Feasibility Study
Disposal of Dredged Material
Morris Cove, New Haven Harbor

Disposal Area Monitoring System Damos

Contribution 36
July 12, 1984

US Army Corps of Engineers
New England Division

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The dye study of the borrow pit in the Morris Cove area of New Haven Harbor was performed to determine the suitability of this area for the disposal of dredged material from the Mill and Quinnipiac Rivers. Although the borrow pit has relatively steep sides and a depth greater than 12 meters, and even though a strong northerly wind was blowing during the period of measurement, the dye moved northward under the influence of tidal circulation. Further, the high

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20. concentration of dye found in the vicinity of the northern boundary of the borrow pit indicates that the current flows horizontally across the bottom of the pit until striking the slope of the borrow pit, where it is then deflected upwards. Although a dye survey was not conducted on an outgoing tide, similar dispersive characteristics, only in the southerly direction, would be expected. These include a bottom flow with the tide and an upward deflection on contact with the southern boundary of the borrow pit.

Based upon the results of this dye study, the Morris Cove borrow pit does not appear to be a suitable location for the disposal of dredged material. The strong tidal flow in this area demonstrates that the dredged material, especially low density, flocculant material characteristic of Mill River, could be easily transported away from this site under the influence of normal tidal action.

A FEASIBILITY STUDY OF THE DISPOSAL OF DREDGED MATERIAL AT MORRIS COVE, NEW HAVEN HARBOR

Contribution #36

July 12, 1984

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U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Submitted by:

John W. Cutler, Jr.
Science Applications, Inc.
Ocean Science & Technology Division
379 Thames Street
Newport, RI 02840
(401) 847-4210

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1.0 INTRODUCTION

The borrow pit located in the Morris Cove area of New Haven Harbor has been proposed as a possible disposal site for dredged material from the Mill and Quinipiac Rivers. In order to characterize the conditions within and immediately surrounding this borrow pit and to determine its suitability as a disposal site, a bathymetry survey and a tracer dye study were performed at this location as part of the ongoing Disposal Area Monitoring System (DAMOS). This report presents the results of those field studies and makes suggestions based upon the observed results.

2.0 BATHYMETRY

On March 11,1983 a bathymetric survey of the Morris Cove borrow pit and the surrounding area was performed. This survey was conducted at a 25 meter lane spacing with the 38 lanes running in an east-west orientation as shown in Figure 2.0-1. In order to maintain a high degree of position accuracy, navigation control for this and all other aspects of the cruise was provided by the SAI Navigation and Data Acquisition System. This system utilizes a Del Norte Model 540 microwave positioning system integrated with an Apple II microcomputer to provide a position accuracy of $\pm$2 meters. Depth data from a Raytheon Model DE719B recording fathometer with a 200 KHz transducer were input into this microcomputer system via a Raytheon Model SSD-100 digitizer. Shore stations for the Del Norte positioning system were located at Lighthouse Point Light at 41°14.932N, 72°54.254W and at New Haven Harbor Lower Range Light at 41°15.640N, 72°56.111W.

Profile plots of the 38 lanes sailed are presented as

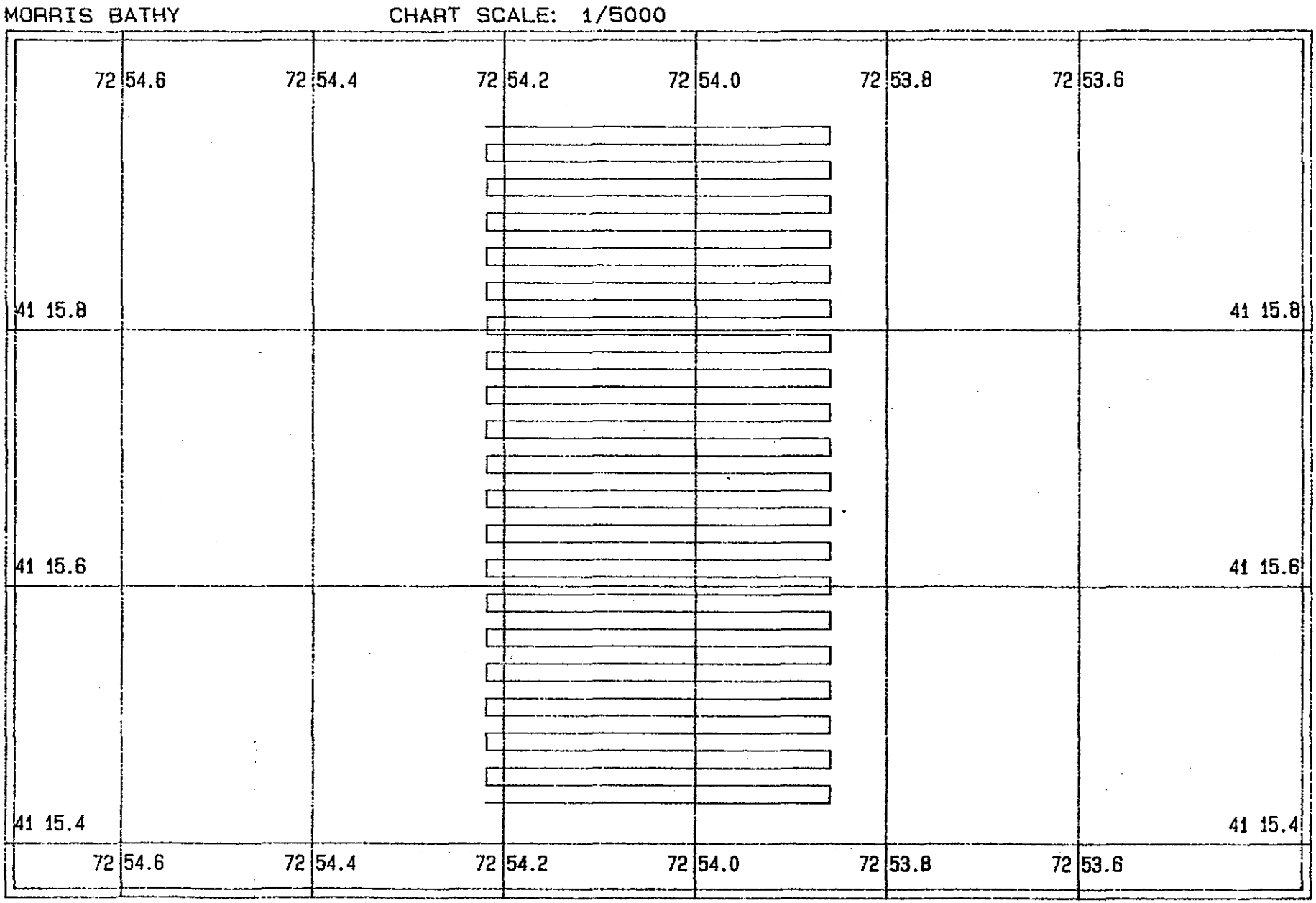


Figure 2.0-1. Bathymetric Survey Lanes

Figures 2.0-2 thru 2.0-11 and contour charts generated from these data are presented as Figures 2.0-12 and 2.0-13. These figures show that the borrow pit is a north-south trending depression which deepens to a maximum depth of approximately 12.5 meters in the south western portion of the feature (lane 26, Fig. 2.0-8). In contrast, the area immediately surrounding the borrow pit may be characterized as flat and featureless with a depth varying from approximately 2.5m at the northern boundaries to about 3.0m at the southern edge of the pit. The width of the borrow pit varies from a minimum of 70m at its northern terminus to a maximum width of approximately 220m across lane 20 (Fig. 2.0-6). Further, while the edges of the borrow pit are generally well defined, there are a few locations notably at the eastern ends of lanes 25 thru 30 (Fig. 2.0-8, 2.0-9) where this boundary is not distinct. The most unusual feature of the borrow pit is the uneven distribution of topography within the pit in the more southern lanes. The profile plots of the northern lanes (lower lane number) show only a single depression in the bottom, while the more southern lanes have profiles which indicate two depressions separated by a rise of as much as 4m (lanes 27 & 28). This topography distribution is most likely the result of material that was not removed during the creation of the borrow pit. Utilizing the volume difference portion of the SAI bathymetric software, it has been determined that 1,207,154 yards^3 (922,990 meters^3) of material would be required to fill this pit to a level equal to that of the surrounding bottom (Fig. 2.0-14).

3.0 DYE STUDY

Figure 2.0-2. Depth Profiles

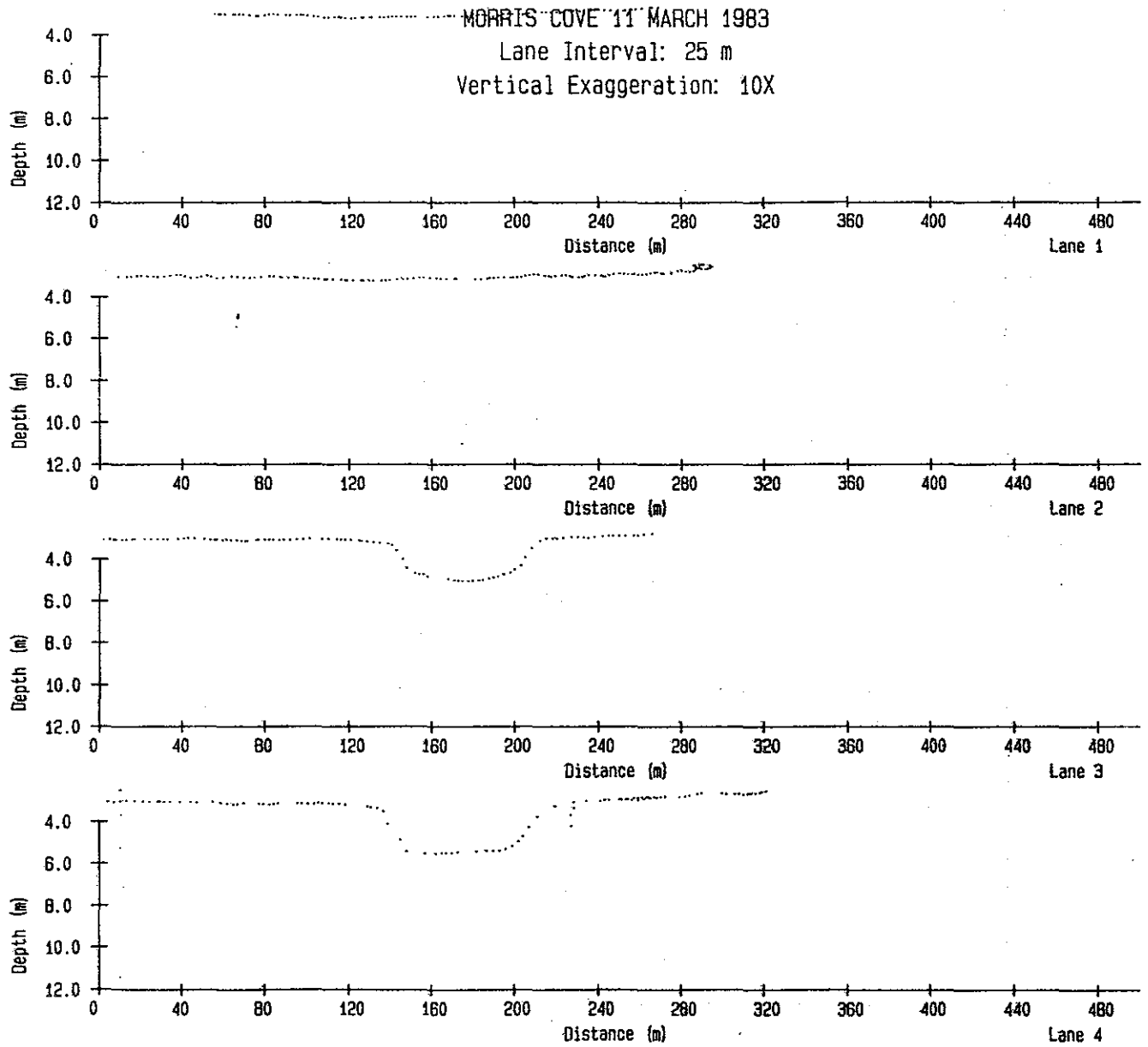


Figure 2.0-3. Depth Profiles

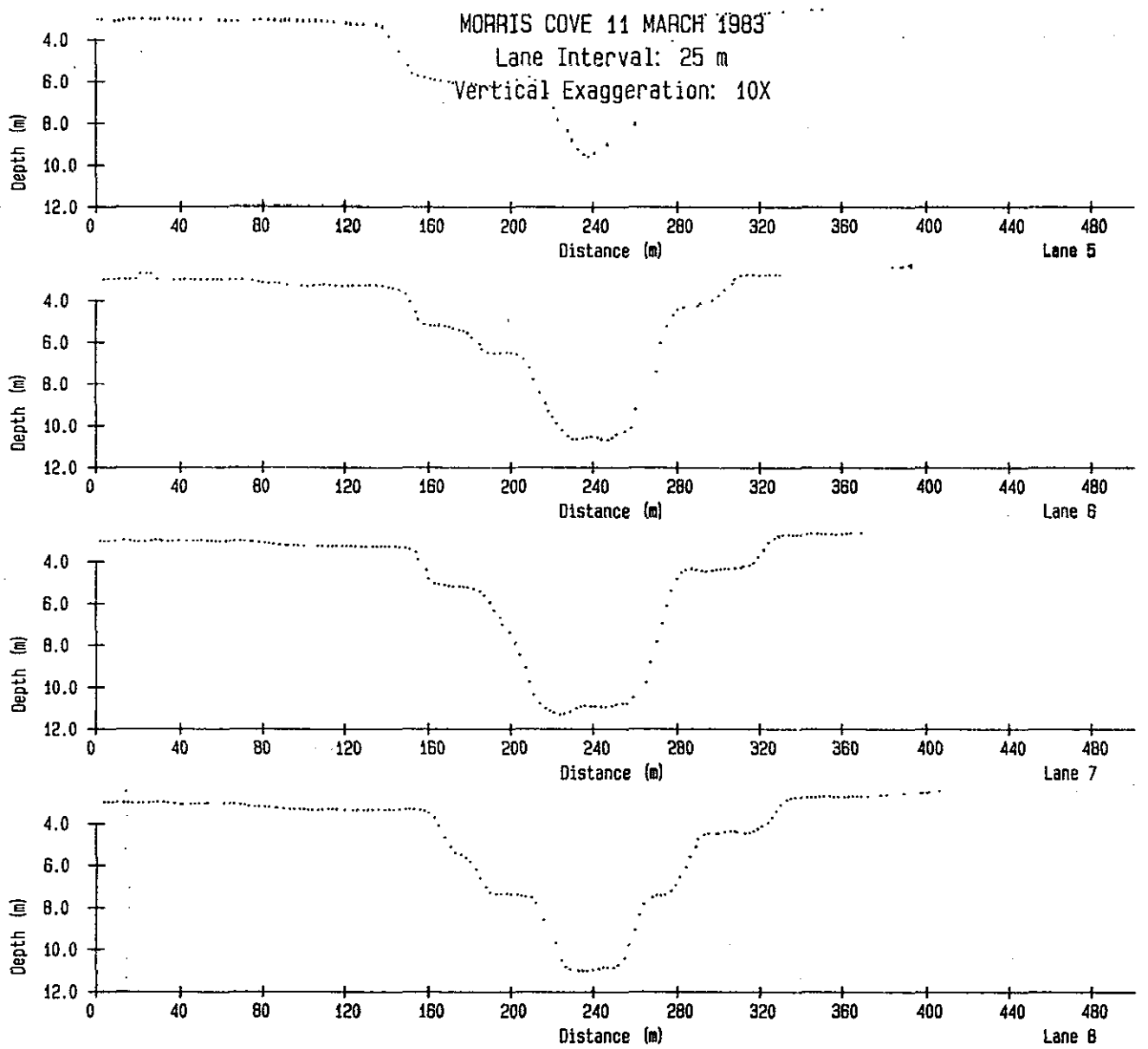


Figure 2.0-4. Depth Profiles

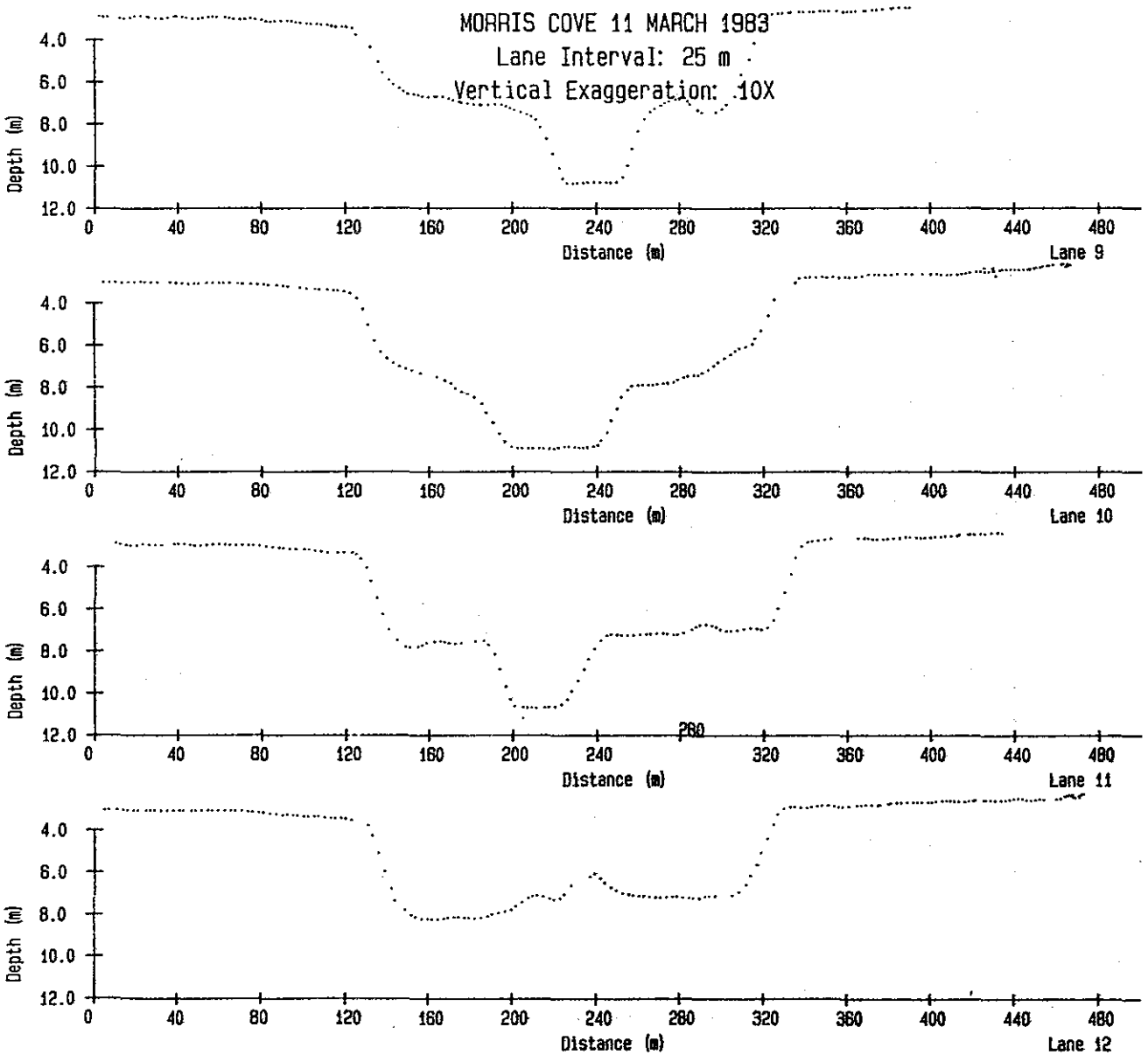


Figure 2.0-5. Depth Profiles

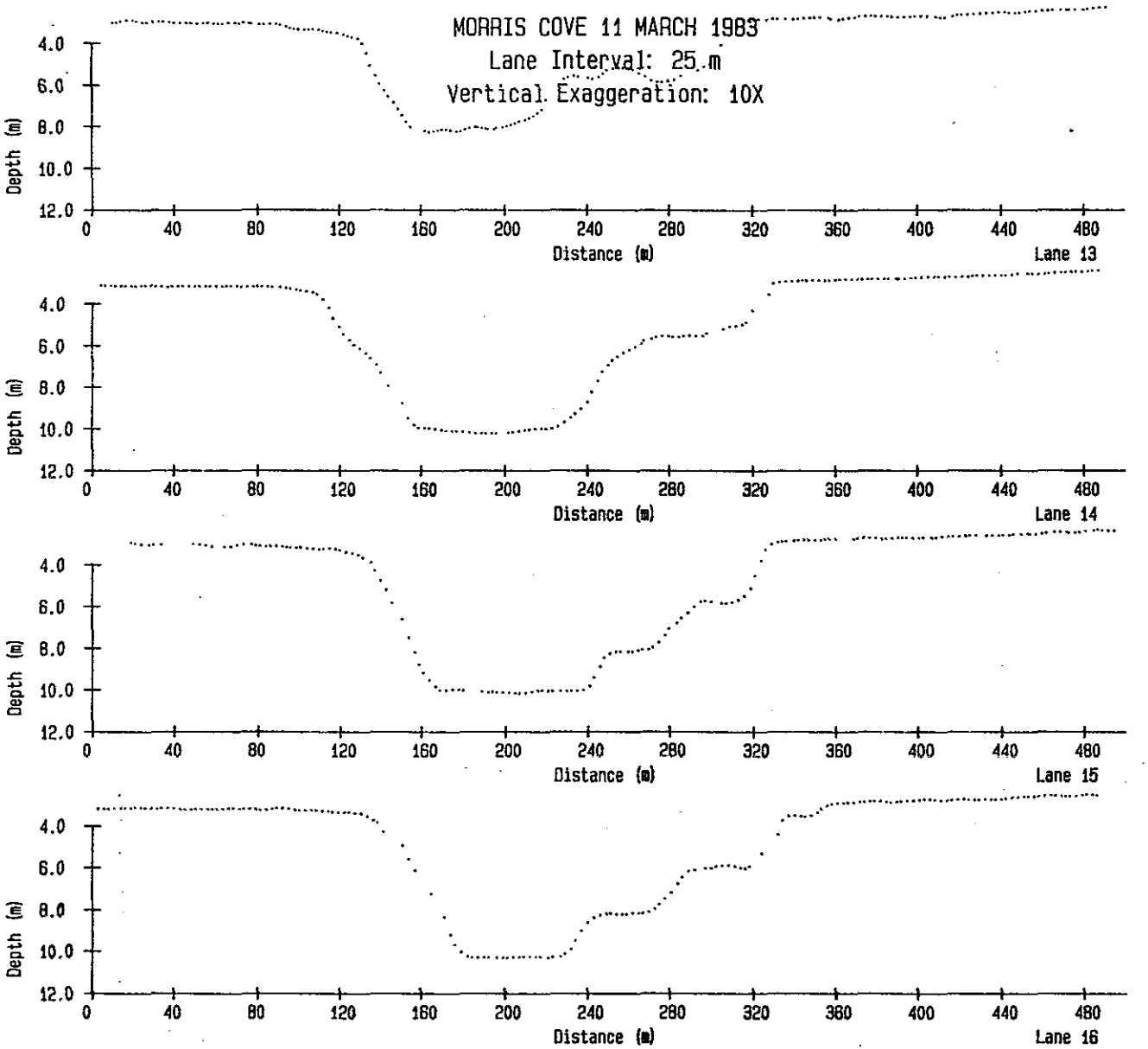


Figure 2.0-6. Depth Profiles

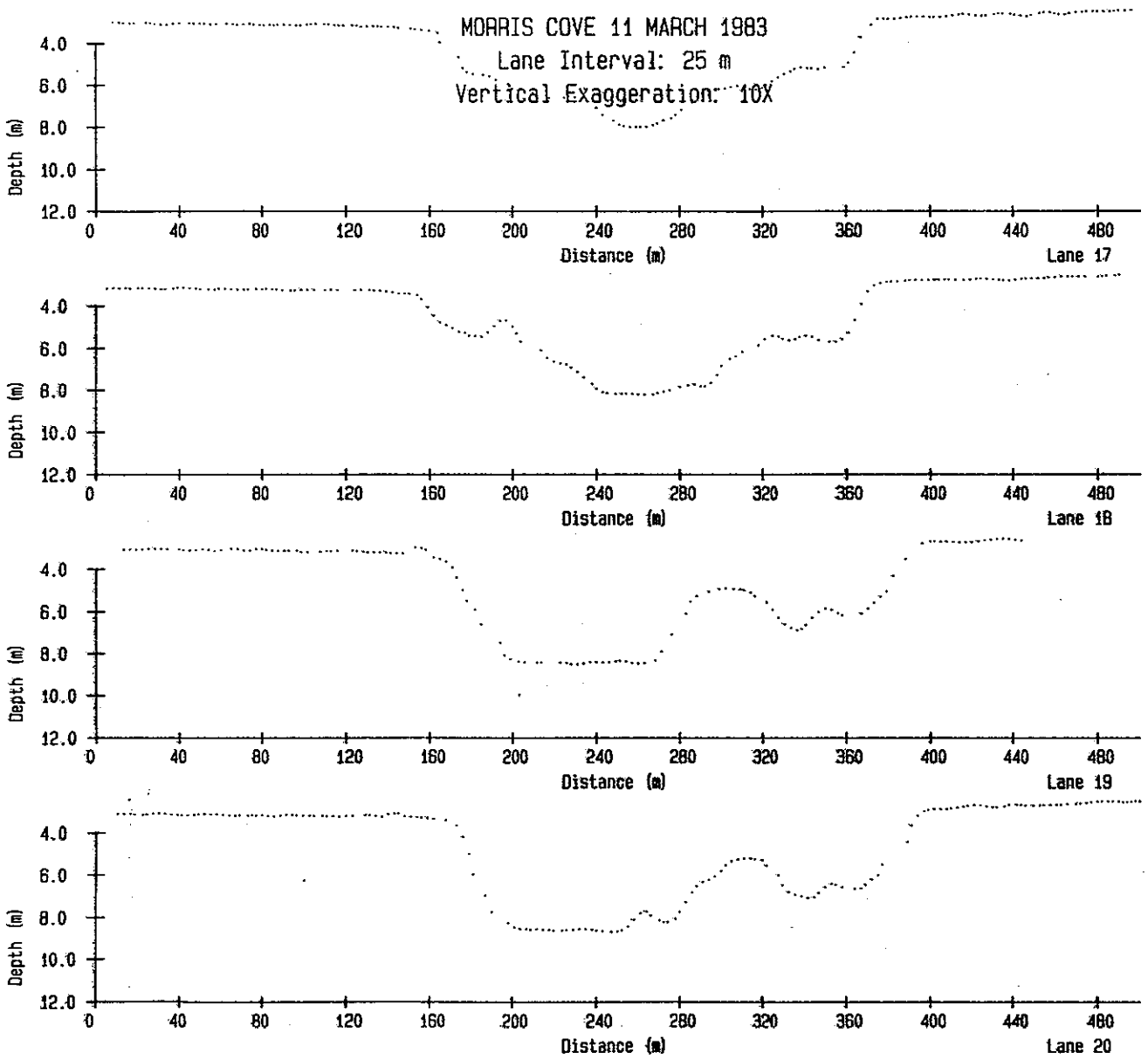


Figure 2.0-7. Depth Profiles

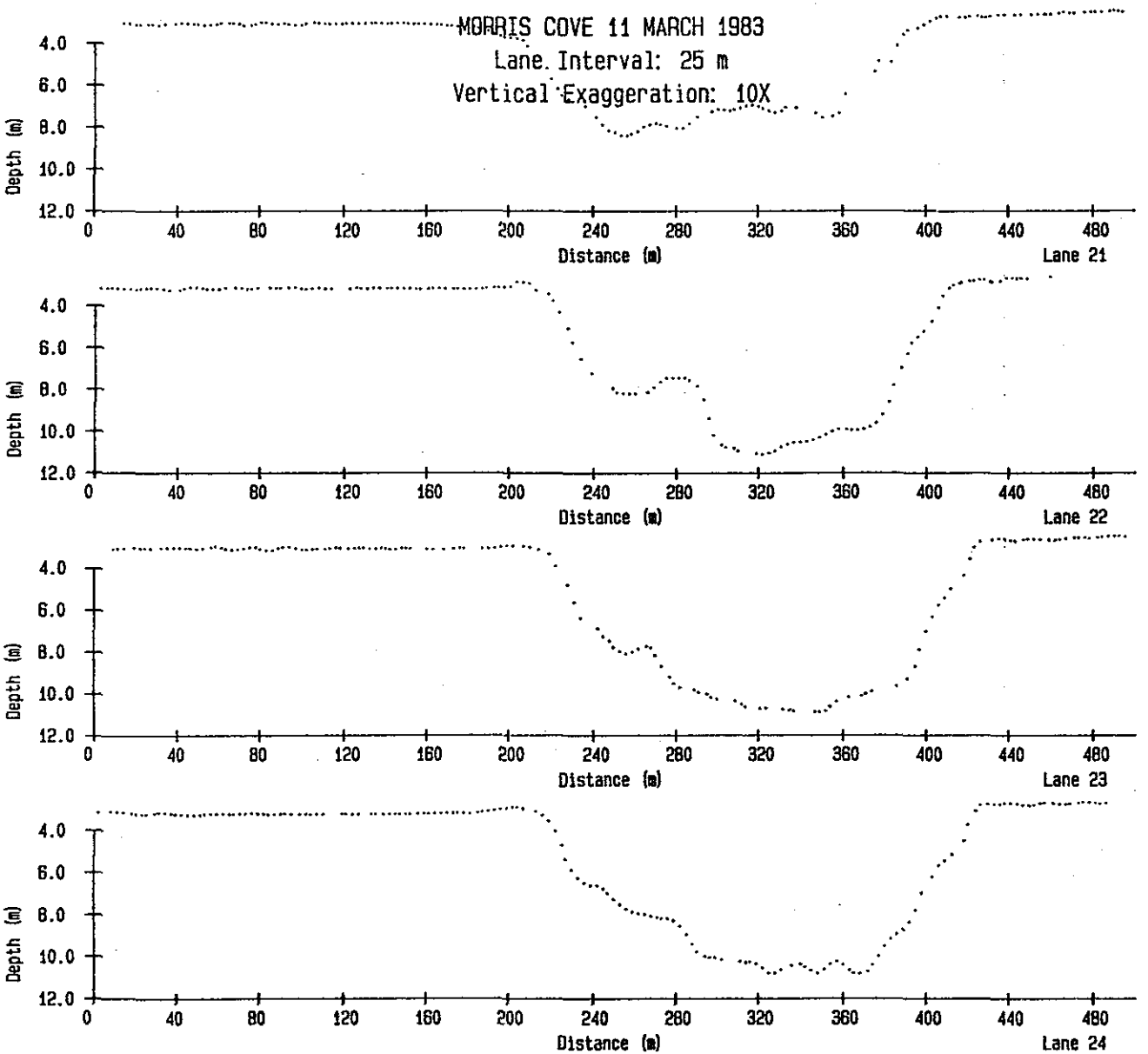


Figure 2.0-8. Depth Profiles

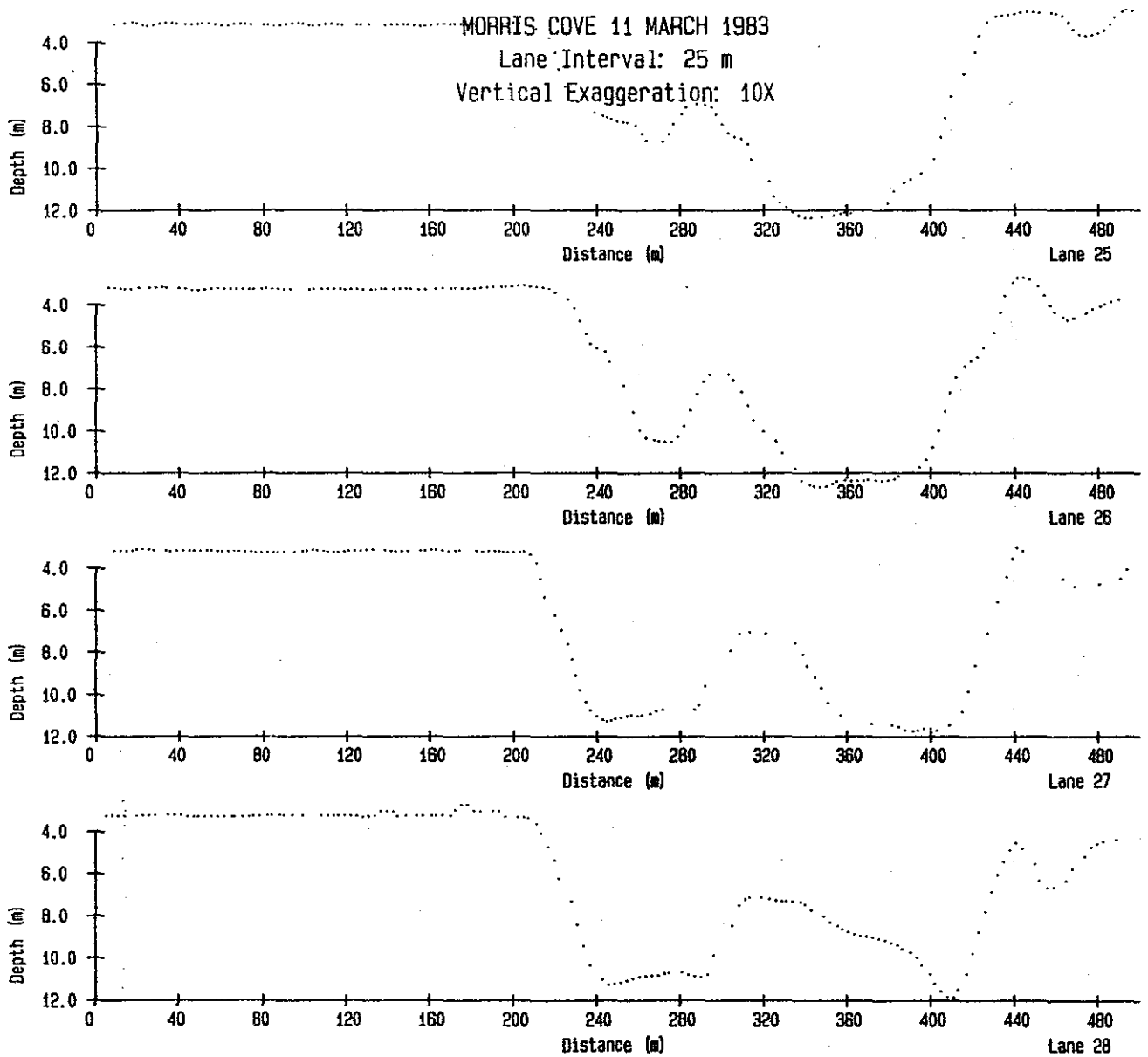


Figure 2.0-9. Depth Profiles

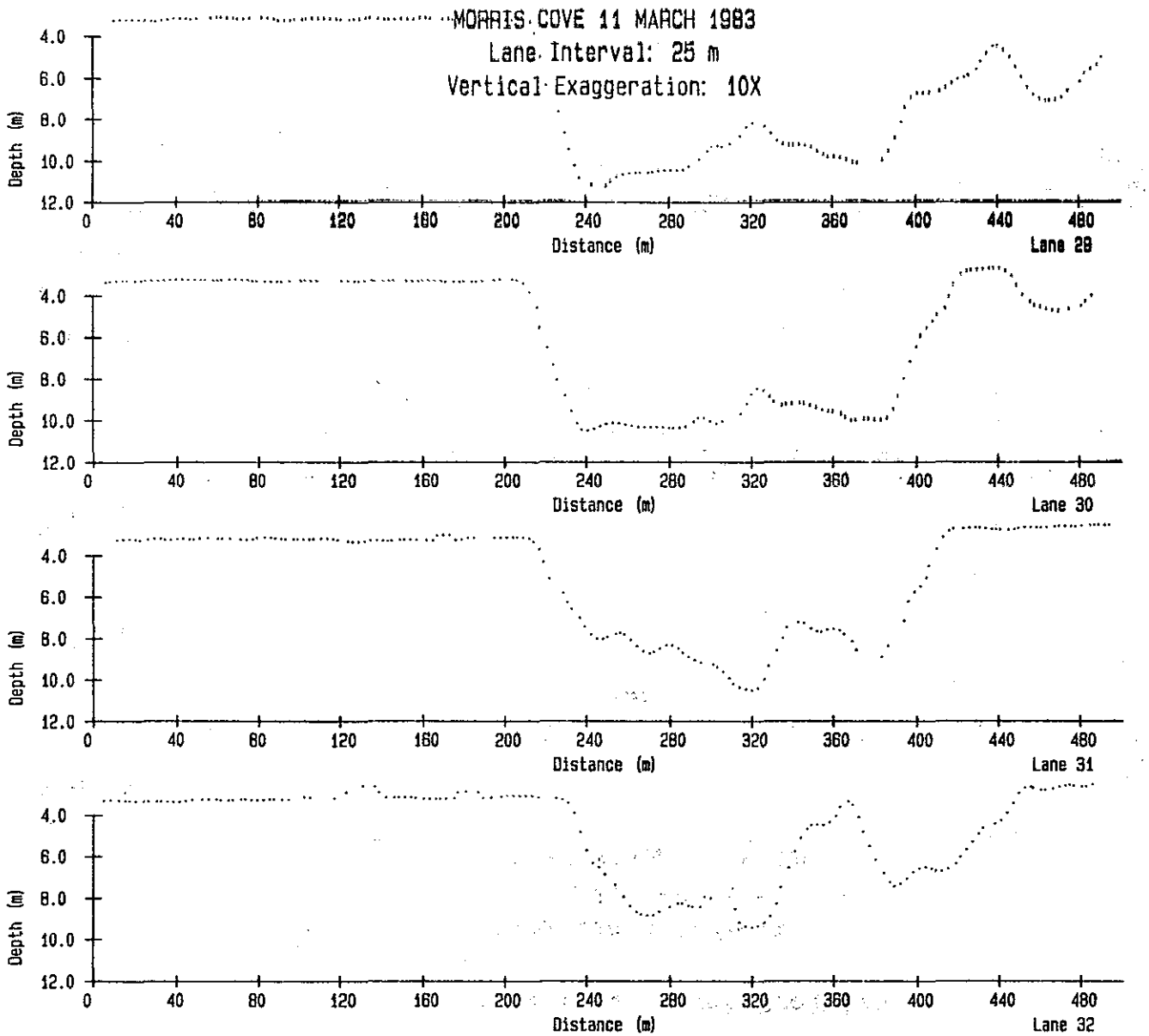


Figure 2.0-10. Depth Profiles

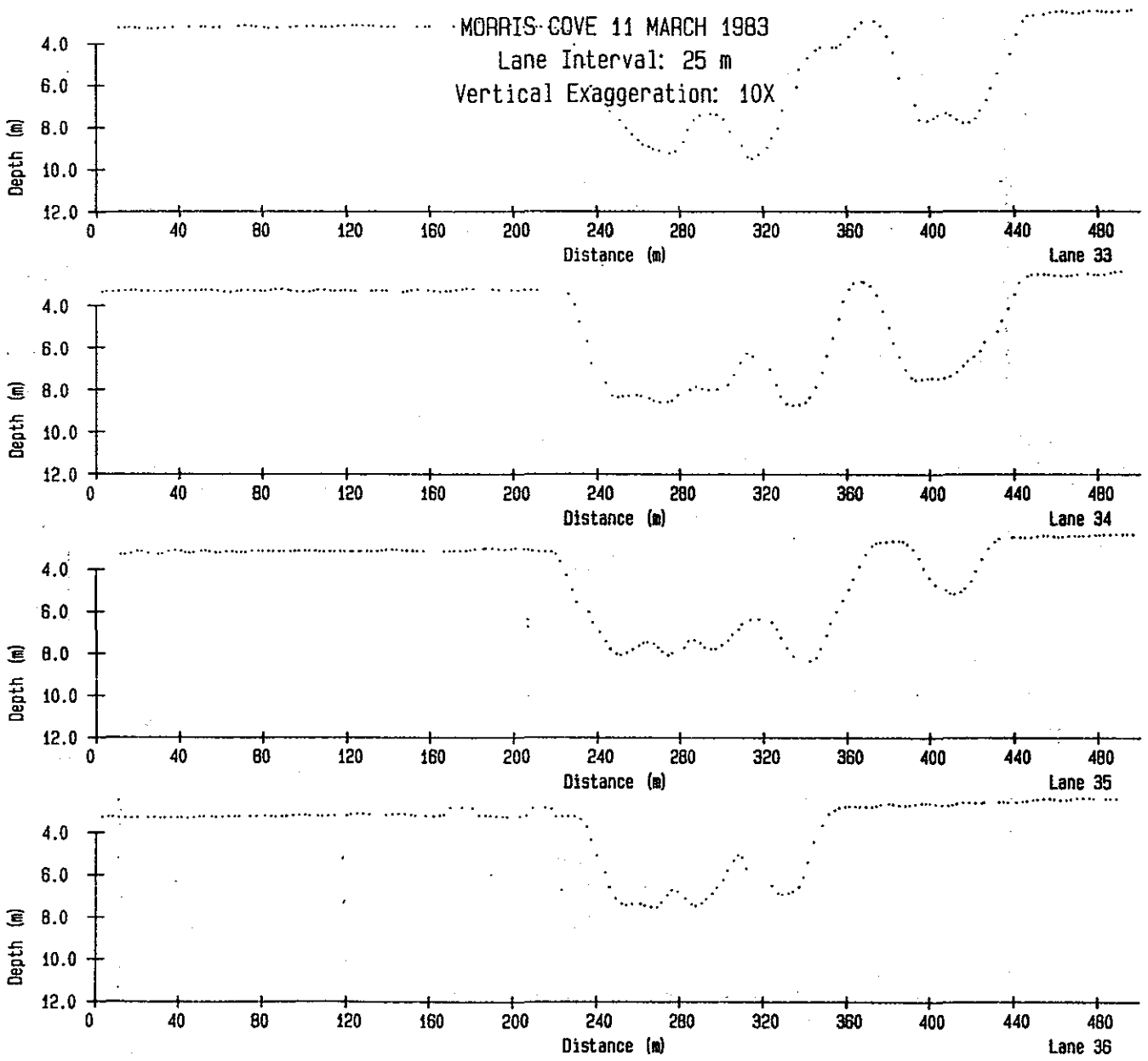
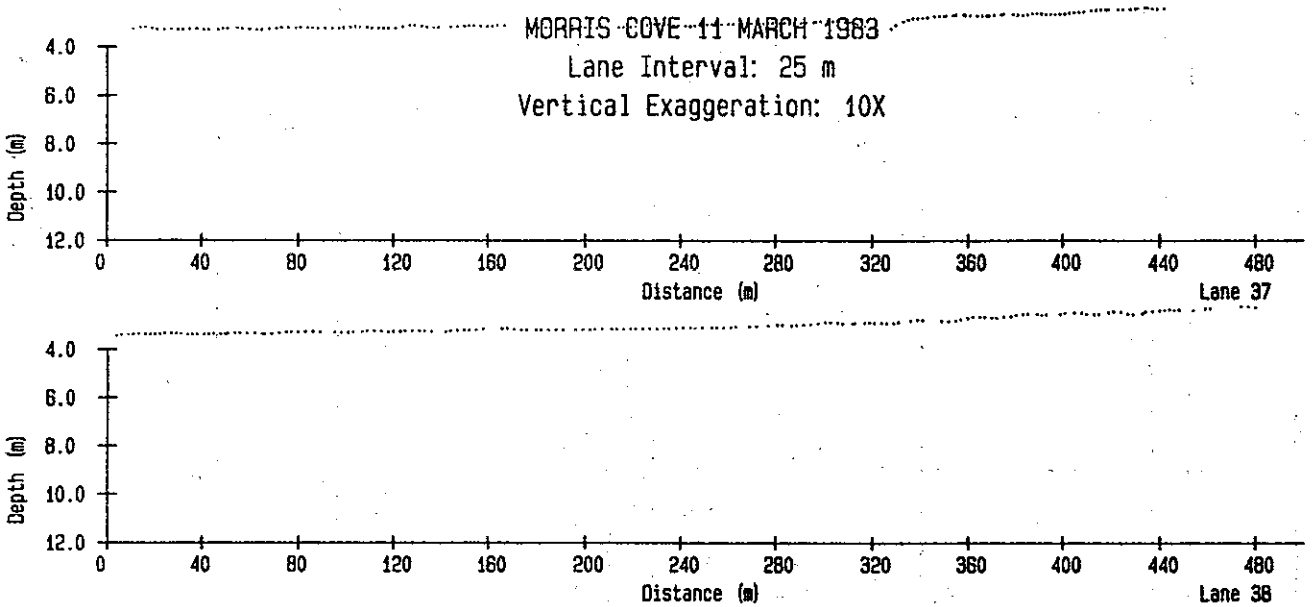


Figure 2.0-11. Depth Profiles



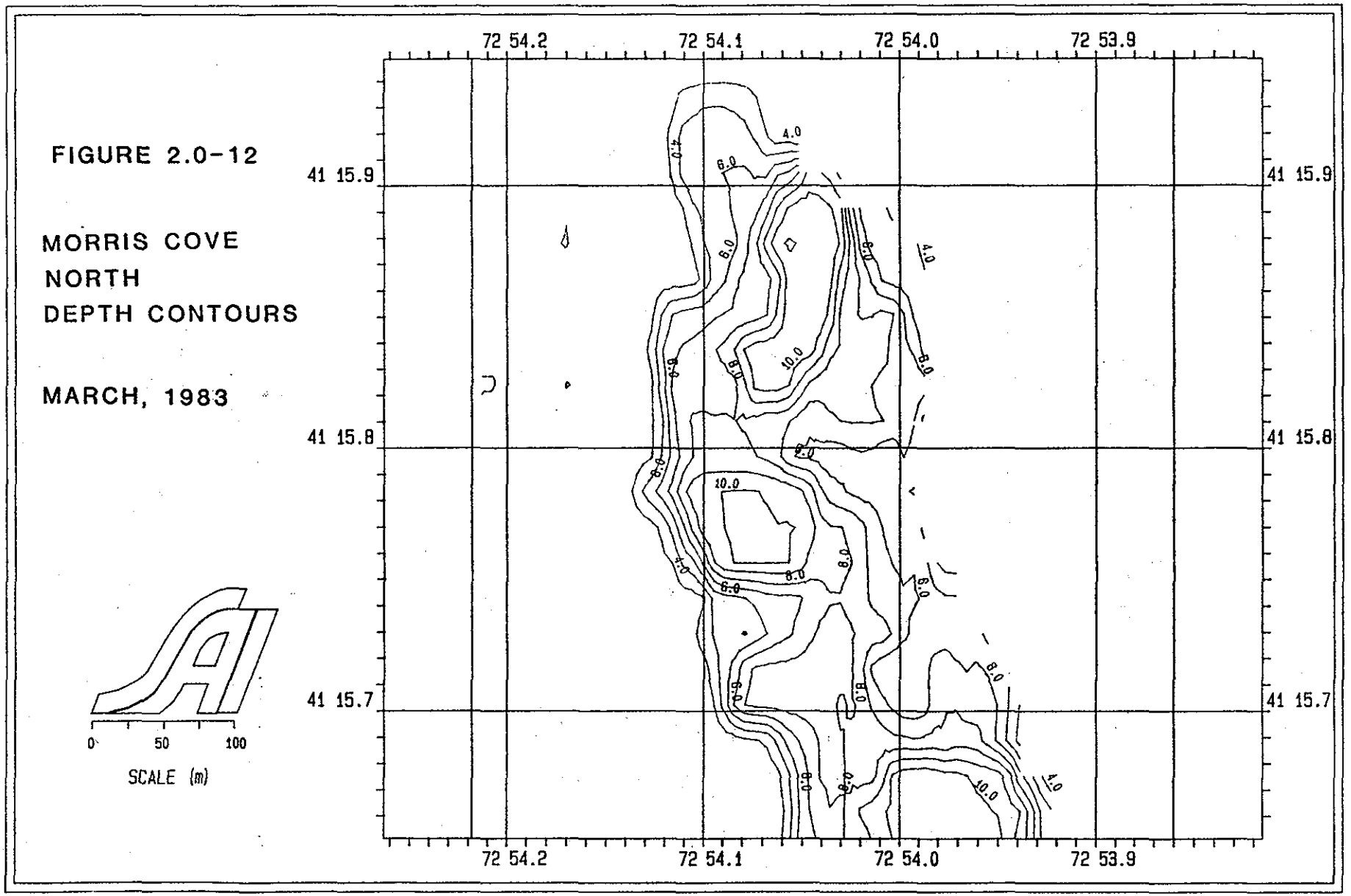


FIGURE 2.0-12
MORRIS COVE
NORTH
DEPTH CONTOURS
MARCH, 1983
72 54.2
72 54.1
72 54.0
72 53.9
41 15.9
41 15.8
41 15.7
4.0
6.0
8.0
10.0
0
50
100
SCALE (m)

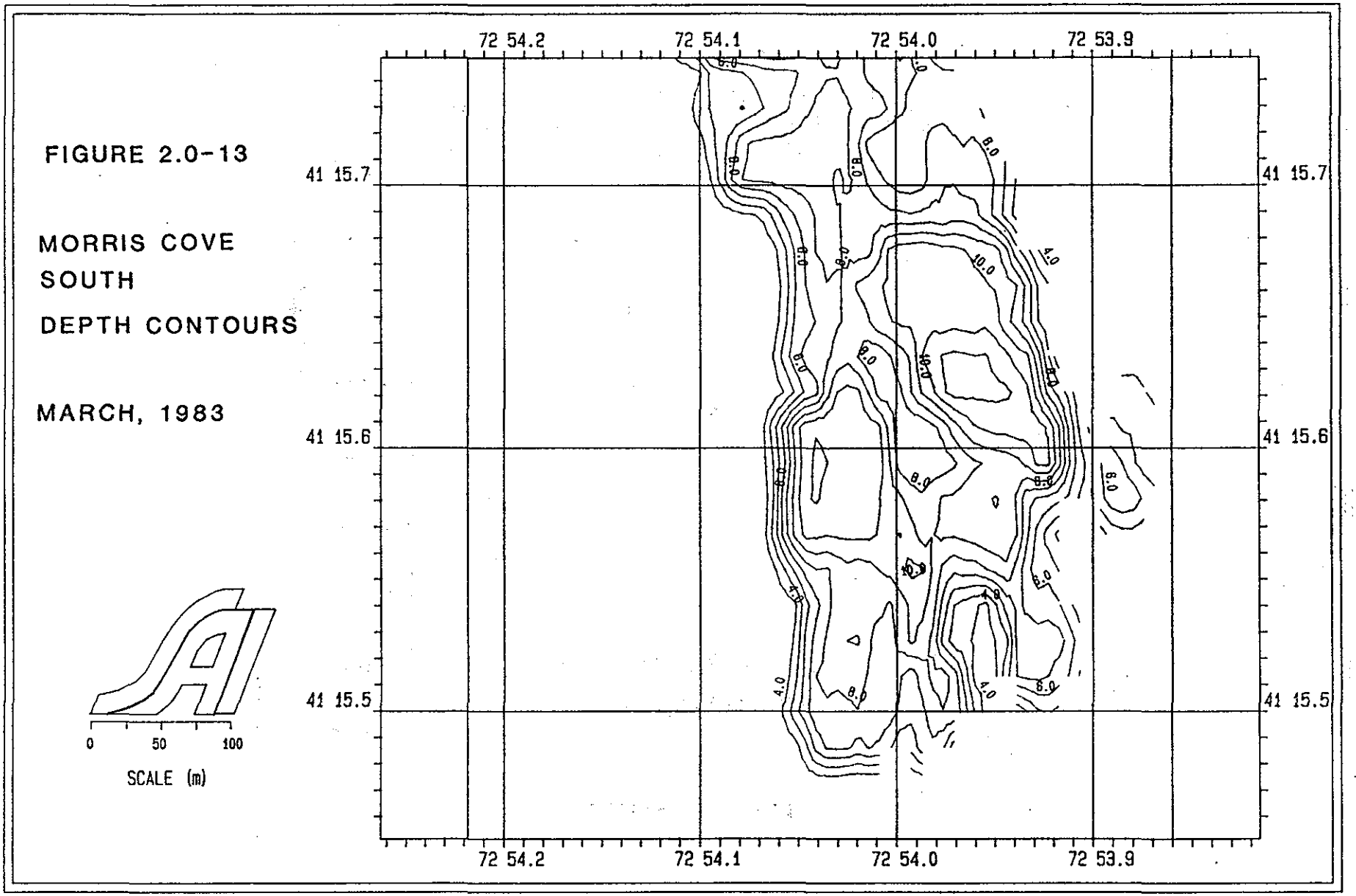
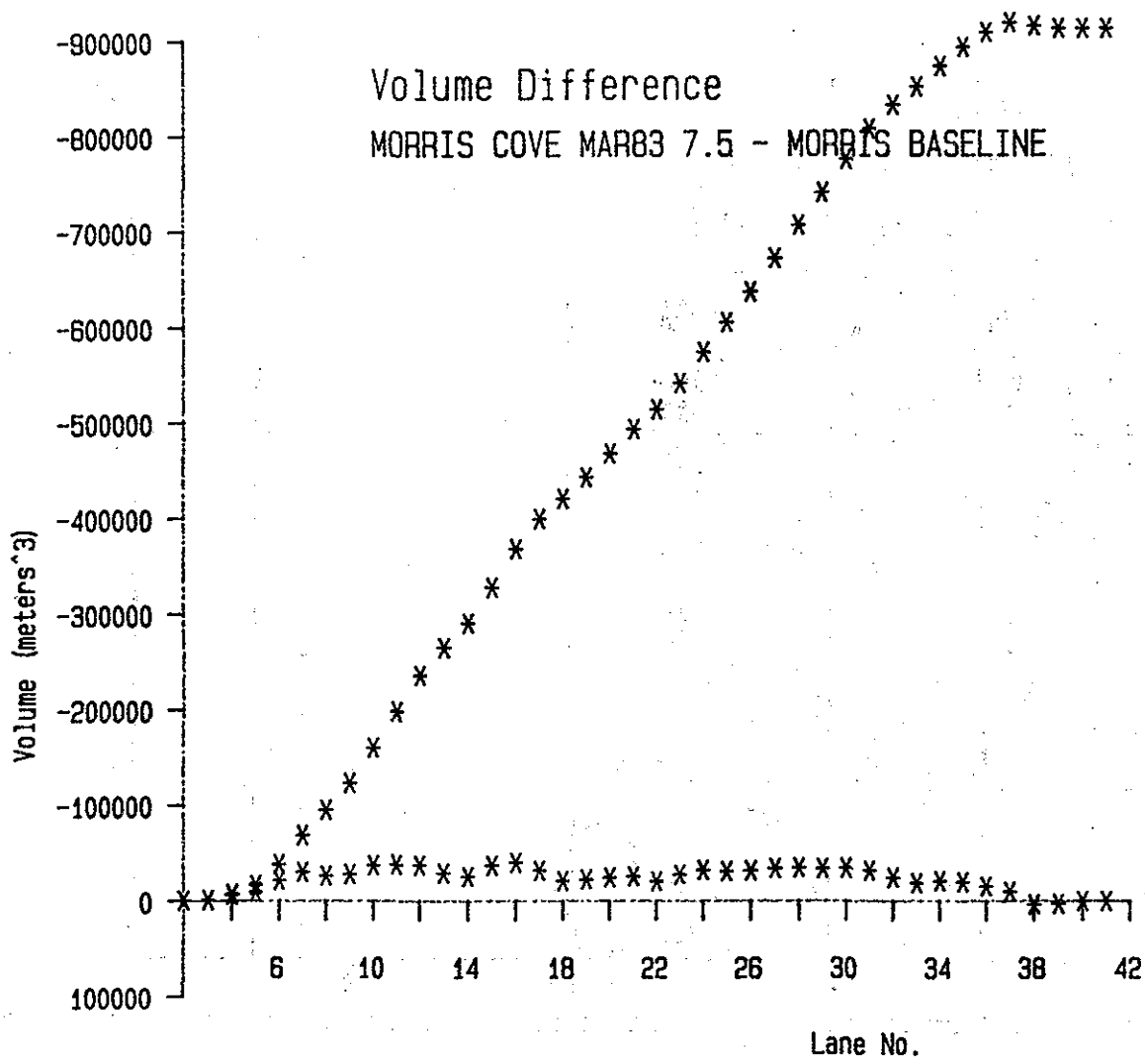


FIGURE 2.0-13
MORRIS COVE
SOUTH
DEPTH CONTOURS
MARCH, 1983
72 54.2
72 54.1
72 54.0
72 53.9
41 15.7
41 15.6
41 15.5
0
50
100
SCALE (m)

Figure. 2.0-14


Volume Difference
MORRIS COVE MAR83 7.5 - MORRIS BASELINE
Volume (meters^3)
-900000
-800000
-700000
-600000
-500000
-400000
-300000
-200000
-100000
0
100000
6
10
14
18
22
26
30
34
38
42
Lane No.

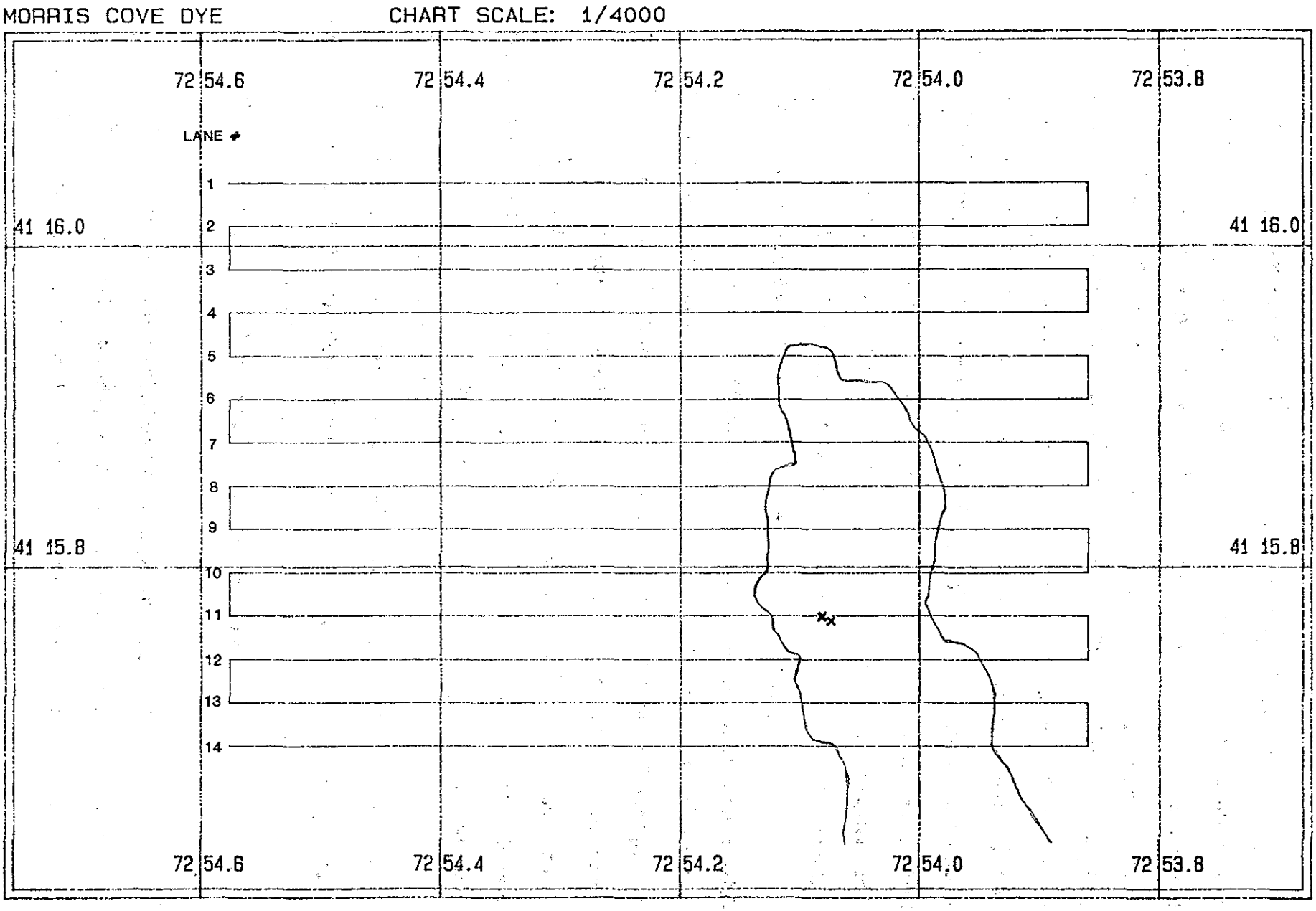
On March 11,1983, a tracer dye study was performed for the purpose of measuring the circulation pattern within the borrow pit and thereby contributing to an understanding as to the distribution of any dredge material sediments which might be disposed of at this location. As with the bathymetric study, position information for this investigation was provided by the SAI navigation and data acquisition system. In place of digital depth data, dye concentrations as measured by a Turner Designs Model 10 Series Fluorometer were input into this microprocessor for display purposes, correlation with time and position information and subsequent storage to magnetic disk.

Most waters contain natural fluorescence from scattered light and natural material or pollutants. Prior to releasing dye into the study area, a preliminary survey was made to determine background fluorescence values. Background concentrations were determined from water pumped from several locations at depth increments of 5 ft. (1.52m) from the surface to the bottom. Based upon these measurements, a mean background fluorescence for the borrow pit study area was 0.01 ppb.

The dye was released at a continuous rate from a small skiff moored in the approximate center of the borrow pit (see Fig. 3.0-1). Release of the dye commenced at 1600; approximately 1 hour after low tide. For this study, a 5% solution of rhodamine WT dye was pumped at a rate of 0.75 gal/hr. (7.886×10^{-7} m^3/sec.)

Initially the water immediately surrounding the dye release boat was sampled until the general direction of flow could be established. Approximately 1 hour after the pumping

Figure 3.0-1. Dye Study Survey Lanes



began, dye was detected and subsequently determined to be moving in a northerly direction with the incoming tide, despite a very strong northerly wind. As a result, a dye survey was established with east-west lanes seperated by 50m so that transects of the plume could be made. This dye survey setup showing the approximate dye release location is shown as Figure 3.0-1.

Three series of transects were made measuring the surface concentration of the dye plume. Series 1 and Series 3 transects were made over lanes which progressed in a northerly direction while Series 2 transects were made of lanes which progressed southward. The starting and ending times of each lane transect in these three series is presented in Table 3.0-1.

Profile plots of observed dye concentration as a function of distance along a lane from west to east are shown in Figures 3.0-2 thru 3.0-7. Figure 3.0-2 shows the profiles for the Series 1 northerly transects. At this early stage in the dye study it can be seen that no data was observed as far north as lane 1 and that the maximum concentration of approximately 6.0 ppb was in lane 4. Lane 4 is approximatley 50m north of the northern edge of the borrow pit.

Profiles of Series 2 southerly transects (Figs. 3.0-3 thru 3.0-5) show a maximum concentration of approximately 6.0 ppb in lane 2 with gradually decreasing maximum values for lanes 3 thru 8. Finally, Series 3 transects show a maximum concentration of only about 2 ppb in lanes 5 and 6 (Fig. 3.0-6, 3.0-7).

Considering that the wind on this particular day was blowing from the north at 20-30 knots, these profile plots show that from its release point at the bottom of the approximate

TABLE 3.0-1.

Start and End Time For
Dye Study Transects

SERIES 1 TRANSECTS - NORTHERLY

Lane #	Start Time	End Time
4	17:32:27	17:33:42
2	17:33:43	17:36:32

SERIES 2 TRANSECTS - SOUTHERLY

Lane #	Start Time	End Time
1	13:36:24	17:39:07
2	17:39:27	17:42:12
3	17:42:13	17:44:58
4	17:44:59	17:47:14
5	17:47:15	17:51:16
6	17:51:17	17:54:21
7	17:54:22	17:58:35
8	17:58:36	18:01:22
9	18:01:29	18:05:05
13	18:05:45	18:07:51
14	18:07:52	18:09:35

TABLE 3.0-1.(CONT.)

SERIES 3 TRANSECTS - NORTHERLY

Lane #	Start Time	End Time
7	18:17:18	18:21:44
6	18:21:45	18:27:17
5	18:27:18	18:31:11
4	18:31:12	18:36:40
3	18:36:41	18:40:08
1	18:40:09	18:44:15

Figure 3.0-2. Dye Concentration

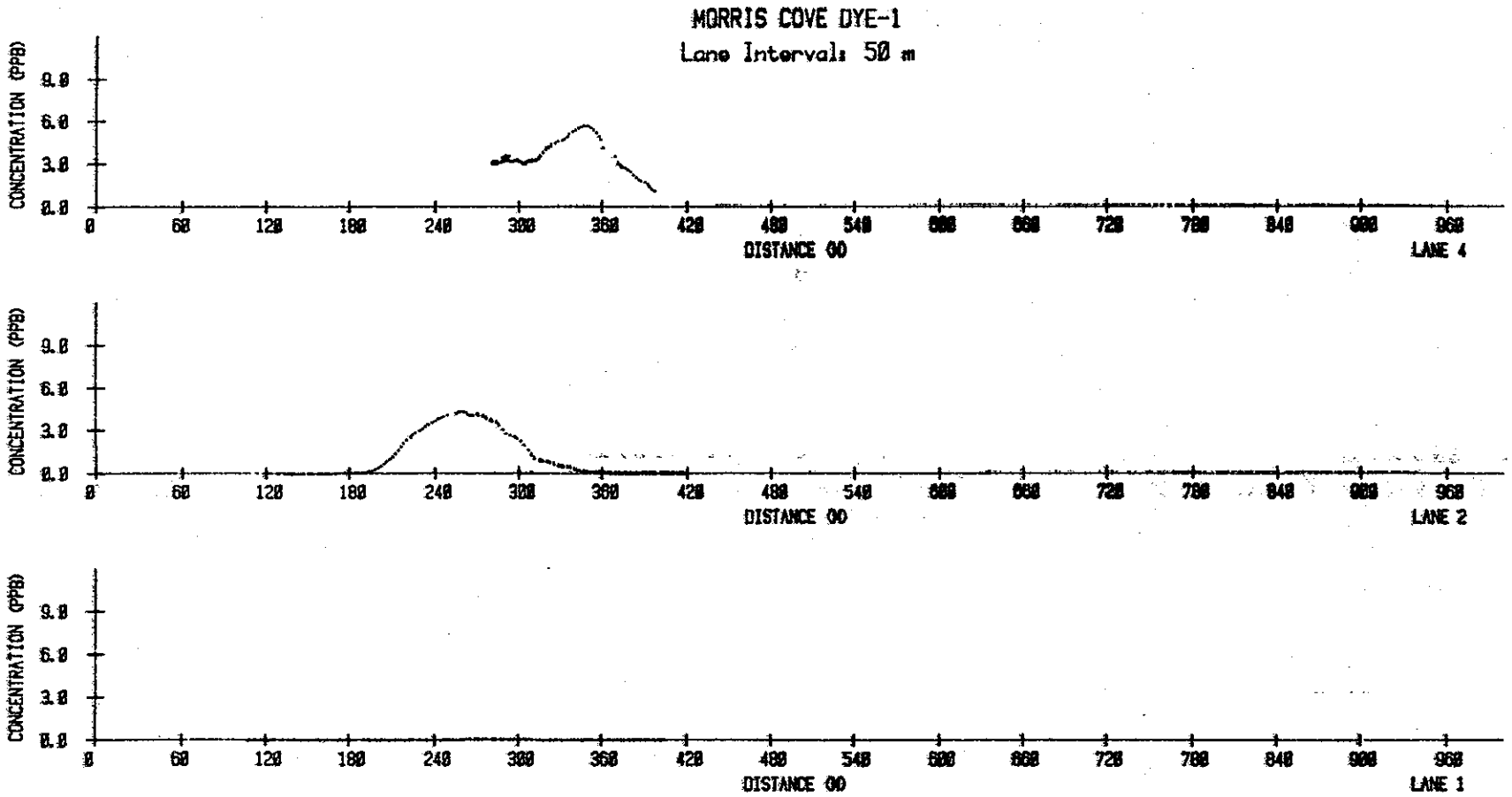


Figure 3.0-3. Dye Concentrations

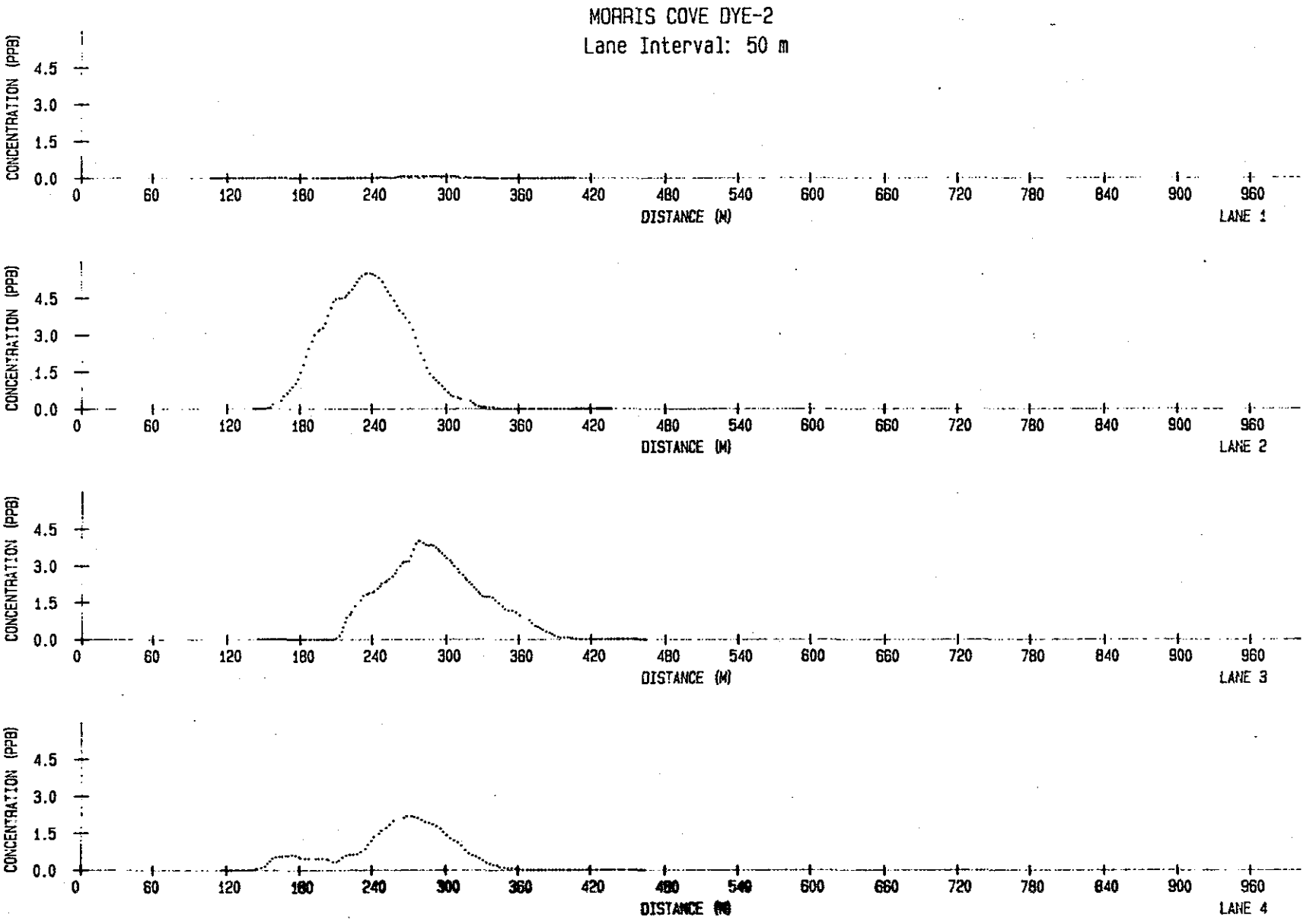


Figure 3.0-4. Dye Concentrations

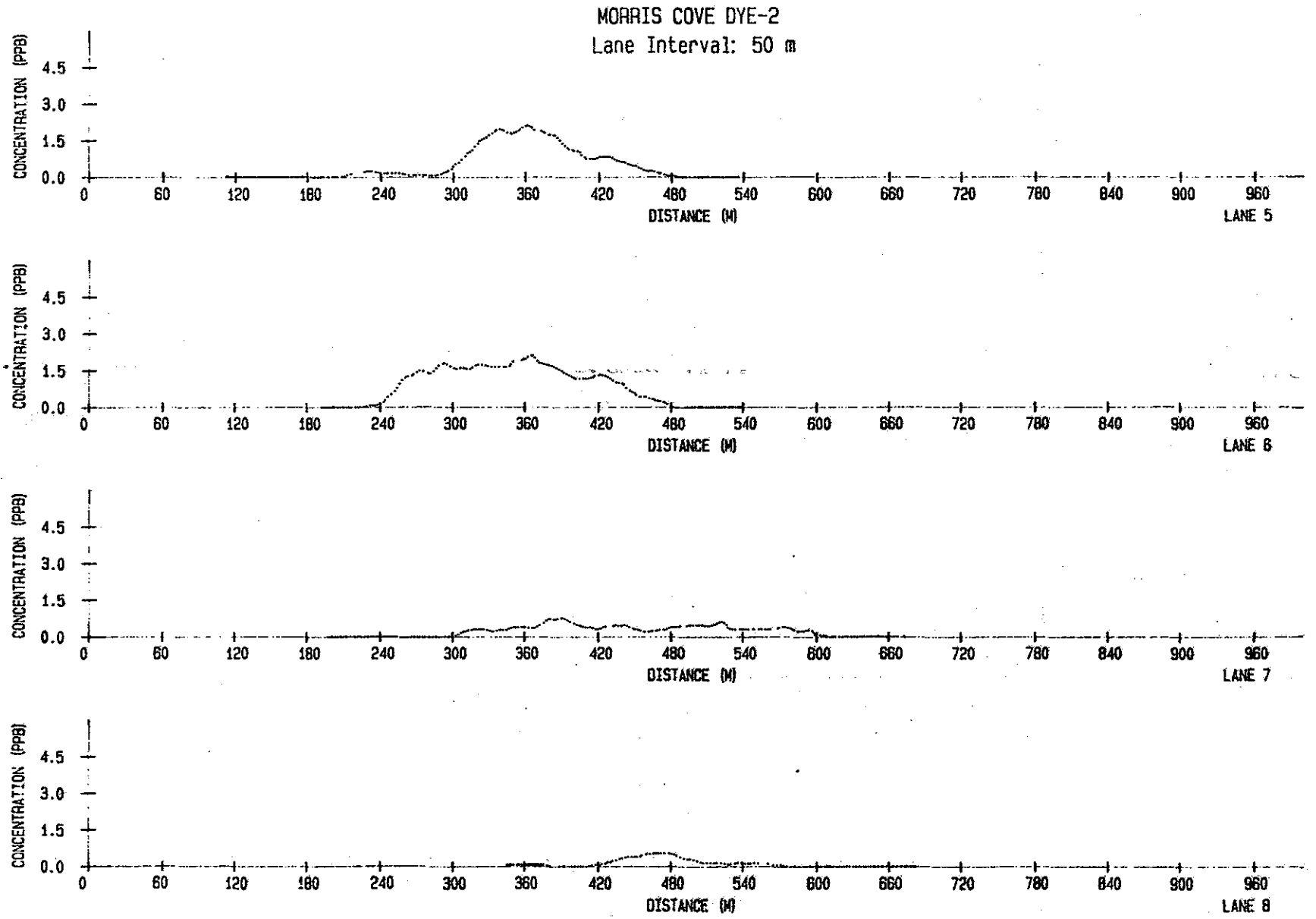


Figure 3.0-5. Dye Concentrations

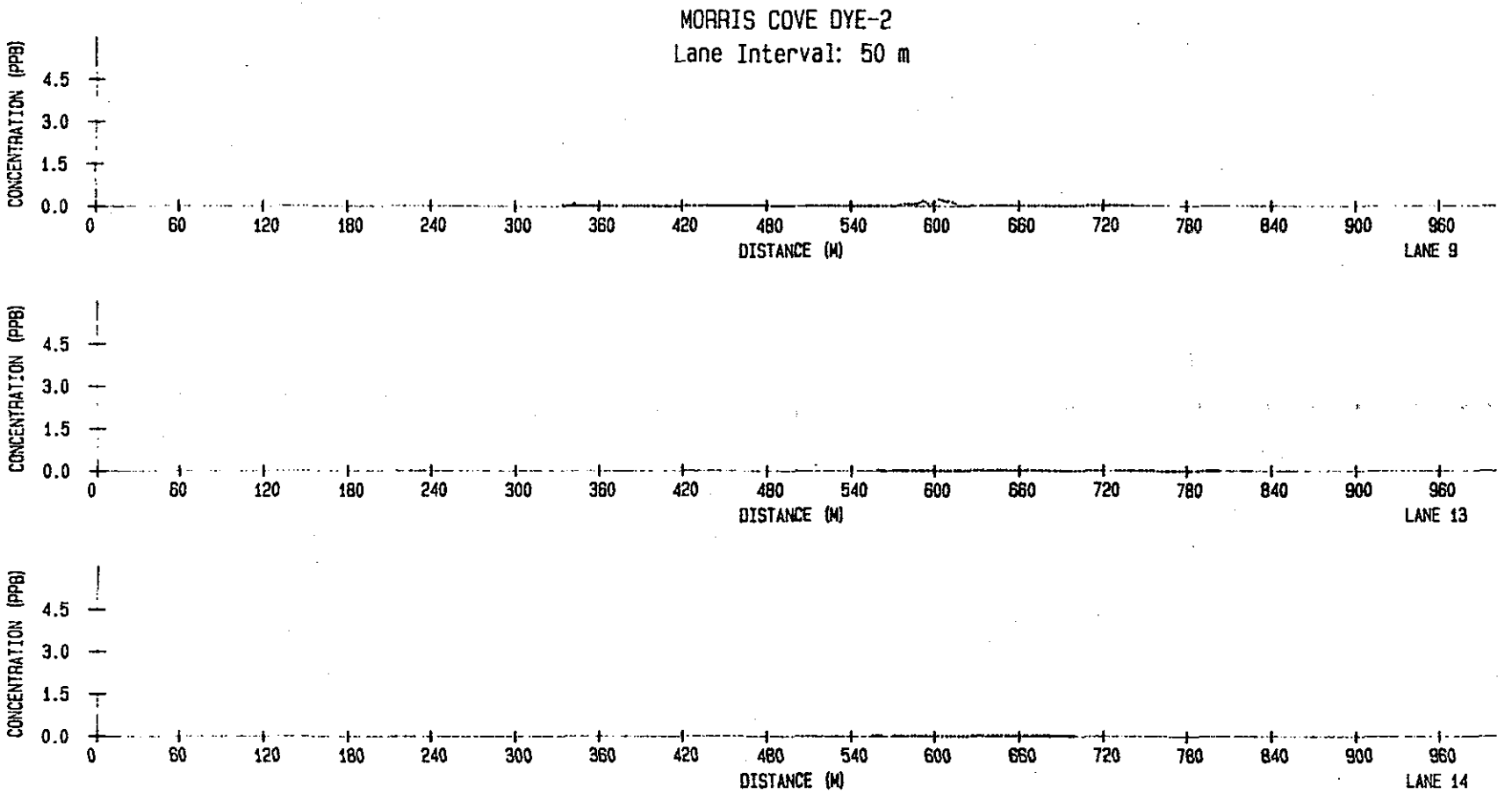


Figure 3.0-6. Dye Concentrations

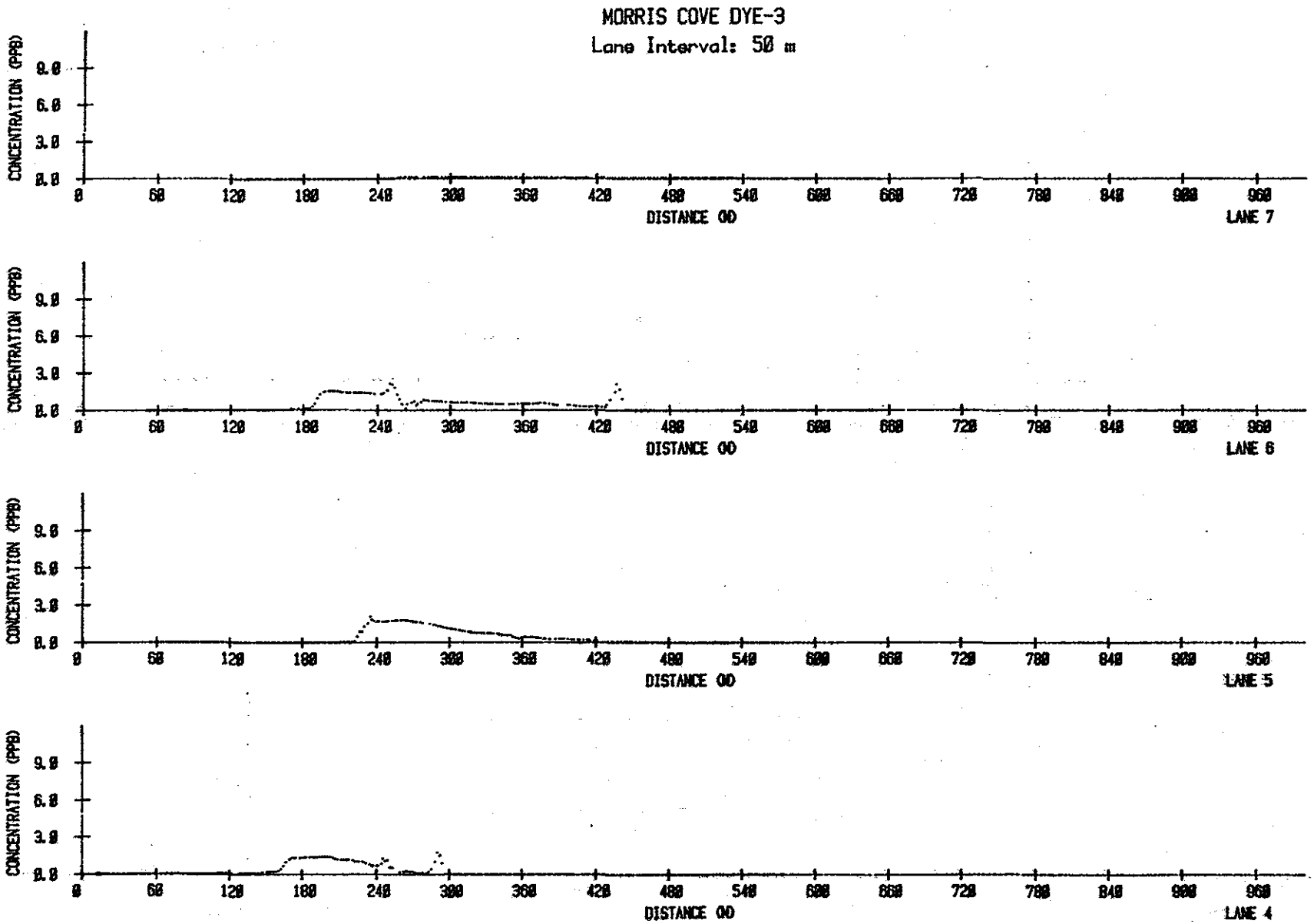
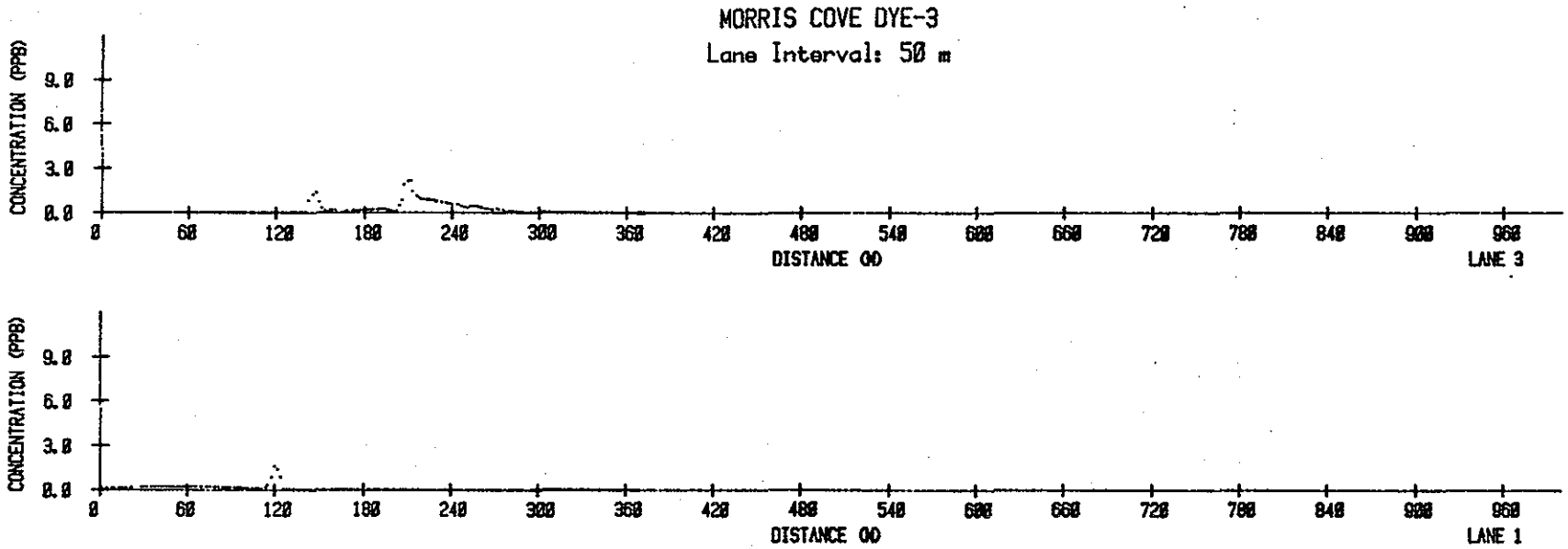


Figure 3.0-7· Dye Concentration



center of the borrow pit, the dye was carried in a northerly direction by tidal currents. Upon contact with the northern edge of the borrow pit, the dye appears to have been driven upwards towards the surface resulting in maximum concentration being observed in lanes 2 and 4. The edge of the borrow pit is approximately beneath lane 5.

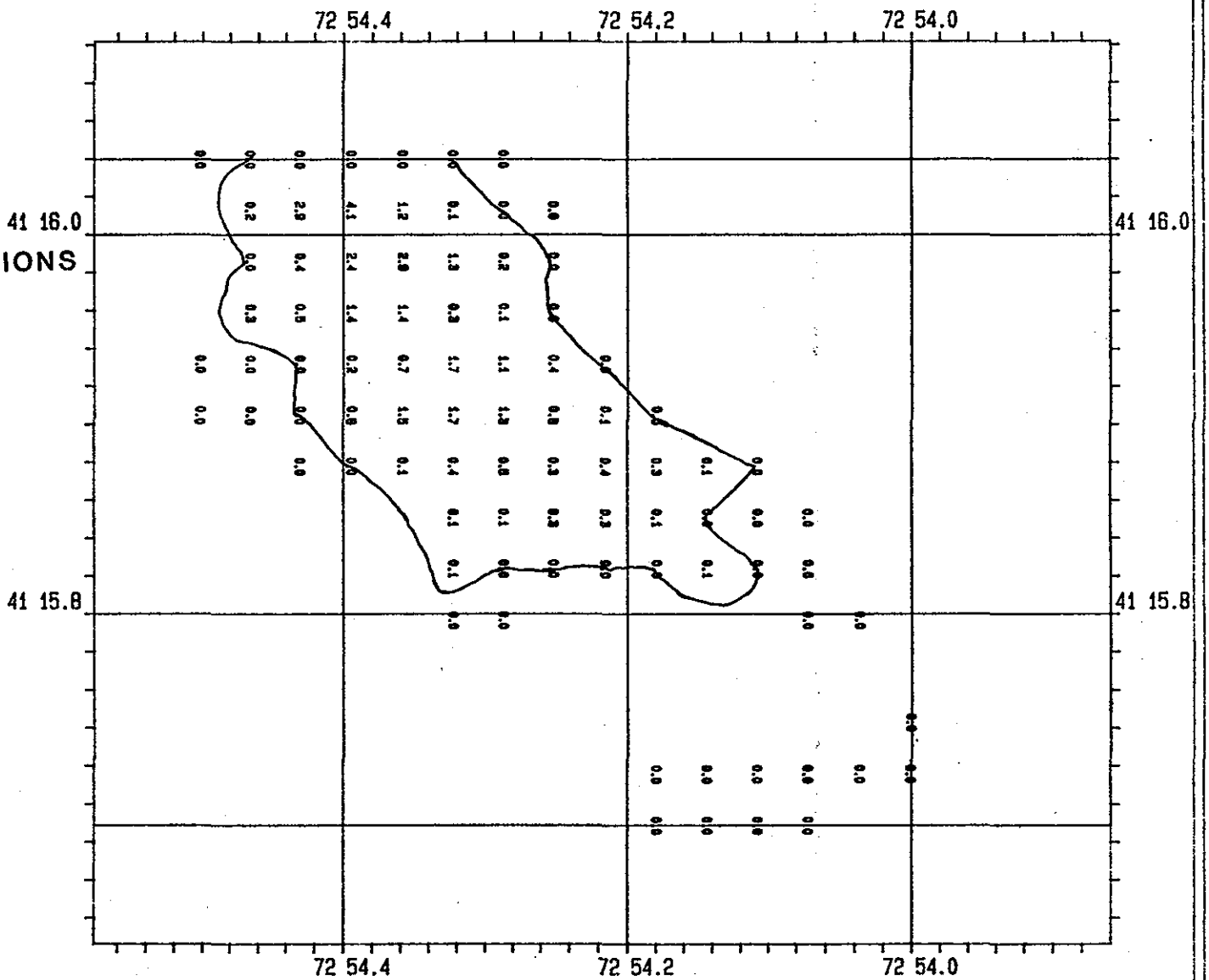
Since Series 2 transects contain the greatest number of lanes with the highest concentration of dye, these data were used to construct a dye concentration contour map of the study area shown in figure 3.0-8. This contour map dramatically shows that maximum dye concentration values were located at the northwest end of the study area, slightly north of the northern edge of the borrow pit. Therefore, these data indicate that despite the presence of a strong northerly wind, the dye was propelled along the bottom by the incoming tidal current until contacting the northern edge of the borrow pit. When this contact was made, the dye was then forced upwards as well as northward under the influence of the tidal currents.

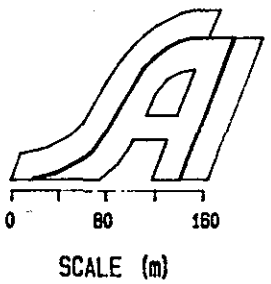
Using this contour map, it is possible to estimate the percentage of the dye released which was detected by the fluorometer. Assuming that the dye measured by the fluorometer is representative of a column of water 10 feet (3.05m) deep, then 83.4% of the available dye was sampled as part of the Series 2 transects. While the exact percentage of dye seen is not important, the relative magnitude of this number indicates that this sampling technique was valid in determining the current regime in the borrow pit area.

FIGURE 3.0-8

MORRIS COVE
DYE CONCENTRATIONS
(PPB)

MARCH, 1983





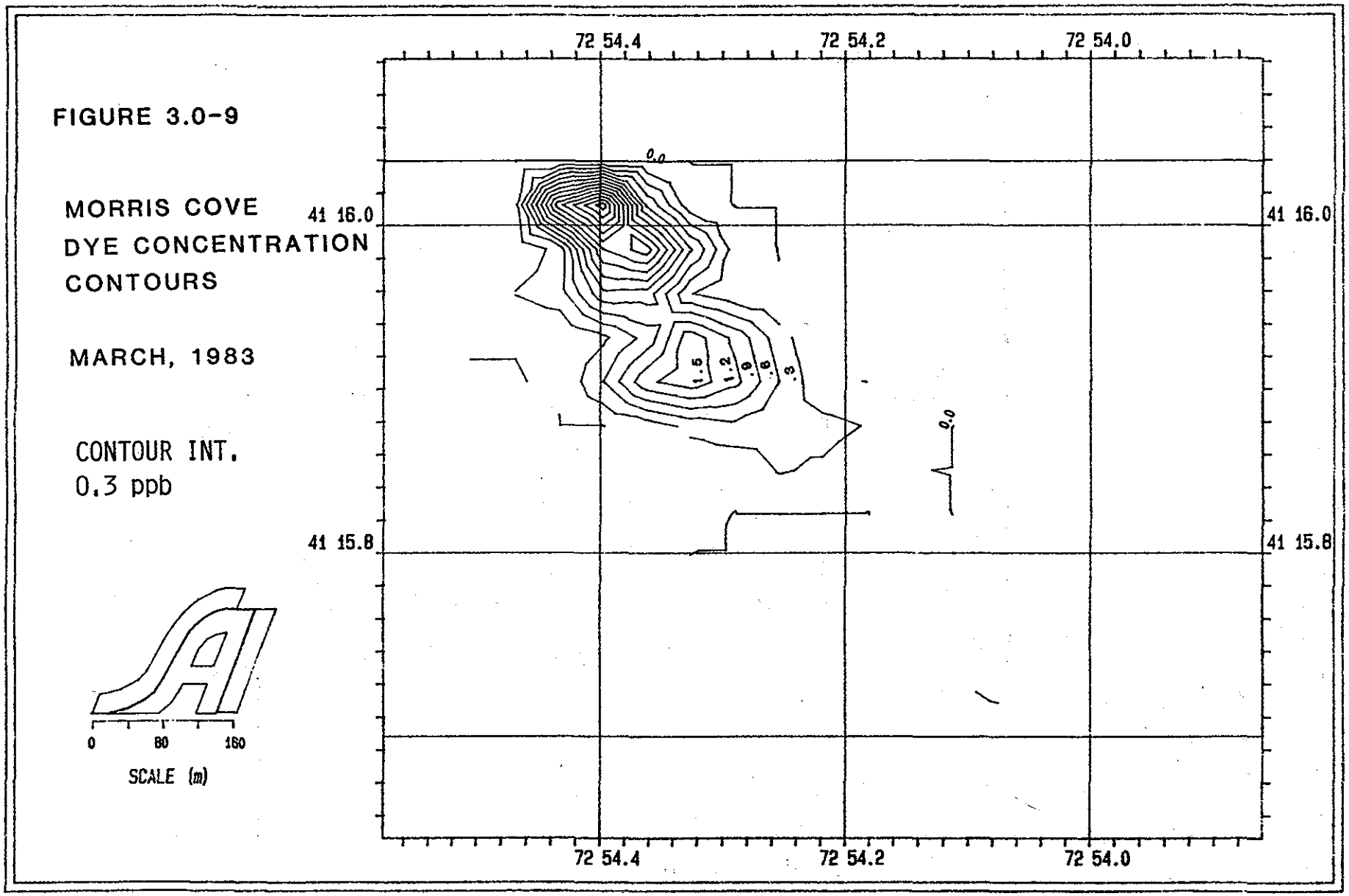


FIGURE 3.0-9
MORRIS COVE
DYE CONCENTRATION
CONTOURS
MARCH, 1983
CONTOUR INT.
0.3 ppb
72 54.4
72 54.2
72 54.0
41 16.0
41 15.8
0.0
1.5
1.2
0.9
0.6
0.3
0
80
160
SCALE (m)

4.0 SUMMARY AND RECOMMENDATIONS

The dye study of the borrow pit in the Morris Cove area of New Haven Harbor was performed to determine the suitability of this area for the disposal of dredged material from the Mill and Quinnipiac Rivers. Although the borrow pit has relatively steep sides and a depth greater than 12 meters, and even though a strong northerly wind was blowing during the period of measurement, the dye moved northward under the influence of tidal circulation. Further, the high concentration of dye found in the vicinity of the northern boundary of the borrow pit indicates that the current flows horizontally across the bottom of the pit until striking the slope of the borrow pit, where it is then deflected upwards. Although a dye survey was not conducted on an outgoing tide, similar dispersive characteristics, only in the southerly direction, would be expected. These include a bottom flow with the tide and an upward deflection on contact with the southern boundary of the borrow pit.

Based upon the results of this dye study, the Morris Cove borrow pit does not appear to be a suitable location for the disposal of dredged material. The strong tidal flow in this area demonstrates that the dredged material, especially low density, flocculant material characteristic of Mill River, could be easily transported away from this site under the influence of normal tidal action.