lanes 13 - 16.

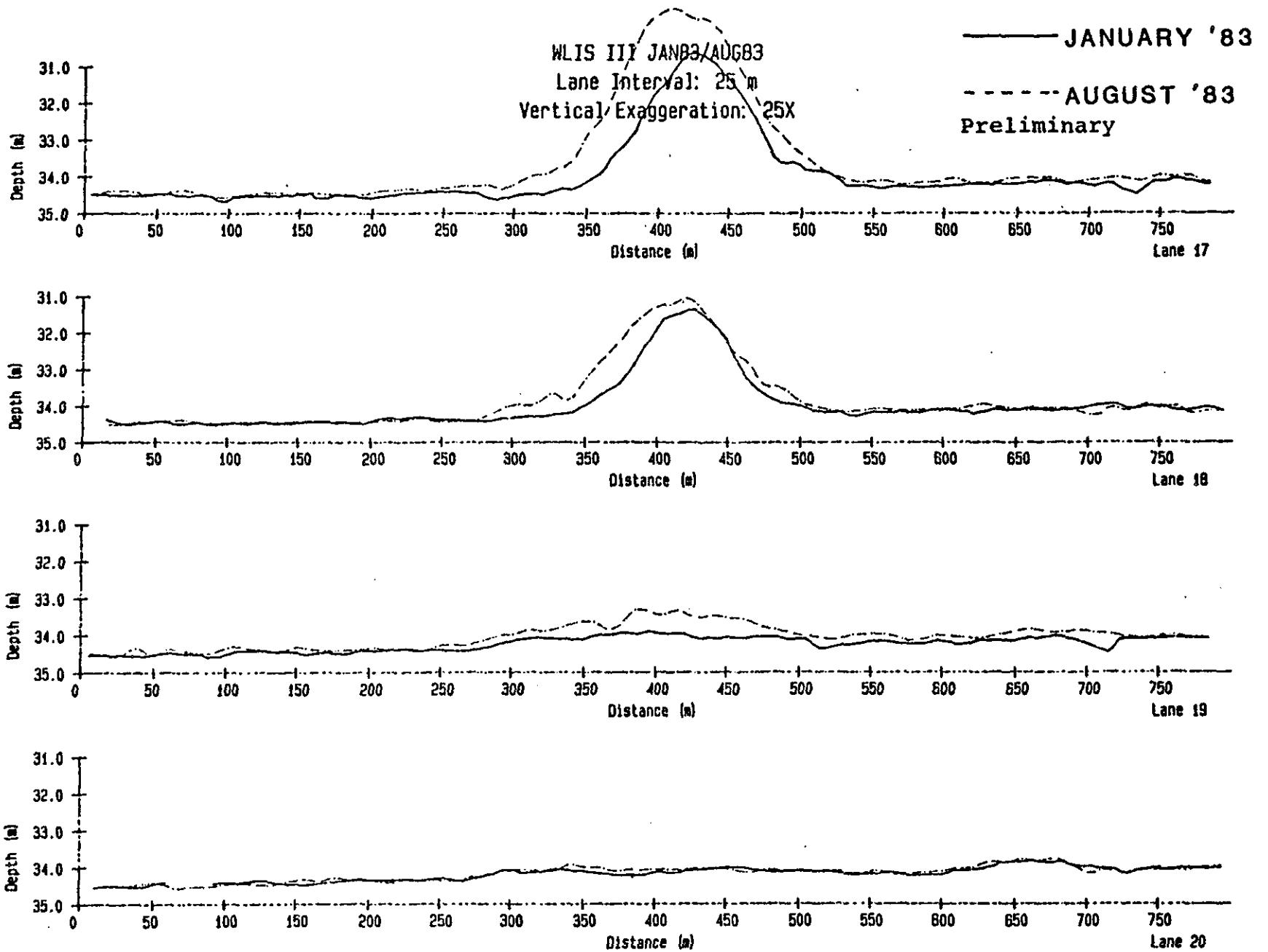


FIGURE I-2-31. Bathymetric profiles at WLIS III, January 1983 and August 1983, lanes 17-20.

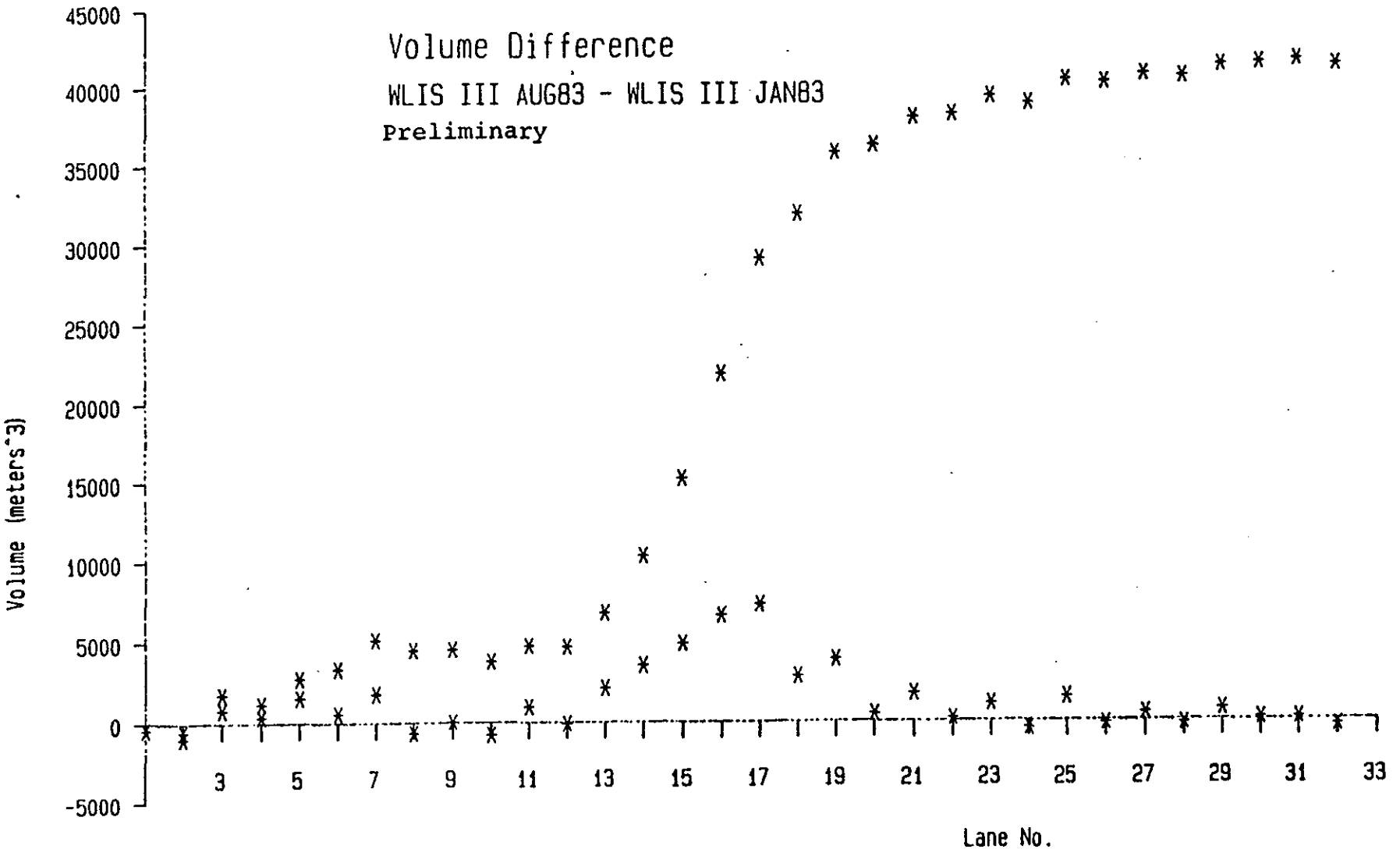


FIGURE I-2-32. Volume difference at WLIS III, August-January 1983.

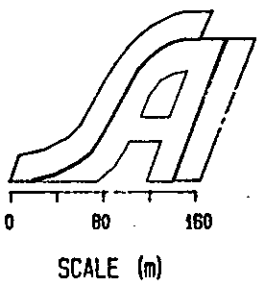
WLIS III

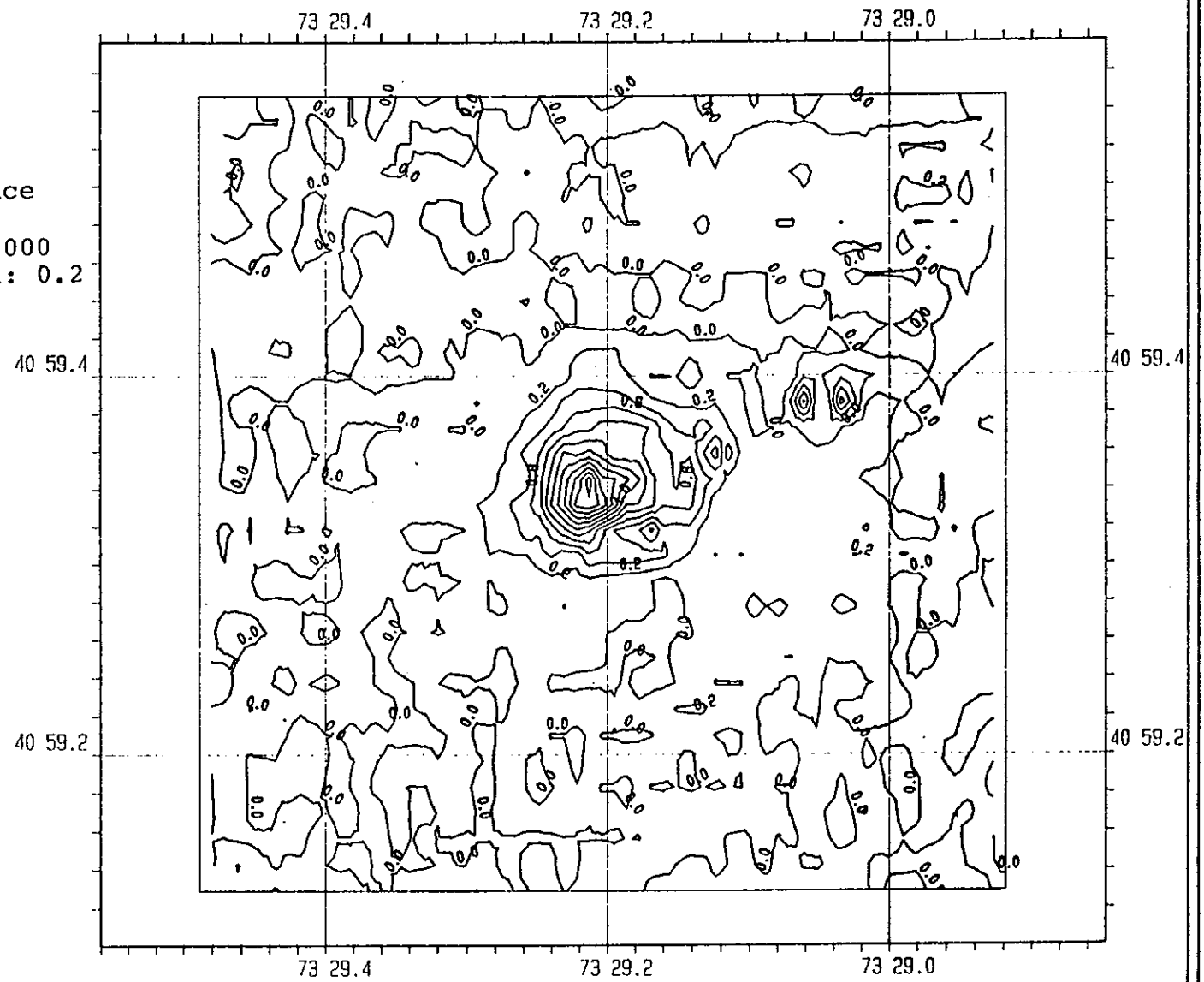
Contour Difference
Aug 83 - Jan 83
Chart Scale: 1/4000
Contour Interval: 0.2
Datum: MLW

Figure I-2-33.

Preliminary

FIGURE I-2-33





WLIS III POINT "A"

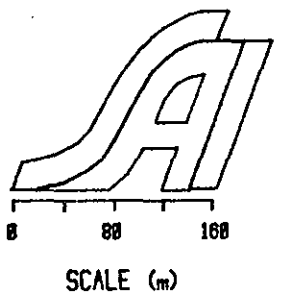
14 MARCH 1984

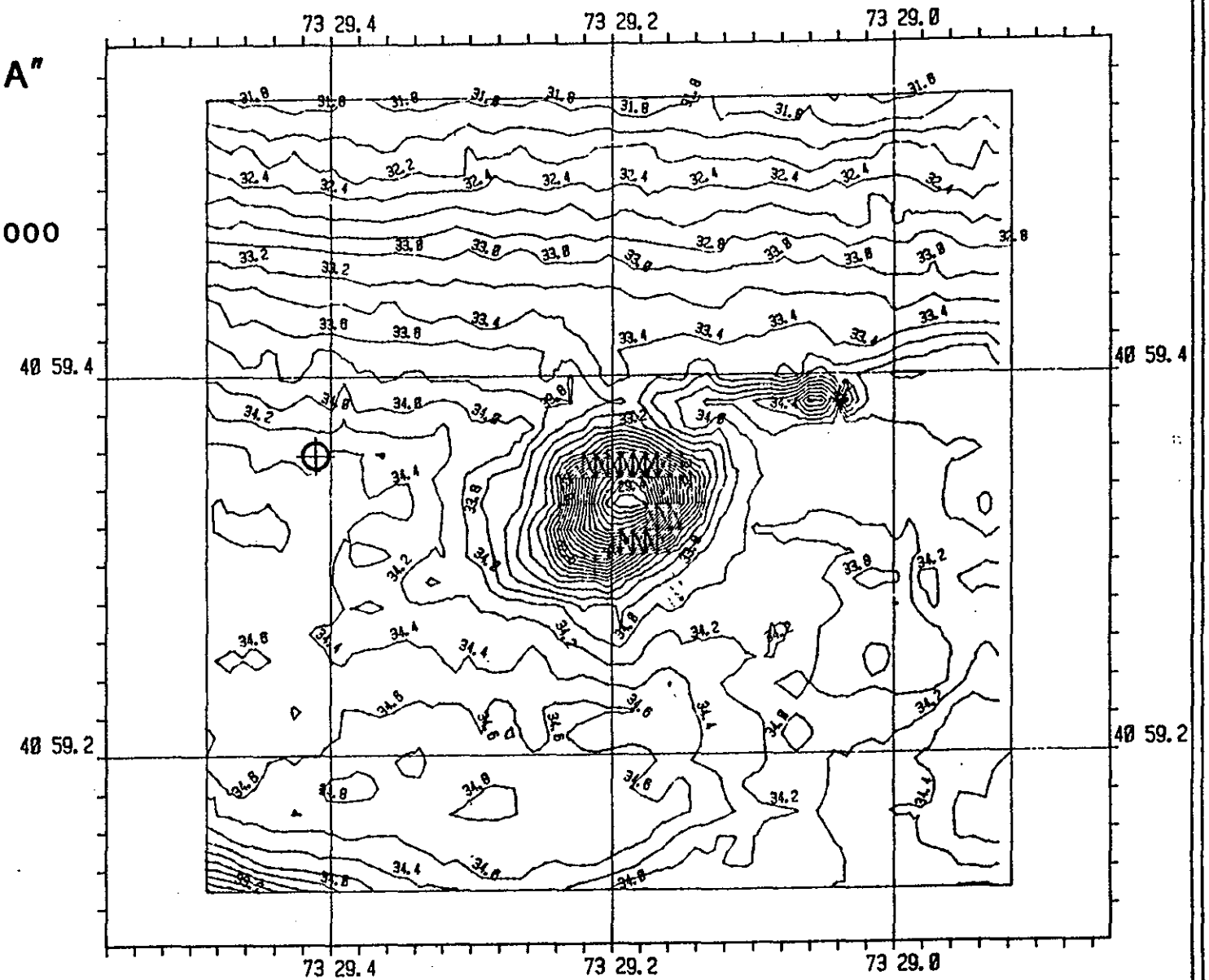
INTERVAL: 0.2m

CHART SCALE: 1/4000

DATUM: MLW

Figure I-2-34





WLIS III 14 MARCH 1984 CHART SCALE: 1/4000 CONTOUR INTERVAL: .2

WLIS III POINT "B"

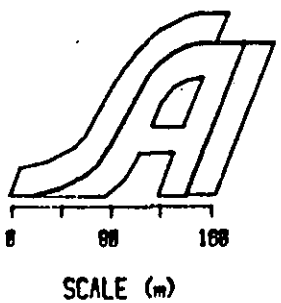
14 MARCH 1984

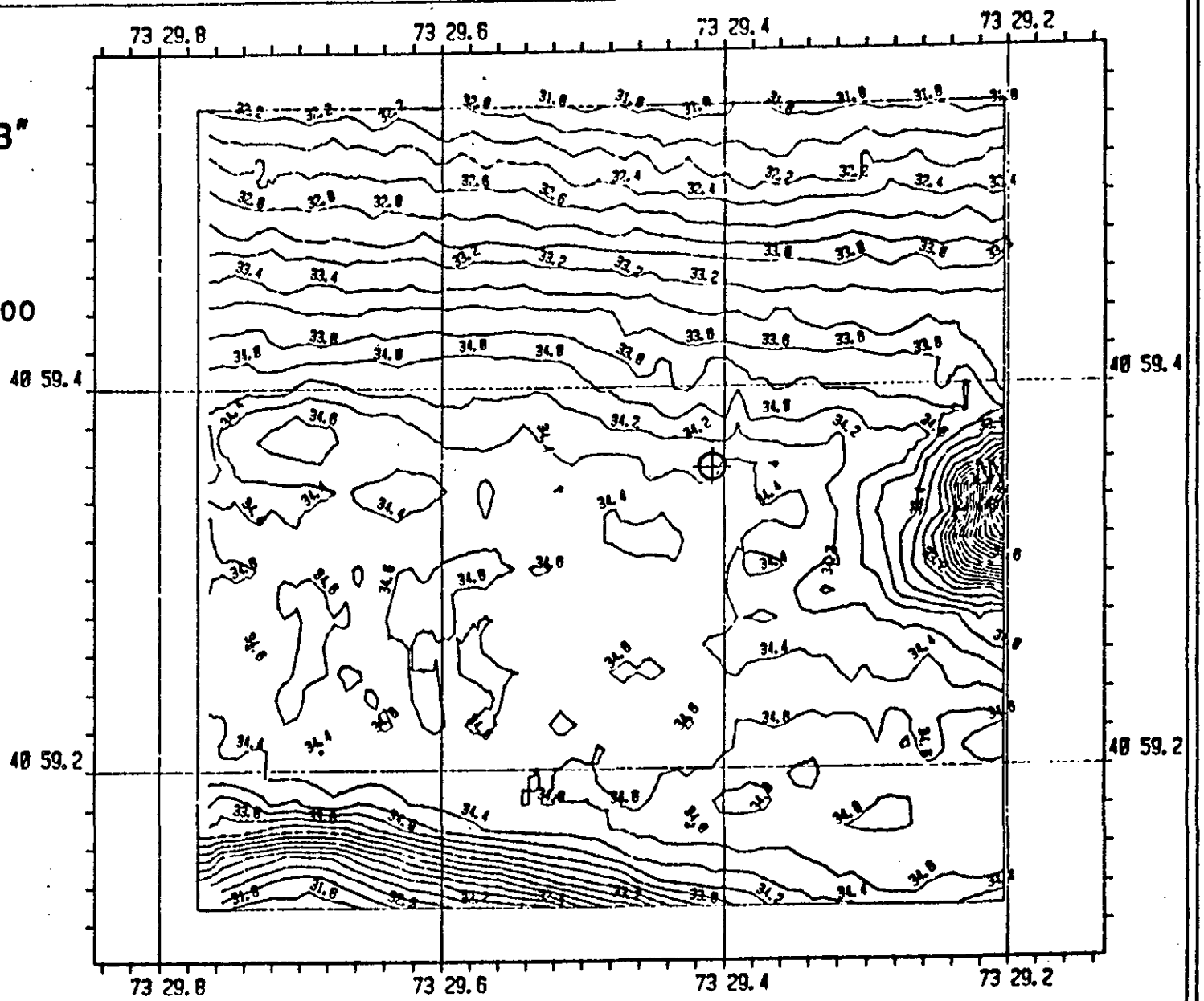
INTERVAL: 0.2m

CHART SCALE: 1/4000

DATUM: MLW

Figure I-2-35





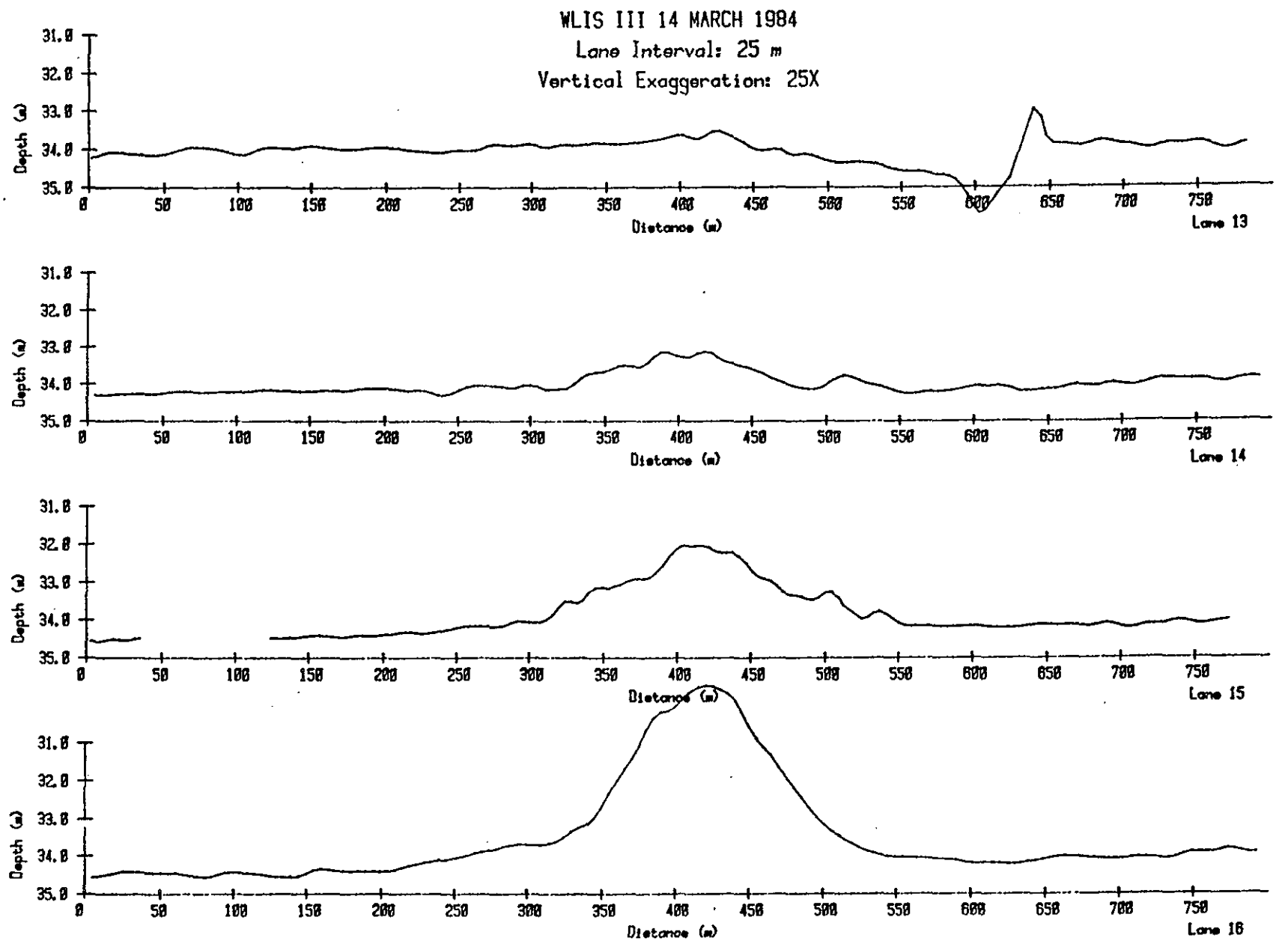


FIGURE I-2-36. Bathymetric profiles.

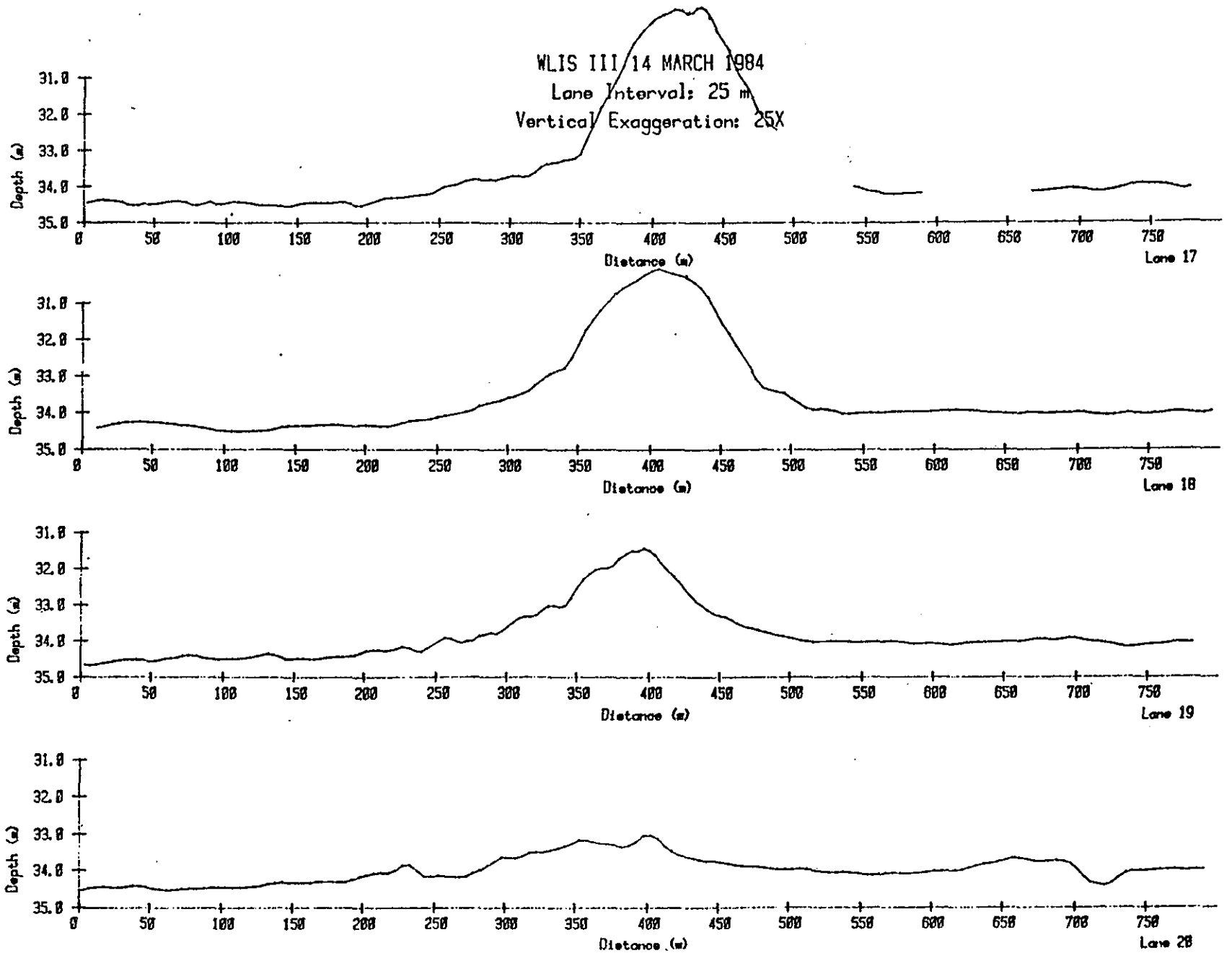


FIGURE I-2-37. Bathymetric profiles.

WLIS III POINT "B"

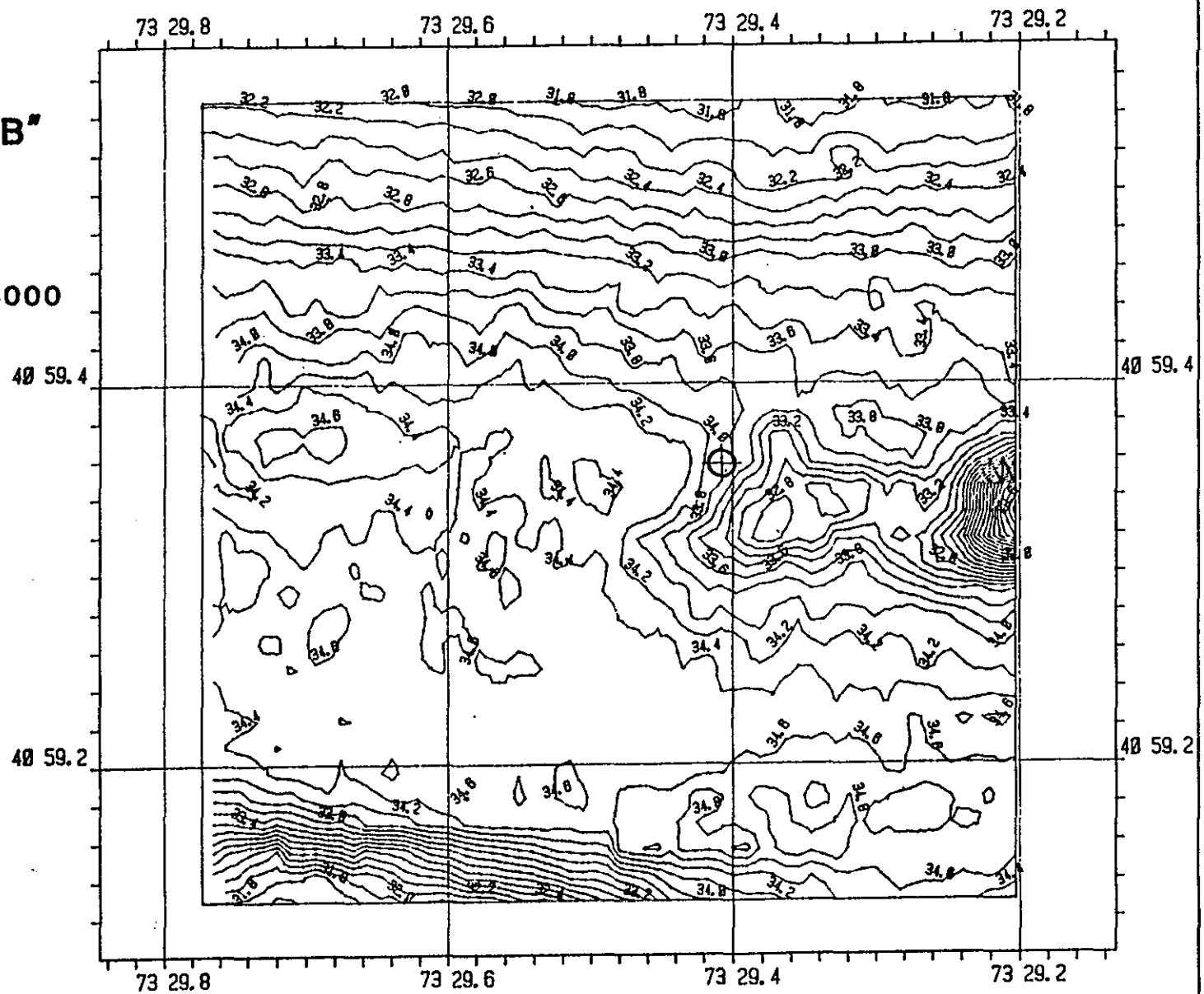
25 JUNE 1984

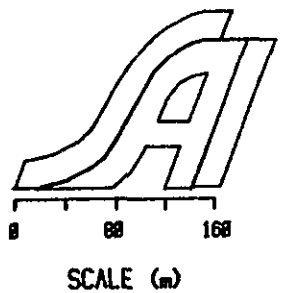
INTERVAL: 0.2m

CHART SCALE: 1/4000

DATUM: MLW

Figure I-2-38





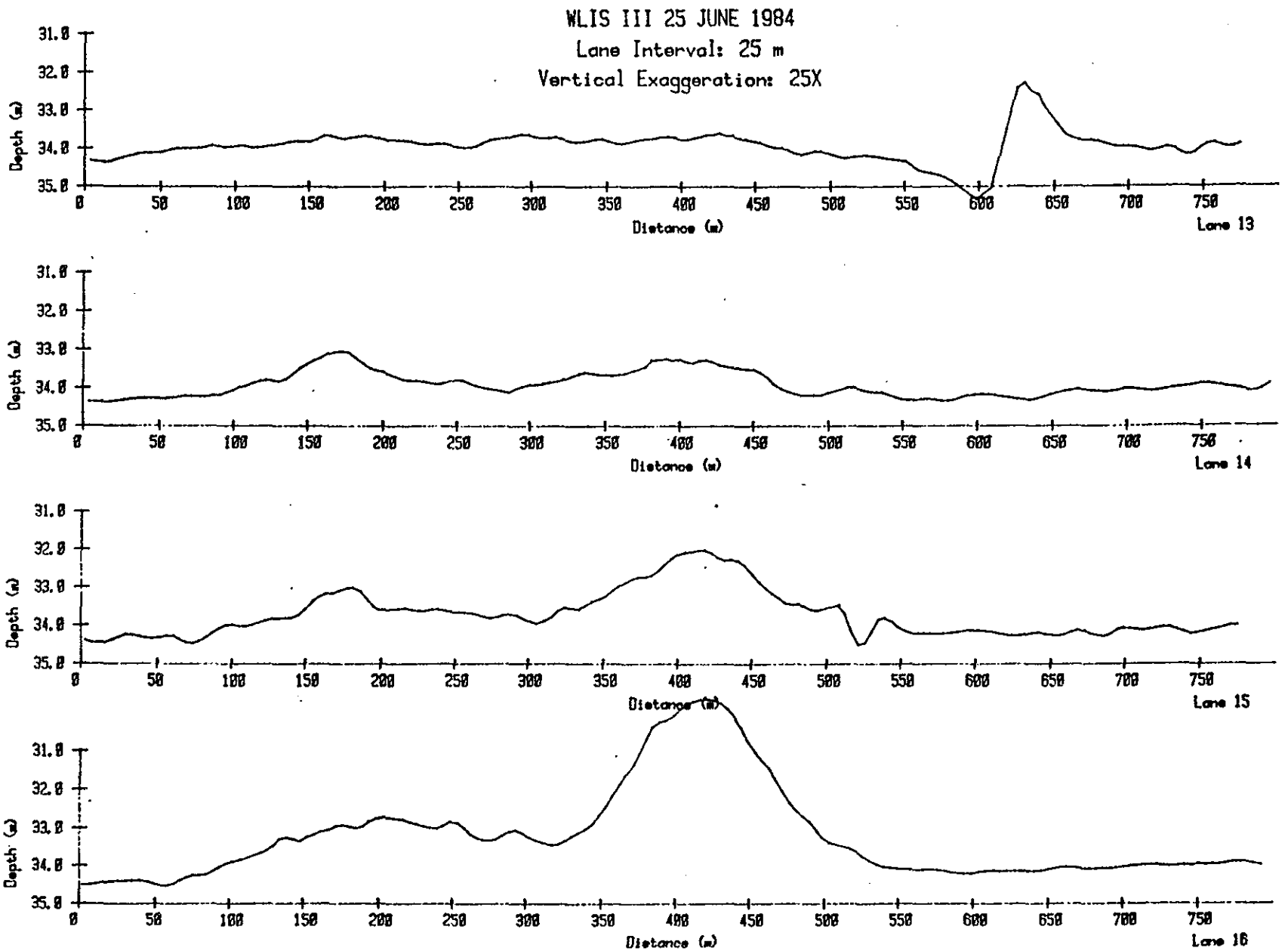


FIGURE I-2-39. Bathymetric profiles.

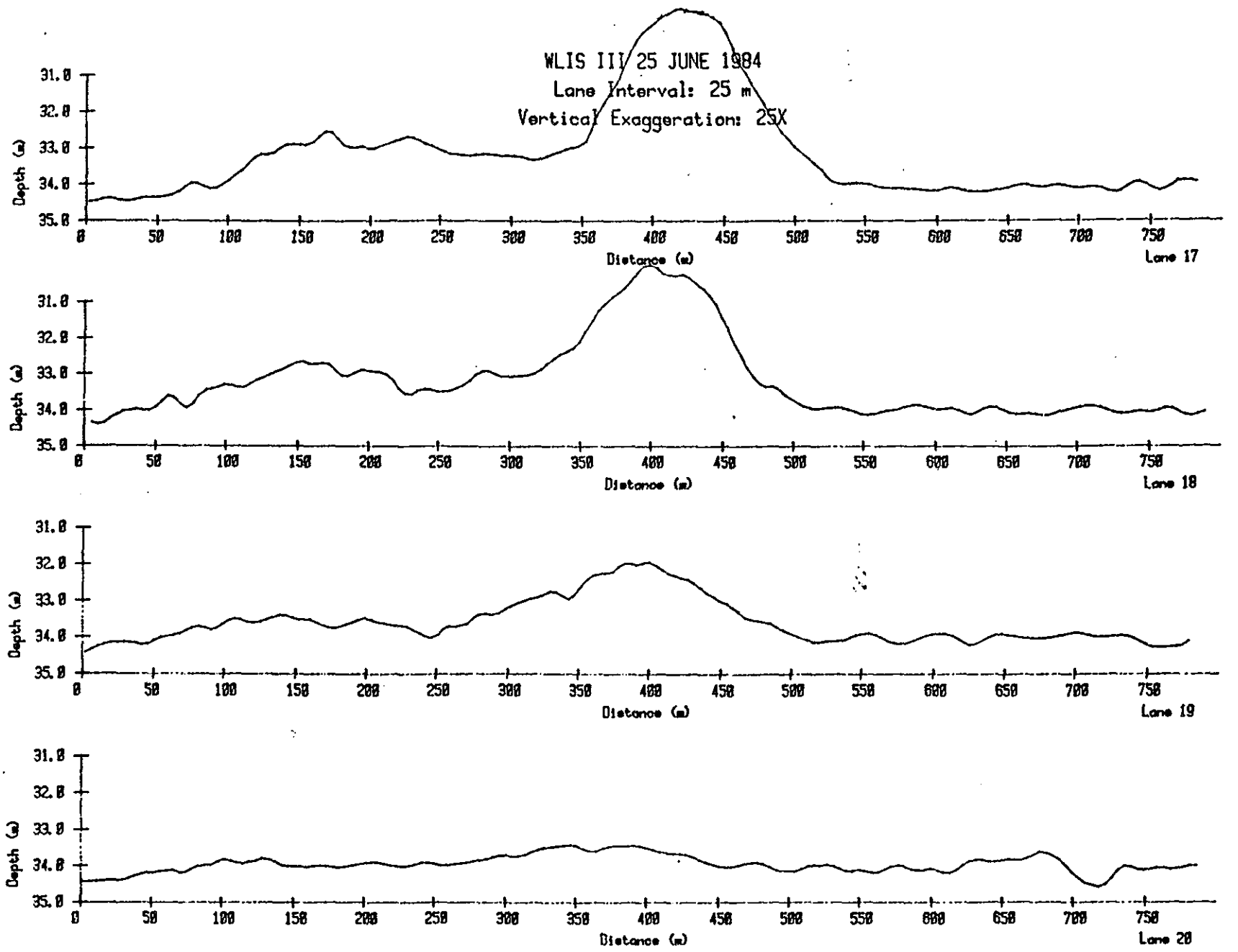


FIGURE I-3-40. Bathymetric profiles.

CONTOUR DIFFERENCE

WLIS III POINT "B"

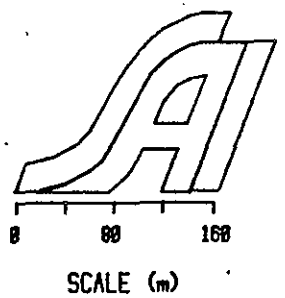
25 JUNE 1984

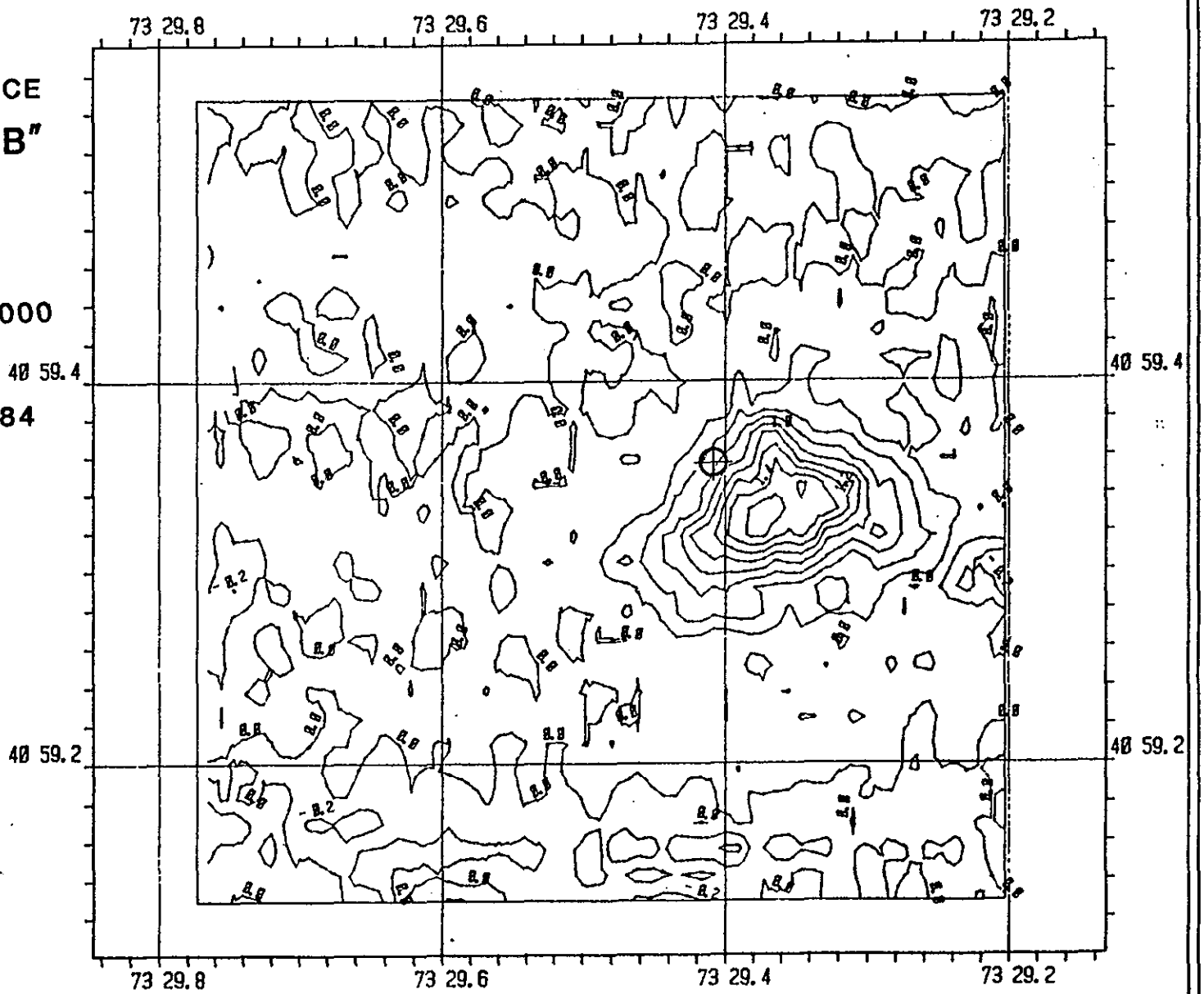
INTERVAL: 0.2m

CHART SCALE: 1/4000

DATUM: MARCH 1984

Figure I-2-41





VOLDIFF WLIS-8JUN84-MAR84 BASE

CHART SCALE: 1/4000

CONTOUR INTERVAL: .2

indicates a mound of approximately 300 m diameter in the east-west direction, and 200 m diameter in the north-south direction.

3.0 SEDIMENT CHARACTERISTICS

A series of sediment samples were obtained with a 0.1 m^2 Smith-MacIntyre grab over the survey area as shown in Figure I-3-1 to provide physical and chemical data for support of the side scan survey and to obtain representative benthic population samples within the WLIS III site. Two replicate samples were obtained at each site, one for bulk sediment analysis and a second for support of biological investigations. The locations and descriptions of the sediment samples are provided in Table I-3-1.

The grain size data for these samples (Table I-3-2) indicate that the sediment was consistent with the side scan records and generally varied according to depth. Samples taken toward the margins of the site, in shallower water, tended to have coarser surface sediments overlying gray cohesive clays and silts. In the deeper areas of the site, the sediments were a dark organic silt that was much less oxidized and had a strong odor. All samples had a thin oxidized surface layer, similar to the fluff layer observed at the Central Long Island Sound Disposal Sites. This oxidized sediment is moved by tidal currents throughout the area while the reduced material remains in place, unless affected by bioturbation. Samples from the proposed disposal point (Sample #1869-1887) were fine, silty clays with a mean grain size of approximately .01mm and showed very little variability between samples.

Bulk sediment chemistry analyses were performed on all samples obtained from this site. The results of these analyses are presented in Table I-3-3 and a comparison with data provided in the WLIS III Environmental Impact Statement and DAMOS samples from the Central Long Island Sound Disposal Site is shown in Table I-3-4.

In general, the samples from the WLIS III site have higher concentrations of metals than expected from the EIS data and significantly higher values than Central Long Island Sound. These higher values are particularly apparent in the samples from the designated disposal point where in the case of Cu and Zn the concentrations are nearly double the expected levels.

Hg values for WLIS data are consistently low, to the extent that problems with the analysis procedures and detection levels should be considered as the most probable explanation rather than actual sediment properties.

The presence of coal cinders, leaves and other terrestrial material suggests that some of the sediment in this site may actually be dredged material that was deposited during previous operations. Since most of the sediment in the basin

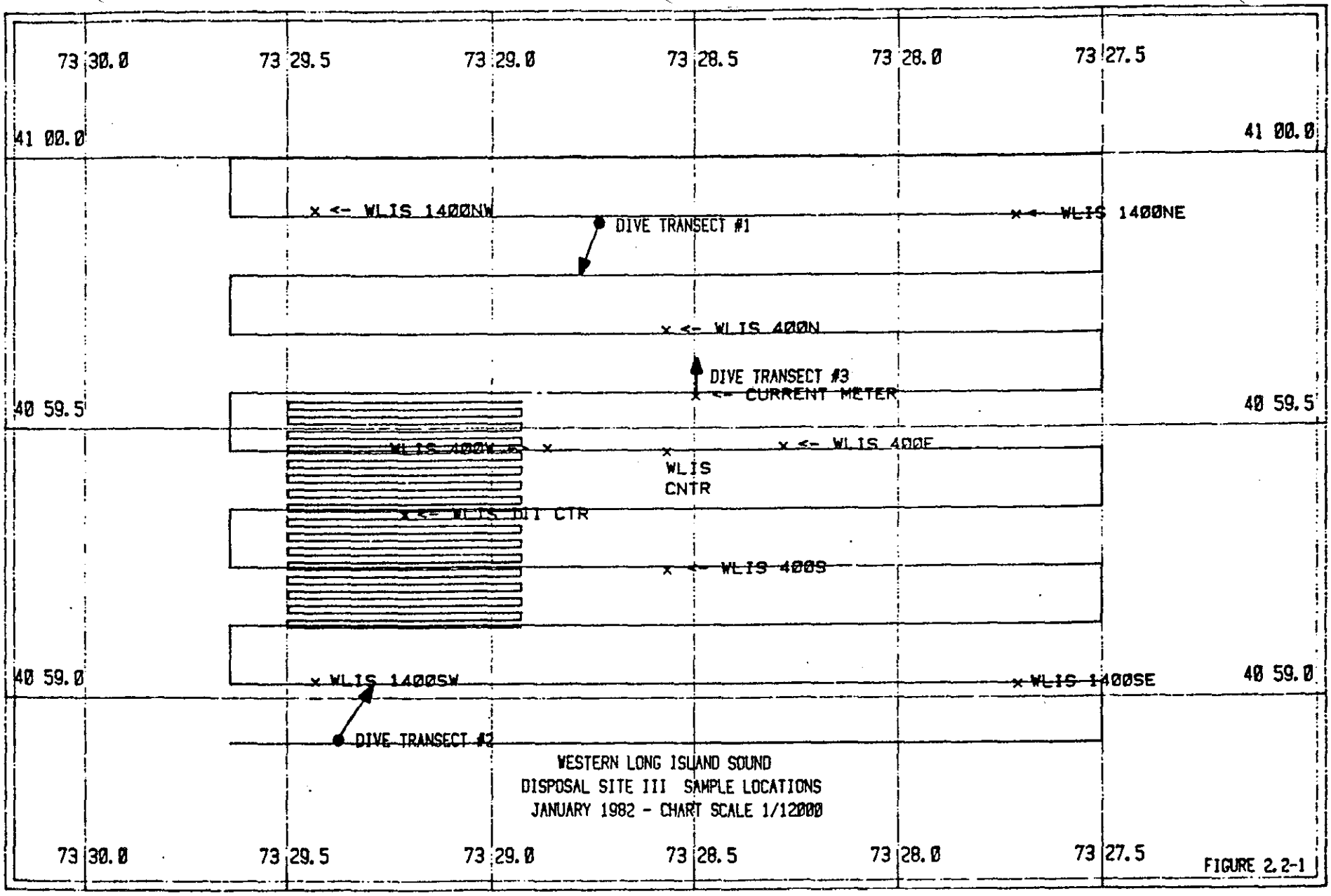


FIGURE I-3-1. Western Long Island Sound Disposal Site III, sample locations, January 1982.

TABLE I-3-1. Location and Description of Sediment Samples Obtained in the Proposed WLIS III Disposal Area

Station Designation	Location	Depth (m)	Red Range	Green Range	Description
WLIS Ctr	40°59.46' 73°28.57'	31.4	10541	7897	oxidized silt layer over dark organic silt, slight odor
400E	40°59.46' 73°28.28'	32.6	10315	7566	oxidized layer with shell hash and some gravel over black organic silt
400N	40°59.68' 73°28.57'	32.0	10195	8255	less oxidized black organic silt with coal cinders and slight odor
400W	40°59.46' 73°28.86'	33.5	10756	8255	small oxidized layer over black organic silt, strong odor
400S	40°59.24' 73°28.57'	35.0	10883	7690	Oxidized layer over black organic silt, strong odor
1400SE	40°59.03' 73°27.71'	32.6	10659	6451	Shellhash and oxidized silt layer over light gray cohesive clay, no odor
1400SW	40°59.03' 73°29.43'	30.8	11868	8613	oxidized silty sand over gray cohesive clay, no odor
1400NW	40°59.90' 73°29.43'	25.3	10601	9358	Coarse sand over silt, no odor
1400NE	40°59.90' 73°27.71'	28.3	9234	7409	shell hash and oxidized silt layer over gray cohesive clay
WLIS III-CTR	40°59.34' 73°29.21'	33.5	11226	8578	fine silt oxidized layer over black organic silt with strong odor, few animals present

TABLE I-3-2

GRAIN SIZE DATA
WLIS III - JANUARY, 1982

SAMPLE #	LOCATION	DEPTH (m)	25% DIAM (mm)	50% DIAM (mm)	75% DIAM (mm)	MEAN (mm)	SORTING COEFF.
1838	WLIS CTR	31.4	.0040	.0097	.022	.012	.43
1841	400E	32.6	.0085	.0360	.290	.078	.21
1844	400N	32.0	.0025	.0088	.030	.013	.29
1847	400W	33.5	.0021	.0086	.017	.009	.48
1850	400S	35.1	.0026	.010	.024	.012	.33
1853	1400SE	32.6	.0023	.011	.035	.016	.26
1856	1400SW	30.8	.013	.020	.028	.061	.68
1859	1400NW	25.3	.020	.390	.540	.317	.19
1862	1400NE	28.3	.0042	.018	.13	.051	.18
1869	DSPSL PT	34.8	.0019	.013	.023	.013	.29
1871	DSPSL PT	34.8	.0022	.0098	.030	.014	.27
1873	DSPSL PT	34.8	.0020	.0067	.016	.008	.34
1885	DSPSL PT	34.8	.0040	.0093	.016	.010	.5
1887	DSPSL PT	34.8	.0010	.009	.015	.008	.26

TABLE I-3-3. Sediment Sample Data, WLIS III, January 1982

SAMPLE NUMBER	STATION	DATE OBTAINED	OIL AND GREASE	PERCENT SOLIDS	PERCENT VOLITILE SOLIDS-NED	PERCENT VOLITILE SOLIDS-EPA	HG	PB	ZN	AS	CD	CR	CU	NI	V	NH3	COD
1838	WLIS-CTR-A	01-19-82	380	33.50	4.49	7.90	0.11	78	210	20	6	120	110	48	160	-	67600
1839	WLIS-CTR-A	01-19-82	380	33.50	4.49	7.80	0.11	78	210	20	6	120	110	48	160	-	67600
1840	WLIS-CTR-B	01-19-82	260	35.92	5.27	8.72	0.20	20	180	8	4	10	46	51	145	842	72000
1841	WLIS-400E-A	01-19-82	270	49.30	3.60	5.94	0.16	63	140	13	3	68	90	31	160	-	61700
1842	WLIS-400E-A	01-19-82	270	49.30	3.60	5.94	0.16	63	140	13	3	68	90	31	160	-	61700
1843	WLIS-400E-B	01-19-82	340	44.02	3.60	6.10	0.20	74	180	9	5	70	82	59	145	460	67000
1844	WLIS-400N-A	01-19-82	260	41.40	4.73	7.48	0.08	81	210	14	3	120	110	44	160	-	61700
1845	WLIS-400N-A	01-19-82	260	41.40	4.73	7.48	0.08	81	210	14	3	120	110	44	160	-	61700
1846	WLIS-400N-B	01-19-82	270	38.08	4.48	7.93	0.20	92	240	10	5	100	140	73	145	789	79000
1847	WLIS-400W-A	01-19-82	580	36.00	5.32	8.37	0.03	77	190	16	3	98	95	39	160	-	67700
1848	WLIS-400W-A	01-19-82	580	36.00	5.32	8.37	0.03	77	190	16	3	98	95	39	160	-	67700
1849	WLIS-400W-B	01-19-82	310	39.42	5.15	8.03	0.05	88	230	10	5	100	160	75	145	556	72000
1850	WLIS-400S-A	01-19-82	240	44.00	5.06	7.75	0.12	69	170	13	6	110	87	46	160	-	65200
1851	WLIS-400S-A	01-19-82	240	44.00	5.06	7.75	0.12	69	170	13	6	110	87	46	160	-	65200
1852	WLIS-400S-B	01-19-82	63	32.97	5.14	8.07	0.05	100	200	9	4	59	100	55	145	725	78000
1853	WLIS1400SE-A	01-19-82	47	46.80	3.28	5.95	0.03	20	84	13	3	51	23	30	160	-	47600
1854	WLIS1400SE-A	01-19-82	47	46.80	3.28	5.95	0.03	20	84	13	3	51	23	30	160	-	47600
1855	WLIS1400SE-B	01-19-82	150	45.97	3.29	5.43	0.05	31	120	8	4	13	26	64	145	739	46000
1856	WLIS1400SW-A	01-19-82	160	57.90	2.26	3.68	0.08	48	110	8	3	56	57	25	160	-	28900
1857	WLIS1400SW-A	01-19-82	160	57.90	2.26	3.68	0.08	48	110	8	3	56	57	25	160	-	28900
1858	WLIS1400SW-B	01-19-82	220	50.15	3.25	5.00	0.10	44	120	7	4	49	70	40	145	508	47000
1859	WLIS1400NW-A	01-19-82	130	58.10	1.65	3.23	0.06	35	81	5	3	45	44	17	160	-	35400
1860	WLIS1400NW-A	01-19-82	130	58.10	1.65	3.23	0.06	35	81	5	3	45	44	17	160	-	35400
1861	WLIS1400NW-B	01-19-82	73	67.44	1.51	2.60	0.05	20	88	7	4	19	47	30	145	356	26000
1862	WLIS1400NE-A	01-19-82	160	50.10	2.40	4.73	0.07	39	110	12	3	64	59	26	160	-	33700
1863	WLIS1400NE-A	01-19-82	160	50.10	2.40	4.73	0.07	39	110	12	3	64	59	26	160	-	33700
1864	WLIS1400NE-B	01-19-82	70	49.91	2.96	5.62	0.05	37	93	7	4	37	39	54	145	455	68000
1866	WLIS-CTR-1	01-19-82	270	34.11	5.00	8.39	0.00	84	210	11	4	89	110	61	145	-	-
1868	WLIS-CTR-2	01-19-82	340	37.98	4.92	7.91	0.00	95	240	9	6	110	140	53	145	-	-
1870	WLIS-CTR-3	01-19-82	320	34.34	5.28	8.56	0.00	96	250	10	10	110	160	60	145	-	-
1872	WLIS-CTR-4	01-19-82	320	32.75	4.66	8.47	0.00	80	230	12	9	98	140	63	145	-	-
1874	WLIS-CTR-5	01-19-82	410	32.80	5.87	8.15	0.00	90	220	8	7	82	130	54	145	-	-
1885	WLIS-CTR-A	01-19-82	130	33.55	5.08	8.19	0.08	25	250	14	4	14	74	63	145	71	99000
1888	WLIS-CTR-C	01-19-82	520	30.76	5.34	8.36	0.05	20	210	11	4	50	91	44	145	833	110000

* SAMPLES 1866-1888 FROM PROPOSED WLIS III DISPOSAL POINT

DISPOSAL AREA MONITORING SYSTEM (DAMOS)
SEDIMENT SAMPLE DATA

WESTERN LONG ISLAND SOUND III DISPOSAL AREA

VALUES IN PARTS PER MILLION (PPM)

TABLE I-3-4

Comparison of Heavy Metal Concentrations from Bulk Sediment Analysis. (all values = mean PPM)

METAL	WLIS III EIS	CLIS (DAMOS '79)	WLIS	WLIS III DISPOSAL PT.
CR	63	40	71	79
Hg	.26	.26	.09	.02 (Trace)
Cu	73	51	76	121
Ni	48	18	41	57
Pb	41	44	56	70
Zn	117	134	150	230

consists of relatively anoxic, organic silts with relatively high levels of metal concentration, it is doubtful that additional disposal of dredged material would significantly alter the existing sediment conditions.

In April 1982, three sediment samples were obtained for bulk sediment chemical analyses from the dredged material immediately south of the buoy and at three locations east of the site beyond the margin of current disposal operations. The dredged material was a light gray cohesive clay sediment, with a thin layer of fine black silt intermixed between the clay modules.

The samples taken east of the site were similar to previous samples obtained prior to disposal consisting primarily of a dark grey, organic silt wih a higher water content than the present dredged material. This silt is overlaid by a thin oxidized silt layer and some small shell hash on the sediment surface.

Bulk sediment analysis of heavy metal content (Table I-3-5) indicated that the disposed dredged material had metal concentrations on the order of background levels, but with higher variability. Two of the three samples from the center of the site had relatively low metal concentrations, while the third was substantially higher than background. Such high variability is characteristic of disposed dredged material, however, all levels seem quite low when compared with disposal operations at the Central Long Island Sound Disposal Site. For example, copper concentrations from Stamford dredged material were on the order of 5-600 ppm, while New Haven silts were between 1 and 200 ppm.

The samples taken east of the disposal site were much less variable and were approximately the same level of concentration as baseline sediments obtained in January 1982.

A comparison of metal concentration data from the interim survey with heavy metal concentrations from previous sources is presented in Table I-3-6. Although only a small number of samples were available, first indications were that the changes in heavy metal concentrations throughout the disposal site were negligible.

During the August and December 1982 surveys, samples at the WLIS III site were obtained at specific locations on North, South, East and West transects (Figs. I-3-2 and I-3-3). Descriptions of the samples taken during these cruises are presented in Tables I-3-7 and I-3-8. In general, it is difficult to distinguish dredged material from the black organic silt which is common to the natural bottom of the trough within the WLIS III site. The most common features identifying dredged material are the presence of leaves and branches, more coarse material and the presence of shell hash from nearshore deposits. However, once beyond the flanks of the mound, the fine-grained organic silts deposited on the margins are nearly identical to the natural sediments and the thickness of dredged material cannot be measured.

TABLE I-3-5

Heavy metal concentrations in sediments from Western Long Island Sound Disposal Site.
Values in parts per million (PPM)

SAMPLE NUMBER	STATION	DATE OBTAINED	OIL AND GREASE	PERCENT SOLIDS	PERCENT VOLITILE SOLIDS-NED	PERCENT VOLITILE SOLIDS-EPA	HG	PB	ZN	AS	CD	CR	CU	NI	V	COD
2082	WLIS-CTR-A	4/23/82	73	45.5	4.31	6.29	.04	72	79	3.8	3	42	35	42	100	71000
2083	WLIS-CTR-B	4/23/82	42	46.8	4.13	6.09	.04	75	69	4.1	3	36	30	40	100	71000
2084	WLIS-CTR-C	4/23/82	840	40.7	6.27	8.91	.42	157	310	3.6	3	65	175	48	100	100000
2086	WLIS-EAST-A	4/23/82	440	31.7	5.64	8.84	.11	117	219	5.8	3	86	118	53	100	71000
2087	WLIS-EAST-B	4/23/82	330	36.1	4.48	7.96	.04	38	219	4.0	3	29	89	47	100	75000
2088	WLIS-EAST-C	4/23/82	560	30.3	5.80	8.88	.04	125	210	3.8	3	87	113	49	100	83000

TABLE I-3-6

Comparison of heavy metal concentrations from bulk sediment analysis. (all values = mean ppm)

	WLIS III EIS	CLIS DAMOS '79	WLIS	WLIS III DISPOSAL POINT	WLISIII POST-DISPOSAL	WLIS III POST DISPOSAL EAST TRANSECT
Hg	.26	.26	.09	.02	.17	.06
Pb	41	44	56	70	101	93
Zn	117	134	150	230	153	213
Cr	63	40	71	79	48	67
Cu	73	51	76	121	80	107

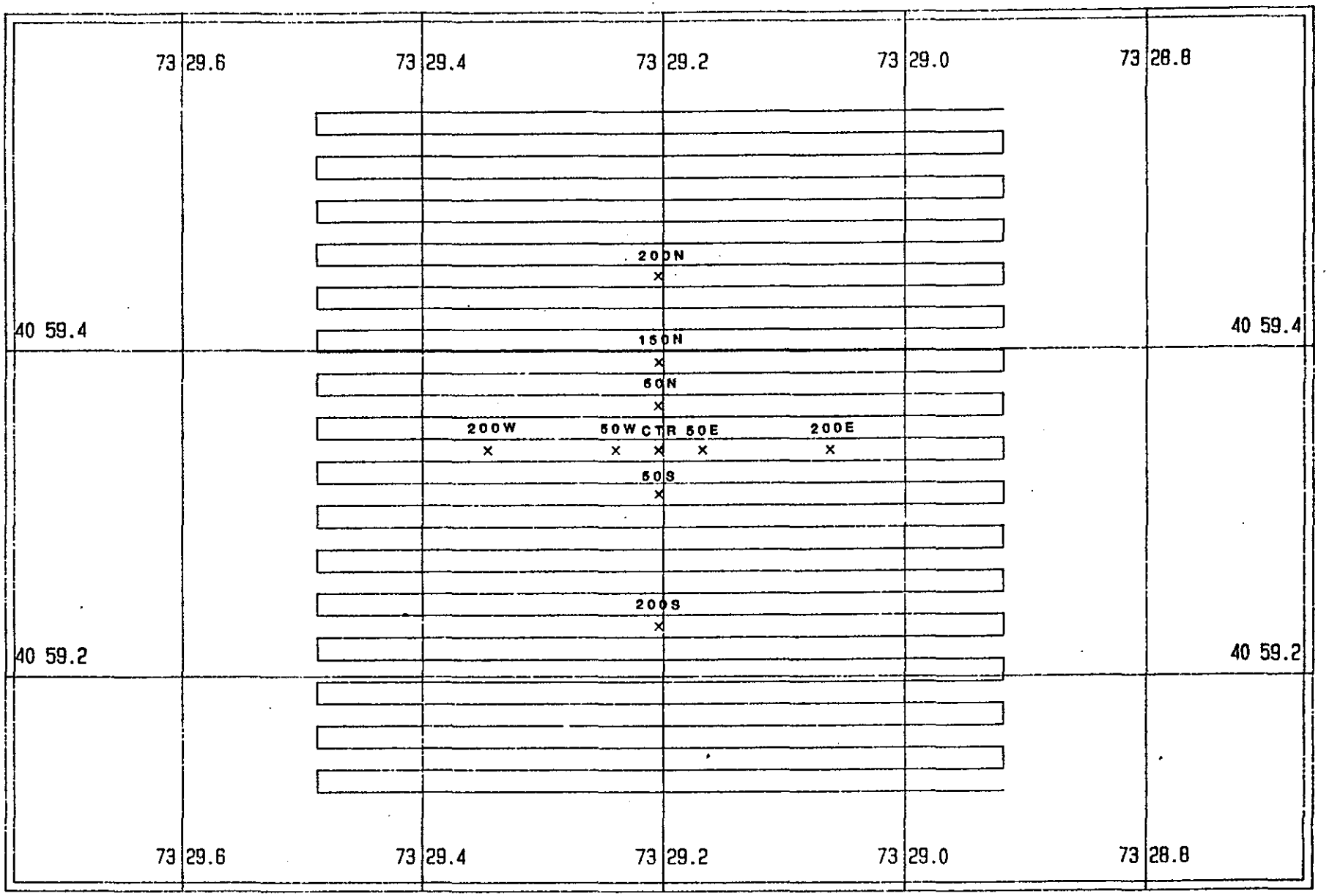


FIGURE I-3-2. Sediment Sample Locations, August 1982.

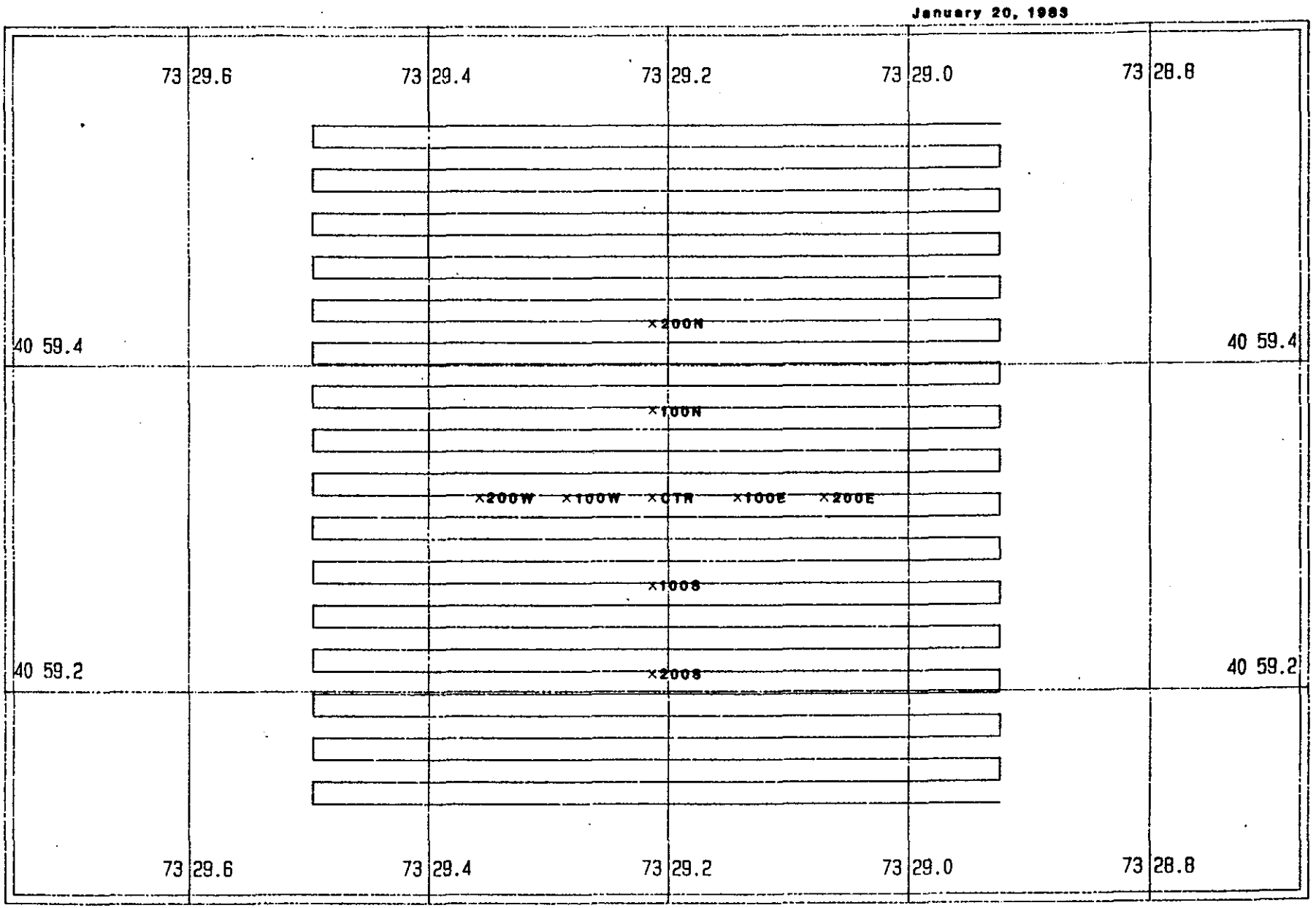


FIGURE I-3-3. Sediment Sample Locations WLIS, January 1983.

TABLE I-3-7

Sediment Sample Descriptions
August, 1982

CTR A	black silty dredged material over gray cohesive clay; some odor
B	similar to A, shell hash on surface, less gray clay; definite odor
C	same as A & B, more clay; strong odor
50E-A	oxidized layer with fine shell hash over black organic silt
B	same as A, very soft, same odor at bottom of grab
C	more like dredged material, has terrestrial material - plastic and cloth; same odor, less cohesive
200E-A	oxidized layer with small clams (Nucula proxima) over black organic silt; slight odor
B	same as A
C	same as A & B
50N	coarse shell hash over gray modular clay (no chemistry)
100N-A	lot of leaf material, black organic silt over gray clay; strong odor
B	same as A
C	fewer leaves, oxidized layer present over black organic silt
200N-A	similar to 200E, Nucula proxima on oxidized layer over black organic silt
B	same as A
C	same as A & B
50W-A	shell hash, over dark organic silt, over gray cohesive clay

TABLE I-3-7 (Cont.)

B	same as A
C	same as A & B, rock present, more coarse material
200W-A	oxidized layer over fine black organic silt, similar to 200 E&N
B	same as A
C	same as A & B
50S-A	oxidized layer over black organic silt, concentration of leaves in bottom of grab
B	same as A
C	same as A & B
200S-A	oxidized layer over black organic silt
B	same as A
C	same as A & B
REF-A	same as 200m stations, oxidized layer with some shell hash over dark organic silt
B	same as A
C	same as A & B

TABLE I-3-8

Sediment Sample Descriptions
January 1983

CTR A	thin oxidized layer, black organic silt with clay balls, branches and leaves present; strong odor, not cohesive
B	same as A
C	same as A & B
100E-A	thin oxidized layer over black organic silt, strong odor, non-cohesive
B	same as A
C	same as A & B
200E-A	slight odor, thin oxidized layer over black silt
B	same as A
C	same as A & B
100N-A	very thin patchy oxidized layer, clay balls, cohesive sand with shell hash
B	leaf debris present
C	same as A
200N-A	no oxidized layer, strong odor, black silt with shell hash
B	same as A
C	same as A & B
100W-A	thin oxidized layer over black silt, gravel & shell hash present; strong odor
B	same as A
C	same as A & B

TABLE I-3-8 (Cont.)

200W-A	thin oxidized layer over black silt, clay 8cm below surface
B	same as A, but shell hash and strong odor
C	same as A
100S-A	thin oxidized layer over black silt, cohesive; strong odor
B	same as A with wood debris
C	same as A
200S-A	thin oxidized layer over black silt with shell hash; strong odor
B	same as A
C	same as A & B
REF-A	1.5cm oxidized layer over black silt over gray clay; thick shell hash
B	same as A
C	same as A & B

The results of the chemical analysis of sediment from the August sampling are presented in Table I-3-9. Table I-3-9a section "a" consists of data close to the center of the mound and certainly represents dredged material, while Table I-3-9b contains samples 200 meters from the center and at the reference site, which should be representative of background levels at the site.

A comparison of mean values from pre-disposal, interim and post-disposal samples collected from the center of the disposal site is presented in Table I-3-10. An analysis of variance (ANOVA) was used to test whether the concentrations had changed at this location as a result of disposal. Table I-3-11 summarizes the results of the tests and indicates that, at this site, % solids, oil and grease, and nickel were the only parameters with significant concentration changes through time. The % solids were lower before and increased to a fairly constant level during and after disposal. In contrast, oil and grease and nickel concentrations were higher in the pre-disposal sediments and decreased during disposal. No other parameters had significant differences. The higher amounts of solids, probably due to the coarser nature of the sediment in the dredged material, are consistent with the lower values observed for associated contaminants.

It is also important to test for differences in sediment chemistry on and off of the disposal mound to assess the potential impact of spreading material over the ambient bottom. The August 1982 samples (Table I-3-9) were collected from several locations both on and off the mound and were analyzed by ANOVA. The results, summarized in Table I-3-12, indicate that the disposal mound differed from the natural bottom in levels of % solids, iron, chromium and magnesium. Higher levels of solids were measured in samples from the disposal mound, which is consistent with the result (Table I-3-11) that solids increased after disposal began. Concentrations of iron, chromium and magnesium were lower in the disposal mound samples than in samples taken off the mound indicating that the dredged material dumped at the site is similar to, but generally less contaminated than, sediments currently existing in the area.

In January and August 1983, sediment samples were taken at the locations described in Table I-3-13. Visual observations were made on every grab from each station and sediment samples were collected in triplicate for subsequent analysis by NED.

The results of the chemical analyses for January and August 1983 are shown in Tables I-3-14 to I-3-17. The concentrations of zinc, chromium and copper were higher in all surface sediment samples taken in January. These samples were taken during the disposal operation after the deposition of approximately 11,000m^3 of dredged material. The median grain size of the sediments was smaller, which would also account for the higher metal concentrations. There were no apparent station

TABLE I-[illegible]a

WESTERN LONG ISLAND SOUND III
SEDIMENT CHEMISTRY DATA - AUGUST, 1982
VALUES IN PARTS PER MILLION

	COD	% SOLIDS	Hg	Pb	Zn	As	Fe	Cd	Cr	Cu	Mg	Ni	Ca	% TOTAL CARB	OIL & GREASE
CTR-A	53,200	53.5	.05	57	125	1.6	24,300		30	50	8150	83	10,100	2.28	313
B	88,000	41.5	1.35	101	196	2.0	27,600		47	100	8310	--	1,240	3.01	---
C	90,300	43.0	.29	70	164	15.3	26,000	4	40	77	9020	--	6,580	2.17	---
50E-A	93,000	43.1	.46	233	285	6.4	30,100	--	49	130	9030	74	1,240	3.14	899
B	89,500	44.3	.32	162	238	5.4	26,700	4	46	124	8180	--	772	3.11	---
C	123,000	45.5	.31	254	264	5.5	30,700	6.8	51	138	8020	53	5,280	4.55	---
100N-A	120,000	43.4	.15	199	232	3.0	25,100	--	47	119	7700	--	1,820	4.63	1250
B	167,000	45.6	---	214	239	1.9	22,900	--	51	124	7470	--	3,500	4.85	---
C	81,000	50.3	.31	193	230	2.9	25,300	--	48	109	7400	--	1,000	4.00	---
50W-A	85,300	46.2	.40	59	99	3.1	13,500	--	25	41	4000	--	740	2.94	246
B	93,600	43.5	.22	72	152	3.8	30,600	--	48	66	9410	--	1,150	2.88	---
C	89,200	48.2	.41	70	171	1.7	30,200	--	51	98	8250	66	1,480	2.41	---
50S-A	105,000	41.2	---	143	207	1.3	24,500	--	51	121	8530	--	1,880	3.63	1090
B	85,800	43.7	.27	141	229	3.8	23,600	--	50	102	7800	--	1,000	3.78	---
C	102,000	46.4	.20	207	225	.7	22,500	--	46	103	7620	--	2,030	3.85	---

TABLE 3-9b

WESTERN LONG ISLAND SOUND III
SEDIMENT CHEMISTRY DATA - AUGUST 1982
VALUES IN PARTS PER MILLION

	COD	% SOLIDS	Hg	Pb	Zn	As	Fe	Cd	Cr	Cu	Mg	Ni	Ca	% TOTAL CARB	OIL & GREASE
200E-A	93,400	40.0	.19	120	232	4.2	29,100	--	77	104	10,400	--	1,850	2.86	310
B	94,100	38.0	.23	130	222	3.7	29,400	--	78	106	10,600	--	1,500	3.24	---
C	95,300	36.9	.13	104	205	1.3	28,200	--	73	100	10,400	--	1,560	3.07	---
200N-A	92,500	33.4	.25	150	230	4.3	30,600	--	75	123	10,400	52	507	3.43	547
B	95,400	39.2	.27	150	252	4.4	30,600	--	71	115	9,810	--	503	3.41	---
C	110,000	35.6	.33	126	248	3.1	30,600	--	70	114	9,770	--	622	3.43	---
200W-A	109,000	30.6	---	124	225	3.7	29,200	--	89	124	10,900	80	1,620	3.11	261
B	110,000	30.7	---	111	246	1.8	29,600	--	95	134	10,900	59	3,090	3.12	---
C	96,800	32.2	.15	77	234	1.0	29,600	--	87	116	11,800	50	2,760	3.28	---
200S-A	89,300	34.0	.05	104	240	0.4	29,900	--	77	113	11,300	83	650	3.12	---
B	86,400	35.8	.05	114	253	1.7	30,300	--	81	111	11,400	78	1,980	3.14	---
C	77,100	33.0	---	106	234	4.0	28,300	--	76	109	11,700	55	3,980	3.22	---
REF-A	89,900	35.4	.18	107	233	5.9	27,100	--	78	107	10,300	--	3,140	3.16	354
B	83,900	31.9	.22	128	248	3.0	28,800	--	96	135	10,900	55	1,610	3.05	---
C	76,100	40.2	.39	131	220	3.0	26,400	--	82	125	9,900	--	2,640	2.90	---

TABLE I-3-10

Mean Concentration of Chemicals and Materials in Sediments Collected at the Center of the Western Long Island Sound III Disposal Site Before, During and After Disposal. Values in Parts Per Million.

	COD	% Solids	HG	Pb	Zn	As	Cd	Cr	Cu	Mg	Ni	Ca	% Total Carbon	Oil & Grease
Pre-Disposal	105,000	33.76	.02	70	230	11	6	79	125	--	57	--	--	330
Interim	81,000	44.30	.16	101	150	4	3	48	80	--	43	--	--	118
Post-Disposal	77,200	46.00	.56	76	162	6.3	4	39	76	8490	83	5,970	2.49	313

TABLE I-3-11

Summary of Statistical Tests Comparing Pre-Disposal, Interim and Post-Disposal Concentration of Chemicals at the Center of the Disposal Site.

Chemical	Significance of ANOVA	Times Which Differ in Concentration
COD	NS	
% SOLIDS	**	Pre-Disp. < Interim & Post
Hg	NS	
Pb	NS	
Zn	NS	
As	NS	
Fe	Not Tested	
Cd	NS	
Cr	NS	
Cu	NS	
Mg	Not Tested	
Ni	*	Pre-Disp. > Interim
Ca	Not Tested	
% Total Carbon	Not Tested	
Oil & Grease	*	Pre-Disp. > Interim

NS = not significant
* = signicant difference (≥ .05)
** = highly significant difference (≥ .010)
Not Tested = lack of replication precluded testing

TABLE I-3-12

Summary of Statistical Tests Comparing Samples From On or Off the Disposal Mound in August 1982

Chemical	Significance of ANOVA	Places (On or Off Mound) Which Differ in Concentration
COD	NS	
% SOLIDS	**	On > Off
Hg	NS	
Pb	NS	
Zn	NS	
As	NS	
Fe	*	Off > On
Cd	Not Tested	
Cr	**	Off > On
Cu	NS	
Mg	**	Off > On
Ni	NS	
Ca	NS	
% Total Carbon	NS	
Oil & Grease	NS	

NS = no significant difference
* = signicant difference (≥ .05)
** = highly significant difference (≥ .010)
Not Tested = lack of replication precluded testing

TABLE I-3-13

Location of Sediment Samples, August 1983.

WLIS III AUGUST 1983

SAMPLE#	DISPOSAL SITE	LOCATION	TYPE
3323	WLIS-III	WLIS-III-200W-A	GS
3324	WLIS-III	WLIS-III-200W-A	HM
3325	WLIS-III	WLIS-III-200W-B	HM
3326	WLIS-III	WLIS-III-200W-C	HM
3327	WLIS-III	WLIS-III-100W-A	GS
3328	WLIS-III	WLIS-III-100W-A	HM
3329	WLIS-III	WLIS-III-100W-B	HM
3330	WLIS-III	WLIS-III-100W-C	HM
3331	WLIS-III	WLIS-III-CTR-A	GS
3332	WLIS-III	WLIS-III-CTR-A	HM
3333	WLIS-III	WLIS-III-CTR-B	HM
3334	WLIS-III	WLIS-III-CTR-C	HM
3335	WLIS-III	WLIS-III-100E-A	GS
3336	WLIS-III	WLIS-III-100E-A	HM
3337	WLIS-III	WLIS-III-100E-B	HM
3338	WLIS-III	WLIS-III-100E-C	HM
3339	WLIS-III	WLIS-III-200E-A	GS
3340	WLIS-III	WLIS-III-200E-A	HM
3341	WLIS-III	WLIS-III-200E-B	HM
3342	WLIS-III	WLIS-III-200E-C	HM
3343	WLIS-III	WLIS-III-200N-A	GS
3344	WLIS-III	WLIS-III-200N-A	HM
3345	WLIS-III	WLIS-III-200N-B	HM
3346	WLIS-III	WLIS-III-200N-C	HM
3347	WLIS-III	WLIS-III-100N-A	GS
3348	WLIS-III	WLIS-III-100N-A	HM
3349	WLIS-III	WLIS-III-100N-B	HM
3350	WLIS-III	WLIS-III-100N-C	HM
3351	WLIS-III	WLIS-III-100S-A	GS
3352	WLIS-III	WLIS-III-100S-A	HM
3353	WLIS-III	WLIS-III-100S-B	HM
3354	WLIS-III	WLIS-III-100S-C	HM
3355	WLIS-III	WLIS-III-200S-A	GS
3356	WLIS-III	WLIS-III-200S-A	HM
3357	WLIS-III	WLIS-III-200S-B	HM
3358	WLIS-III	WLIS-III-200S-C	HM
3359	WLIS-REFERENCE	WLIS-REF-A	GS
3360	WLIS-REFERENCE	WLIS-REF-A	HM
3361	WLIS-REFERENCE	WLIS-REF-B	HM
3362	WLIS-REFERENCE	WLIS-REF-C	HM

GS = Grain Size Analysis HM = Heavy Metal Analysis

TABLE I-3-14

CHEMICAL ANALYSIS
WLIS - III
WEST-EAST TRANSECT
JANUARY 1983

Location	Median Grain Size (mm)	% Volatiles NED	COD ppmx10^{-5}	Fe ppmx10^{-4}	Zn ppm	Cr ppm	Cu ppm	C:N
200W-A	.011	4.60	0.83	2.86	275	126	122	10.5
B		3.79	1.06	2.86	315	114	129	13.5
C		3.64	1.03	2.88	293	136	126	11.1
100W-A	.011	3.41	1.17	2.51	275	104	101	9.6
B		6.86	0.86	2.89	183	98	104	12.7
C		2.57	1.30	2.56	299	97	94	10.2
CTR-A	.010	6.09	0.54	1.96	218	83	110	14.1
B		6.86	0.86	2.89	183	98	95	12.7
C		5.32	0.76	2.97	214	86	92	11.5
100E-A	.013	5.47	1.51	2.79	116	50	24	10.9
B		6.54	1.40	1.96	184	67	69	9.9
C		7.05	0.78	2.61	300	86	82	8.7
200E-A	.006	6.62	0.94	2.66	410	99	98	10.0
B		7.48	0.88	2.66	210	111	94	10.2
C		3.36	0.86	2.68	267	115	102	10.5
REF-A	.006	6.58	0.74	2.83	168	58	37	11.4
B		6.13	0.71	2.69	367	24	27	13.4
C		4.50	0.91	0.84	146	45	19	11.3

TABLE I-3-15

CHEMICAL ANALYSIS
WLIS - III
NORTH-SOUTH TRANSECT
JANUARY 1983

Location	Median Grain Size (mm)	% Volatiles NED	COD ppmx10^{-5}	Fe ppmx10^{-4}	Zn ppm	Cr ppm	Cu ppm	C:N
200N-A	.015	3.75	1.28	2.66	469	116	111	12.0
B		4.41	1.05	2.78	261	112	112	10.3
C		6.63	0.80	2.75	463	120	105	8.6
100N-A	.027	4.50	0.89	2.43	206	70	74	12.4
B		5.58	0.85	2.52	201	96	110	11.5
C		4.61	0.75	2.28	256	58	53	14.6
CTR-A	.010	6.09	0.54	1.96	218	83	110	14.1
B		6.86	0.86	2.89	183	98	95	12.7
C		5.32	0.76	2.97	218	86	92	11.5
100S-A	.010	5.50	0.90	2.57	445	96	106	12.7
B		2.97	0.77	2.70	269	102	102	11.0
C		4.11	1.06	2.34	462	89	91	10.2
200S-A	.011	5.46	0.92	2.93	289	142	129	9.4
B		5.35	0.94	2.78	272	127	116	9.6
C		4.67	0.94	2.88	323	132	121	9.4
REF-A	.008	6.58	0.74	2.83	168	58	37	11.4
B		6.13	0.71	2.69	367	24	27	13.4
C		4.50	0.91	0.84	146	45	19	11.3

TABLE I-3-16

CHEMICAL ANALYSIS
WLIS - III
NORTH-SOUTH TRANSECT
AUGUST 1983

Location	Median Grain Size (mm)	% Vol. NED	COD ppmx10^{-5}	Fe ppmx10^{-4}	Zn ppm	Cr ppm	Cu ppm	Oil and Grease ppm	C:N
200N-A	.130	3.32	0.39	1.68	133	49	40	124	9.3
B		3.40	0.46	2.09	167	59	52	119	10.3
C		2.37	0.29	1.73	99	46	24	60	--
100N-A	.120	2.40	0.27	1.57	100	38	25	23	--
B		2.46	0.22	1.35	84	**	22	24	10.7
C		1.83	0.24	1.11	88	**	27	81	11.6
CTR-A	.095	2.12	0.34	1.39	72	37	23	35	9.2
B		1.51	0.27	1.19	69	29	24	48	--
C		1.56	0.17	1.27	73	34	24	65	13.1
100S-A	.025	4.28	0.41	1.92	171	56	115	280	11.2
B		3.83	0.49	2.12	166	65	57	190	11.3
C		4.66	0.45	2.09	175	69	57	299	11.4
200S-A	.009	7.02	0.81	2.18	216	88	89	518	9.1
B		7.28	0.70	2.04	216	86	89	310	9.1
C		6.87	0.75	2.53	249	95	102	306	9.2
REF-A	.006	4.27	0.54	2.50	107	46	29	73	8.8
B		3.89	0.56	2.74	136	46	33	72	11.5
C		3.19	0.51	2.61	95	**	21	60	12.2

TABLE I-3-17
CHEMICAL ANALYSIS
WLIS - III
WEST-EAST TRANSECT
AUGUST 1983

Location	Median Grain Size (mm)	% Vol. NED	COD ppmx10^{-5}	Fe ppmx10^{-4}	Zn ppm	Cr ppm	Cu ppm	Oil and Grease ppm	C:N
200W-A	.030	3.87	0.54	1.81	142	55	54	255	11.3
B		3.52	0.46	1.93	166	61	65	289	10.5
C		3.20	0.43	1.96	169	62	66	149	11.6
100W-A	.170	2.51	0.35	1.77	134	46	35	38	--
B		1.61	0.27	1.24	82	30	20	52	--
C		1.60	0.35	1.33	82	31	30	1	--
CTR-A	.095	2.12	0.34	1.39	72	37	23	35	9.2
B		1.51	0.27	1.19	69	20	24	48	--
C		1.56	0.17	1.27	73	34	24	65	13.1
100E-A	.090	3.04	0.41	1.83	115	52	43	123	11.6
B		4.39	0.56	2.12	174	68	69	182	12.7
C		3.64	0.58	2.31	196	74	97	144	10.5
200E-A	.060	4.08	0.58	2.23	170	68	65	217	10.1
B		3.94	0.51	2.11	179	67	61	175	13.5
C		3.76	0.38	2.00	146	63	55	261	11.7
REF-A	.006	4.27	0.54	2.50	107	46	29	73	8.8
B		3.89	0.56	2.74	136	46	33	72	11.5
C		3.19	0.51	2.61	95	**	21	60	12.2

differences in January, except that the center samples were generally lower in metal content. By August, this station difference is much more dramatic, principally because the center station had coarser sediment. The 200N, 100N and 100W stations also consisted of coarser sediments with lower metal levels.

The sediment characteristics of the WLIS III site are compared to previous sediment data in Table I-3-18. The January 1983 concentrations for most constituents are higher than those taken during the 1982 disposal operations; however, the metal concentrations are still lower than those measured under baseline conditions. These results indicate no significant contamination as a result of the dredged material disposal. The lowest values measured to date were in the August 1983 survey, reflecting the presence of coarser, and probably cleaner, dredged sediments.

Sediment samples at this site were characterized by the presence of a coarse sand mixed with grey, possibly oxidized silt on the surface of each grab extending to a depth of 2-3cm. The sediment under this layer was dark gray to black and exhibited a strong sulphide odor. All samples showed signs of colonization with large numbers of juvenile Cancer, Pagurus and amphipod tubes. Also present in most samples were large amounts of broken shell material. These characteristics gradually thinned out until the sediment appeared essentially natural at a distance of 200 meters from the center in any direction.

In April and June 1984, additional sediment samples were collected at both the WLIS III A and B (approx. 250 meters west of A) disposal sites. The sediment at the A site consisted of coarse to fine sand at the outlying station (400E) and medium to fine sand and clayey silt at the center. The profiles for the west to east transect show the more silty material to the west of the site. The chemical data for April 1984 (Table I-3-19) when compared to August 1983 at site A, reveals consistently higher concentrations throughout the area. The June 1984 chemical data (Table I-3-20) show the same general patterns for this site.

The results from analysis of the sediment samples collected at WLIS III site B show the same sediment characteristics as found at 200W for site A. The bottom consists of clayey silt with some fine sand. Proceeding east from site B, samples contain more medium and fine sand. In April and June 1984, chemical concentrations (Tables I-3-21 and 22) resemble closely those found at site A and exceeded those determined at the reference site. The variability in concentrations among the station appears to be associated with grain size with the finer sediment yielding somewhat higher values.

4.0 BENTHIC SAMPLING

In January 1982, sediment samples taken with the 0.1 m^2 Smith-MacIntyre grab, from each of the station locations (Fig. I-3-1), were sieved through a 1mm mesh screen and analyzed to determine the species composition of benthic infauna within

TABLE I-3-18

Mean Concentration of Chemicals and Materials in Sediments Collected at the Center of the Western Long Island Sound III Disposal Site from January 1982 to August 1983. Values in Parts Per Million.

	COD	% Solids	HG	Pb	Zn	As	Cd	Cr	Cu	Mg	Ni	Ca	% Total Carbon	Oil & Grease
Pre-Disposal January 1982	105,000	33.76	.02	70	230	11	6	79	125	--	57	--	--	330
Interim	81,000	44.30	.16	101	150	4	3	48	80	--	43	--	--	118
Post-Disposal August 1982	77,200	46.00	.56	76	162	6.3	4	39	76	8490	83	5970	2.49	313
January 1983	72,000	39.70	.45	59	205	5.4	*	89	99	7553	*	2773	2.66	790
August 1983	26,200	69.40	.13	17	71	4.8	*	33	23	--	*	--	1.36	49

Table I-3-19

Chemical Analysis
WLIS IIIA Disposal Site
April 1984
North-South Transect

Location	ppm Oil & Grease	ppm $COD \times 10^{-5}$	ppm $Fe \times 10^{-4}$	ppm Pb	ppm Zn	ppm Cu	ppm Cr	C:N
400N-A	681	0.89	2.94	93	256	100	97	9.3
B	1,010	0.82	2.83	78	273	98	89	8.9
C	1,080	0.79	2.75	97	276	104	112	9.2
200N-A	1,280	0.90	2.98	78	318	105	99	9.7
B	889	0.92	2.85	94	347	98	90	9.3
C	4,640	0.89	2.77	82	239	92	90	9.0
CTR-A	335	0.69	2.57	76	220	78	72	9.1
B	298	0.43	2.31	61	155	68	57	9.9
C	348	0.51	2.31	58	156	64	50	10.1
200S-A	1,050	0.85	2.83	80	270	94	90	9.7
B	3,240	0.70	2.74	80	265	100	93	9.9
C	3,470	0.83	2.68	83	260	86	85	10.8
400S-A	880	0.43	1.66	49	182	54	51	14.1
B	1,250	0.19	1.36	45	180	47	42	-
C	1,010	0.31	1.34	43	140	38	37	10.2
REF-A	1,040	0.62	2.59	41	105	52	25	11.6
B	1,080	0.56	2.84	43	168	61	30	10.9
C	850	0.51	2.24	43	107	39	30	11.7

Table I-3-19 (cont.)

Chemical Analysis
WLIS IIIA Disposal Site
April 1984
West-East Transect

Location	ppm Oil & Grease	ppm $COD \times 10^{-5}$	ppm $Fe \times 10^{-4}$	ppm Pb	ppm Zn	ppm Cr	ppm Cu	C:N
400W-A	573	0.84	2.83	80	286	103	91	9.3
B	725	0.93	2.97	74	323	104	91	9.1
C	481	0.75	2.98	76	311	106	98	9.4
200W-A	741	0.99	2.81	90	289	106	95	9.2
B	599	0.82	2.65	78	280	102	91	8.9
C	661	0.90	2.57	88	358	101	130	9.4
CTR-A	335	0.69	2.57	76	220	78	72	9.1
B	298	0.4	2.31	61	155	68	57	9.9
C	348	0.51	2.31	58	156	64	50	10.1
200E-A	552	0.34	2.33	45	139	62	46	11.4
B	1,750	0.36	1.92	41	135	51	37	11.4
C	2,540	0.50	2.44	78	214	65	70	10.7
400E-A	891	0.34	1.57	52	139	30	33	
B	1,091	0.12	0.92	88	129	25	48	-
C	534	0.12	0.91	56	133	26	56	-
REF-A	1,040	0.62	2.59	41	105	52	25	11.6
B	1,080	0.56	2.84	43	168	61	30	10.9
C	850	0.51	2.24	43	107	39	30	11.7

Table I-3-20

Chemical Analysis
WLIS IIIA Disposal Site
June 1984
North-South Transect

Location	ppm Oil & Grease	ppm Fex10^{-4}	ppm CODx10^{-5}	ppm Zn	ppm Pb	ppm Cr	ppm Cu	C:N
200N-A	44	2.01	0.54	253	39	52	51	10.8
B	62	1.93	0.59	152	45	49	43	10.1
C	59	2.04	0.47	167	40	54	111	12.7
100N-A	160	2.67	1.06	455	89	78	101	10.2
B	322	2.25	0.84	300	77	62	78	10.1
C	596	2.60	0.98	313	118	74	96	10.9
CTR-A	72	1.76	0.57	241	59	50	65	10.8
B	103	2.16	0.61	361	80	56	76	11.2
C	89	2.28	0.70	426	40	28	44	9.5
100S-A	129	2.09	0.81	314	71	60	75	9.7
B	193	2.56	0.90	343	87	73	94	9.9
C	324	2.42	0.94	300	83	70	109	11.2
200S-A	128	2.32	0.57	246	55	69	63	11.1
B	75	2.09	0.56	236	72	60	69	11.9
C	81	2.13	0.77	276	70	64	66	11.2
REF-A	63	2.40	0.64	150	60	47	109	13.6
B	39	2.33	0.70	203	61	49	40	15.3
C	38	2.49	0.69	201	57	50	32	11.8

Table I-3-20 (cont.)

Chemical Analysis
WLIS IIIA Disposal Site
June 1984
West-East Transect

Location	ppm Oil & Grease	ppm Fex10^{-4}	ppm CODx10^{-5}	ppm Zn	ppm Pb	ppm Cr	ppm Cu	C:N
200W-A	116	2.77	0.88	245	80	44	48	12.5
B	1,120	2.20	0.94	336	169	54	79	12.8
C	382	2.72	0.89	348	169	79	-	10.9
100W-A	179	2.70	1.14	371	128	75	125	10.0
B	349	2.60	1.04	393	154	79	109	10.8
C	1,120	2.64	1.00	392	228	79	114	11.4
CTR-A	72	1.76	0.57	241	59	50	64	10.8
B	103	2.16	0.61	361	80	56	76	11.2
C	89	2.28	0.70	426	40	28	44	9.5
100E-A	154	2.15	0.53	156	40	59	59	9.3
B	133	1.28	0.71	180	77	27	59	15.6
C	91	1.83	0.55	151	61	49	58	10.5
200E-A	86	2.33	0.65	235	61	66	71	9.2
B	102	2.23	0.68	230	65	66	65	9.2
C	256	1.98	0.68	248	87	51	102	11.0
REF-A	63	2.40	0.64	150	60	47	109	13.6
B	39	2.33	0.70	203	61	49	40	15.3
C	38	2.49	0.69	201	57	50	32	11.8

Table I-3-21

Chemical Analysis
WLIS IIIB Disposal Site
April 1984

Location	ppm Oil & Grease	ppm COD$\times 10^{-5}$	ppm Fe$\times 10^{-4}$	ppm Pb	ppm Zn	ppm Cr	ppm Cu	C:N
West-East Transect								
50W	3,350	0.83	2.47	73	257	111	108	10.5
CTR	1,490	0.95	2.52	87	249	101	91	10.8
50E	1,100	0.78	2.14	57	223	90	74	9.6
100E	143	0.64	2.09	76	166	67	66	10.3
150E	649	0.71	2.23	215	255	87	107	12.1
North-South Transect								
50N	873	0.88	2.58	82	260	96	89	8.9
CTR	1,490	0.95	2.52	87	249	101	91	10.8
50S	963	0.94	2.40	72	216	86	76	9.8
REF-A	1,040	0.62	2.59	41	105	52	25	11.6
B	1,080	0.56	2.84	43	168	61	30	10.9
C	850	0.51	2.24	43	107	39	30	11.7

Table I-3-22

Chemical Analysis
WLIS III B Disposal Site
June 1984
North-South Transect

Location	ppm Oil & Grease	ppm Fex10^{-4}	ppm CODx10^{-5}	Pb	ppm Zn	ppm Cr	ppm Cu	C:N
400N-A	-	-	-	-	-	-	-	-
B	86	2.53	0.77	83	293	90	118	8.8
C	102	2.47	0.75	63	273	83	81	8.4
200N-A	256	2.44	0.89	74	298	81	188	8.9
B	240	2.50	0.75	68	319	84	132	9.0
C	123	2.69	0.86	84	403	82	158	9.0
CTR-A	-	-	-	-	-	-	-	-
B	1,070	2.92	0.52	178	381	75	119	11.4
C	557	2.07	1.40	136	297	51	81	13.1
200S-A	128	1.98	0.70	70	245	58	70	9.6
B	123	2.08	0.83	67	229	57	89	9.1
C	85	2.01	0.52	64	223	55	63	9.5
400S-A	136	2.45	0.85	74	332	93	92	10.4
B	64	2.26	0.71	36	262	74	73	10.0
C	154	1.46	0.74	76	264	84	100	10.3
REF-A	63	2.40	0.64	60	150	47	109	13.6
B	39	2.33	0.70	61	203	49	40	15.3
C	38	2.49	0.69	57	201	50	32	11.8

Table I-3-22 (cont.)

Chemical Analysis
WLIS IIIB Disposal Site
June 1984
West-East Transect

Location	ppm Oil & Grease	ppm Fex10^{-4}	ppm CODx10^{-5}	ppm Zn	ppm Pb	ppm Cr	ppm Cu	C:N
400W-A	103	1.94	0.67	236	36	62	61	9.7
B	63	2.06	0.63	317	55	61	74	9.1
C	71	2.26	0.78	263	53	67	69	9.1
200W-A	102	1.95	0.45	200	146	51	59	11.4
B	60	1.43	0.66	224	36	31	47	10.1
C	113	1.52	0.50	356	39	37	68	11.6
CTR-A	-	-	-	-	-	-	-	-
B	1,070	2.92	0.52	351	178	75	119	11.4
C	557	2.07	1.40	297	136	51	81	13.1
200E-A	43	1.66	0.55	211	19	33	30	16.1
B	84	1.82	0.64	231	59	48	60	11.4
C	227	2.25	0.82	306	100	63	85	10.6
400E-A	184	2.11	0.60	295	79	56	71	9.2
B	102	2.13	0.89	389	89	58	78	9.6
C	228	1.98	0.74	300	85	54	248	9.5
REF-A	63	2.40	0.64	150	60	47	109	13.6
B	39	2.33	0.70	203	61	49	40	15.3
C	38	2.49	0.69	201	57	50	32	11.8

the proposed disposal site. In addition, three replicates were analyzed from the proposed WLIS III disposal point. The total species list developed from this analysis is presented in Table I-4-1, a predominant species list is shown in Table I-4-2, and a summary of data by station location is given in Table I-4-3.

The population of benthic macrofauna is similar to that described in the EIS and in a Dredged Material Research Program (DMRP) report (Serafy et al., 1977) except for the dominance of Owenia fusiformis and Pectinaria gouldii which were not present in significant numbers during earlier studies. It is important to note that Owenia, Malinia, Yoldia and Pectinaria were mostly juvenile forms, generally more than 95%. Consequently, one would expect much fewer individuals to survive and that the population sampled here represents an early stage of a recruitment period and that the number of individuals per sample is probably skewed towards higher values.

When grouped by location (Table I-4-4), the data show similarities between populations depending on their relationship to the soft sediment in the deeper water of the site. The WLIS center, WLIS 400m, and WLIS III samples are all similar in that they have relatively low population densities as compared with the WLIS 1400m stations which have approximately twice the population densities and are generally located in more shallow depths with coarser sediments.

Figures I-4-1, 2 and 3 provide an indication of the distribution of population parameters over the proposed disposal area. From Figure I-4-1, it is apparent that both the number of species and individuals are higher on the margins of the site than in the central depression. This lower population density in the central area further supports selection of a disposal point in the soft mud depression.

5.0 DIVER OBSERVATIONS

Three dive transects were made in the WLIS III site to provide visual confirmation of the data obtained by remote measurements and to assess the macrobenthic population of the proposed site. The locations of the dive transects are shown on Figure I-3-1. The first dive on 18 January 1982, a transect to the southwest (100m), was made in the north central area. On 19 January, two diver photographic transects were made, one in the extreme southwest corner (northeast transect 70m) and one at the central current meter position (north transect 70m). The logs obtained from these dives are presented in Tables I-5-1, 2 and 3, and photographs obtained are presented in Figures I-5-1 through I-5-15.

The visual observations indicated that the sediment, as expected, consisted generally of soft silt. Burrows attributed to lobster activity were observed, as were fine imprints from winter flounder and mucal tracings from small hermit crabs. The

TABLE I-4-1

SPECIES DISTRIBUTION: WESTERN LONG ISLAND SOUND, JANUARY 1982

SPECIES	OCCURENCE/ 12 SAMPLES	TOTAL NO. INDIVIDUALS
Phylum Cnidaria		
Class Hydrozoa		
1. Bougainvillea sp.	1	1+
2. Campanulariid sp.	3	3+
3. Sertulavella sp.	2	2+
4. Thuiaria sp.	2	2+
class Anthozoa		
5. Cerianthropsis americanus	3	3
6. Holoclana producta	1	1
Phylum Platyhelminthes		
7. Platyhelminth sp.	1	4
Phylum Rhynchocoela		
8. Cerebratulus sp.	1	1
9. Tubulanus pellucidus	3	3
Phylum Mollusca		
Class Gastropoda		
10. Acteocina canaliculata	1	1
11. Nassarius trivittatus	12	59
Class Pelecypoda		
12. Lyonsia hyalina	8	27
13. Macoma tenta	3	5
14. Mulinia lateralis	7	48
15. Nucula proxima	12	92
16. Pandora gouldiana	4	6
17. Pitar morrhuana	3	3
18. Tellina versicolor	2	5
19. Yoldia limatula	11	69
20. Yoldia sp. (juv.)	3	6
Phylum Annelida		
Class Polychaeta		
21. Ampharete aretica (juv.)	3	4
22. Clymenella torquata	2	2
23. Euclymeninae sp.	6	57
24. Glycera americana	3	3
25. Loimia medusa	4	8
26. Lumbrineris fragilis	1	1
27. Mediomastus ambiseta	3	4
28. Nephtys incisa	12	138
29. Ninoe nigrippes	1	1
30. Owenia fusiformis	12	174

TABLE I-4-1 (Cont.)

CIES	OCCURENCE/ 12 SAMPLES	TOTAL NO. INDIVIDUALS
31. Pectinaria gouldii	7	91
32. Pherusa affinis	2	3
33. Phyllodoce avenae	1	1
34. Polycirrus sp.	1	2
35. Sabellaria vulgaris	1	1
36. Spiochaetopterus oculatus	2	2
Phylum Sipunculida		
37. Golfingia minuta	1	1
Phylum Phoronida		
38. Phoronis architecta	5	11
Phylum Arthropoda		
Class Crustacea		
O. Cumacea		
39. Diastylis sculpta	1	1
O. Isopoda		
40. Edotea triloba	1	1
O. Amphipoda		
41. Ampelisca abdita	9	31
Leptocheirus pinguis	2	2
43. Unciola irrorata	2	3
O. Decapoda		
44. Cancer irroratus	1	1
45. Panopeus herbstii	1	1
46. Pinnixa chactopterana	3	6
47. Upogibeia affinis	1	1
Phylum Echinodermata		
Class Holothuroidea		
48. Caudina sp.	1	1

TABLE I-4-2

PREDOMINANT SPECIES LIST, LONG ISLAND SOUND - JANUARY 1982

Total No. Phyla : 9
Total No. Species : 48
Total No. Individuals : 893+

Predominant Species List

Species	Phylum	Feeding Type	Occurrence/ 12 Samples	Total No. Individuals	% Total	Cumul. Total
Owenia fusiformis	AN	DF	12	174	19.48	
Nephtys incisa	AN	DF	12	138	15.45	34.93
Nucula proxima	M	DF	12	92	10.30	45.23
Pectinaria gouldii	AN	DF	7	91	10.19	55.42
Yoldia limatula	M	DF	11	69	7.73	63.15
Nassarius trivittatus	M	SF	12	59	6.61	69.76
Euclymeninae	AN	DF	6	57	6.38	76.14
Mulinia lateralis	M	SF	7	48	5.38	81.52

AN : Annelida
M : Mollusca
DF : Deposit Feeder
SF : Suspension Feeder

TABLE I-4-3

DATA SUMMARY (TOTAL DISTRIBUTION): WESTERN LONG ISLAND SOUND

JANUARY 1982

	Center	400m N	400m S	400m E	400m W	1400m NE	1400m NW	1400m SE	1400m SW	WLIS III #1	WLIS III #3	WLIS III #7
No. Phyla/Station	4	4	4	3	4	7	5	5	5	5	3	5
No. Species/Station	12	11	13	12	10	21	15	21	23	13	9	13
No. Individuals/Station	55	49	73+	42	36+	90	105+	155+	114	76	39	59+

Total No. Phyla/12 Samples : 9
Total No. Species/12 Samples : 48
Total No. Individuals/12 Samples : 893+

TABLE I-4-4

DATA SUMMARY: DISTRIBUTION BY PHYLA

STATION	CENTER	400m	1400m	WLIS III
No. of Samples	1	4	4	3
Total No. Species	12	25	39	19
Total Nol Individuals	55	200+	464+	174+
Total No. Molluscs/ % Contribution	16/ 29.1	75/ 37.5	140/ 30.2	89/ 51.1
Total No. Annelids/ % Contribution	118/ 327	115/ 57.5	284/ 61.2	74/ 42.5

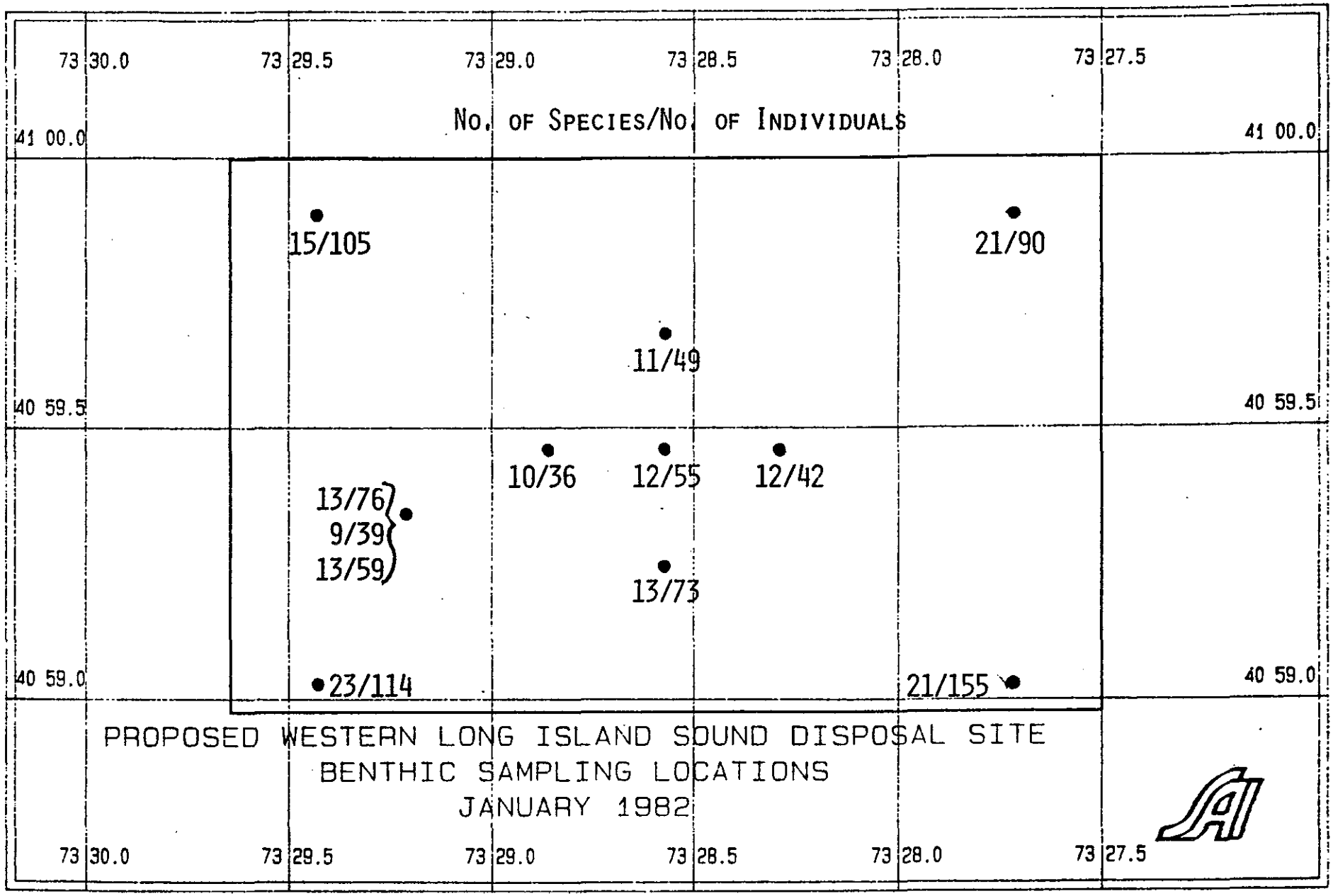


FIGURE I-4-1. Number of species/Number of individuals at Benthic Sampling Locations, WLIS, January 1982.

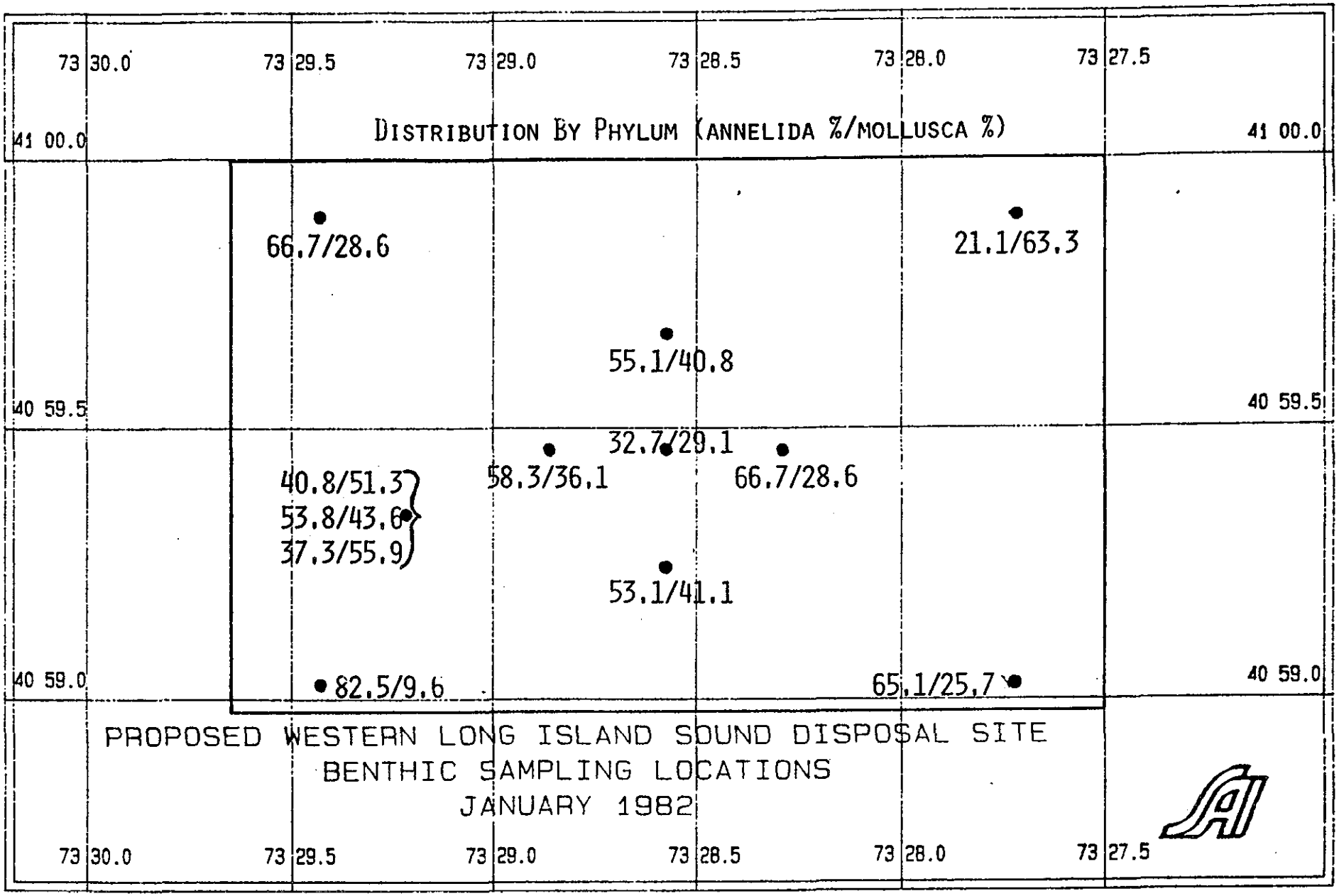


FIGURE I-4-2. Distribution by Phylum (Annelida %/Mollusca %) at Benthic Sampling Locations, WLIs January 1982.

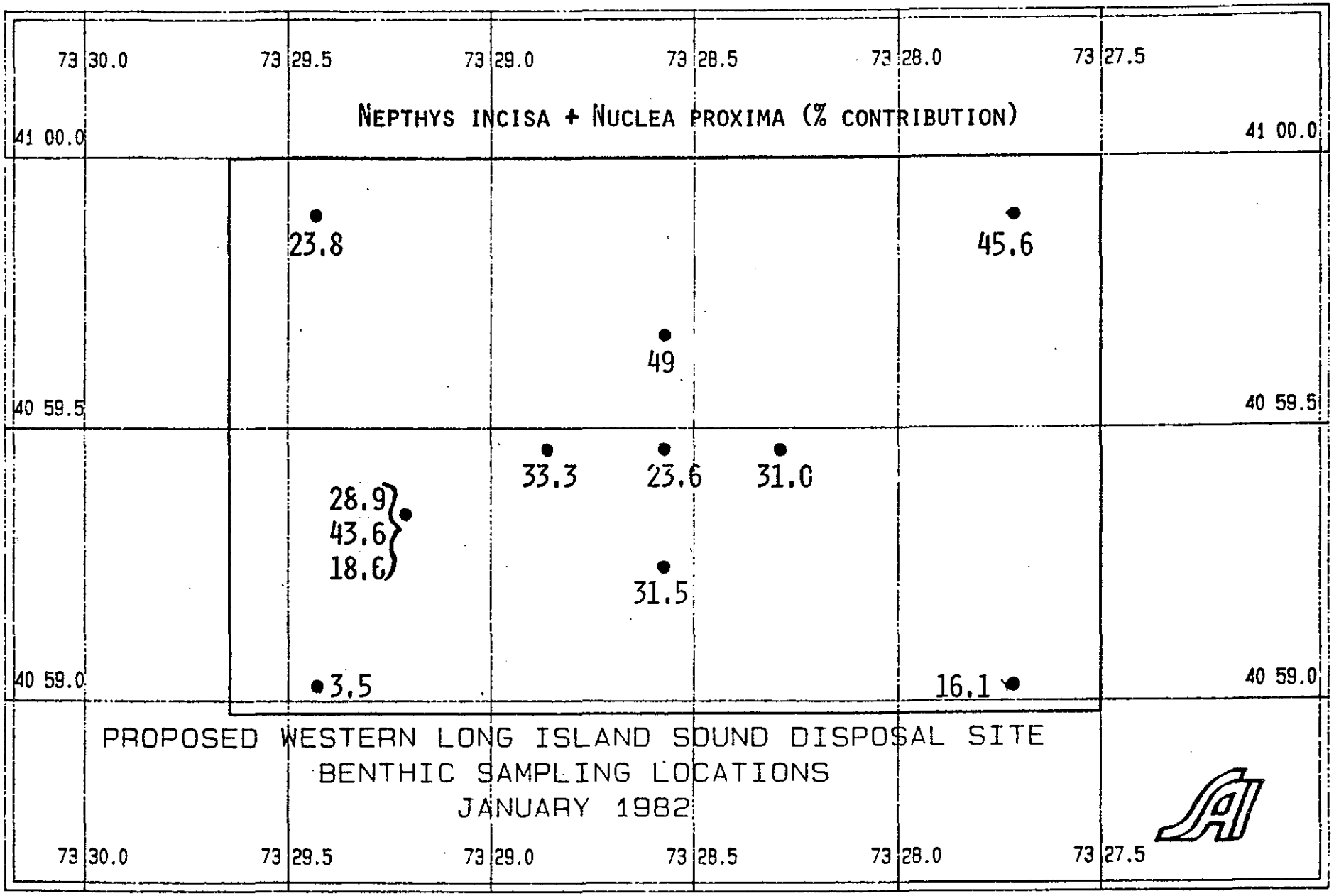


FIGURE I-4-3. Nepthys incisa and Nuclea proxima (% contribution) at Benthic Sampling Locations, WLIS January 1982.

TABLE I-5-1

D.A.M.O.S. DIVER MONITORING LOG

DATE: 18 Jan. 82 **LOCATION:** WLIS III Northwest corner (S.W. transect), Site #1.

DIVERS: Stewart DeGoursey **TIME:** 1130-1158 **DEPTH:** 89 ft. **T°C:** 2°C **VISIBILITY:** 2 m+

DIVE (in/out Loran C): 26828.5/43979.3 to southwest (~100m) **DISPOSAL or REFERENCE BUOY L/C:**

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Flood tide (E - W) @ <.5 ht. Surface slush ice and particulate matter observed was noticably reduced on bottom. 1-2 cm neffloid layer of unconsolidated material formed veneer on soft silt bottom. Diver penetration to .5 m was indicative of uncompacted sediment condition. No shell mix noted in region, evidence of upland debris (leaf, Phragmites) encountered. Benthic excavations, pockmarking, mounds and burrows observed along entire transect.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Photo log: (20) 35 mm wide angle lens @ 2.5 ft. (15) 3:1 close up lens @ 6 in. (see representative prints).

Extensive burrowing attributed to lobster, Homarus americanus, and rock crab Cancer irroratus. Surface furrows and mucal trails of Nassarius. Benthic finfish Pseudopleuronectes, Scopthalmus buried to 1-2 cm in sediment.

Species count:
- Nassarius trivattatus (100+)
- Cancer irroratus (10)
- Homarus americanus (6)
- Pagurus longicarpus (2)
- Asterias (12)
- Pseudopleuronectes americanus (3)
- Scopthalmus aquosus (4)
- Merluccius bilinearis (1 juv.)

Not observed: hard substrate, hydroids, Corymorpha, Cerianthus.

II. DISCRETE SAMPLES OR METHODS:

_____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target specie**

__X__ **B. .25 m² quadrant count photography.**

_____ **C. Penetrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index).**

_____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius).**

TABLE I-5-2

D.A.M.O.S. DIVER MONITORING LOG

DATE: 19 Jan. 82 **LOCATION:** WLIS III Southwest corner (N.E. transect) Site #2

DIVERS: Stewart Arimoto **TIME:** 1059 - 1122 **DEPTH:** 92 ft. **T°C:** 2°C **VISIBILITY:** 2 m+

DIVE (in/out Loran C): 26830.0/43970.2 **DISPOSAL or REFERENCE BUOY L/C:**

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Ebb <.5 ht W-E. Soft mud with high patch shell fragment (50%) zones (Pecten irradians, Crassostrea); occasional hard underlying cohesive clay patches protruding to adjacent soft sediment surface. Various size and orientation of burrows "grotto structures" at 3-5 m spacing. Brown oxygenated 2-5 cm surface sediment. Finfish fin imprints and mucal trails evident on sediment surface.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Photo log: (12) Nikonos macro system. Camera flooding required special film processing (not yet available) therefore prints from this transect not included.

Biological activity in this region intermediate to Dive Site #1 and #3. Organisms of smaller size (Decapod crustacea) than Site #1. More patch cluster concentration and distinct (2-3 m) areas of intensive bioturbation.

Species count: Nassarius trivattatus (200+) (30 x 30 cm counts (3) = 8, 15) patchy.
Cancer irroratus (3)
Homarus americanus (2) juv.
Scopthalmus aquosus (20)
Pseudopleuronectes americanus (8) juv.
Pectinaria (3) casts

II. DISCRETE SAMPLES OR METHODS:

_____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target specie**

__X__ **B. .25 m² quadrant count/photography.** 30 x 30 cm square count.

_____ **C. Penetrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index).**

_____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius).**

TABLE I-5-3

D.A.M.O.S. DIVER MONITORING LOG

DATE: 19 Jan. 82 LOCATION: WLIS III Central current meter position (N transect) Site #3.

DIVERS: DeGoursey, Arimoto TIME: 1452-1509 DEPTH: 107 ft. T°C: 1°C VISIBILITY: 2 m+

DIVE (in/out Loran C): 26825.6/43976.3 - DISPOSAL or REFERENCE BUOY L/C: 26825.7/43976.6 (~70 m)

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

Current meter deployment inspection. Ebb end < .25 ht W-E. Flat featureless, very soft fine mud/clay. Fewer biological sediment structures; occasional mounds;(2-3) 3 cm diam. verticle burrows. No hard substrate shell or protrusions noted. Soft unconsolidated neffloid layer (.5cm) evident.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Photo log: (10) 28 mm wide angle, twin strobe @ 2.5 ft.

A soft sediment, "quiet" depression zone with the least biological sediment reworking of all three sites. Shell fragment mix estimated at < 10%.

Species count: Mysids (*Neomysis* sp.) ubiquitous (1000+)
Nassarius trivattatus (200+)
Scopthalmus aquosus (17) 10-15 cm
Cancer irroratus (4)
Not observed: *Homarus*, *Cerianthus*

II. DISCRETE SAMPLES OR METHODS:

_____ A. Epibenthic net (30 sec. traverse): on or off spoil, target specie

__x__ B. .25 m^2 quadrant count/photography.

_____ C. Penetrometer tests, elevation stake readings, sediment trap.

_____ D. Mussel deployment - bioaccumulation subsample.

_____ E. Sonic beacon placement or electrolyte change.

_____ F. Remote bathymetric camera photos.

_____ G. Video tape (location, time min. run, tape index).

_____ H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*).

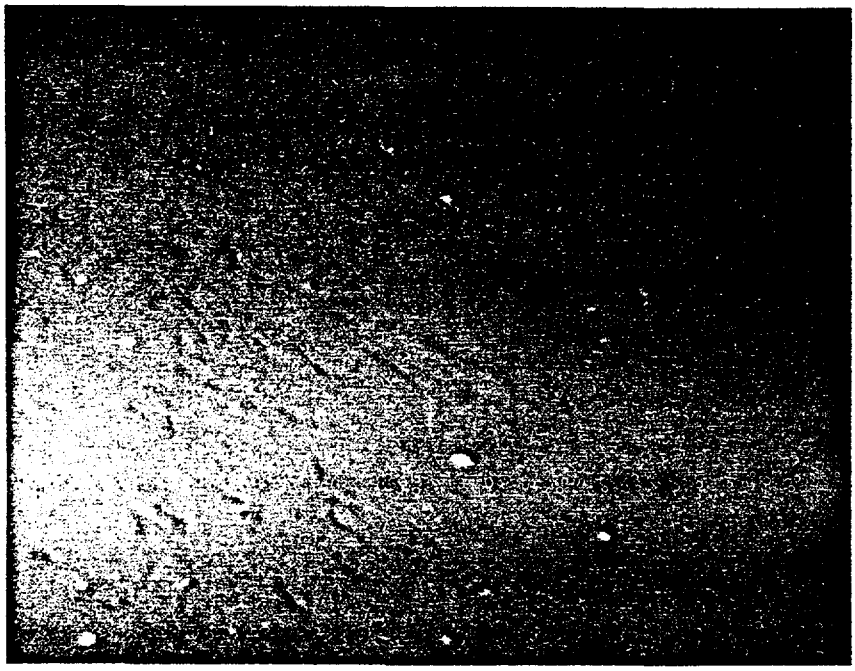


Figure I-5-3 The winter flounder Psuedopleuronectes americanus exhibits sediment fin movement, sediment consistency maintains fin imprints of foraging pattern.

Figure I-5-4 The sand dab Scopthalus aquosus, was observed at times completely covered by fine silt veneer overlay.

Figure I-5-5 Mucal snail tracings, crab tracks and fin imprints are noted in the vicinity of Cancer irroratus.

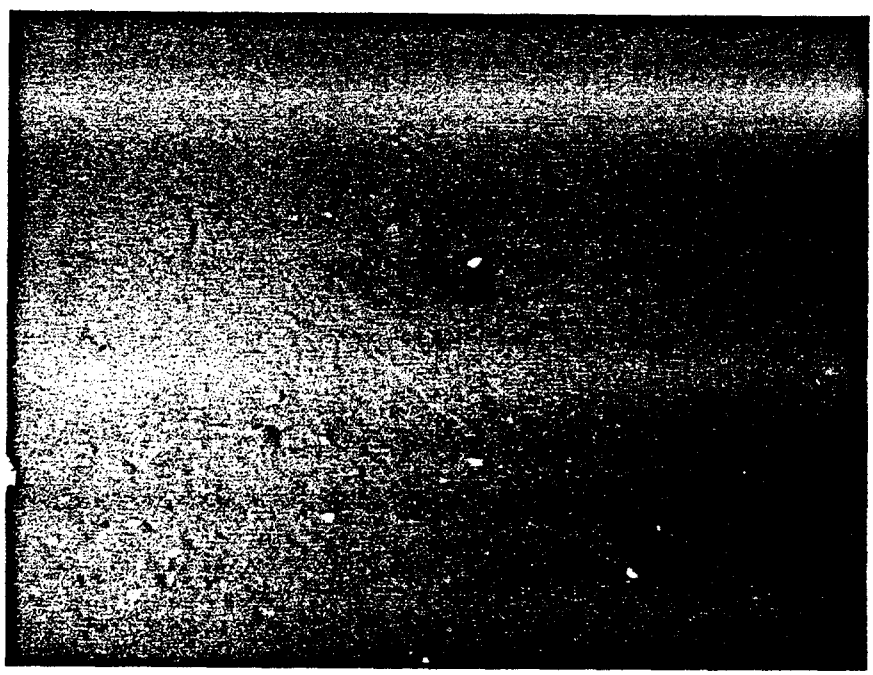


Figure I-5-6 Vertical burrows exceeding (1m) depth were ovserved. Juvenile Urophysis have previously occupied similar structures however their origin is assumed due to Squilla or Axius.

Figure I-5-7 Macrophotograph of Nassarius trivattatus illustrates the fecal/pelletized mephloid layer. The mucal tracing and microtopographic effect on sediment displacement and conditioning are of note.

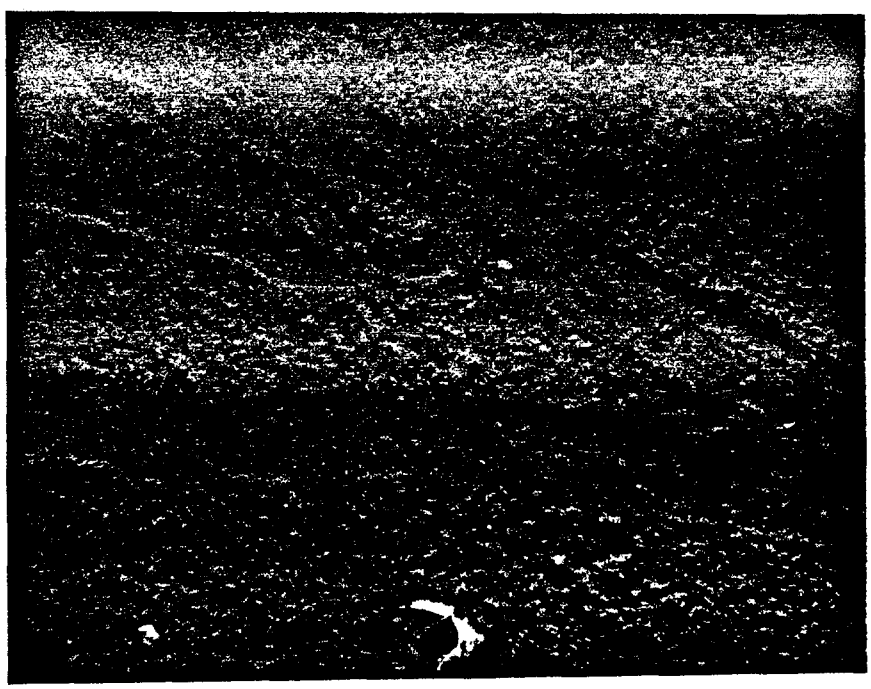


Figure I-5-8 Mucal tracings crisscrossed the observational path of the north central transect.

Figure I-5-9 Cluster concentrations of N. Trivattatus occurred throughout transect, presumably due to "group grazing" behavior.

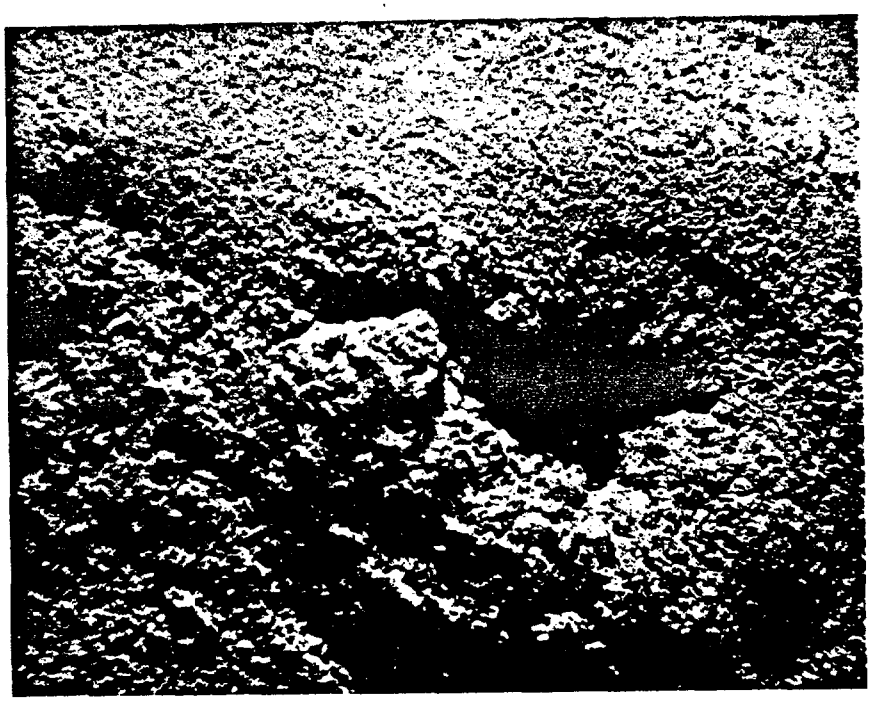


Figure I-5-10 2 cm burrow entrances detail illustrates the particulate nature of surface sediment, the organic matrix and grannular texture.

Figure I-5-11 Large scale mound of biogenic origin at central deep water site. Mounds of this sort result from excavated and abandoned lobster burrows.

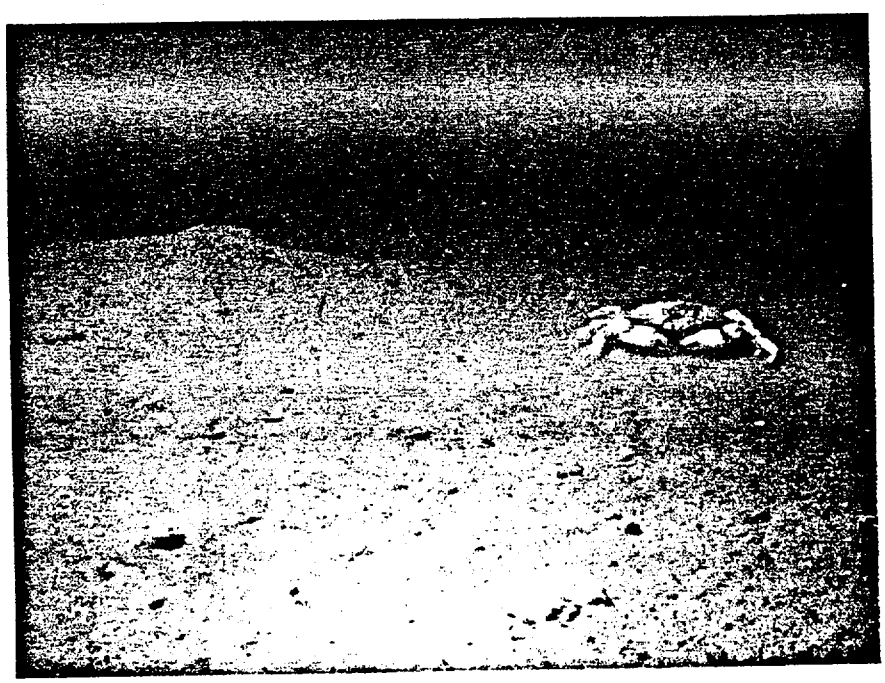


Figure I-5-12 The most common decapod, Cancer irroratus, readily moves across the bottom causing a silt cloud trail. The crabs also burrow in sediment to the horizon/carapace level.

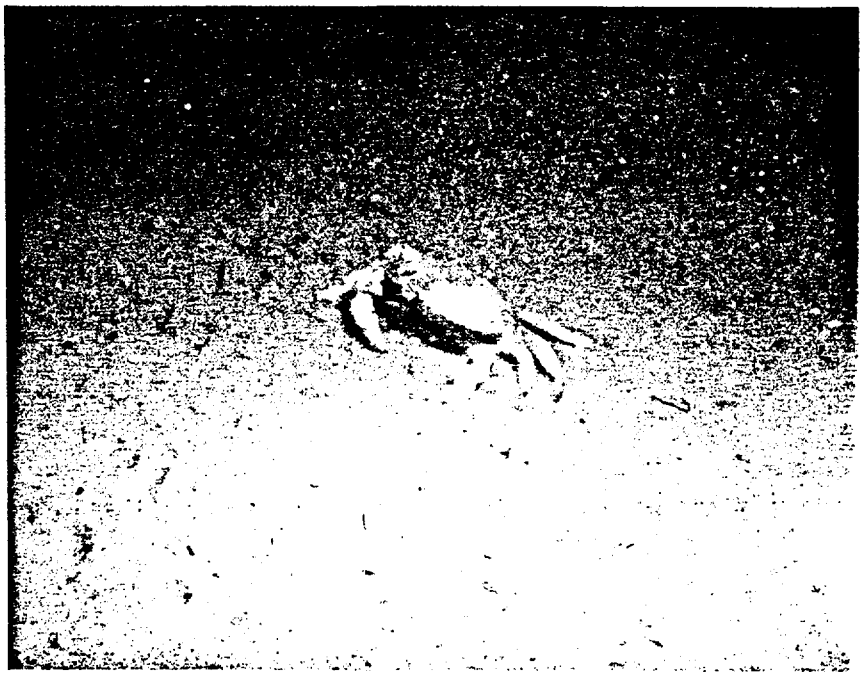


Figure I-5-13 The eyespots of numerous Mysids (Neomysis) are barely evident in this photo. The organisms are cryptic against a pockmarked dimpled substrate surface.

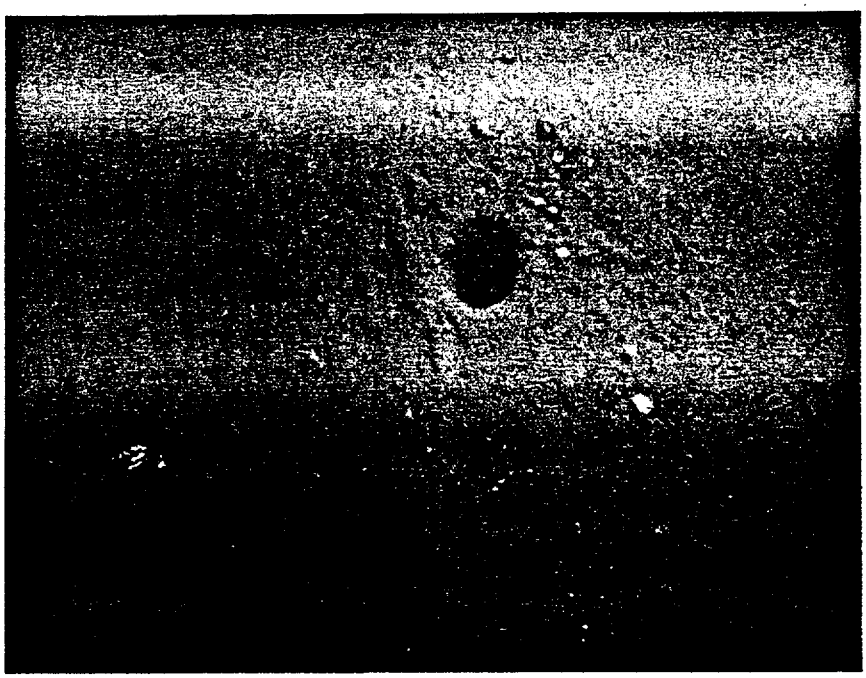


Figure I-5-14 A maintained and mature verticle burrow with associate Nassarius trivattatus activity.

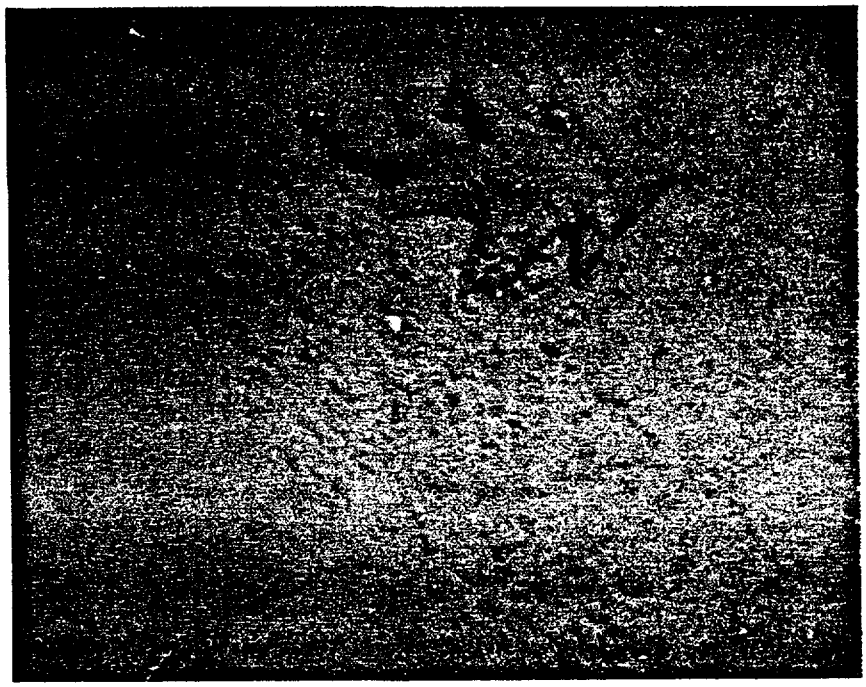


Figure I-5-15 Upland debris (oak leaf) was encountered. Accummulation of silt (1 mn) illustrates boundary layer movement of the silt veneer on each tidal cycle. Numerous crab tracks indicates attraction to objects by the macrobenthos.

number of animals observed was relatively small compared with other disposal sites studied.

Based upon the results of the depth profiles, an east-southeasterly inspection dive from the area of the disposal buoy was considered most appropriate relative to predicted current dispersion vectors in the direction toward the Cable and Anchor Reef lobster ground. Direct observation and photography were obtained on a diver transect from the buoy base in an east-southeasterly direction (50m) and then north along the pile (20-30m) providing a visual assessment of benthic conditions (Fig. I-2-11).

The one-month old dredged material pile revealed less vertical microtopographic relief (.5m) over the surface than previously inspected sites in shallower water (i.e. New London and CLIS). Observations indicated the dredged material may have been more highly compacted (dense) than the natural deposited sediment at the site and, on disposal, may have settled deeper into the soft natural sediments. A distinct border region could be detected by divers after the disappearance of small grey, clay fragments. This periphery zone was followed north (20m) on the inspection dive. Similar to the CLIS site, a light brown (1 cm deep) nepheloid layer had migrated up onto the pile and was evident in the interspaces between protruding clay masses and organic debris. A continuous, undisturbed flat "suspension" nepheloid layer was characteristic of the adjacent natural bottom sediment. Detailed diver descriptions are presented on the DAMOS diver monitoring log (Table I-5-4).

A series of underwater photographs were taken along the course of the east and north transect legs. These photos (Figs. I-5-16 to 26) document surface sediment conditions and densities of organisms noted on the dive.

A diver survey was conducted on 19 August 1982 to assess post-disposal benthic conditions. The two divers, in 118 feet of water, observed sediment surface conditions and species type and abundance on a transect from the center of the disposal site to the edge of the mound in an E-SE direction. The divers then made additional observations while swimming north for 50 feet. Photographs were taken to document the benthic conditions.

The disposal mound sediment surface was composed of a clay matrix containing shells (fragments and whole valves) which often protruded upward. Small mounds (0.5-1m elevation) characterized the surface in the immediate area of deposition, however, no steep slope contours were observed.

Significant bioturbation was created by the organsisms inhabiting the mounds. Macrobenthic organisms, listed in Table I-5-5, were concentrated in dense shell hash patches (50% shell cover). Figures I-5-27 through I-5-32 provide documentation of conditions at the disposal site. Additional notes are included on the DAMOS diver log, Table I-5-6.

TABLE I-5-4

D.A.M.O.S. DIVER MONITORING LOG

DATE: 23 April 82 **LOCATION:** WLIS III R/V Schock (U.R.I.)

DIVERS: Stewart DeGoursey **TIME:** 1114-1129 **DEPTH:** 118' **T°C:** **VISIBILITY:** 2 m

DIVE (in/out Loran C):
at buoy → east 20 m then N on spoil
edge surfaced ~ 30 m NO^{S} of buoy

DISPOSAL or REFERENCE BUOY L/C:
WLIS buoy = 26830.6
III 43975.0

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Slack high, 0 kt. current slight start ebb W-E, no evident turbidity. Clay clump diam~10 cm - 75 cm spaced 1-4 m apart, soft interspace spoil, patchy light brown nepheloid layer throughout spoil relief (low 5 cm - .25 cm height clumps). High organic (upland debris): leaf, phragmites, Spartina, peat components. Relict shell-Crassostrea white bleached condition, Mya (live specimen diver collected). Mulinia/Gemma valves incorporated in surficial spoil. Gradual slope to SE (toward 120' depth) grading rapidly to flat, soft natural bottom. Recent spoil condition - faceted fractures of cohesive clay.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

On spoil: Few megabenthic species on spoil. Snails dominant - (2 sps) Nassarius obsoletus, N. trivattatus est. (~10-20 m^2) ubiquitous, numerous interlaced mucal trails over new spoil surface.
(2) Pseudo americanus (buried to indetectable level).
(6) lobster and/or crab tracks, no live specimens observed.

At border: No evidence of small clay (10 cm diam) fragments, epibenthic sample = (1) Squilla cast tail section. (1) Totoga onitus (12 cm) dormant, resting at clay mound base.

Off spoil: Very flat featureless bottom, less compact (diver sense) than spoil, .5 - 1 cm surficial nepheloid layer with numerous mucal trails interlaced.

Photos R.D. 3:1 Nikonos (1-9)
L.S. Canon - (#1-22) Surface sediment conditions; evident invasion species.

II. DISCRETE SAMPLES OR METHODS:

_X_ **A. Epibenthic net (~~30~~ 15 sec. traverse): on or off spoil, target specie** at periphery in E direction

_X_ **B. .25 m^2 quadrant count/photography.** 18 Nassarius (sp) actively grazing.

___ **C. Penetrometer tests, elevation stake readings, sediment trap.**

___ **D. Mussel deployment - bioaccumulation subsample.**

___ **E. Sonic beacon placement or electrolyte change.**

___ **F. Remote bathymetric camera photos.**

___ **G. Video tape (location, time min. run, tape index).**

_X_ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius).** Squilla cast tail section.

Figure I-5-16 Surface texture typical of cohesive clay mound protruding from soft interspace dredge material. Note evidence of Zostera blades at base and to lee of mound. HFV = 9 cm.

Figure I-5-17 Marsh reed, Phragmites, stalks incorporated in clay material, peat fragments, and high organic debris were characteristics of the disposal pile. HFV = 7 cm.

Figure I-5-18 Faceted clay surfaces provide entrapment crevices for nephaloid layer material. Two Nassarius graze the upper mound surface. A Mercenaria valve shows in left background. HFV = 7.

Figure I-5-19 Granular, flocculant nature of natural nephaloid layer is illustrated in close-up photo within depression zones of dredged material surface. HFV = 12 cm.

Figure I-5-20 Several observations of live transplanted coastal zone mollusks were noted in observational transects.

Figure I-5-21 Shell fragments were often bleached white and did not reveal discolorations indicative of origin from H_2S or petroleum contaminate zones.

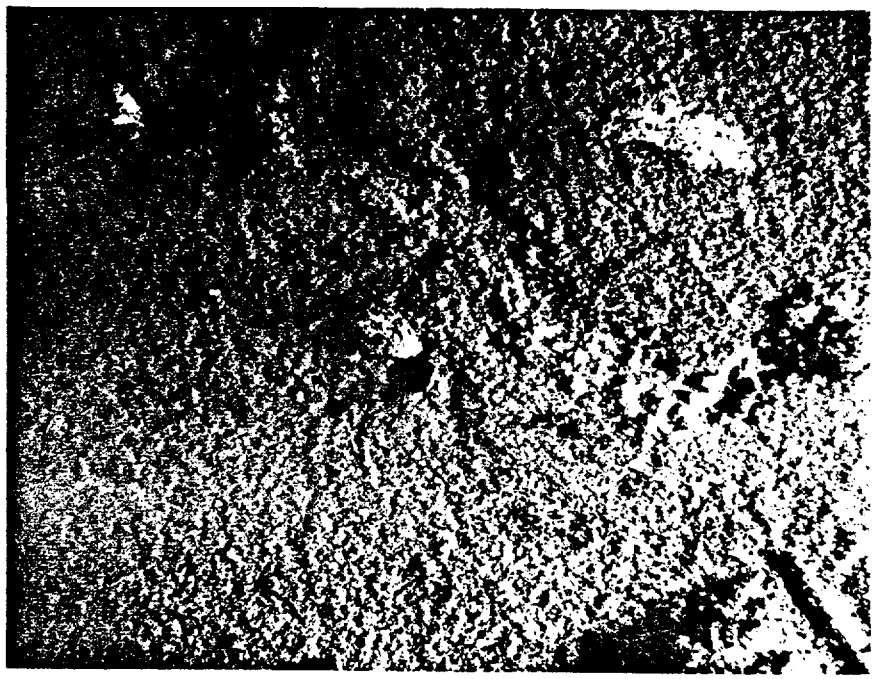


Figure I-5-22 Typical dredge sediment surface conditions - small clay cluster, marsh vegetation, Nassarius presence, and the natural suspension nephaloid layer. HFV = 10 cm.

Figure I-5-23 The undistrubed flat sediment veneer of natural bottom directly abuted the dredge pile. Mucal tracks of Nassarius created an interlaced pattern on natural bottom. HFV = 15 cm.

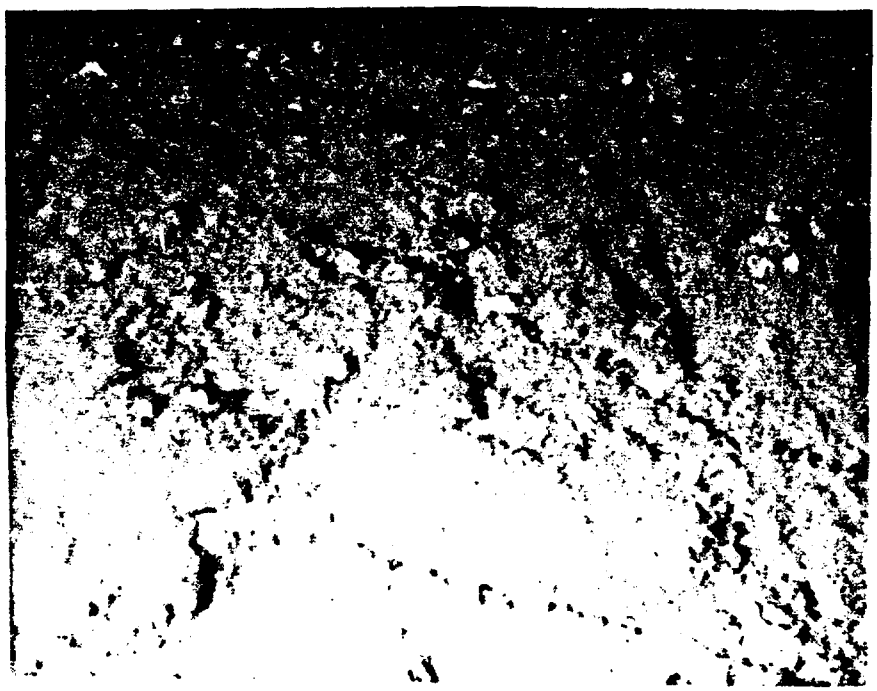


Figure I-5-24 Numerous contagious concentrations of Nassarius and Mulinia valve patches were typical of natural bottom along the border region. HFV = 25 cm.

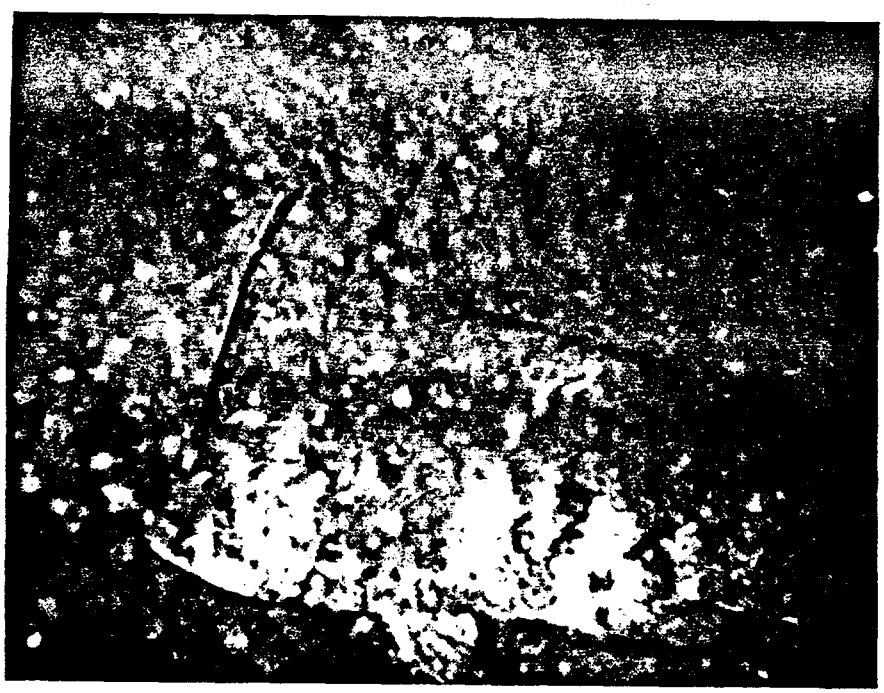


Figure I-5-25 The tautog, Tautoga onitus (30 cm t.l.) was observed in overwintering dormant state at the base of a border region clay mound. HFV = 40cm.

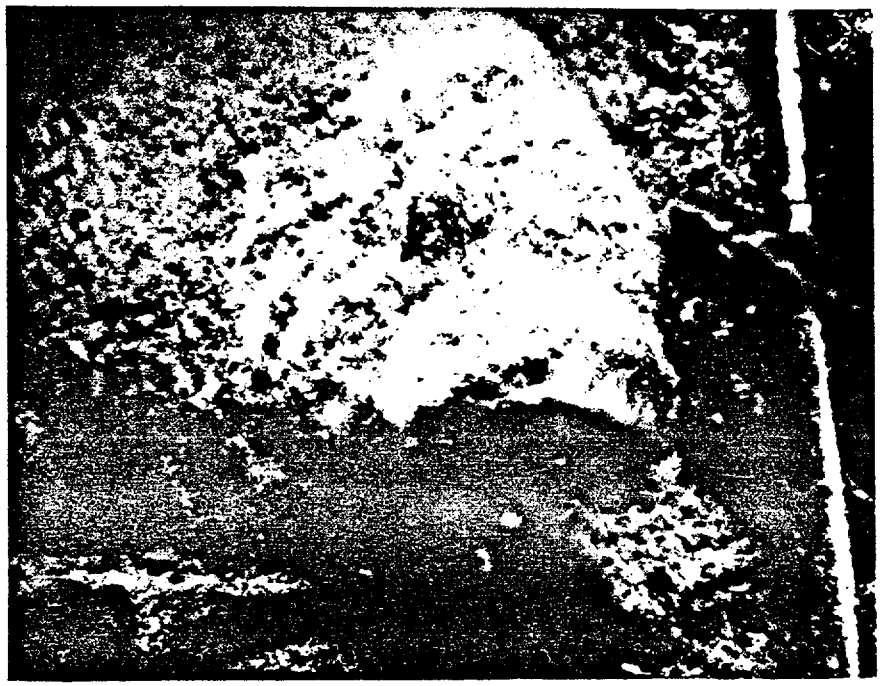


Figure I-5-26 Close-up anterior photo of the dormant tautog revealed the vascularized fin condition and evidence of immobility.

TABLE I-5-5

Macrobenthic Organisms
Observed on the WLIS III Disposal Site
August, 1982

Species	Relative Abundance
Crustacea	
Homarus americanus (juv.)	2
Crangon septemspinosa	20+
Pagurus longicarpus	10
Cancer irroratus (1-2 cm)	25+
Cancer irroratus (10)	5
Gastropoda	
Nassarius trivittatus	15+
Pisces	
Pseudopleuronectes americanus	4
Sygnathus fuscus	1
Raja	1

Figure I-5-27 Bivalve (Mercenaria) shell fragments on surface of disposed dredged material. Disposed sediment appeared more compacted then surrounding natural bottom sediment.

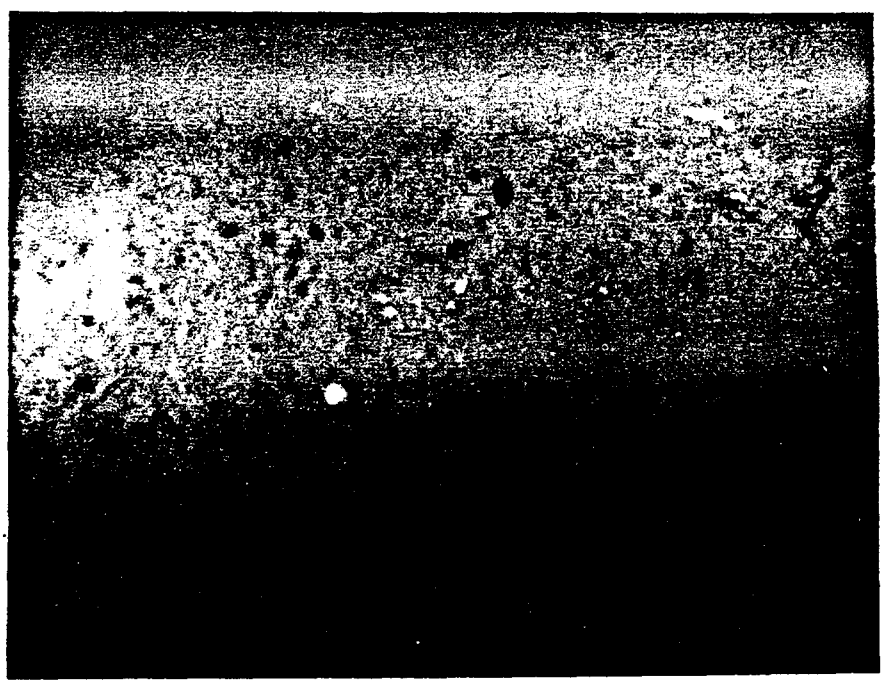


Figure I-5-28 Semi-consolidated dredged material with no apparent macroorganisms. Sediment surface veneer obscures siphons, tubes & muscal tracks.

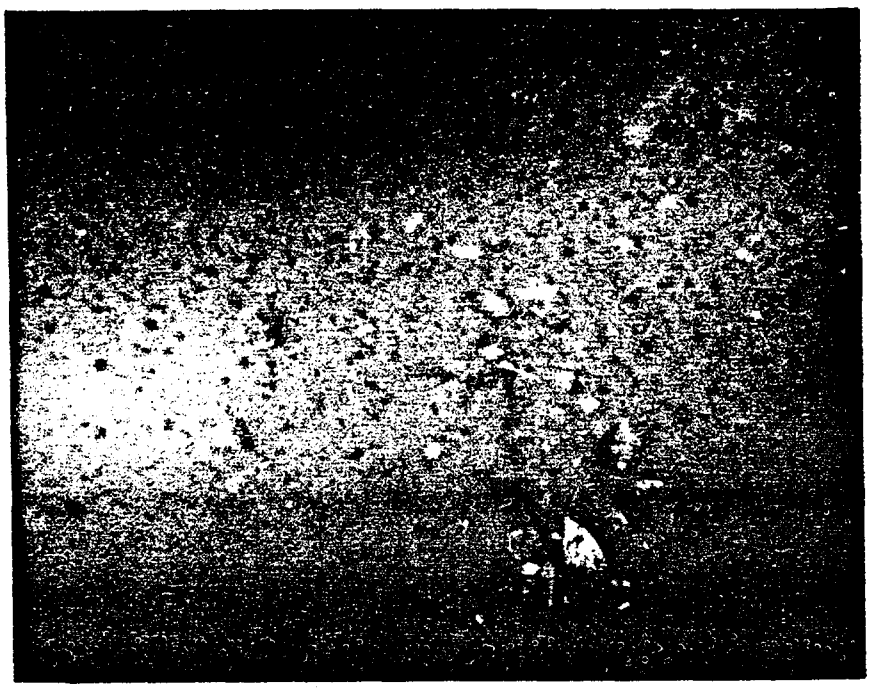


Figure I-5-29 Shell fragment patches attracted mobile benthic species on the mound. The recolonization process has formed a patchy or "mosaic" distribution pattern.

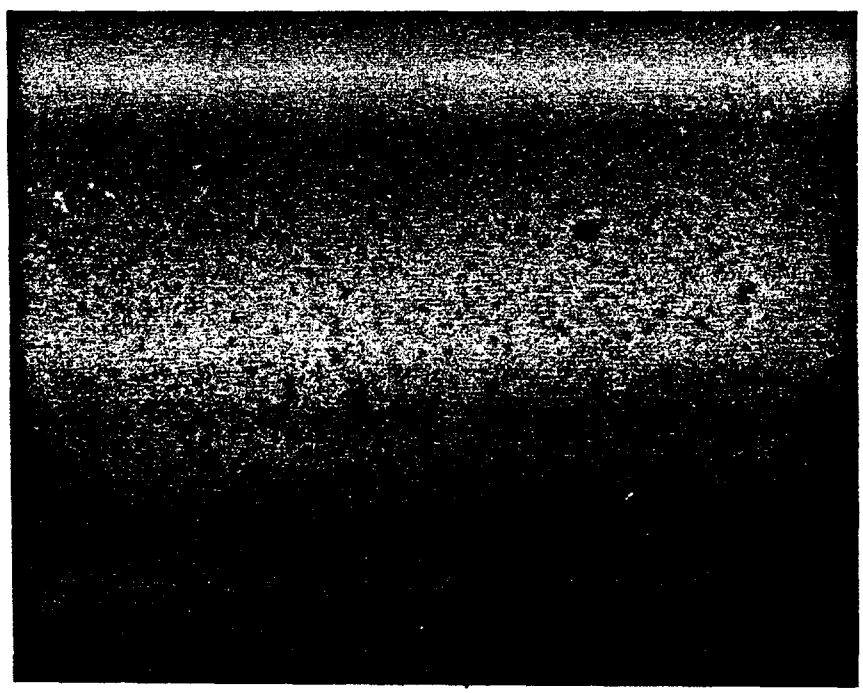


Figure I-5-30 The winter flounder, Pseudopleuronectes americanus, creates bioturbation in active feeding and cryptic burial behavior.

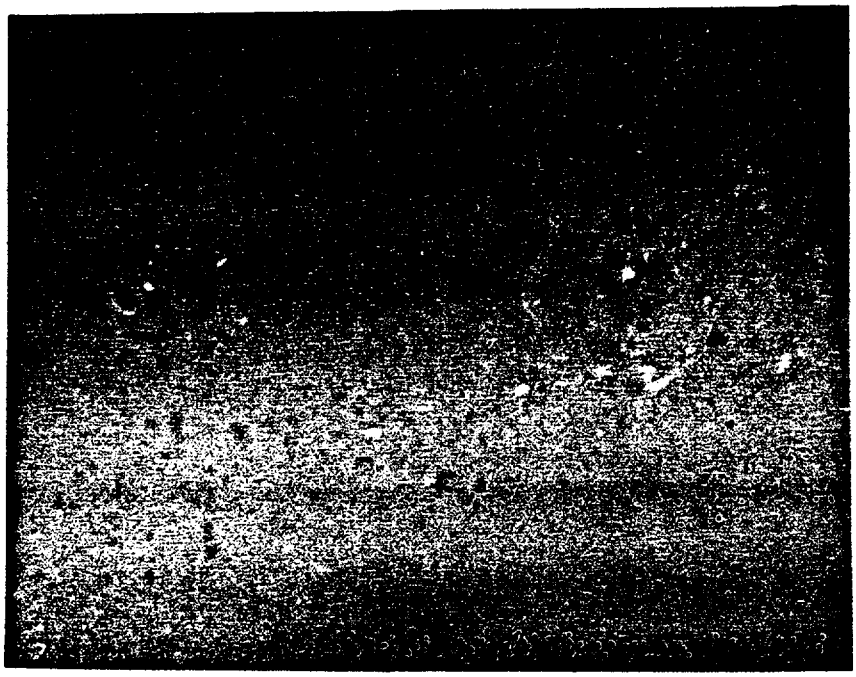


Figure I-5-31 Pseudopleuronectes americanus partially buried in the sediment. Note shell fragments exposed around fin ray margin.

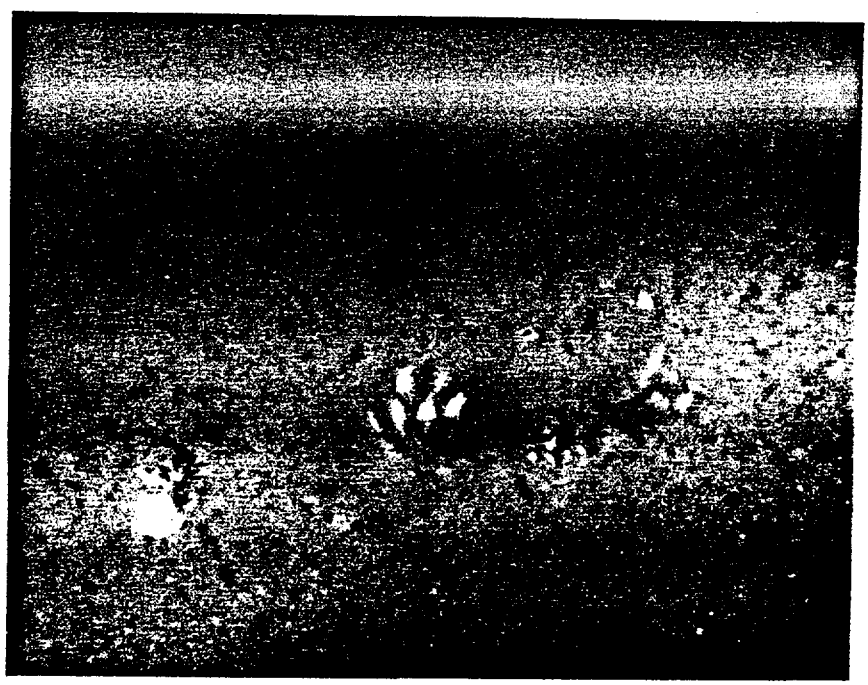


Figure I-5-32 Cancer irroratus and Pagurus longicarpus manipulate the surface sediment layer in seeking food and shelter.

TABLE I-5-6

D.A.M.O.S. DIVER MONITORING LOG

DATE: 19 Aug '82 **LOCATION:** Western Long Island Sound III site - central

DIVERS: Stewart Buchholz **TIME:** 1152-1206 **DEPTH:** 118' **T°C:** 62°F **VISIBILITY:** 1.5'

DIVE (in/out Loran C): 43975.1/26830.6 **DISPOSAL or REFERENCE BUOY (L/C:**
Descend to disposal buoy base and followed ESE course to "natural" bottom, then tracked perimeter of pile 50' to north.

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Current negligible, direction indefinite, 1.5 foot visibility, surface of spoil material compact with protruding shell (fragments and whole valves) comprising a shell-sticky clay base matrix. Small mound (.5 - 1 m elevation) topography characterized the spoil surface.Dense (50%) shell hash patches attracted small macro benthos into notable concentration zones. No steep slope contours were observed. Significant bioturbation was occurring due to spoil repopulation by benthic representatives listed below.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tu' tracks, casts, etc.).

Concentrations of small benthic organisms were noted in shell patch ar
Crangon (20+), Pagurus (10), Cancer irroratus, (1-2 cm) (25+), Nassarius trivatatus (15+)
Pseudopleuronectes americanus (4) C. irroratus (10 cm) (5)
Sygnathus fuscus (1)
Raja (sp) (1)
Homarus americanus (2) juvenile.

II. DISCRETE SAMPLES OR METHODS:

_____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

_X_ **B. .25 m^2 quadrant count/** photography.

_____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index)..**

_____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

An additional diver survey was conducted on 20 December 1982 to assess conditions at the WLIS III disposal site during disposal operations. Two dives were conducted in 121 feet of water in order to observe sediment surface conditions, survey species types and relative abundances, and provide photodocumentation of conditions.

Sedimentary conditions were typical of an active disposal site. Small-scale bottom relief was from 1 to 1.5m. The transect was over a continuous series of small crests and valleys. Large fracturing cohesive clay clumps were common. Shell hash was embedded in the clay clumps and in the dredged material in general. Most of the hash was from Mya and Mercenaria valves and covered 10-15% of the surface.

Tracks of Cancer sp. and Homarus americanus were observed on the dredged material surface. Active individuals of both species were also noted along the transect. Mysids were of low density. A single hake, Urophycis tenuis, was observed in a typical shallow depression.

Table I-5-7 summarizes species observed and their relative abundances along the transect and Figures I-5-33 through I-5-37 document conditions at the site. The DAMOS diver logs are provided in Tables I-5-8 and I-5-9.

In late August and September 1983, diver surveys were conducted to further assess conditions at the WLIS III disposal site. On 31 August, two dives were performed to observe sediment surface conditions and to survey and sample species types and abundances on a 50m easterly transect from the center of the disposal site and near the border of the dredged material. A southeasterly transect for ~70m from a beginning position of 50m E of the center of the site was performed on 7 September.

The sediment condition at the center of the disposal site on 31 August was 1cm of flocculent natural silt over hard gravel. At slack tide, there was no nepheloid layer but the top layer of silt was easily disturbed by the diver's manual agitation. The gravel below the silt was highly compacted and not easily moved by hand. The only anthropogenic input observed was a 6-foot long iron pole protruding out of the sediment surface. The general sediment topography was flat and featureless, except for patchy areas where large Mercenaria mercenaria and Crassostrea virginica shells littered the surface. Because these shells are not native to this environment, it is thus assumed that they were transported along with the dredged material. Primary bioturbation activity appeared to be from decapods, noteably juvenile Cancer irroratus. At the center of the site, a diver-collected epibenthic sample was taken and Table I-5-10 presents the species collected, showing a moderate mix of motile and sedentary epifauna.

Sediment conditions outside of the border of dredged material were equally flat and featureless unconsolidated silt, except that no hard gravel layer was detected below. Here, too,

TABLE I-5-7

Macrobenthic Organisms observed on the WLIS III Disposal Site. December, 1982

Species	Relative Abundance
Crustacea	
Mysid Sp.	1/.25 m^3
Cancer irroratus	13
Homarus americanus	1
Pisces	
Prionotus evolans	2
Urophycis tenuis	1

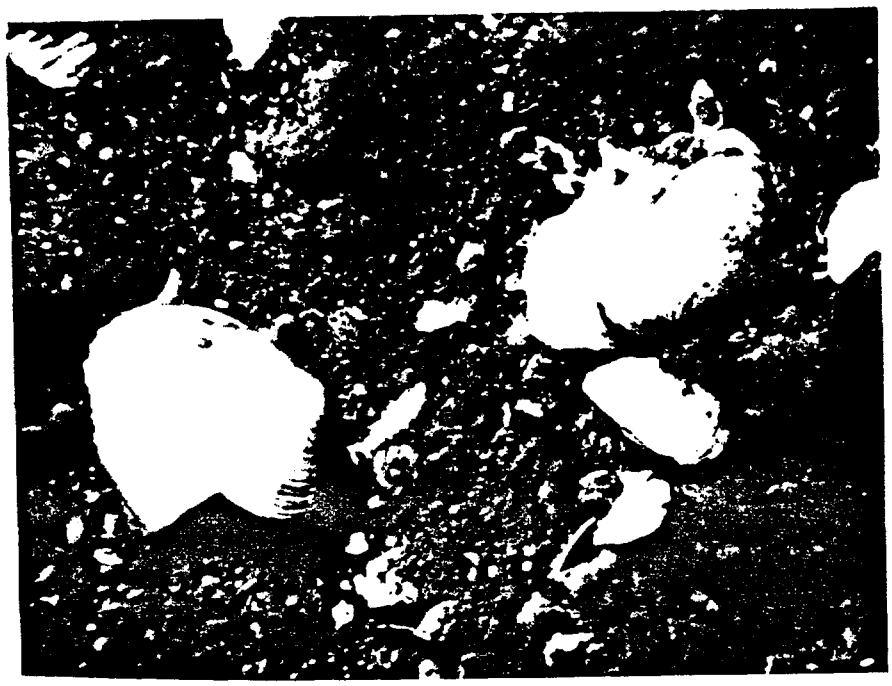


Figure I-5-33 Embedded shell material from Mya and Mercenaria valves in dredged material surface. Notice coarse granular material around shell debris.

Figure I-5-34 Shell material embedded in clay clump. Notice more cohesive surface texture than in previous photograph.

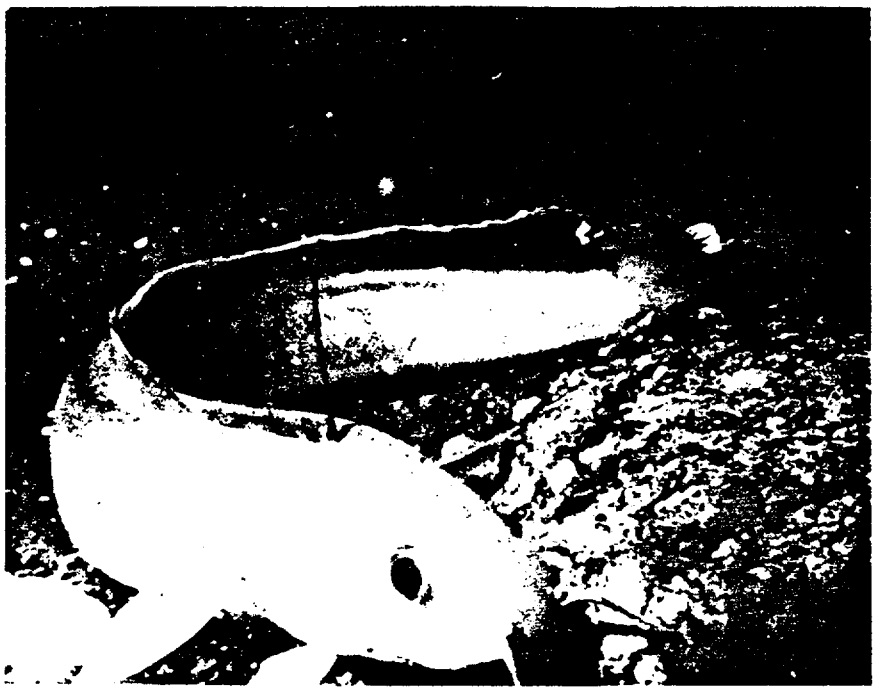


Figure I-5-35 A red hake, Urophycis tenuis, in a shallow surface depression. The form of the depression indicates it may have formed by tail fanning of the fish.

Figure I-5-36 An active Cancer irroratus tracking across the surface of the dredged material.

Figure I-5-37 An eroding clay clump. Note granular remains where lighter material was eroded away.

TABLE I-5-8

D.A.M.O.S. DIVER MONITORING LOG

DATE: 20 Dec 1982 LOCATION: WLIS III Site

DIVERS: Auster/ Buchholz TIME: 1229-1239 DEPTH: 121' T°C: 5°C VISIBILITY: 5 ft

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

43975.1 - 26830.8
43975.1 - 26831.0

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Bottom current < .25 kt to W. Site typical of active disposal site Large scale local bottom relief from 1 to 1.5 m long, fracturing clay clumps and continuous crests and valleys. Shell hash imbedded in clay clumps and in spoil overall. Mya and Mercenaria debris shell hash cover - 10 - 15%

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Prionotos evolans - 2 active
Urophycis tenuis - 1 unreactive, in mud depression obviously formed by tail sweeping
Cancer irroratus - 13 - active - tracking over spoil surface and burrowed into surface layer of spoil
Homarus americanus - 1 - active - walking over bottom - not in burrow
Mysids - < 1/.25m^2

II. DISCRETE SAMPLES OR METHODS:

_____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

__X__ B. .25 m^2 quadrant count/photography. 6 frames

_____ C. Penotrometer tests, elevation stake readings, sediment trap.

_____ D. Mussel deployment - bioaccumulation subsample.

_____ E. Sonic beacon placement or electrolyte change.

_____ F. Remote bathymetric camera photos.

_____ G. Video tape (location, time min. run, tape index)..

_____ H. Opportunistic collection (i.e. natural mussel bed, Corvmorpha Axius.)

TABLE I-5-9

D.A.M.O.S. DIVER MONITORING LOG

DATE: 20 Dec. 82 LOCATION: WLIS dumpsite

DIVERS: Buchholz, Auster TIME: 1229-1239 DEPTH: 120' T°C: 5 VISIBILITY: 6-8'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C: same

43975.1/26830.8 - 43975.1/26831.0

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

- No current or turbidity. Visibility 6-8'.
- Fine sediment with large clay clumps of spoil creating 1' riffs and valleys.
- Clay clumps appeared stable, could scrape away by hand.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

- Auster took approximately 6 photographs.
- No observable small organisms, nor any bioturbation.
- Observed: 1 hake in hollowed-out sediment
  1 legal size lobster
  2 sea robins
  3 *Cancer* crabs

II. DISCRETE SAMPLES OR METHODS: (fouled our bouy line in site bouy chain. (very brief < 10' epibenthic run

__X__ A. Epibenthic net (30-sec. traverse): on or off spoil, target species.

_____ B. .25 m^2 quadrant count/photography.

_____ C. Penetrometer tests, elevation stake readings, sediment trap. sampling from raft

__X__ D. Mussel deployment - bioaccumulation subsample. - done by divers: DeGoursey/Tettlebach

_____ E. Sonic beacon placement or electrolyte change.

_____ F. Remote bathymetric camera photos.

_____ G. Video tape (location, time min. run, tape index)..

_____ H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*.)

Table I-5-10

Summary of Diver Operated Epibenthic Sample Over Dredged Material at Center WLIS III, 31 August 1983

Species	Quantitative Abundance
Cnidaria	
hydroid sp.	1
Bivalvia	
Mulinia lateralis	13
Nucula proxima	1
Yoldia limatula	51
Gastropoda	
Nassarius trivittatus	850
Polychaeta	
polychaete sp.	2
Crustacea	
Cancer irroratus	7
Crangon septemspinosa (incl. 23 berried females)	290
Neomysis americana	9
Pagurus longicarpus	14
amphipod sp.	1

bioturbation was evident as pock marks and tracks from the ubiquitous community of decapods. Additionally, mud shrimp and lobsters were noted at this location.

At both sites, the comb jelly, Mnemiopis leidyi, was observed throughout the entire water column. Table I-5-11 summarizes all the visual biological observations made by the four divers, and additional notes on these two dives are shown in Tables I-5-12 and I-5-13. Photographic documentation of the conditions described above is provided in Figures I-5-38 through I-5-47.

On 7 September, the general sediment condition at the 50m east site was hard packed sand with a 0.2 - 1cm flocculant overlay. Ten percent of the total substrate was covered with dense shell fragments, being primarily from Mercenaria mercenaria, Crassostrea virginica and Mytilus edulis. Anthropogenic debris near the 50m E of center site included scraps of metal and wood, rubber band type packing material, tin cans and broken glass. The topography was a gentle slope downward from the 105' depth at the beginning of the dive to 120' at the perimeter of the dredged material. At the border of the pile, several large planks and pilings were found and numerous lobster burrows were observed alongside. Outside of the dredged material border, there was a 5cm layer of soft surface sediment where small bivalve venting was observed.

Bioturbation was only observed outside of the dredged material in the form of burrows and bivalve venting. Both on and off the mound, there were numerous species of motile epifauna. Additional notes are provided in Table I-5-14.

A hand-held diver epibenthic sample was taken halfway through the transect and a summary of the species obtained are presented in Table I-5-15, and the visual observations are summarized in Table I-5-16.

On 27 June 1984, an additional diver survey was conducted at the mounds of dredged material at WLIS IIIA and WLIS IIIB. Site A received material from several dredge sites, while site B received contaminated material from Milton Harbor. In addition to diver observations, the diver-operated epi-benthic net was used to sample the smaller abundant species associated with the substrate surface. The transects extended 50 m to the north at site A and 50 m to the west at site B.

Sedimentary conditions at site A have changed in a predicted manner, as at other LIS disposal sites. This post-disposal survey showed that initial clay clumps (.5 - 1 m diameter) had rapidly disintegrated within one season due to biotic excavations and surface sediment winnowing. Small-scale relief had been smoothed, and the disposal material had compacted with a thin ($<$ 5 mm) surface nepheloid layer overlying a soft cohesive silt/clay basal sediment.

TABLE I-5-11

Summary of Diver Visual Species Observations at Center and Edge of Dredged Material WLIS III, 31 August, 1983.

Species	Relative Abundance
Ctenophora	
Mnemiopsis leidyi	$16/m^3$ at bottom
Bivalvia	
Mercenaria mercenaria	1
Cephalopoda	
Loligo pealei	3
Crustacea	
Cancer irroratus (juv. 2 cm carapaces)	$8/m^2$
Crangon septemspinosa	ubiq.
Homarus americanus	2
Libinia emarginata	11
Pagurus longicarpus	$12/m^2$
Pisces	
Scopthalmus aquosus	4
Tautogolabrus adspersus	1

TABLE I-5-12

D.A.M.O.S. DIVER MONITORING LOG

DATE: 31 Aug 83 LOCATION: WLIS III tCenter 50 m E

DIVERS: Buchholz/ Moffat TIME: 1219 1213.5 12.5 min. DEPTH: 112' T°C: VISIBILITY: 5.6'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

26830.7
43995.1 30 m E

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

1/4 kt W, 5-6' visibility. 1 cm flocculent silt over hard gravel-type sand that was not easily dug by hand. No neffloid layer but silt was easily suspended. 1-2% shell hash incl. adult Mercenaria and Crussostrea shells on surface (dead). No change slope. Only anthropogenic input observed was a 6' long iron pole sticking out of the sediment at a 75° angle - 3 cm in diameter and encrusted w/hydroids. Bioturbation - juv. decapod tracks.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Mercenaria mercenaria - evidence of transport
Crangon - ubiq.
Windowpane flounder - (4) all 4-9" length
Libinia emarginata - (1) - 30 cm tip to tip legs
Cancer irroratus - juv. 2/1/4m^2 - 3 cm carapace
Pagurus longicarpus - 3/1/4m^2
Mnemiopsis leidyi - comb jelly - 2/0.25m^3 at bottom
(1) cunner - Tautogolabrus adspersus
(3) squid - Loligo pealei - 6-8 cm long

II. DISCRETE SAMPLES OR METHODS:

X A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

X B. .25 m^2 quadrant count/photography. Nikonos 21 - 36

____ C. Penotrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index)..

____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

TABLE I-5-13

D.A.M.O.S. DIVER MONITORING LOG

DATE: 31 Aug 83 LOCATION: WLIS III Platform site

DIVERS: Miller, DeGoursey TIME: 1301 - 1311 DEPTH: 112' T°C: 21.7° VISIBILITY: 2 m

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

43976.1
26832.1

26830.7
43975.1

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

Flat, featureless, soft unconsolidated sediment. No spoil material evident. Visibility 2 meters. Few particulates. Nmemiopsis abundant through entire water column. Pole marks and tracings. Ubiquitous due to Cancer irroratus and Pagurus longicarpus. Burrows of mud shrimp ~1/5m². No clay clumps, no evidence of spoil.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Juvenile Cancer irroratus <3 cm carapace length were ubiquitous, estimate 1/m². Both Cancer and P. longicarpus responsible for high level of mechanical disturbance of upper sediment layers. Adult C. irroratus >10 cm c L (~15 individuals). Libinia emarginata (adults) ~10 and Homarus am. were observed on and under experimental platform.

II. DISCRETE SAMPLES OR METHODS:

____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

X B. .25 m² quadrant count/photography. 1 - 7

____ C. Penotrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index)..

____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

Figure I-5-38 WLIS III, 31 August 1983 - Post disposal. 3 cm *Cancer irroratus* tracking over dredge material containing large *Mercenaria mercenaria*.

Figure I-5-39 WLIS III, 31 August 1983 - Post disposal. Sedimentation and epiphytic fouling by a bryozoan colony on oyster shells that had been transported with the dredge material.

Figure I-5-40 WLIS III, 31 August 1983 - Post disposal. *Mercenaria mercenaria* shells on the sediment surface near the middle of the site - evidence of transport with dredge material.

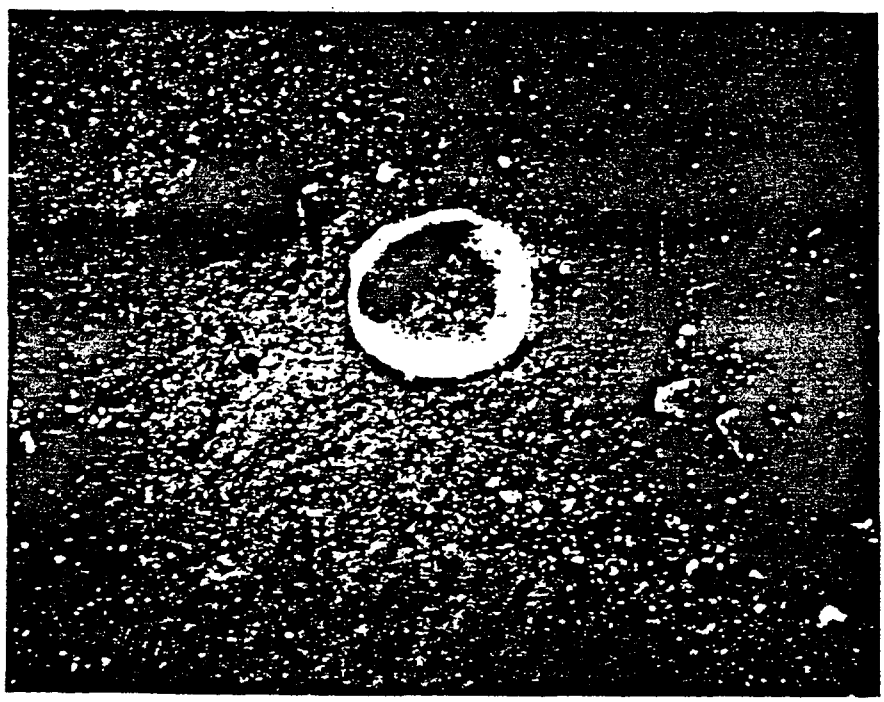


Figure I-5-41 WLIS III, 31 August 1983 - Post disposal. A cockle shell on the sediment surface.

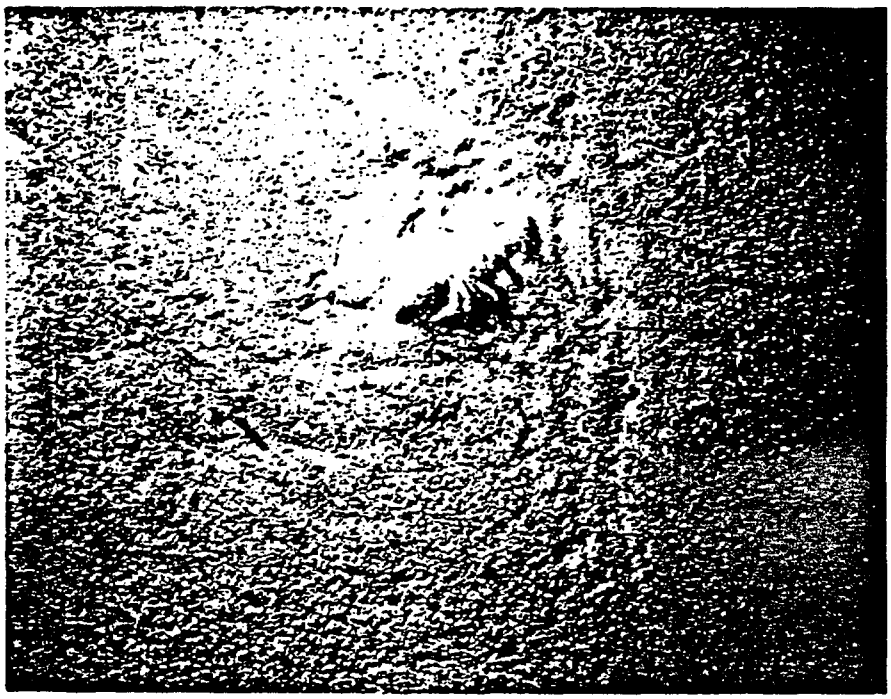


Figure I-5-42 WLIS III, 31 August 1983 - Post disposal. Two Pagurus longicarpus hermit crabs interacting - possibly displaying reproductive or territorial behavior.

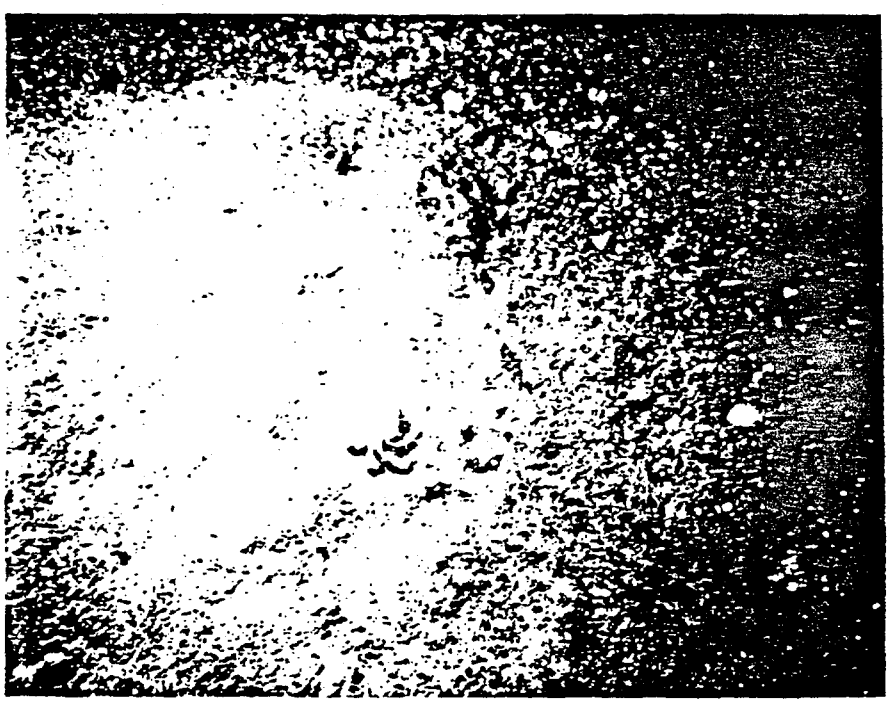


Figure I-5-43 WLIS III, 31 August 1983 - Post disposal. Pagurus longicarpus, hermit crabs tracking over oxidized dredge material.

Figure I-5-44 WLIS III, 31 August 1983 - Post disposal. A small, 3 cm, Cancer irroratus tracking across the sediment surface near the middle of the disposal site.

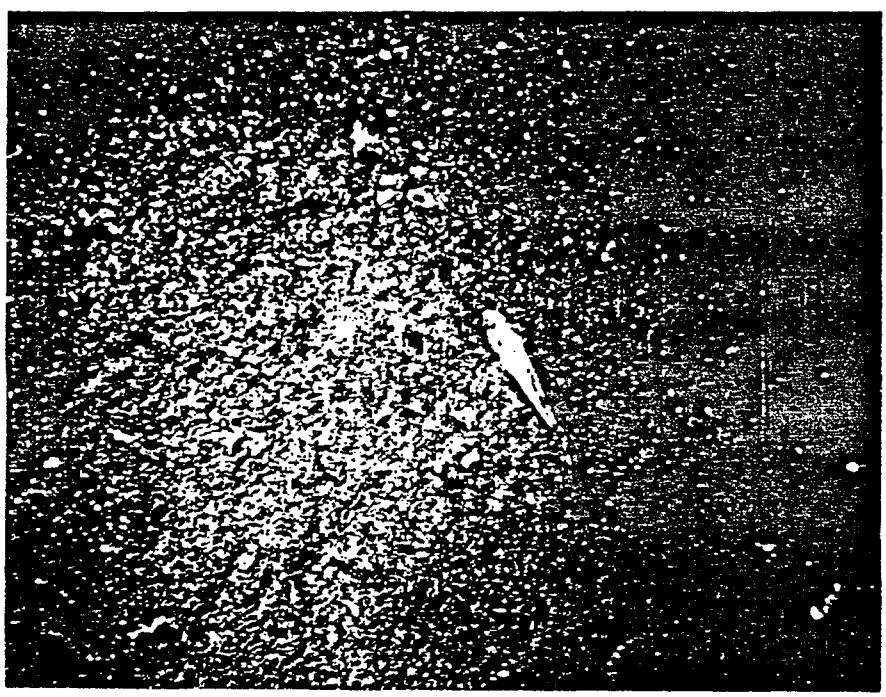


Figure I-5-45 WLIS III, 31 August 1983 - Post disposal Tautogolabrus adspersus resting on the sediment surface.

Figure I-5-46 WLIS III, 31 August 1983 - Post disposal. A large, 30 cm tip to tip, Libinia emarginata spider crab following at the center of the disposal site.

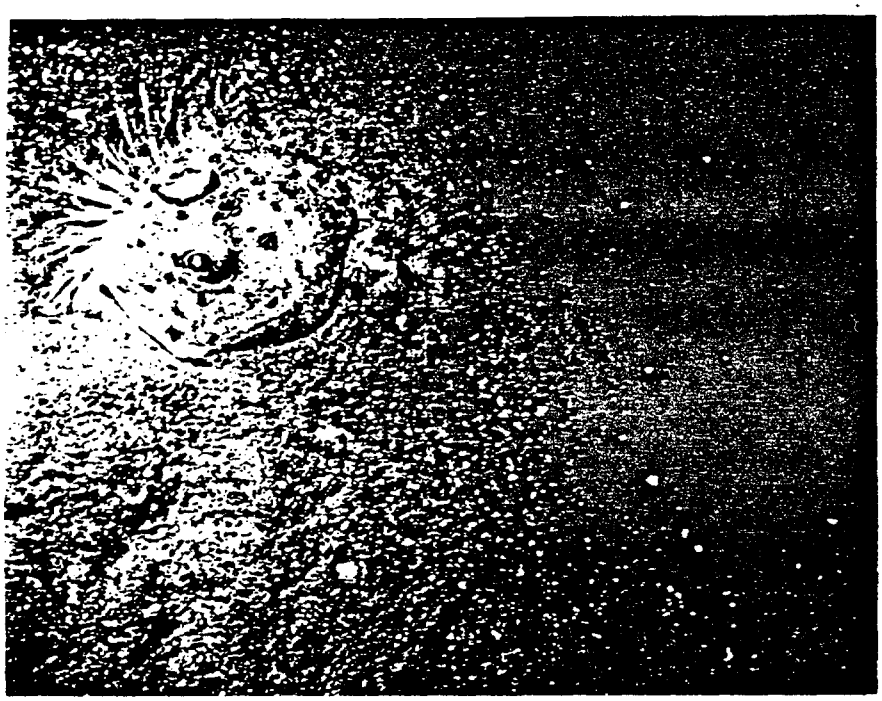


Figure I-5-47 WLIS III, 31 August 1983 - Post disposal. Scopthalmus aquosus on the sediment surface.

TABLE I-5-14

D.A.M.O.S. DIVER MONITORING LOG

DATE: 7 Sep 83 LOCATION: WLIS III 50 m East of Center - transect SE

DIVERS: Stewart/ Buchholz TIME: 1207-1223 DEPTH: 105-120 T°C: VISIBILITY: 1.5'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

In: 26832.3/43972.4 Buoy deployed at Loran C coordinates for diver decent

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

See attached page

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

See attached page

II. DISCRETE SAMPLES OR METHODS:

X A. Epibenthic net (30 sec. traverse): on or off spoil, at border of target species.

X B. .25 m^2 quadrant count/photography. 2 frames, strobe malfunctioning

____ C. Penotrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

X G. Video tape (location, time min. run, tape index). - see attached page

X H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*.)

TABLE I-5-14 (Cont.)

Addendum - D.A.M.O.S. Diver Monitoring Log for WLIS III Dredge Disposal Site, 7 September 1983

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL)

0 velocity current, slack high tide. On spoil 50 m E of center at 105' depth. Sediment was hard packed sand with silt veneer, numerous bivalve shells (clams, oysters, etc.) and crab carapace comprised surface substrate - up to 100% cover in some areas. Anthropogenic material sighted: bottles, cans, scraps of metal, wood and rubber band packing material. Same 70 m SE from drop point and encountered spoil border at 120'. The natural sediment was very soft at upper 5 cm. On return to the south edge of the spoil border, several planks and pilings were observed w/burrow excavations.

During the epibenthic sampling, encountered a 15' wide area of 3 - 10 cm cobble, planks of wood and large oysters - this must have markedly reduced trawl efficiency.

At the spoil border and upon the apron over natural sediment a distinct decrease ($\sim$ 50%) in epibenthic fauna occurred. Crab tracks were observed across the SE border region. On soft natural sediment, infaunal venting was evident (apparently Yoldia siphon discharge) on diver passage.

B. (BIOLOGICAL)

Pagurus longicarpus ($\sim 8/m^2$)
Cancer irroratus (100^+ @ $\sim 14/m^2$) 80% juveniles, < 3 cm carapace width
Scopthalmus aquosus (17) < 5 cm to adult 30 cm range
Crangon septemspinosa (10^+)
Homarus americanus (2)
Mnemiopsis leidyi (ubiq. in water column)
Cyanea capillata (ubiq. in water column)
Libinia emarginata (4)
Pseudopleuronectes americanus (3)
Yoldia sp. (ubiq. at spoil border)
Pagurus pollicaris 3

II. DISCRETE SAMPLES OR METHODS:

G. Video tape - attempted, but turbidity (1 ft. visibility) precluded good recording. Video sled snagged a "ghost pot" trawl (5^+ abandoned/lost lobster traps). Four legal size lobsters were in one pot. R/V UCONN could not haul the combined weight of the tangled trawl and the videa sled, therefore the traps were cut free.

TABLE I-5-15

Summary of Diver Operated Epibenthic Sample over Dredged Material at ESE of Center WLIS III Dredged Disposal Site. 7 September 1983.

Species	Quantitative Abundance
Gastropoda	
Nassarius trivittatus	135
Bivalvia	
Mercenaria mercenaria	1
Modiolus modiolus	1
Yoldia limatula	7
Crustacea	
Cancer irroratus	10
Crangon septemspinosa	203
Pagurus longicarpus	29
Pagurus sp.	1
Neomysis americana	15
amphipoda sp.	5

TABLE I-5-16

Summary of Diver Visual Species Observations during SE Transect Across Dredged Material Border. WLIS III Dredged Disposal Site. 7 September 1983.

Species	Relative Abundance
Cnidaria	
Cyanea capillata	ubiq. in water column
Ctenophora	
Mnemiopsis leidyi	ubiq. in water column
Bivalvia	
Yoldia sp. (venting of siphons only)	ubiq. at dredge spoil border
Crustacea	
Cancer irroratus (80% juv. 2/ 3 cm carapaces)	100^+ @ $14/m^+$
Crangon septemspinosa	10^+
Homarus americanus	2
Libinia emarginata	4
Pagurus longicarpus	$8/m^2$
Pagurus pollicaris	3
Pisces	
Pseudopleuronectes americanus	3
Scopthalmus aquosus	17

In contrast, interim surveys had shown that disposal material was compacted and formed cohesive clay clumps which remained intact shortly after disposal operations. Small-scale (within 20 m of a transect) bottom relief was on the order of 1 to 1.5 m in obvious crest and valleys formed by discrete masses of material from the dredge scow. Clay clumps began to immediately fracture and weather due to currents and bioturbating benthic megafauna and macrofauna.

The mound surface at site B was flat and composed of loose, non-cohesive coarse sand with organic, vascular plant material throughout. No high relief surface features were observed. These observations agreed with data from previous grab sample operations at this location.

The WLIS III area recolonized rapidly and supports a relatively diverse assemblage of finfish and crustaceans (Tables I-5-17 and 18). Juveniles and adults of commercially important species (i.e. Scophthalmus aquosus) were observed at the site, as well as important prey species (i.e. Crangon septemspinosa, Mysid sp.). Diversity and density of species declined on the site during disposal operations, but recolonization after operations ended was rapid, as at other LIS sites.

Cancer crabs excavated burrows into the clay/silt material. Smaller crustaceans reworked surficial sediments during normal feeding and movement behaviors. Finfish fanned sediments and created surficial sediment plumes during normal swimming activities. The increased spatial complexity of the site itself attracted higher densities of animals of all species than the adjacent flat, featureless natural bottom. Increased densities, however, increase the rates at which the substrate is manipulated and bioturbated.

In conclusion, the general events that characterized post-disposal site succession on the macro-scale in the LIS area (i.e. rapid megafaunal recolonization, bioturbation and erosion of small-scale topographic features, and compaction of disposal material) also occur at the WLIS III site.

6.0 REMOTS CAMERA ANALYSIS

A REMOTS benthic camera survey was made of the WLIS III disposal site on 19 and 20 January 1983. The survey provided photographic information on the sediment particle size, the depth of the oxygenated zone (Redox Potential Discontinuity or RPD), and the presence and depth of infaunal organisms. The RPD depth is given special attention in the REMOTS analysis because it is a sensitive indicator of infaunal succession, within station patchiness, and bioturbation. The camera was deployed at seven stations (Fig. I-6-1) located along north (N) - south (S) and east (E) - west (W) transects oriented about the center (CTR) of the disposal mound. The stations were located at 100m intervals and were designated 200S, 100S, CTR, 100N, 200N, 100E and 200E. No samples were obtained on the western transect because the camera flooded.

Table I-5-17

Summary of Species Collected by Diver Operated Epibenthic Net

Species	Site Alpha	Site Bravo
Bivalvia		
Mulinia lateralis	150	4
Gastropoda		
Nassarius trivittatus	800	252
Crustacea		
Cancer irroratus	1	
Crangon septemspinosa	3	1
Neomysis americana	2380	280
Pagurus longicarpus		14
Cumacean sp.	20	
Pycnogonid sp.	10	

Table I-5-18

Summary of Species Observed by Divers at WLIS III

Species	Relative Abundance	
	Site Alpha	Site Bravo
Gastropoda		
Nassarius trivittatus	50+	
Crustacea		
Cancer irroratus	6	4 (10 cm)
Libinia emarginata		2
Pagurus longicarpus	50+	22
Crangon septemspinosa		4
Mysid spp.	25-30/0.25 m^2	25-30/0.25 m^2
Pisces		
Scophthalmus aquosus	2	1

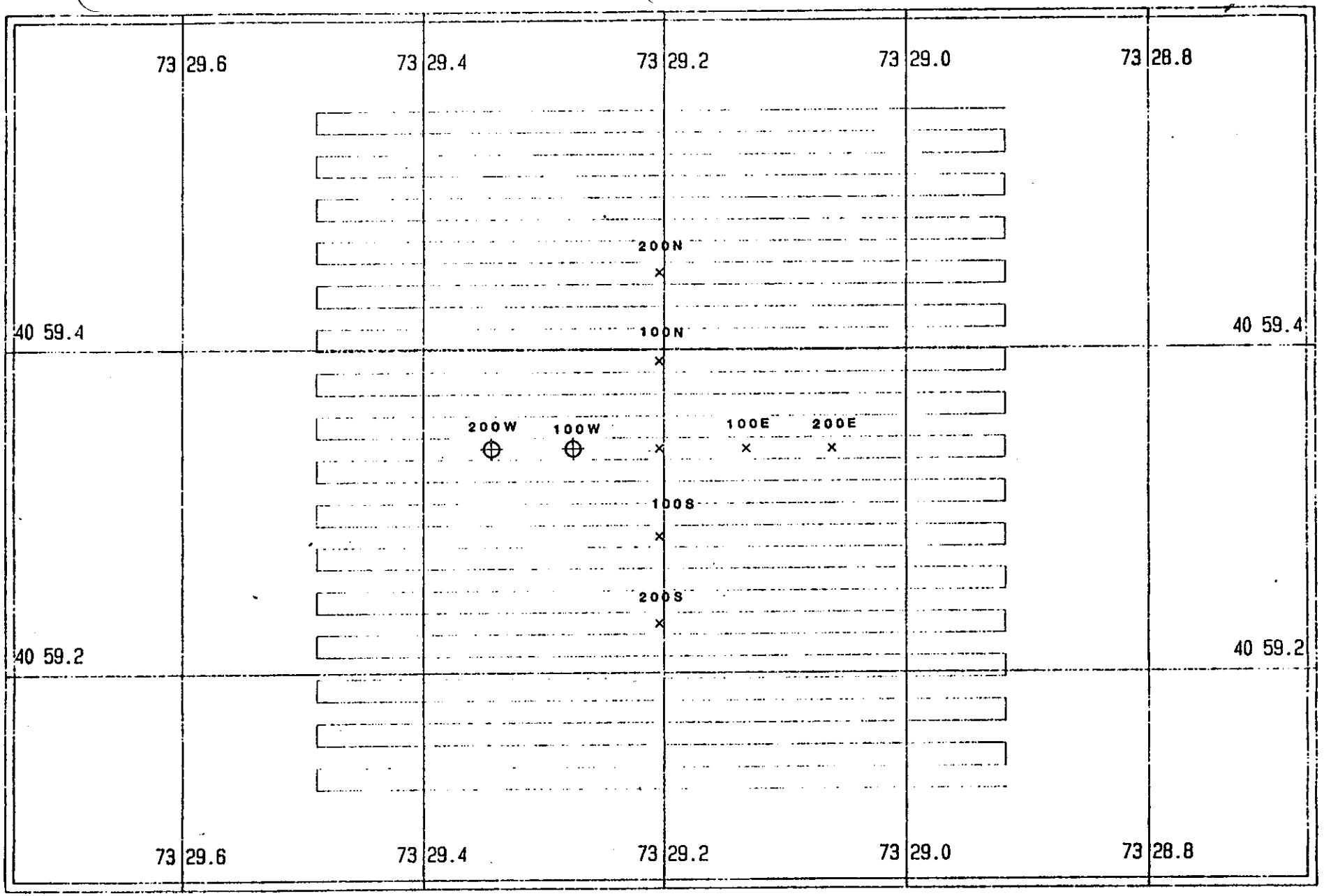


FIGURE I-6-1. REMOTs Photographed Locations, WLIS III, January 1983.
⊕ No photos taken at these sites in January 1983.

Sediment texture ranged from silt-clay to very fine sand at these stations. The disposal mound had very shallow RPD depths which ranged from 0 to 2.37 cm (Fig. I-6-2). Stations 100N and 100E, which had no apparent RPD, exhibited a "chaotic" mixture of oxidized and reduced mud clasts, silt-clay and sand, and shell fragments. This chaotic structure and absence of an RPD is interpreted as representing newly deposited dredged material (see Figs. I-6-3 through I-6-5).

The absence of the RPD is diagnostic of recent dredged material disposal and the absence of invertebrate infauna. Some of the stations (see Fig. I-6-2), including CTR and 100S, had an RPD present and apparently had been colonized by shallow-burrowing infauna. Figure I-6-6, taken at 200E, demonstrates that the RPD was much deeper in the past, indicating that a more established biological community was present prior to disposal.

The purpose of the August 1983 REMOTS survey was to determine the successional status and habitat index for the summer period and to compare these results to data from the winter (January) survey.

Sediment texture ranged from silt-clay (21 replicates) to very fine sand (6 replicates) (Fig. I-6-7). This grain-size distribution is the same as described for the WLIS site in January 1983. The modal boundary roughness value is 1.2cm (Fig. I-6-8), and represents an increase in the modal roughness of 4mm since the January survey. Most of the small-scale roughness, 1cm, appears to be related to either surface erosion or the presence of mud clasts at the sediment-water interface.

The major modal redox depth for this site falls within the 2.1-3.0 cm class (Fig. I-6-9). This represents a significant improvement over the modal value recorded for this site in January 1983 (0 to 1 cm). The mean RPD depth for the CLIS-REF station in August 1983 was 4cm, while the mean RPD depth for the WLIS-Ref site was 2.2 cm.

Successional stages are mapped in Figure I-6-10 as well as habitat indices (Fig. I-6-11) for each station replicate (n=3). Figure I-6-12 gives the habitat-index frequency distribution for the WLIS site. Within station variation is high suggesting local patchiness in faunal colonization on a very small scale. Stations 200N, 100N, 200W, 100E, 100S, and 200S all have values equal to, or greater than, the WLIS-REF station (i.e. successional stage=III or I-III; habitat indices=10,6,6,7 with a mean of 7.25). Only six station replicates have values below the reference station (Fig. I-6-12). The January 1983 WLIS habitat indices ranged from -3 to +5 with a mean of 0.60 (n=15). The August 1983 values represent a marked improvement. This rate of change is unprecedented in previous experience with patterns of faunal recovery in Long Island Sound. For example, the FVP site (see Volume II, Section III, this report) experienced a change in habitat indices from +3 to +5 over a period of three months. The

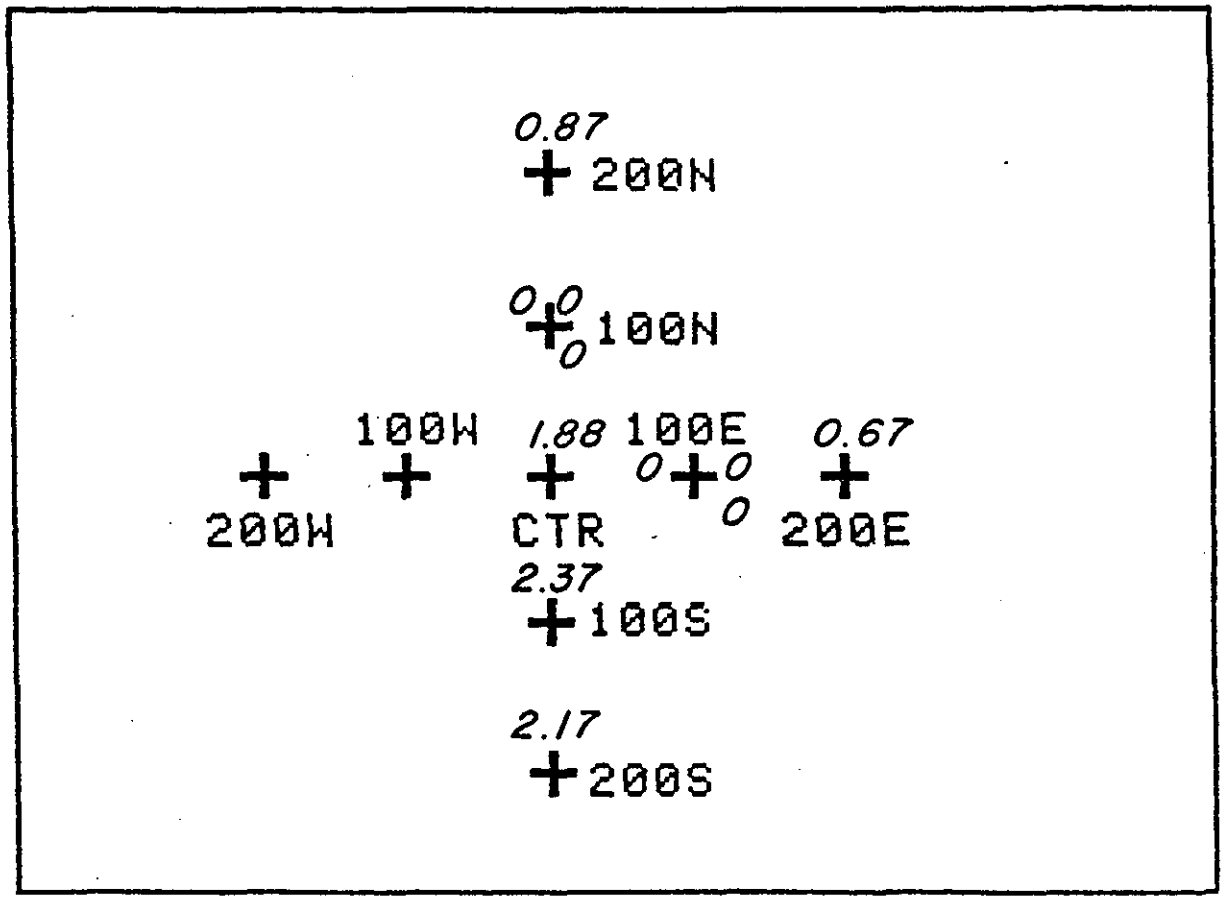


FIGURE I-6-2. Mean depth of the oxygen penetration zone (or RPD).

Figure I-6-3 WLIS III Disposal Site, station 100N. Scale = 1.5x.
This recently deposited material has a "chaotic" fabric related to the rapid deposition of a heterogeneous mixture of oxidized and reduced mud clasts, sand, and shell. A vertical "conduit" (arrow) probably represents a dewatering structure.

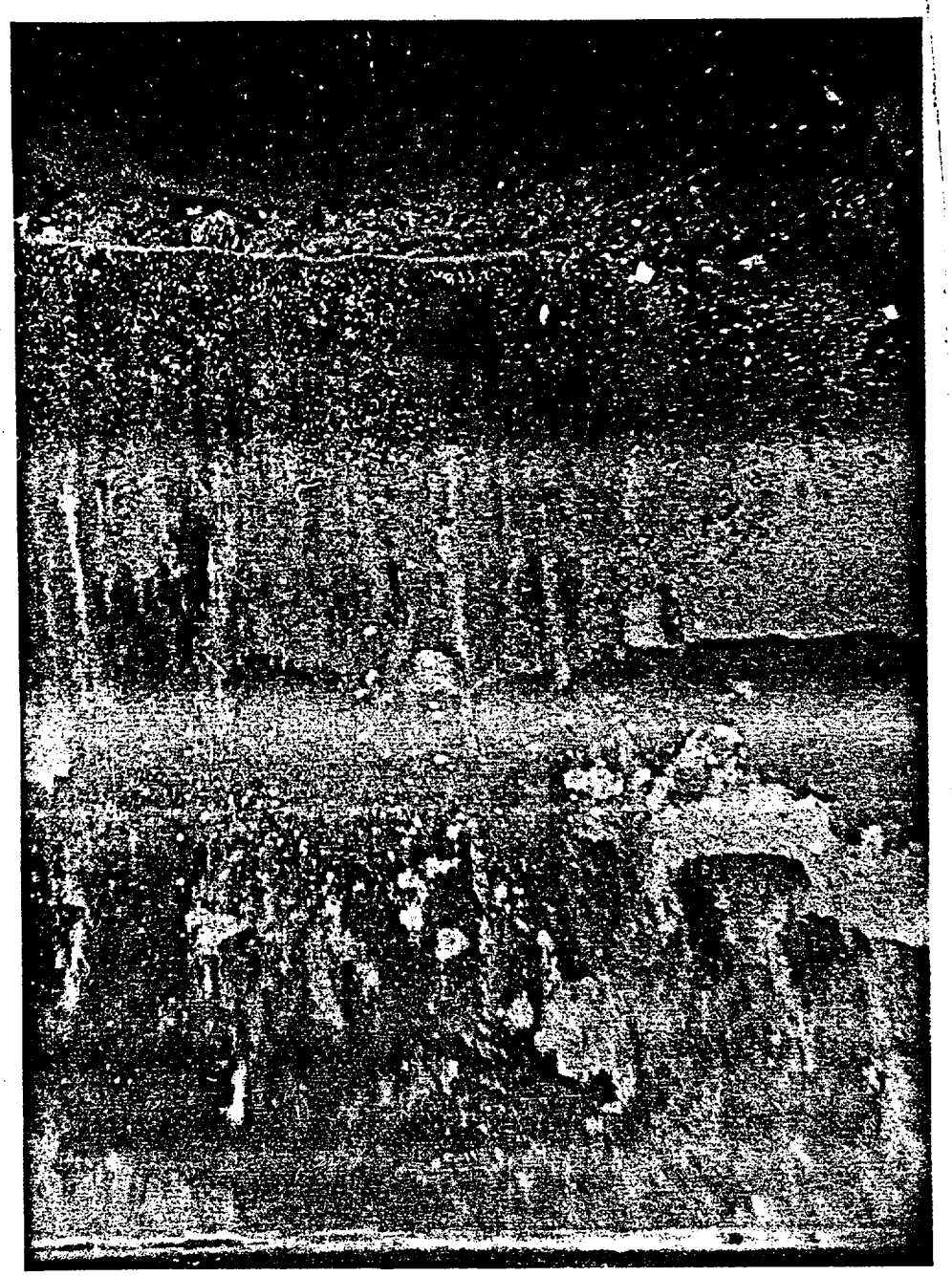


Figure I-6-4 WLIS III Disposal Site, station 100N. Scale = 1.5x
Fine sand overlies silt-clay mud clasts in recently deposited dredged material.

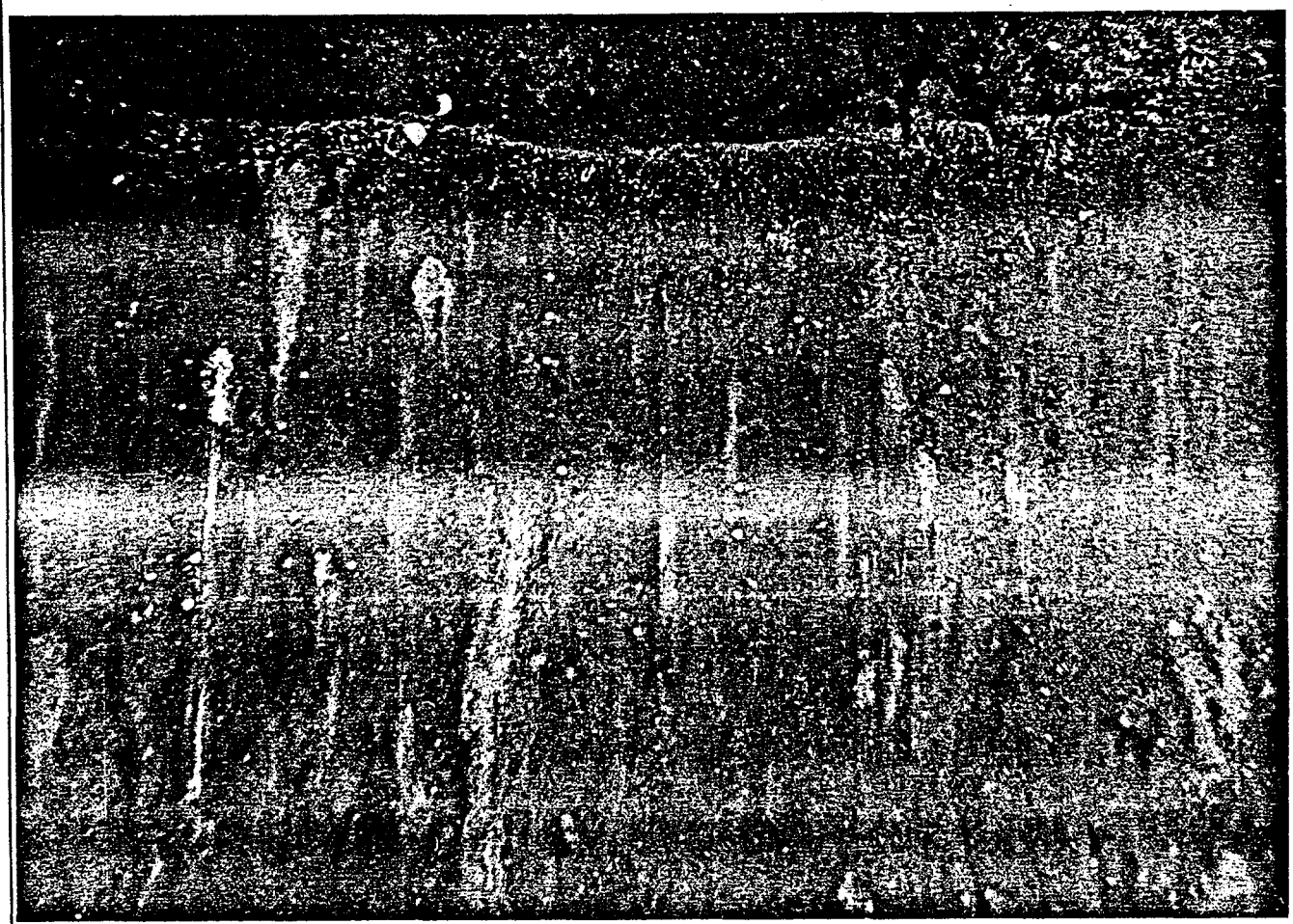


Figure I-6-5 WLIS III Disposal Site, station 100E. Scale = 1.5x.
The presence of a reduced sedimentary surface and reduced mud clasts at the surface identifies recently deposited dredged material.

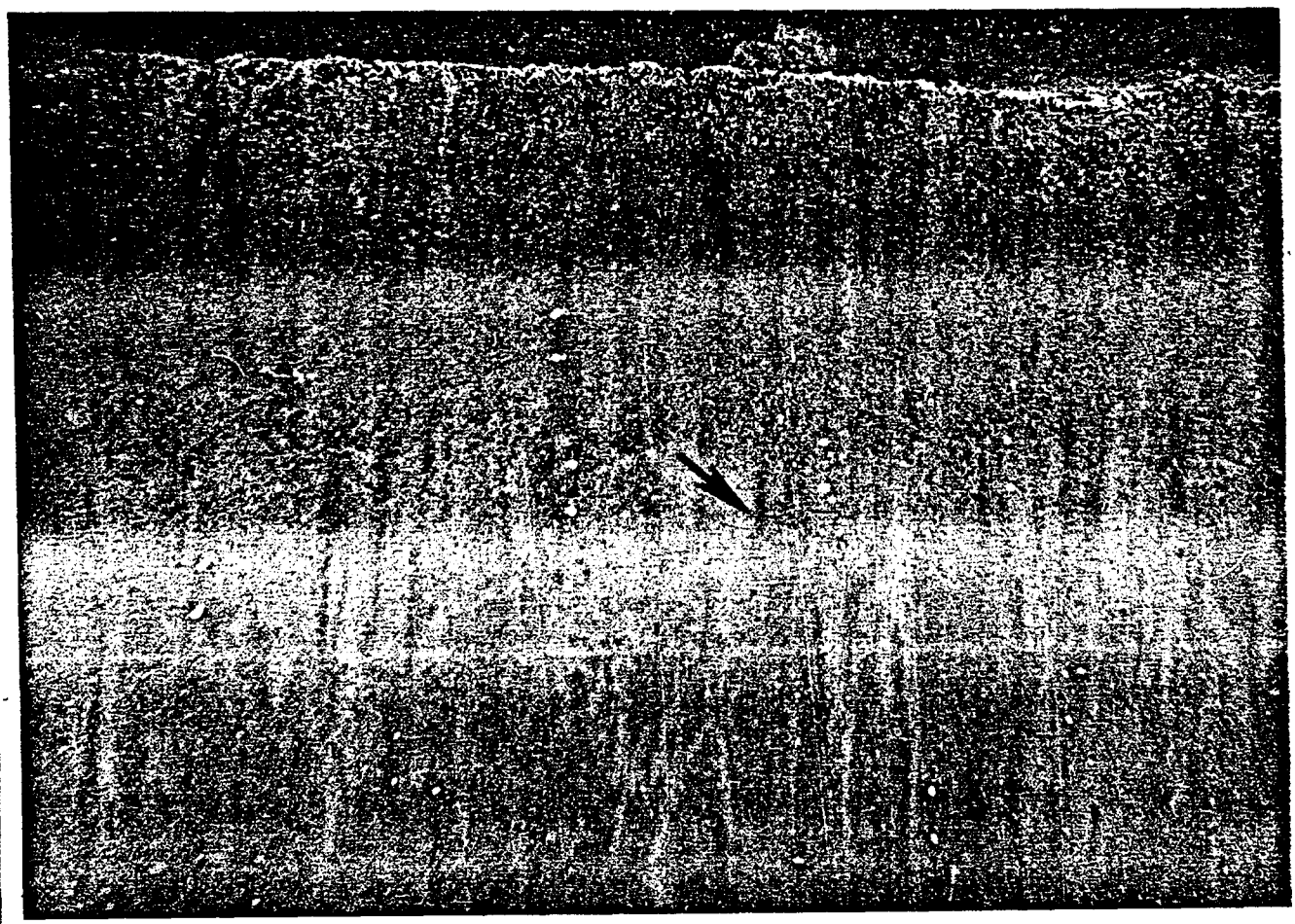


Figure I-6-6 WLIS III Disposal Site, station 200E. Scale = 1.5x.
A rebound RPD is characteristic of a retrograde faunal succession.
The former depth of the RPD is marked by arrow. The present RPD is located at a mean depth of 0.6cm.

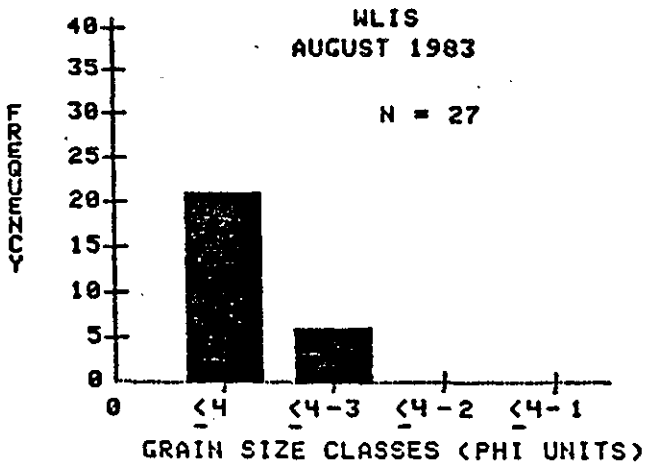


FIGURE I-6-7. Frequency distribution of grain size classes at WLIS III. Size class ranges in phi units on x axis; sample size indicated on each histogram.

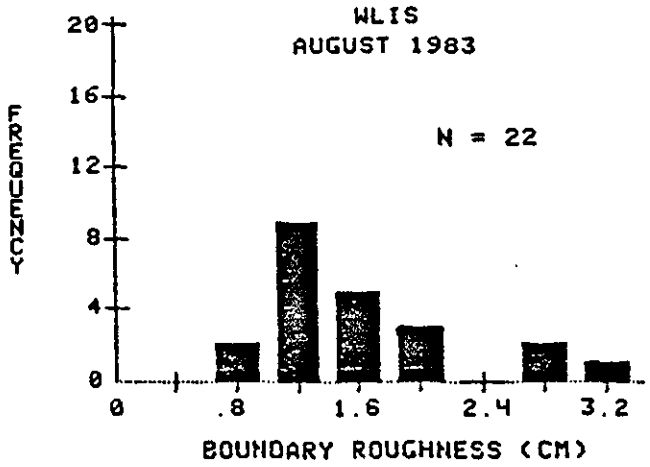


FIGURE I-6-8. Frequency distribution of surface boundary roughness values at WLIS III, sample sizes indicated on each histogram.

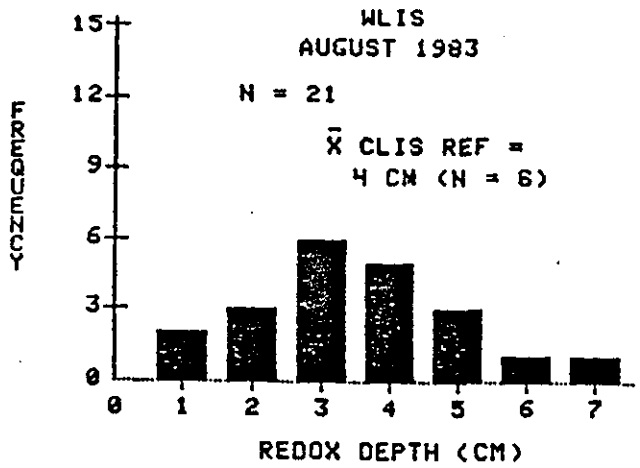


FIGURE I-6-9

Frequency distribution of mean redox depth at the WLIS III; sample sizes indicated on each histogram, also shown is the mean value for the CLIS REF station.

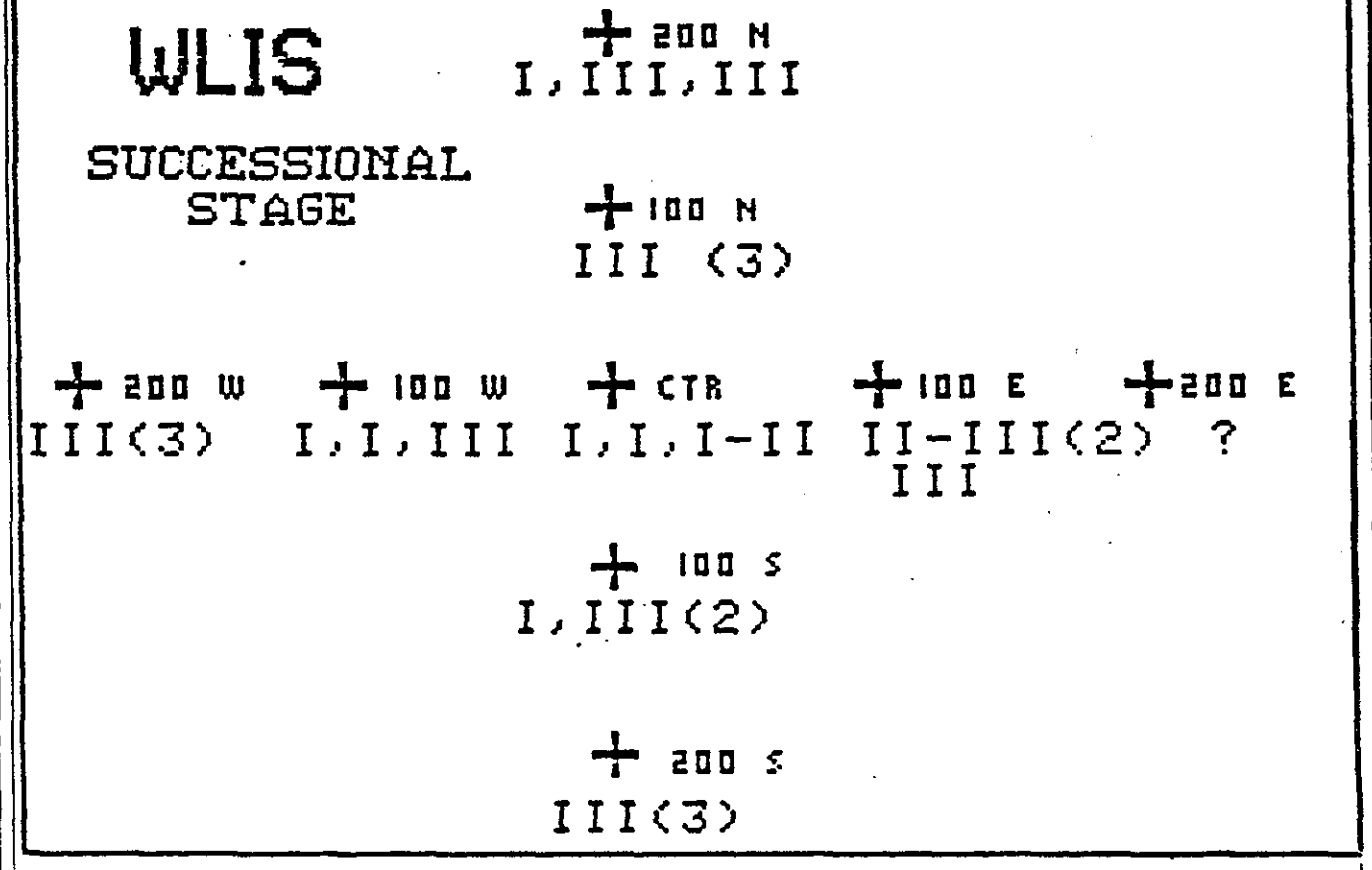


FIGURE I-6-10
Successional stage values for each replicate at WLIS III, August 1983. Numbers in parentheses indicate number of replicates with the same value.

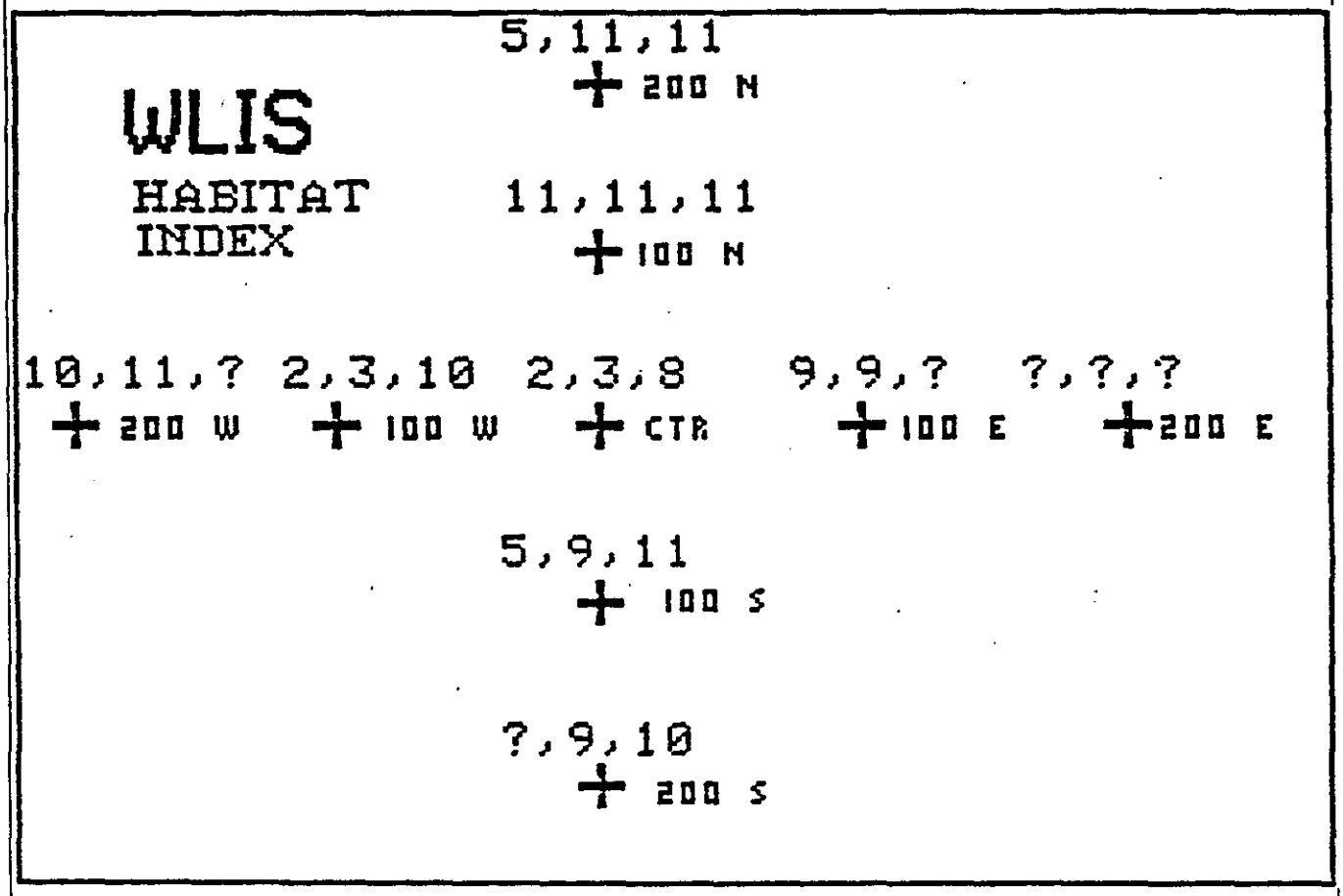


FIGURE I-6-11

Habitat Index Values for each replicate at WLIS III, August 1983. Numbers in parentheses indicate number of replicates with the same value.

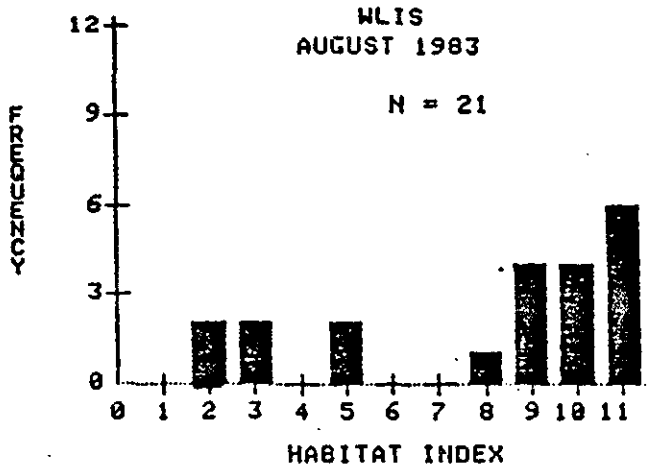


FIGURE I-6-12

Frequency distributions for habitat index values at WLIS III; sample sizes indicated on each histogram.

change in habitat values at the WLIS site over a period of 8 months ranged from no change to +14 habitat index units. The very large rate of change of habitat indices from -3 to +11 (e.g. Sta. 100N) over the 8 month period has never been observed before.

On 15 March 1984, a REMOTS survey was conducted at the WLIS III "B" disposal area located in the Western Long Island Sound disposal site. Seventeen stations (Table I-6-1) were occupied on a cross-shaped sampling grid, and three REMOTS images were taken at each station. The center of the survey was located at the initial point "B" buoy location, and is approximately 250 meters west of the final disposal point.

The purpose of the survey was to define the baseline conditions at this site prior to disposal of dredged materials. As previously described, REMOTS images were measured for RPD depths, boundary roughness, sediment grain-size modes, prism penetration depth, faunal successional stage, and disposed material thickness where it was encountered.

The major modal grain-size for most stations was less than 4 ϕ (silt to clay). Seven stations in the central and eastern part of the sampling grid showed a layer of coarser material of varying thickness, apparently from some prior disposal operation in the vicinity. The stations where this surface layer of sand exists are listed in Table I-6-2. This layer of coarse material probably continues to the east beyond the limits of the sampling grid, where the previous WLIS III "A" disposal took place. The southern limit of this coarse material was detected at Station 100S where one replicate image showed coarse material and shell lag deposits at the sediment surface. The shell lag deposit is not evidence of bottom erosion, as other replicates from this station showed an undisturbed surface with low boundary roughness values.

The frequency distribution for surface boundary roughness values is shown in Figure I-6-13. The major mode is at the 0.4 cm class interval; these values are comparable to those found at other areas surveyed in Central Long Island Sound.

Evidence of dredged material was present at eight stations (200W, 200N, 100N, CTR, 100S, 100E, 200E, 400E). The thickness of the deposits varied from approximately 0.2 cm to 3.5 cm over all stations except CTR and 200W. At these stations, the thickness of dredged material exceeded the penetration depth of the REMOTS prism. The thin redox layer at these two stations indicates that either patchy deposits of dredged material were dumped during the winter months when larval recruitment and infaunal metabolic rates are low, or, assuming the deposits at these stations occurred at the same time as those on the eastern half of the grid, that the dredged material at these particular stations is extremely polluted and inhibiting normal recolonization. Because of the extreme difference in granulometry between the deposits at 400E and 200W, the former explanation is more likely.

TABLE I-6-1

Stations Occupied in the Baseline Survey WLIS III, March 1984.

400N	200N	100N	CTR	100S	200S
400S*	400E	200E	100E	200W	200W
400W	400N/W	400N/E	400S/E*	400S/W	

*Only 2 replicate images were suitable for data analysis at these stations.

TABLE I-6-2

Thickness and Major Mode of Coarse Surface Layer, WLIS III, March 1984.

STATION	THICKNESS OF COARSE SURFACE LAYER (cm)	MAJOR MODE OF LAYER (phi units)
200N	0.27 - 0.38	4 - 3
100N	0.67 - 0.88	3 - 1
CENTER	0.79 - 0.84	3 - 1
100E	0.38 - 0.86	3 - 1
200E	0.22 - 0.34	3 - 1
400E	0.55 - 1.73	2 - 0
100S	0.10 - 0.33	2 - 0

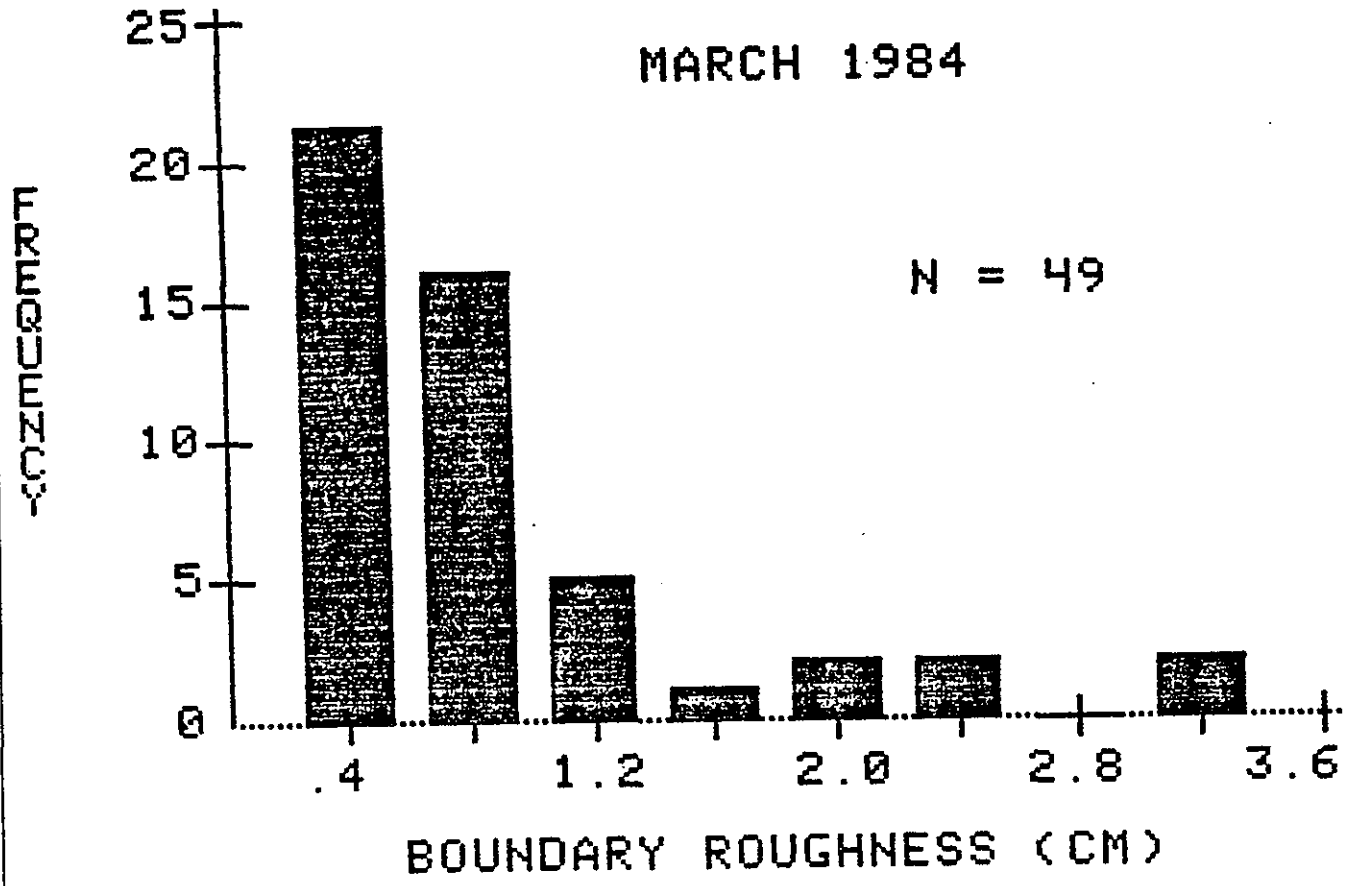


FIGURE I-6-13

Frequency Distribution for Surface Boundary Roughness Values at the WLIS III "B" Site in March 1984.

The frequency distribution for mean RPD depth is shown in Figure I-6-14. The major mode is at the 2 cm class interval; compared with values from the FVP site taken the same time of year, these values are significantly lower (the major mode for the frequency distribution at the FVP site is at the 4 cm class interval).

The spatial distribution of average RPD depths for the stations is shown in Figure I-6-15. The generally low values at this site can be attributed to a number of factors: lowered bioturbational rates in cold winter temperatures, presence of previously disposed dredged material at eight of the stations, and the overall lower densities of Stage III infaunal deposit-feeders normally found in Western Long Island Sound. The only station approaching a value for an RPD depth typical of Central Long Island Sound undisturbed bottoms is Station 400S ($x = 3.84$).

The spatial distribution of successional seres found at each station is shown in Figure I-6-16. The majority (82%) of the replicates show most of the area to be colonized by low-order (Stage I) successional seres. One replicate from 400S was typical of a normal undisturbed bottom in Central Long Island Sound.

The frequency distribution of benthic index values is shown in Figure I-6-17. The major mode is at the +4 class interval; again, these values were significantly lower than the FVP site at this time of year, reflecting the highly disturbed nature of the area. The mapped distribution of benthic index values is shown in Figure I-6-18.

On 26 June 1984, a REMOTS survey was conducted at the Western Long Island Sound disposal site (WLIS III "B"). Twenty-one stations were occupied within the grid defined during the 15 March 1984 WLIS III "B" baseline survey (Table I-6-3). Three replicate REMOTS images were taken at all 400, 200, and the CTR stations; two replicates were taken at 300, 100 and corner (e.g. N/E) stations. In addition, six replicates were taken at a Western Long Island Sound reference site (WLIS-REF).

The purpose of this first post-disposal survey was to map the distribution and thickness of dredged material at the disposal site, to measure changes in benthic parameters occurring as a result of the disposal operation, and to monitor the process of recovery on the affected area.

Dredged material from these recent disposal operations was apparent over most of the survey area. The average thickness of dredged material at each station is mapped in Figure I-6-19. All five central stations (CTR, 100N, 100E, 100S, 100W) had layers thicker than the camera prism penetration depth, which averaged 15.89 cm at these stations. Outside this central region, dredged material was most abundant to the east and north. The zero isopleth apparently lies beyond stations 400E, 400N/E,

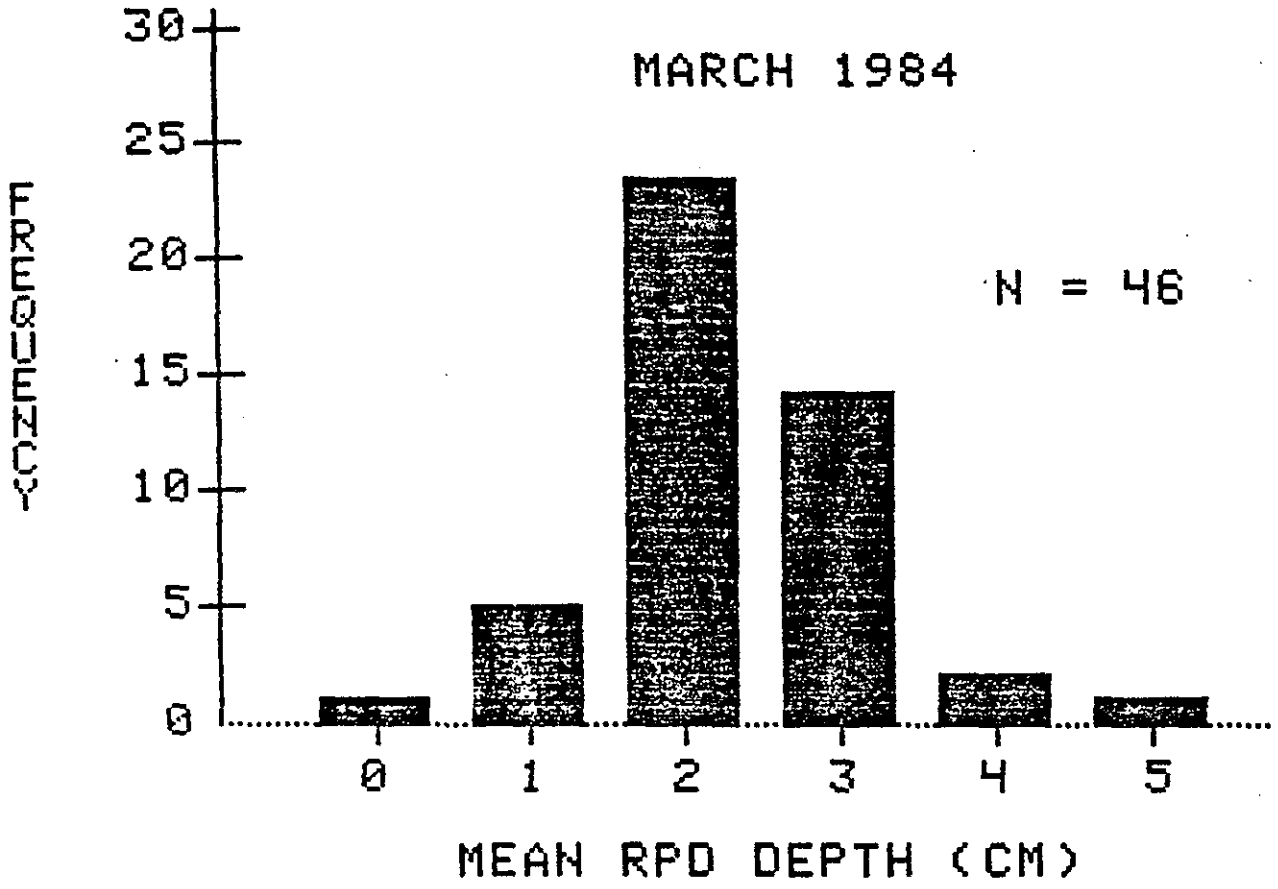


FIGURE I-6-14

Frequency Distribution for Mean RPD Depth at the WLIS III "B" Site in March 1984. RPD Values at 400W Could Not be Measured Due to Inadequate Penetration of the REMOTS Prism.

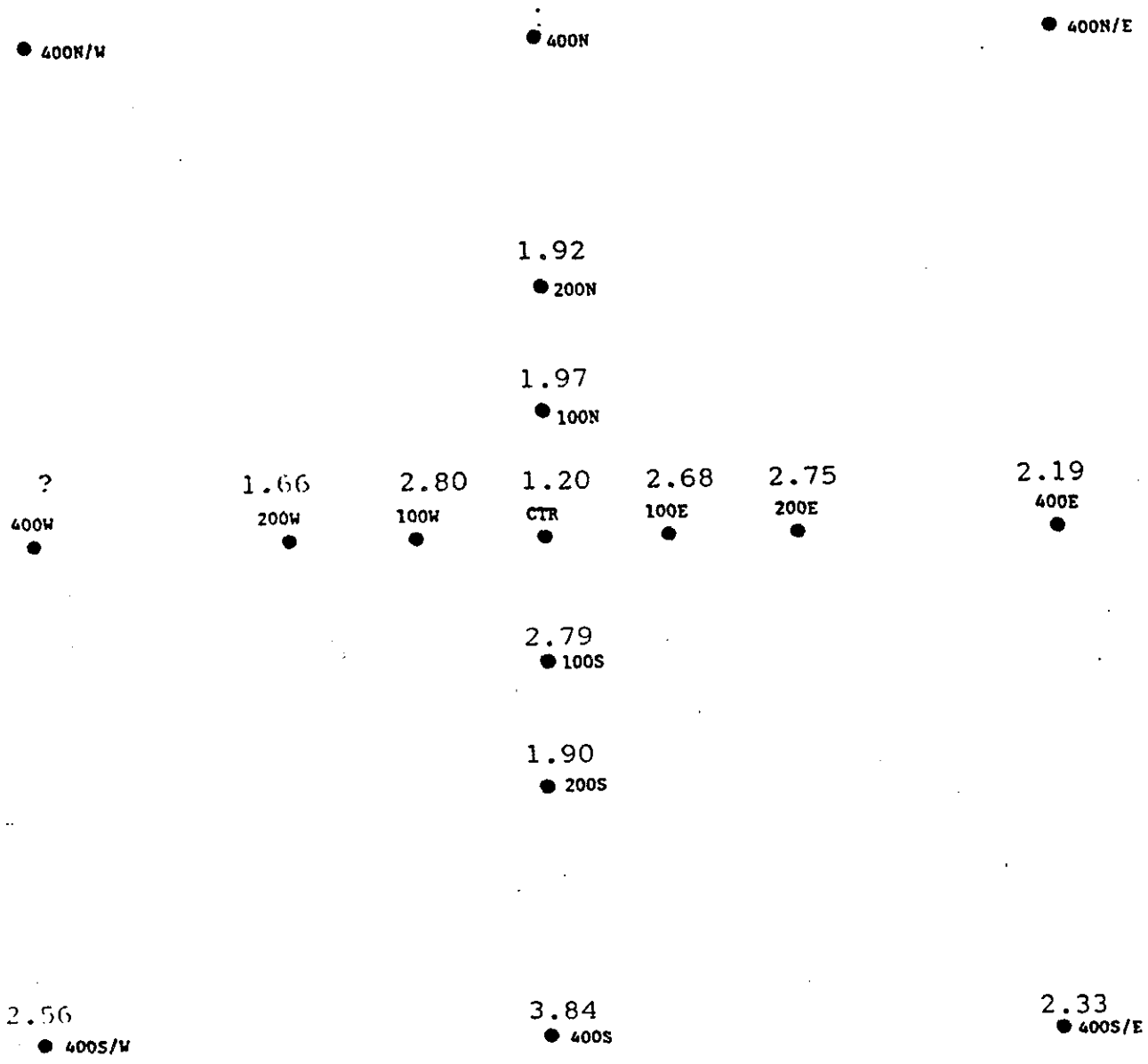


FIGURE I-6-15. Average RPD Depth at Each Station in the WLIS III "B" Site. Values at Station 400W Could Not be Measured Due to Inadequate Penetration of the REMOTS Prism.

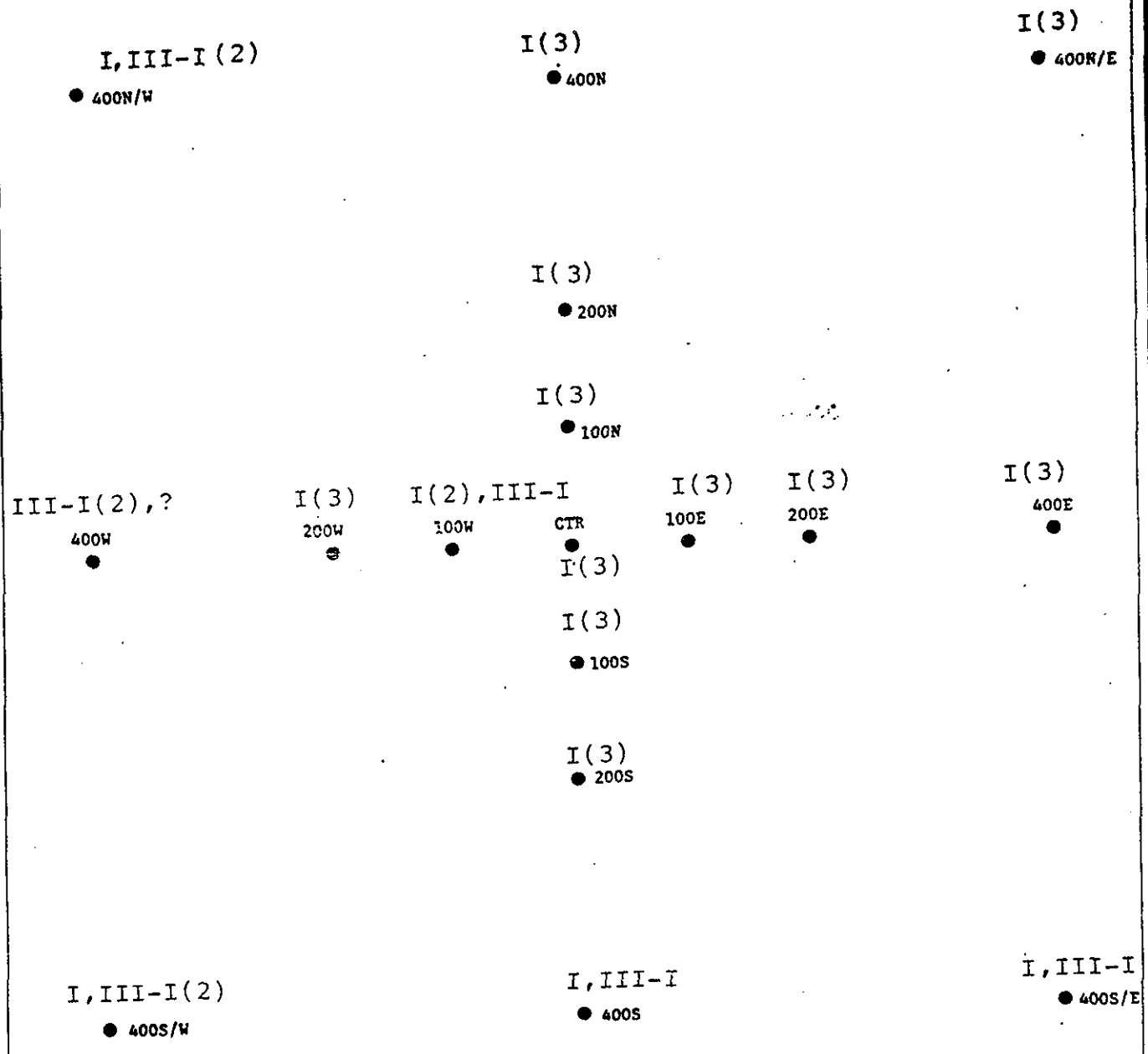


FIGURE I-6-16. Successional Stage at the WLIS III "B" Site in March 1984. The Number of Replicates with Corresponding Value is in Parentheses.

The frequency distribution of benthic index values is shown in Figure I-6-17. The major mode is at the +4 class interval; again, these values were significantly lower than the FVP site at this time of year, reflecting the highly disturbed nature of the area. The mapped distribution of benthic index values is shown in Figure I-6-18.

On 26 June 1984, a REMOTS survey was conducted at the Western Long Island Sound disposal site (WLIS III "B"). Twenty-one stations were occupied within the grid defined during the 15 March 1984 WLIS III "B" baseline survey (Table I-6-3). Three replicate REMOTS images were taken at all 400, 200, and the CTR stations; two replicates were taken at 300, 100 and corner (e.g. N/E) stations. In addition, six replicates were taken at a Western Long Island Sound reference site (WLIS-REF).

The purpose of this first post-disposal survey was to map the distribution and thickness of dredged material at the disposal site, to measure changes in benthic parameters occurring as a result of the disposal operation, and to monitor the process of recovery on the affected area.

Dredged material from these recent disposal operations was apparent over most of the survey area. The average thickness of dredged material at each station is mapped in Figure I-6-19. All five central stations (CTR, 100N, 100E, 100S, 100W) had layers thicker than the camera prism penetration depth, which averaged 15.89 cm at these stations. Outside this central region, dredged material was most abundant to the east and north. The zero isopleth apparently lies beyond stations 400E, 400N/E, and 400N. Dredged material was not observed at stations 400S/E, 300S, and 300W. This suggests that the flanks of the pile extend as indicated in Figure I-6-19. Patches of material were also observed at stations 400N/W (in 1 of 2 replicate images), 400W (in 2 of 3 replicates) and 400S (in 1 of 3 replicates). A similar pattern, i.e. patches of dredged material peripheral to the main body of material, was observed in the post-disposal survey at the FVP site.

Bathymetric surveys of the WLIS III "B" region indicated the presence of a distinct mound approximately centered at station 200E. This mound is apparently comprised of dredged material from previous disposal operations. Dredged material from the March and June operations was draped over this topographic feature. REMOTS images from station 200E reveal a thin layer relative to adjacent stations, as well as evidence of sediment scour.

The major modal grain-size at all stations was silt-clay ($\sim 4\phi$). In addition, minor amounts of very fine to fine sand ($3\text{-}2\phi$) are present at a number of stations. A surface layer of this coarser material exists on the mound top at station 200E and is apparently due to the scouring of the silt-clay fraction. At stations 400W, 300W, 200W, CTR, 300E,

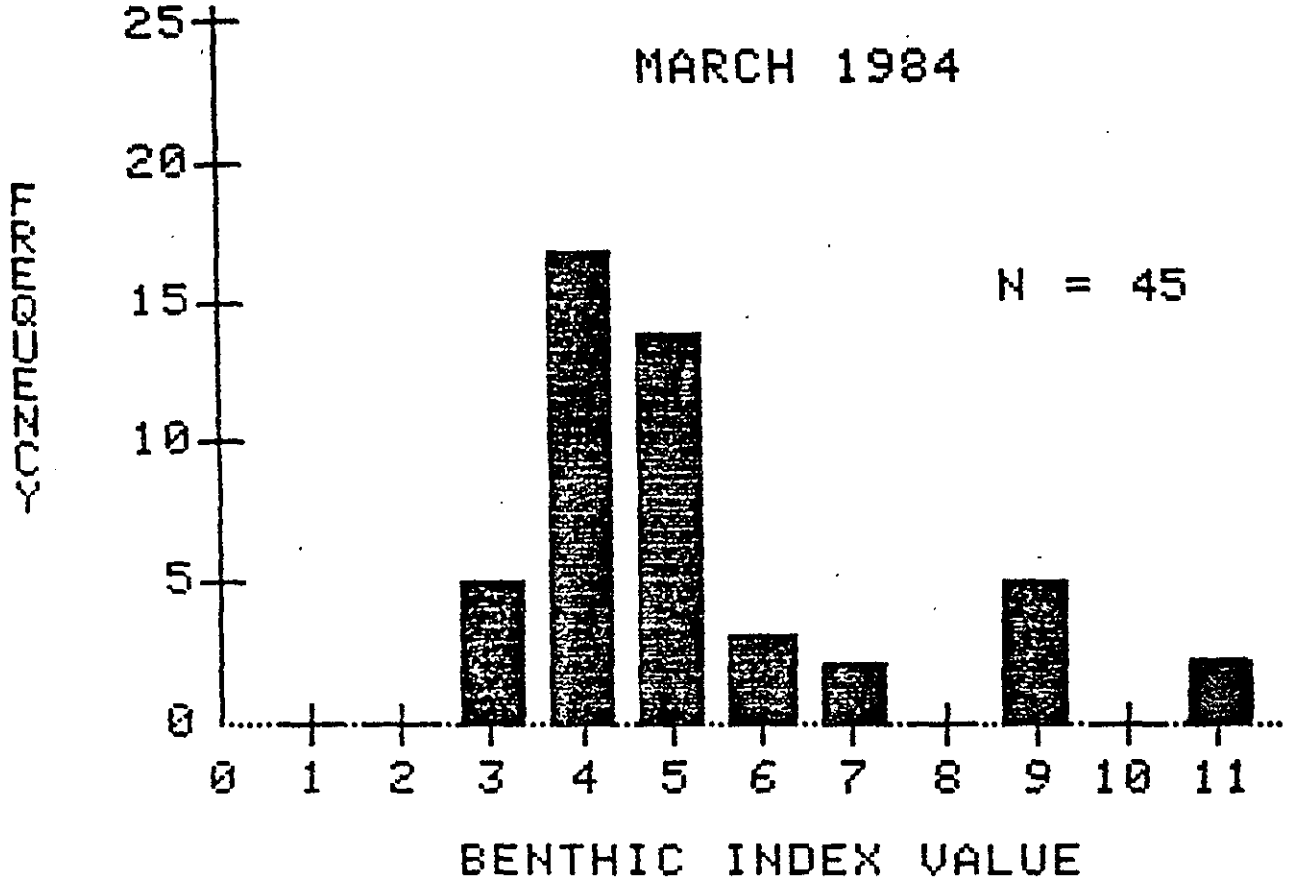


FIGURE I-6-17. Frequency Distribution of Benthic Index Values at the WLIS III "B" Disposal Site in March 1984.

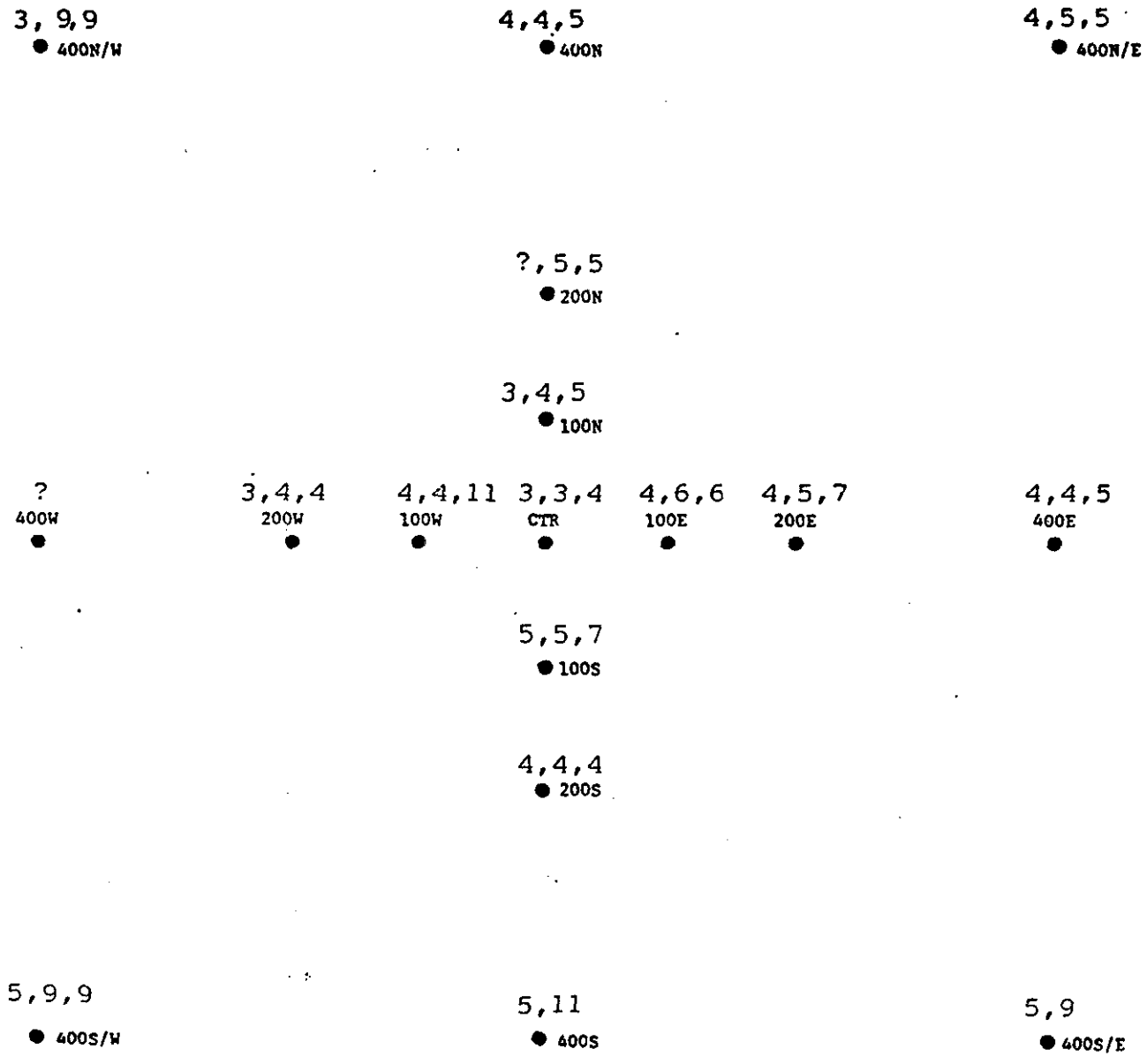


FIGURE I-6-18. Spatial Distribution of Benthic Index Values at the WLIS III"B" Disposal Site in March 1984.

TABLE I-6-3

Stations Occupied During Post-Disposal Survey
March 1984

100N	100E	100S	100W	400N/W	CTR
200N	200E	200S	200W	400N/E	WLIS-REF*
300N*	300E*	300S*	300W*	400S/E	
400N	400E	400S	400W	400S/W+	

* Stations not sampled in the March survey.

+ No data obtained.

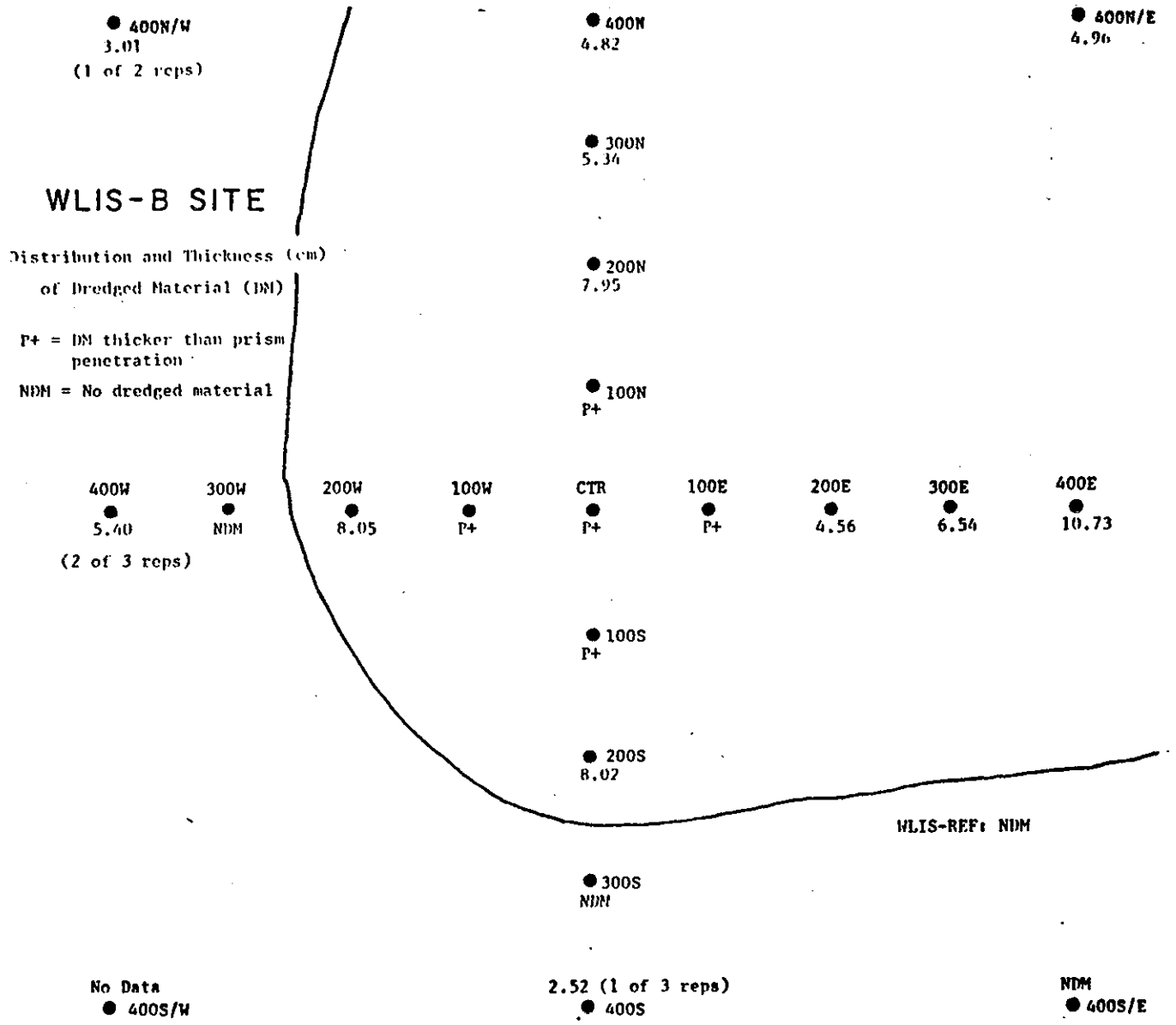


FIGURE I-6-19. Distribution and Thickness of Dredged Material (from the March and June 1984, Disposal Operations) at the WLIS III "B" Site. The Solid Line Indicates the Approximate Boundary of the Main Dredged Material Mound. Patches of Material were also Observed at Station 400NW, 400W, and 400S.

and 400N. Dredged material was not observed at stations 400S/E, 300S, and 300W. This suggests that the flanks of the pile extend as indicated in Figure I-6-19. Patches of material were also observed at stations 400N/W (in 1 of 2 replicate images), 400W (in 2 of 3 replicates) and 400S (in 1 of 3 replicates). A similar pattern, i.e. patches of dredged material peripheral to the main body of material, was observed in the post-disposal survey at the FVP site.

Bathymetric surveys of the WLIS III "B" region indicated the presence of a distinct mound approximately centered at station 200E. This mound is apparently comprised of dredged material from previous disposal operations. Dredged material from the March and June operations was draped over this topographic feature. REMOTS images from station 200E reveal a thin layer relative to adjacent stations, as well as evidence of sediment scour.

The major modal grain-size at all stations was silt-clay ($>4\phi$). In addition, minor amounts of very fine to fine sand ($3-2\phi$) are present at a number of stations. A surface layer of this coarser material exists on the mound top at station 200E and is apparently due to the scouring of the silt-clay fraction. At stations 400W, 300W, 200W, CTR, 300E, 200S, and 400S, a coarse layer ($3-2\phi$) was observed at depth, i.e. beneath the new dredged material layer. In the baseline survey, this sand layer was observed at the sediment-water interface. In conjunction with the relict RPD's (Redox Potential Discontinuity), this buried sand layer proved useful in estimating the thickness of the dredged material layer in many of the REMOTS images.

The frequency distribution of surface boundary roughness values is shown in Figure I-6-20. The major mode was at 0.8 cm; this compares with a major mode of 0.4 cm in March. The increased boundary roughness probably reflects both the effects of the disposal operation (large-scale relief) and a seasonal increase in the production and persistence of biogenic structures (small-scale relief). Three roughness values greater than 2.4 cm are not included in Figure I-6-20. One of these values, 5.16 cm, was observed at station 200E and is associated with the erosion at the top of the mound. The other two large values, 3.42 cm at CTR and 3.69 cm at WLIS-REF, were due to the presence of large macrofaunal burrows.

Evidence of dredged material from disposal operations prior to the March operation was observed in images from stations 400N, 400N/E, 400S, and WLIS-REF. At stations 400N/E and 400N, two, possibly three, relict RPD's were seen representing the recent disposal operations and a previous disposal operation. At the WLIS-REF site, a single dredged material layer, averaging 4.3 cm in thickness, was evident in four of the six replicates. Given the WLIS-REF stations location (approximately 300 m south of 400SE) and its high benthic indices relative to much of the WLIS III "B" grid, it is assumed that this dredged material layer represents a disposal operation which occurred prior to March 1984.

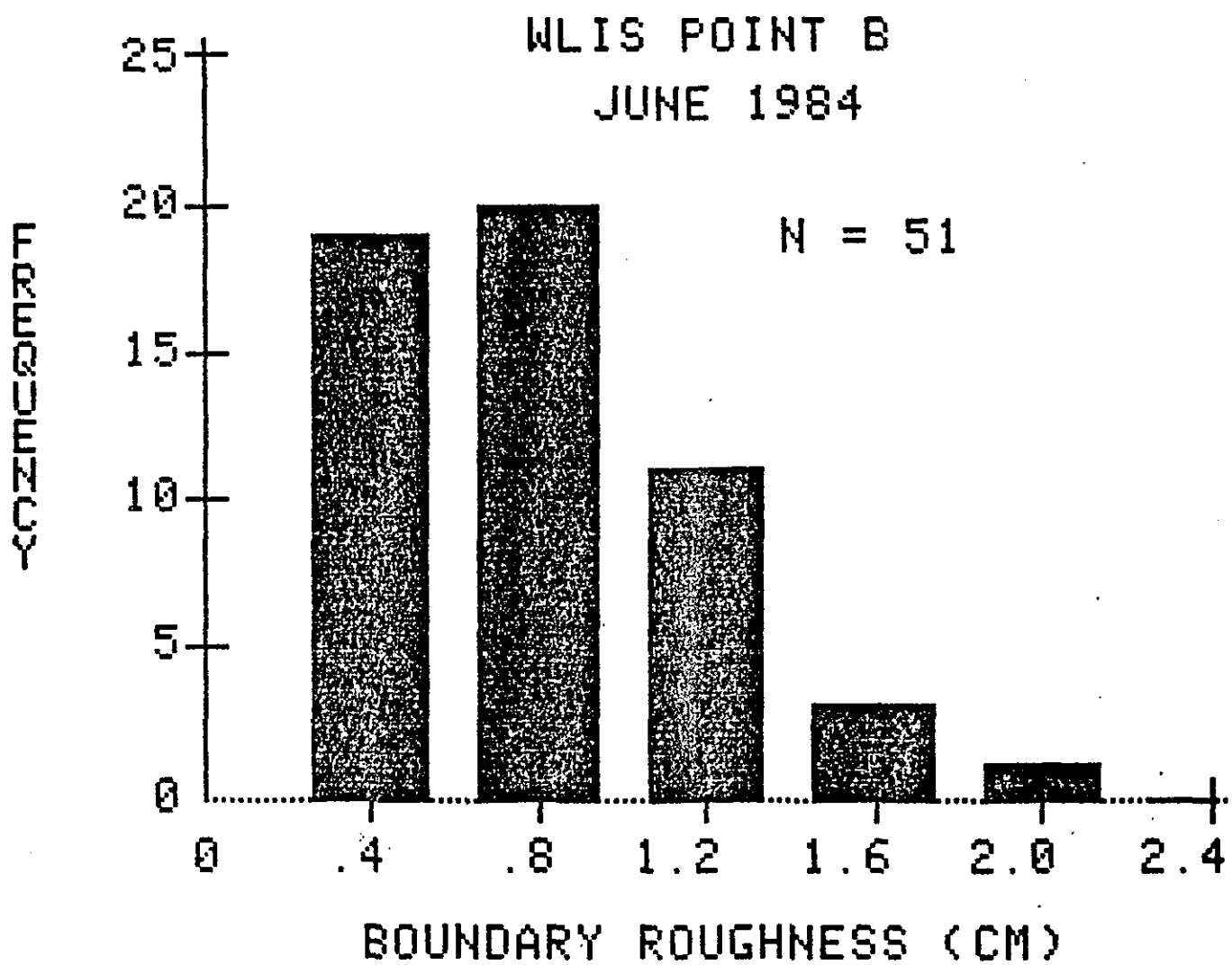


FIGURE I-6-20. Frequency Distribution of Surface Boundary Roughness Values. Three Values Greater Than 2.4 cm are not Included (see text for discussion).

Relict dredged material deposits were observed at eight stations (200W, 200N, 100N, CTR, 100E, 200E, 400E) in the March baseline survey. These dredged material layers were not detected in the present survey because they were buried beneath thick layers of new dredged material.

The frequency distribution of the mean RPD depth for each replicate is shown in Figure I-6-21. The major mode is at 3.5 cm; this compares with 2.0 cm in March. This increase reflects the seasonal (temperature-influenced) increase in biological activity and sediment reworking rates. The mapped distribution of average RPD depths for each station is shown in Figure I-6-22. In general, and despite the recent disposal operation, the RPD depth has increased throughout the WLIS III "B" region since the baseline survey. Only four stations (200E, 300E, 200N, 200S) exhibit average RPD depths less than the WLIS-REF site and, at station 200E, the thin RPD is apparently due to erosional scouring of the sediment-water interface. If these four obviously-affected stations are excluded, there is no significant difference (t-test, $p < 0.4$) between the average RPD depth (3.29 cm) for stations within the main disposal area (as defined by the solid line in Figure I-6-19) and the average RPD depth (3.70 cm) for peripheral stations (including WLIS-REF).

The mapped distribution of successional stages at each station is shown in Figure I-6-23. A majority (74%) of the replicates exhibit Stage I assemblages; this compares closely to the 82% Stage I seres observed in the March survey. Of the stations on the central mound (as defined in Fig. I-6-21) 79% of the replicates are in Stage I, compared with 65% of the peripheral stations (including WLIS-REF). This difference is not significant (G-test for independence, $p < 0.1$), but the pattern does suggest that the main disposal area has not quite returned to the level of the surrounding seafloor in terms of the abundance of Stage III fauna (i.e. head-down feeders).

The frequency distribution for benthic indices is shown in Figure I-6-24. The major mode is at 7; this compares with the major mode of 4 in March. This increase largely reflects the increase in RPD depths throughout the WLIS III "B" region since March. Figure I-6-25 is the mapped distribution of benthic index values. Mirroring the RPD data, only stations 200E, 300E, 200N, and 200S have obviously depressed values (~ 5). Excluding these four stations, the average benthic index for the central region, 7.00, is not significantly different from the average benthic index of the surrounding stations, 7.37 (t-test, $p < 0.5$). This uniform distribution of benthic index values across the WLIS III "B" area indicates that, by and large, the site has returned to ambient WLIS levels.

7.0 CURRENT MEASUREMENTS AND TRANSMISSOMETRY

An Endeco Type 174 ducted impeller current meter was deployed during the January 1982 survey period to provide an

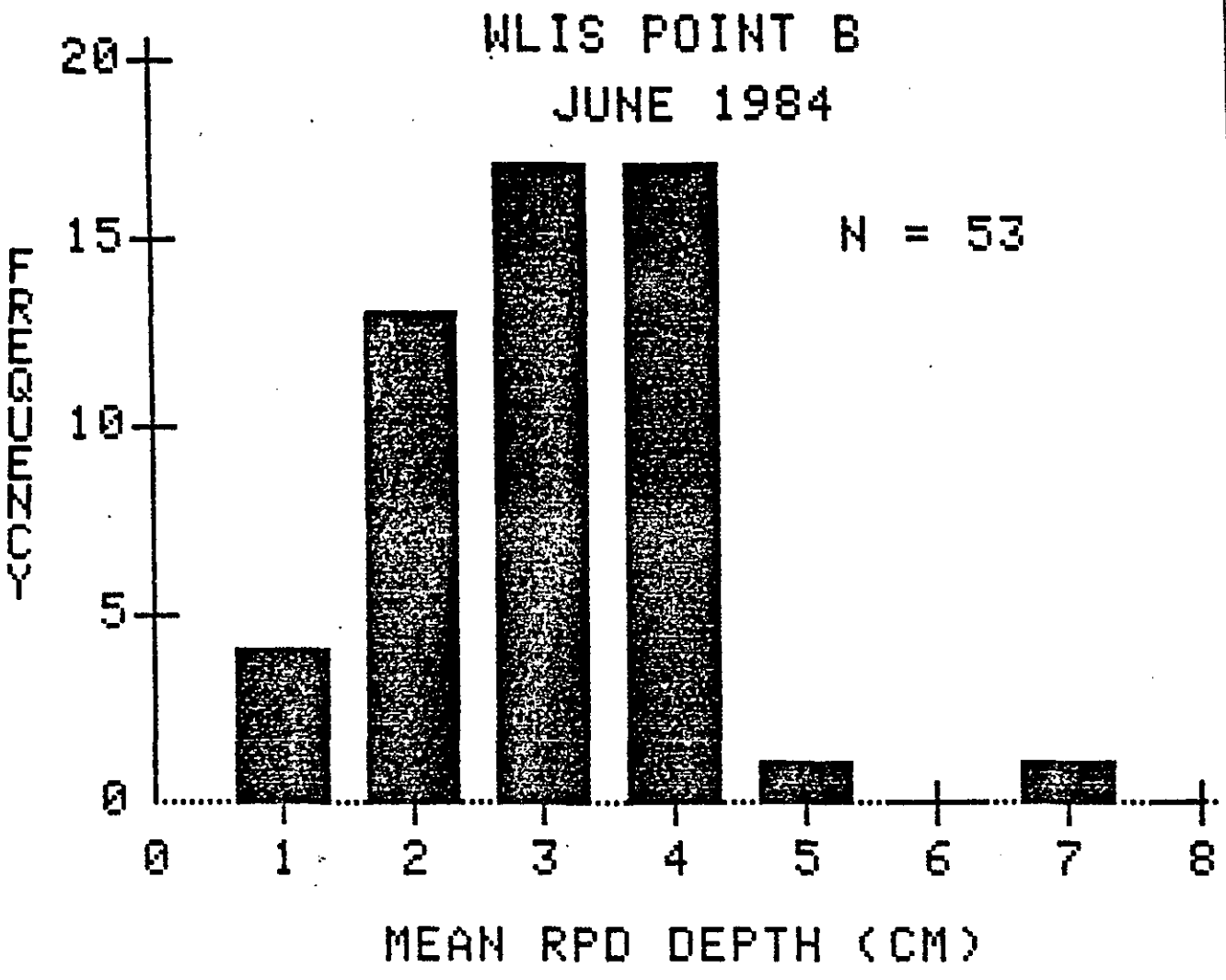


FIGURE I-6-21. Frequency Distribution of Mean RPD Depths for All Stations at the WLIS-B Site.

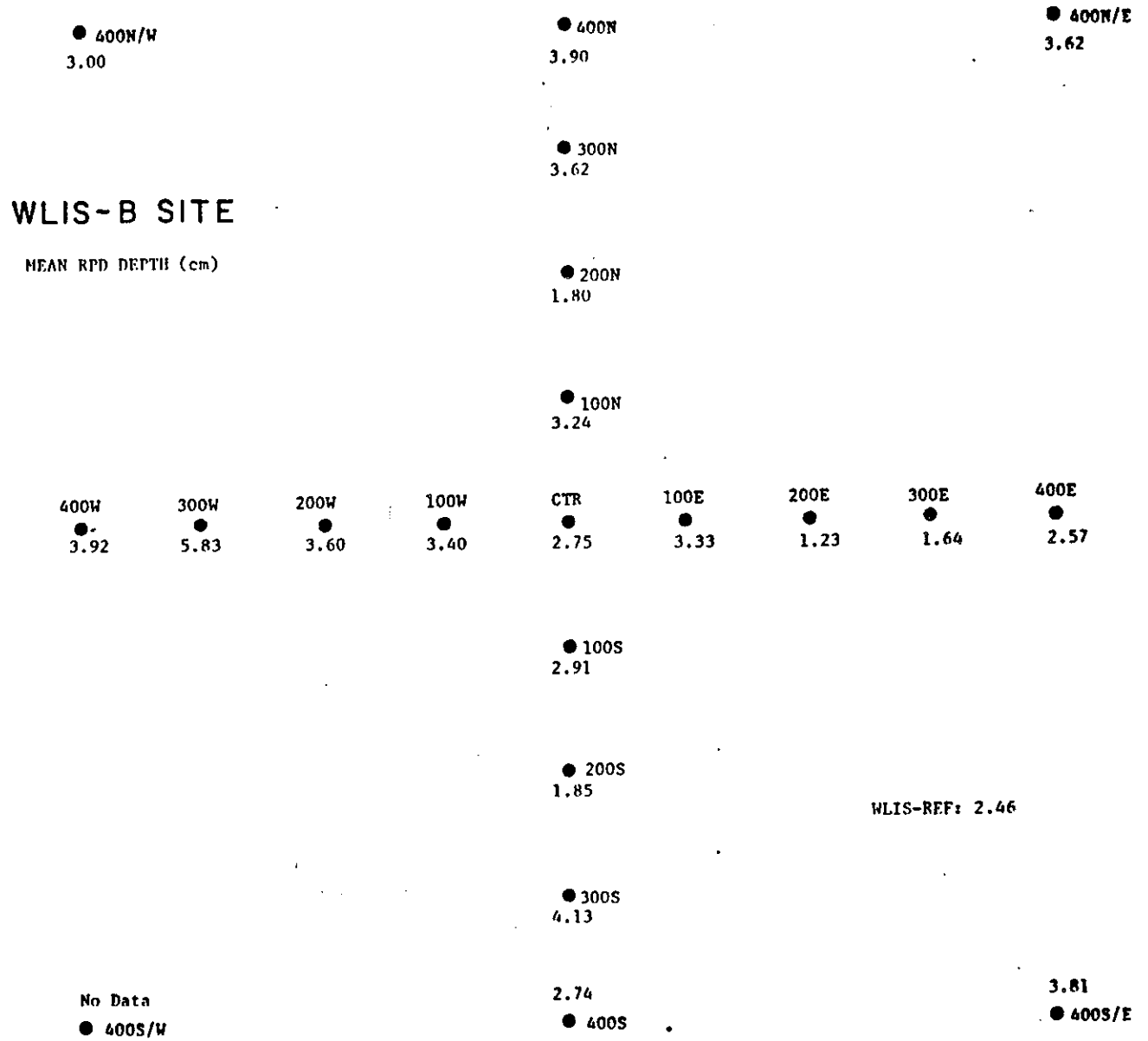


FIGURE I-6-22. Mapped Values of Average RPD Depths at Each Station in the Survey Area. Only Stations 200E, 300E, 200N, and 200S have Mean RPDs Less than the WLIS-REF Station.

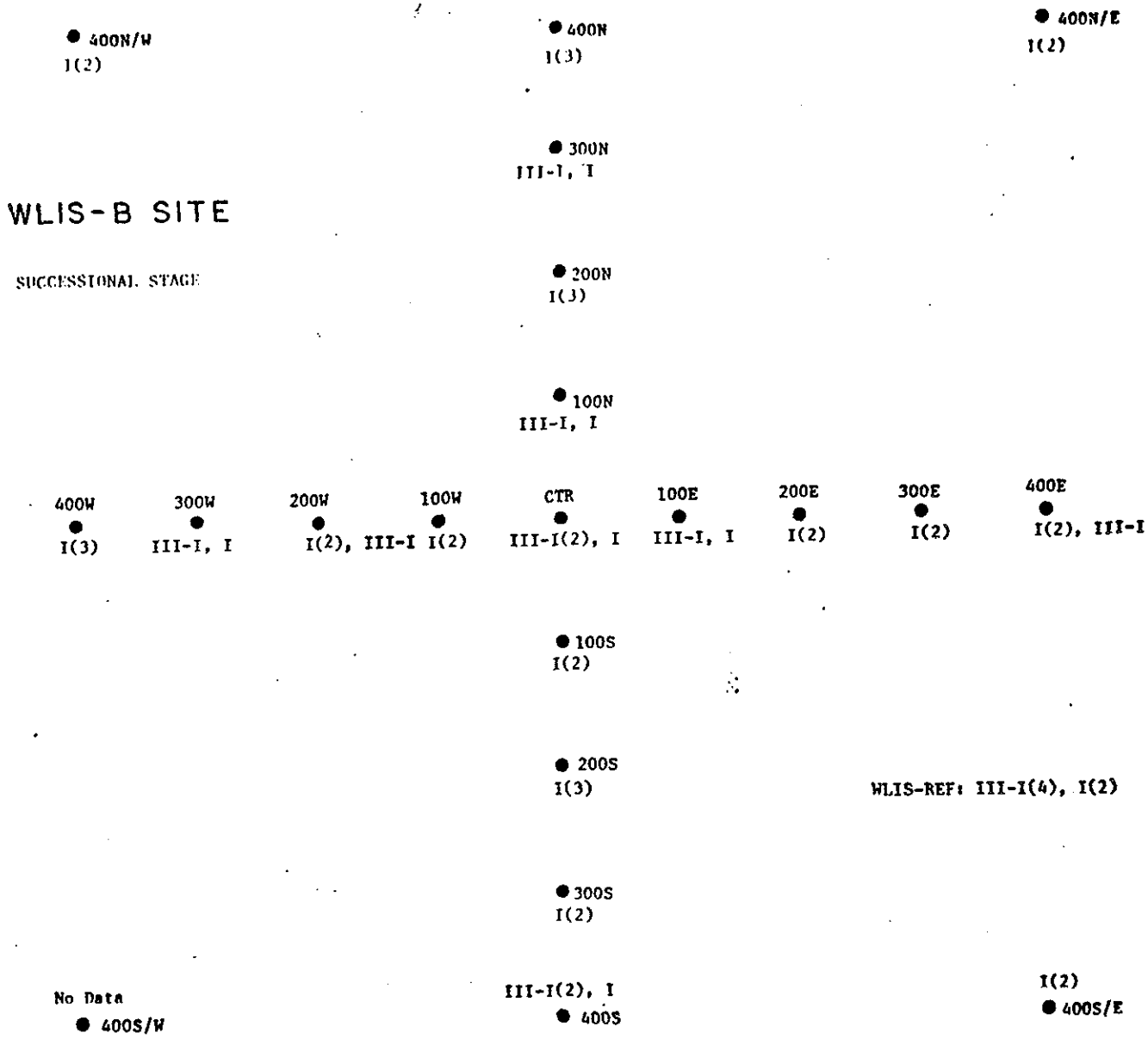


FIGURE I-6-23. Mapped Distribution of Successional Stages at Each Station. Seventy-Eight Percent of the Replicates are Stage I.

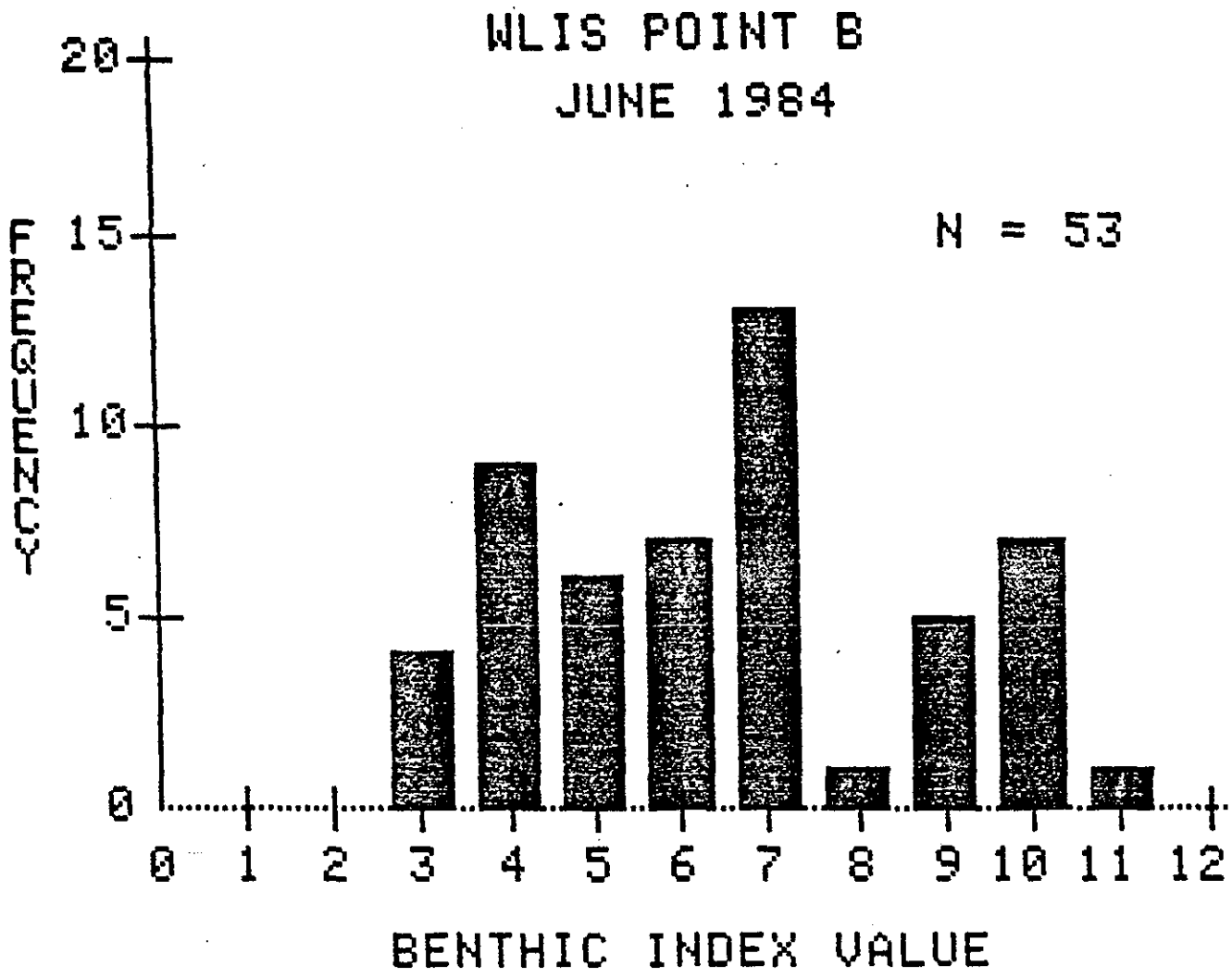


FIGURE I-6-24. Frequency Distribution of Benthic Values for All Stations.

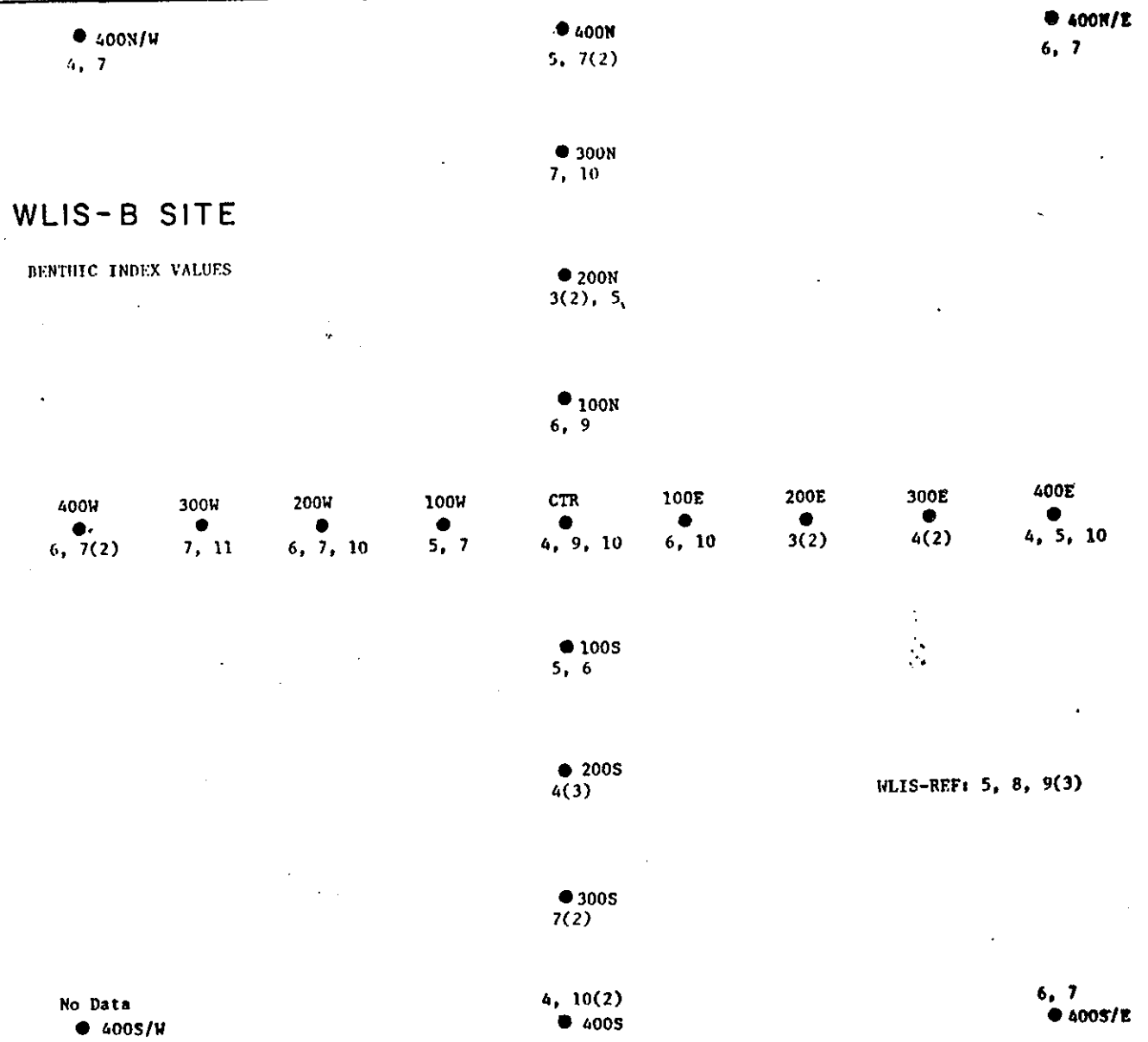


FIGURE I-6-25. Mapped Distribution of Benthic Index Values. Only Stations 200E, 300E, 200N, and 200S Have Obviously Depressed Values.

assessment of the containment potential of the site through a comparison of data previously obtained at the Eatons Neck Disposal Site. The meter was deployed at 40°59.55'N, 73°28.51'W in the standard DAMOS configuration, 1.5 meters above the bottom, at 1230 on 19 January 1982 and retrieved at 1040 on 26 January to provide approximately one week of data.

The direction sensor on the instrument did not operate correctly during the deployment, however, the speed data were unaffected and the results of the measurement period are presented in Figure I-7-1. Although the direction is not accurately known, the general flow can be inferred by relating the time to current velocity so that the ebb (easterly) and flood (westerly) cycles can be distinguished.

In general, the peak tidal velocities encountered were slightly higher than those described in the EIS for WLIS III (flood - 15 cm/sec, ebb - 25cm/sec) and were stronger in the flood rather than ebb direction. Mean flood velocities were about 18 cm/sec toward the end of the survey period, peak velocities for the flood cycle increased dramatically to 45 cm/second although the ebb values remained essentially constant. Some of this increase can be attributed to spring tides which showed an increase in height from 1.9 to 2.2 meters at Bridgeport during the survey period. However, most of this velocity increase probably results from high winds which occurred on 24 and 25 January. Wind speeds on 25 January were over 30 knots and caused cancellation of survey operations on that day. Such a current response to wind conditions, particularly from the east, resulting in higher westerly flows is consistent with previous observations both in Western and Central Long Island Sound sites.

Although the velocities associated with the wind conditions are significantly higher than normal conditions at the site, they are not large enough to cause concern over the long term stability of sediments at the WLIS III site. Tidal currents at the New London disposal site are consistently greater than 40 cm/sec, often reaching values of 60-70 cm/sec. However, the dredged material deposited at the site remains stable with only slight alterations in surface features attributable to tidal current effects.

Measurements of turbidity were obtained on 26 January using a Martek model XMS transmissometer. Vertical profiles were made at 1045 during slack high water, at 1500 near maximum ebb flow and at 1645 during slack ebb conditions. Water samples were obtained with a Niskin bottle at the surface, mid-depth and bottom for calibration of the transmissometer results. The data obtained from this study are presented in Table I-7-1.

Suspended sediment concentrations of 2.65 mg/l were observed at the bottom during the maximum ebb flow. These values are consistent with earlier measurements obtained at the Central Long Island Sound site and are significantly less than recent

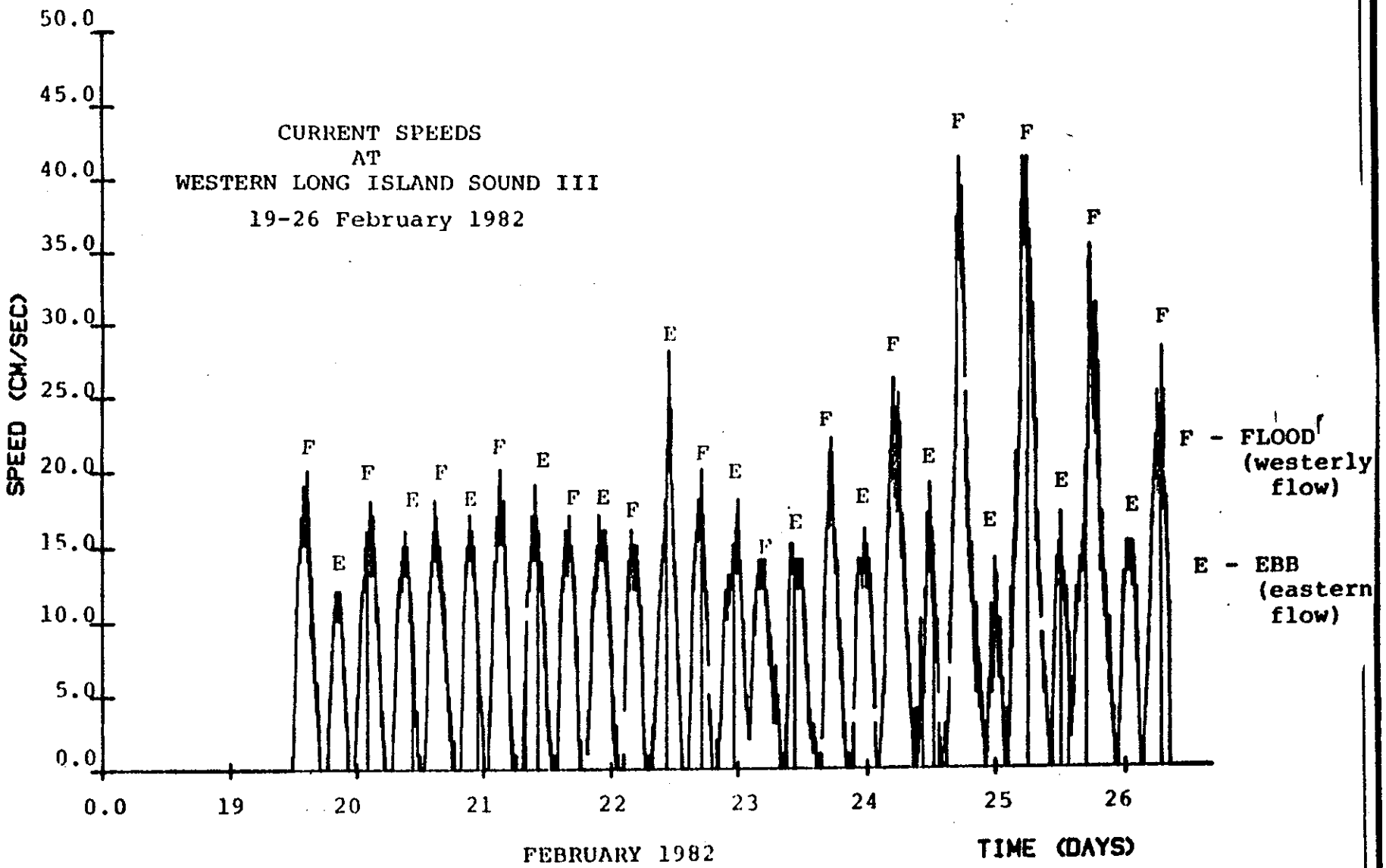


FIGURE I-7-1. Current speeds at WLIS III, 19-26 February 1982.

TABLE I-7-1

Vertical Profiles of Water Column Turbidity
Proposed WLIS III Disposal Site

January 26, 1982

15:00

Depth (m)	Transmission (%)	Water Samples
Surface	17.8	(2A) Surface Suspended material: 2.57[a] 2.27[b] mg/L Salinity: 27.77 27.80°/oo Temperature: -1.2°C -1.2°C
2	18.0	
4	17.2	
6	17.5	
8	18.1	
10	18.2	
12	17.5	
14	17.0	(2B) 15.2 meters Suspended material: 2.26 mg/L Salinity: 27.81°/oo Temperature: -1.0°c
16	17.1	
18	16.7	
20	17.0	
22	17.1	
24	17.1	
26	17.0	
28	16.9	
30	16.3	
32	15.9	
34	15.4	
36	11.0	(2C) Bottom Suspended material: 2.65 mg/L Salinity: 27.80°/oo Temperature: -1.0°C

FIGURE I-7-1 (Cont.)

TABLE I-7-1 (Cont.)

January 26, 1982

16:45

Depth (m)	Transmission (%) Down	Transmission (%) Up	Water Samples
Surface			
2	20.5	20.4	(3A) Surface
4	20.0	20.5	Suspended material: 1.91 mg/L
6	20.2	20.1	Salinity: 27.48°/oo
8	20.2	19.5	Temperature: -1.7°C
10	20.2	20.1	
12	20.0	20.2	
14	20.5	19.8	(3B) 11.6 meters
16	20.4	20.0	Suspended material: 2.64 mg/L
18	20.2	20.0	Salinity: 27.72°/oo
20	20.1	19.5	Temperature: -1.0°C
22	18.5	18.2	
24	17.4	18.5	
26	16.8	16.0	
28	15.2	14.6	
30	14.5	14.0	
32	14.9	15.5	
34	14.5	14.0	
	13.8	--	(3C) Bottom
			Suspended material: 2.27 mg/L
			Salinity: 27.71°/oo
			Temperature: +0.1°C

FIGURE I-7-1 (Cont.)

TABLE I-7-1 (Cont.)

January 26, 1982

10:45

Depth (m)	Transmission (%)		Water Samples
Surface	18.0	(1A)	Surface
			Suspended material: 1.60 mg/L
2	17.5		Salinity: 27.78°/oo
4	17.2		Temperature: -1.0°C
6	17.5		
8	17.5		
10	17.5		
12	17.5		
14	17.5	(1B)	14.6 meters
16	17.7		Suspended material: 1.62 mg/L
18	17.8		Salinity: 27.84°/oo
20	17.6		Temperature: -1.0°C
22	17.2		
24	17.0		
26	16.8		
28	16.6		
30	16.6		
32	14.5		
34	16.0		
36	15.0		
38	15.0	(1C)	Bottom
			Suspended material: 1.79 mg/L
			Salinity: 27.86°/oo
			Temperature: -0.5°C

FIGURE I-7-1. Vertical Profiles of Water Column Turbidity
Proposed WLIS III Disposal Site

The April 1982 survey indicated that disposal operations at WLIS III had been conducted successfully and that a small compact mound of dredged material had been created. The properties of the dredged material, particularly the cohesive nature of the gray clay sediment, combined with the management and operational procedures used at WLIS III, generated the expected results and created a stable deposit which should not have significant impacts beyond the immediate area of disposal.

The August and December 1982 surveys indicated that the disposal operations at WLIS III were conducted successfully with the expected results. Most of the material was deposited in a small mound with a radius of about 100m which has remained stable over the period of measurement. The dredged material deposited at the site does not have significantly higher levels of contaminants than the surrounding sediment, but is coarser with a higher percentage of solids in the center of the mound. Photographs of the sediment-water interface indicate a "chaotic" texture and no RPD layer in the vicinity of recent disposal on the mound. Diver observations have indicated an immediate recolonization of the mound by macrobenthic organisms which should cause significant bioturbation which in turn should serve to lower the RPD level and return the mound to ambient oxidization levels.

The post-disposal bathymetric survey in August 1983 showed that the December 1982 through March 1983 disposal operation successfully deposited approximately 41,000 cubic meters of dredged material at WLIS III. The degree of possible contamination from the disposal operations appears non-existent. Visual observations of the sediment samples surfaces and in-situ diver observations indicated that the surface layers of the disposal mound have become oxidized and are being colonized by some infauna and juvenile crabs. REMOTS data showed that the grain size distribution has not changed since the January 1982 survey which occurred just after the beginning of the disposal operation. The mean redox depth has rebounded from 0-1 cm in January to between 3-4 cm in August 1983. The mean habitat index showed a marked improvement over the January values. Faunal colonization at the site appeared to be quite good.

Using both precision bathymetry and REMOTS during March and June 1984, the disposal of Milford Harbor material at the WLIS III "B" disposal point has been accurately described. The mound lies on the west flank of the WLIS III "A" disposal pile, with a maximum height of 1.6 meters. The dredged material sediments are silt-clay in nature with fine sand at the mound center due to erosion. RPD depths following disposal were higher than in the baseline survey primarily due to an increase in biological sediment reworking. The area was dominated in both surveys by a Stage I assemblage. The benthic index increased (due to increased RPD depths and biological activity) following disposal indicating that the region has returned to pre-disposal conditions.

values (8-15 mg/l) observed on natural bottom south of Bridgeport, Connecticut (Bohlen, personal communication). On all three profiles, the percent of transmission decreases gradually from surface to bottom although the gradient is steeper on the final profile at slack ebb conditions. On this profile, surface waters appeared clearer and bottom waters more turbid than the other profiles. However, total suspended material values did not support this variability. In summary, the suspended sediment load at the site was not increased to any significant amount by the wind and wave conditions experienced during the previous two days.

8.0 SUMMARY

Preliminary evaluation of the data obtained during the January 1982 survey indicated that the bottom of the trough in the southwest corner of the site should be a suitable containment site for the disposal of dredged material. The sediment and bottom relief indicated a depositional environment that was stable and uniform over a 1500 x 500 meter area which consisted of relatively anoxic, black organic silts and clays. Peak currents in the site should generally be on the order of 20 cm/sec, but could be higher under high wind conditions from an easterly direction.

The April 1982 survey indicated that disposal operations at WLIS III had been conducted successfully and that a small compact mound of dredged material had been created. The properties of the dredged material, particularly the cohesive nature of the gray clay sediment, combined with the management and operational procedures used at WLIS III, generated the expected results and created a stable deposit which should not have significant impacts beyond the immediate area of disposal.

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The post-disposal bathymetric survey in August 1983 showed that the December 1982 through March 1983 disposal operation successfully deposited approximately 41,000 cubic meters of dredged material at WLIS III. The degree of possible contamination from the disposal operations appears non-existent.

Visual observations of the sediment samples surfaces and in-situ diver observations indicated that the surface layers of the disposal mound have become oxidized and are being colonized by some infauna and juvenile crabs. REMOTS data showed that the grain size distribution has not changed since the January 1982 survey which occurred just after the beginning of the disposal operation. The mean redox depth has rebounded from 0-1 cm in January to between 3-4 cm in August 1983. The mean habitat index showed a marked improvement over the January values. Faunal colonization at the site appeared to be quite good.

Using both precision bathymetry and REMOTS during March and June 1984, the disposal of Milton Harbor material at the WLIS III "B" disposal point has been accurately described. The mound lies on the west flank of the WLIS III "A" disposal pile, with a maximum height of 1.6 meters. The dredged material sediments are silt-clay in nature with fine sand at the mound center due to erosion. RPD depths following disposal were higher than in the baseline survey primarily due to an increase in biological sediment reworking. The area was dominated in both surveys by a Stage I assemblage. The benthic index increased (due to increased RPD depths and biological activity) following disposal indicating that the region has returned to pre-disposal conditions.

9.0 REFERENCES

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