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GULF POWER
A SOUTHERN COMPANY

April 6, 2004

Ms. Tamara Blyden
Florida Department of Environmental Protection
2600 Blair Stone Road
Mail Station 3545
Tallahassee, Florida 32399-2401

**RE: Gulf Power Company- Scholz Electric Generating Plant**

Dear Ms. Blyden:

Per your request, enclosed is a copy of the document entitled "A Field Measurements Program to Define the Thermal and Dissolved Oxygen Distributions at the Scholz Plant on the Appalachicola River." This study was conducted in July 1973 to define the distribution of the heated water discharge on the river during a period of high ambient temperatures and moderate river level with the Scholz Plant operating at a near peak capacity.

Please feel free to contact me at (850) 444-6144 if you have any questions or need any additional information.

Sincerely,

Michael L. Kyhos
Environmental Affairs

cc: Gulf Power Company
Jim Vick
Joe Neese
Mike Markey

FDEP Pensacola
Bill Armstrong

# A FIELD MEASUREMENTS PROGRAM TO DEFINE THE THERMAL AND DISSOLVED OXYGEN DISTRIBUTIONS AT THE SCHOLZ PLANT ON THE APPALACHICOLA RIVER

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# A FIELD MEASUREMENTS PROGRAM TO DEFINE THE THERMAL AND DISSOLVED OXYGEN DISTRIBUTIONS AT THE SCHOLZ PLANT ON THE APPALACHICOLA RIVER

Conducted for

GULF POWER COMPANY

By

GEO-MARINE, INC.
AUGUST 8, 1973

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# I. INTRODUCTION

A field program of measurement was conducted on the Appalachicola River in the vicinity of the Scholz Steam Plant on 1, 2 July 1973. The purpose of the survey was to define the distribution of the heated water discharge on the river during a period of high ambient temperatures and moderate river level, with the plant operating at a near peak capacity. Parameters measured included temperature and dissolved oxygen distributions over a wide area and current velocities at one point near the discharge at a 2' depth. Thermal and dissolved oxygen measurements were made over that area of the river with depths in excess of 9' (at river stage 44.5') from mile 100.5 to the plant intake. In addition to the bank-to-bank survey, a sensor tow was made along the axis of the river channel from mile 100.5 to the plant intake. Temperature was digitally recorded at five depths during the survey, 1', 2.5', 4.0', 5.5' and 7.0', and dissolved oxygen was recorded at depths of 1', 4.0' and 7.0'. At the conclusion of the survey, auxiliary surface temperature and D.O. recordings were made along the accessible portions of the intake and discharge canals.

## II. METHODS AND INSTRUMENTATION

### A. Thermal and Dissolved Oxygen Surveys

Geo-Marine measured the three-dimensional distribution of temperature and dissolved oxygen in the vicinity of the Scholz outfall by towing a series of sensors along pre-determined tracks. The sensors were towed at depths selected to give the greatest possible depth coverage while measuring as near as possible to shore boundaries.

Sensors were maintained at the selected depths by affixing them to a steel wire stress member, terminated at the lower end with an oceanographic wire line depressor. Wire angle was continuously monitored by a pendulous accelerometer attached to the wire. Sensor depth was controlled to an estimated 5% of set depth for all but the 1' sensors. The 1' sensors were rigidly attached to the boat's transom, and extended beneath the hull to avoid excessive turbulence and air bubble effects.

The outputs of the 5 temperature sensors, 3 dissolved oxygen sensors and 2 calibration channels were sampled sequentially at 1.5 sec. intervals throughout the survey. Vessel speed was calculated as 3.5 MPH, resulting in a complete data set every 30 - 40 feet along the tracks. Temperatures were digitally recorded to a sensitivity of 0.1°F and an absolute accuracy of better than 0.3°F. Dissolved oxygen was recorded to a sensitivity of

0.1 ppm and an absolute accuracy estimated as 0.2 ppm. Temperature sensors were laboratory calibrated prior to departure for the field. Dissolved oxygen meters (YSI Model 54) were standardized at the site against the azide modification of the Winkler technique in waters of approximately midpoint temperature, just downstream of the discharge.

Navigation was by dead reckoning between 29 flag stations which Geo-Marine established along the banks of the river prior to the survey. Positions of each flag were fixed by surveyor's transit and plotted. Positional accuracy of temperature and D.O. profiles along the river channel axis is estimated as 10% of the bank to bank distances. The position of any given measurement set for the bank-to-bank surveys is known within approximately 30'. A depth sounder recording was also made along all tracks.

The data measurements were computer contoured to produce the temperature and dissolved oxygen distribution charts shown in this report.

Current speed was measured by buoy C-217 using a confined drag body current meter with a surface area of 1.5 square feet and immersed weight of 12.5 pounds.

Meteorological data, shown in Table 1, were abstracted from the records of the National Weather Service Station at Tallahassee, Florida, and no

significant differences from those observations were observed at the site. River stage observations are from the Scholz plant intake screen records and are shown in Table 2. Table 3 presents the total plant load during the survey. River flow data shown in Table 4 are from the Jim Woodruff Lock and Dam on Lake Seminole, approximately 5 miles upstream of the plant.

## III. SURVEY DESCRIPTION

Survey area reconnaissance began on 1 July 1973, when the Scholz plant was at approximately full load. A surface temperature record was made from upstream of the plant intake, river mile 103 to mile 100, downstream. The discharge is located at river mile 102.6. This reconnaissance established the survey area. At 1052 on 2 July, the survey along the river channel began and was completed at 1137. This measurement series resulted in the cross sections shown in Figures 1 and 2. The track was along the river channel as defined by the Corps of Engineers, except near buoy C-217, where the boat was steered to the west side of the buoy to better detail the plume near the discharge. The bank-to-bank survey (Figure 3), which resulted in the 8 contours charts (Figures 4-11). began at 1159 and terminated at 1255. Immediately following this, a series of surface recordings was made on a line up the center of the intake and discharge canals. Ten current speed measurements were then made while the boat was moored to buoy C-217.

## IV. RESULTS AND CONCLUSIONS

Thermal and dissolved oxygen data were taken in two different modes. One was a sensor tow along the axis of the river channel from river mile 100.5 to the intake canal (Figure 3). A second survey consisted of bank-to-bank measurements along a zig-zag course from river mile 100.5 to the intake canal (Figure 3).

Results of the sensor tow along the river channel are shown in Figures 1 and 2. In the vicinity of the discharge canal, a course was steered west of the channel axis, and a maximum temperature of 90.8°F was recorded. The thermal plume is essentially contained in the upper 3.5 feet, with a few tenths of a degree rise down to 7 feet. The river channel is approximately 13 feet deep in the area adjacent to the discharge canal. Dissolved oxygen data (Figure 2) along the river channel show a decrease of .2 - .3 ppm immediately adjacent to the discharge canal, returning to ambient within 1000 feet of the discharge.

Results of the bank-to-bank survey are shown in Figures 4-11. Isothermal contour charts show the temperature distributions at 1', 2.5', 4.0', 5.5' and 7.0'. Data at the one foot depth show an influence downstream of approximately 1200 feet (Figure 4). The area enclosed by the 2°F rise isotherm comprises approximately 2 acres. Maximum temperature at the mouth of the discharge canal is 93°F. Mixing with the river water lowers the temperature of the effluent to 85°F within 200 feet of the junction of the discharge canal and river.

Isothermal contour charts at 2.5', 4.0' and 5.5' show decreasing thermal influence with depth. The plume is not seen on the data at 7' (Figure 8).

Throughout the survey, it was noted that water temperature at any given depth was a few tenths of a degree lower in midstream than along the banks. This is seen in the individual contour charts.

Subsequent to the survey runs were made along the intake and discharge canals. Surface temperature in the intake canal was 84.0 - 84.5°F, approximately one half degree warmer than the river water. Maximum surface temperature recorded in the discharge canal was 98°F, at a point 300' from the outfall.

Dissolved oxygen distributions at 1', 4' and 7' are shown in Figures 9-11, respectively. Concentrations ranged from 5.5 - 6.1 ppm, with the higher values generally on the east side of the river. There is no indication of dissolved oxygen changes in the vicinity of the discharge canal.

Surface dissolved oxygen data were taken in the intake and discharge canals at the conclusion of the bank-to-bank survey. Dissolved oxygen concentrations along the intake canal were 5.2 ppm, approximately .4 ppm lower than D.O. concentrations in the river. Dissolved oxygen readings in the discharge canal were 5.7 - 5.8 ppm, slightly higher than the concentrations in the intake canal.

Ten current observations were made at buoy C-217, at a depth of 2 feet. The mean current was measured as 1.9 MPH, with a maximum of 2.1 MPH and a minimum of 1.7 MPH. Measurements were conducted during a ten minute period, ending at 1322 on 2 July. Average flow of the Appalachicola for that date was 12,220 CFS, with the river elevation at 44'6".

## V. REGULATORY IMPLICATIONS

Rules of the Florida Department of Pollution Control are explicit with respect to temperature and dissolved oxygen. Pertinent elements of the rules assessed by this study are:

1. The criteria will be applied only after reasonable opportunity for mixture of wastes with receiving waters has been afforded.
2. Dissolved oxygen shall not be artifically depressed below 4.0 ppm unless background information indicates prior existence of lower values under natural conditions. At no time during this survey was a value less than 4.0 ppm encountered.
3. For fresh waters, heated water with a temperature at the point of discharge more than 5°F higher than the ambient temperature of any stream, shall not be discharged into such stream. Nor shall heated water with a temperature above 90°F be discharged into any fresh waters in Northern Florida regardless of the ambient temperature of the receiving body of water. If the point of discharge is taken as the end of the discharge canal, temperatures are in excess of those allowed. Regulations also limit the area of influence to less than one-third the width of the river and one-fourth of the cross-sectional area at a traverse perpendicular to the flow. Data from the survey (Figure 4) show an influence at the one foot level of approximately 50% of the river width. The cross-sectional area influenced is significantly less than the maximum allowed.

Since rule 1 above implies that a mixing zone is to be allowed, assessment of compliance hinges on the area permitted for mixture of the heated effluent with receiving waters.

TABLE 1

Meteorological Data
N.W.S. Tallahassee

| Time (CST) | 1973 Date | Air Temp. (°F) | Dew Point Temp. (°F) | Wind | | Total Sky Cover % |
|---|---|---|---|---|---|---|
| | | | | Direction | Speed (Kts.) | |
| 2357 | 30 June | 71 | 70 | 360 | 4 | 0 |
| 0155 | 1 July | 70 | 68 | 360 | 3 | 0 |
| 0355 | | 69 | 68 | 360 | 4 | 30 |
| 0556 | | 73 | 71 | 360 | 4 | 60 |
| 0755 | | 82 | 73 | 360 | 3 | 90 |
| 0955 | | 86 | 71 | 050 | 7 | 40 |
| 1155 | | 92 | 68 | 110 | 6 | 90 |
| 1355 | | 94 | 93 | 050 | 6 | 40 |
| 1556 | | 93 | 64 | 040 | 9 | 30 |
| 1756 | | 90 | 65 | 050 | 7 | 30 |
| 1956 | | 80 | 71 | 250 | 4 | 20 |
| 2156 | | 75 | 72 | 290 | 3 | 0 |
| 2355 | | 73 | 71 | 360 | 4 | 0 |
| 0155 | 2 July | 72 | 70 | - | 0 | 0 |
| 0355 | | 71 | 70 | - | 0 | 0 |
| 0555 | | 74 | 73 | 360 | 5 | 20 |
| 0757 | | 81 | 74 | 100 | 5 | 80 |
| 0956 | | 87 | 75 | 080 | 9 | 60 |
| 1155 | | 92 | 70 | 030 | 10 | 70 |
| 1355 | | 94 | 69 | 100 | 13 | 70 |
| 1555 | | 93 | 69 | 090 | 7 | 50 |
| 1755 | | 90 | 67 | 060 | 6 | 50 |

TABLE 2

Appalachicola River Elevation
Inside Intake Screens - Scholz Plant

| Time (CDT) | 1973 Date | Elevation (Above M.S.L.) |
|---|---|---|
| 0900 | 30 June | 49' 2" |
| 1200 | | 48' 8" |
| 1500 | | 48' 2" |
| 1800 | | 47'11" |
| 2100 | | 47'10" |
| 0000 | 1 July | 47' 9" |
| 0300 | | 47' 4" |
| 0600 | | 46'11" |
| 0900 | | 46' 9" |
| 1200 | | 46' 9" |
| 1500 | | 46'11" |
| 1800 | | 47' 0" |
| 2100 | | 47' 1" |
| 0000 | 2 July | 46'11" |
| 0300 | | 46' 7" |
| 0600 | | 46' 1" |
| 0900 | | 45' 7" |
| 1200 | | 44' 8" |
| 1500 | | 44' 2" |

TABLE 3

Plant Load Record - 2 July 1973

| Time (CDT) | Load (MW) |
|---|---|
| 0900 | 40 |
| 1000 | 86 |
| 1100 | 91 |
| 1200 | 91 |
| 1300 | 91 |
| 1400 | 91 |
| 1500 | 91 |

TABLE 4

Appalachicola River Flow
Jim Woodrull Lock and Dam

| Date | Average Daily Flow (CFS) |
|---|---|
| 30 June | 20,581 |
| 1 July | 18,139 |
| 2 July | 12,220 |
| 3 July | 13,570 |
| 4 July | 16,315 |

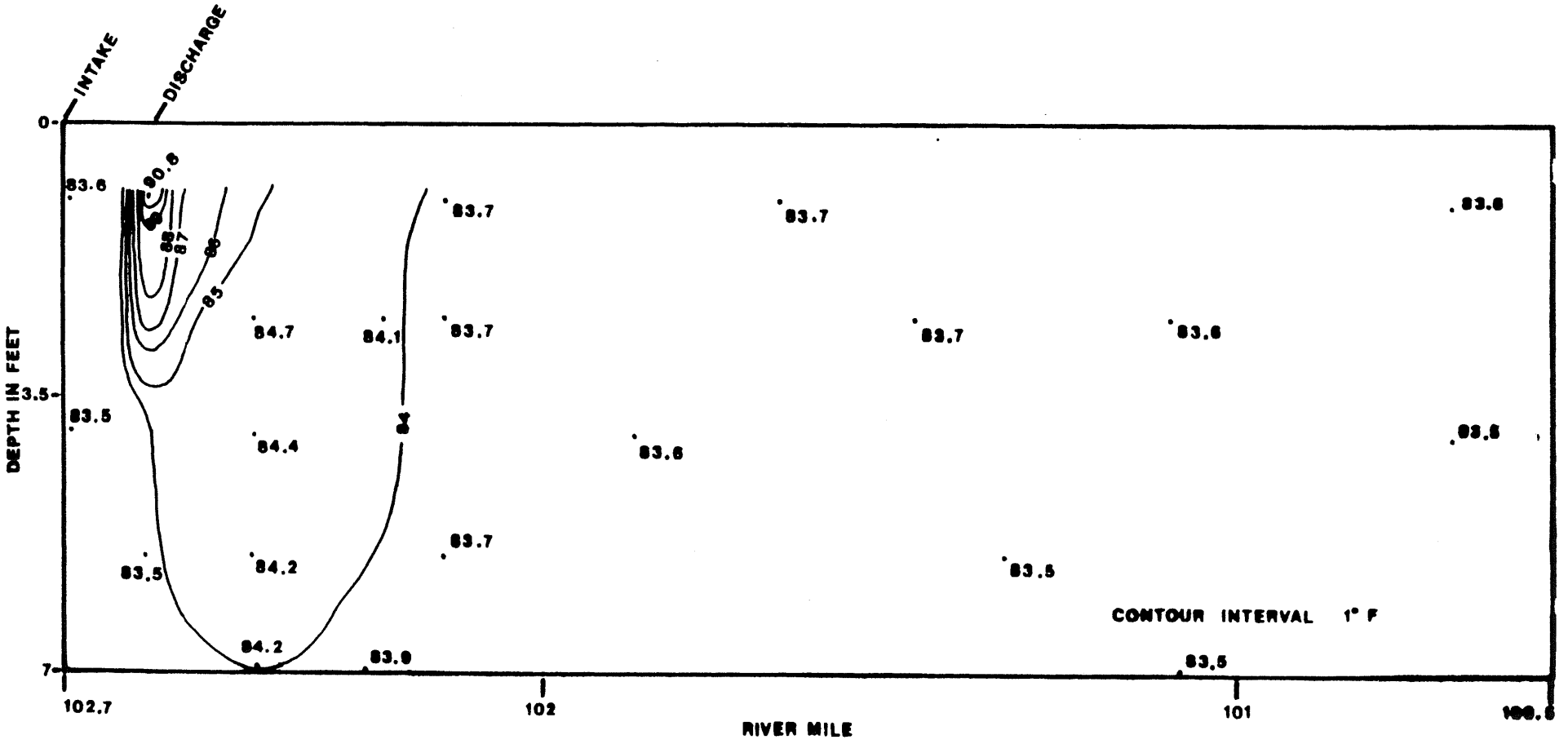


Figure 1. Temperature distribution along axis of river channel. Data were recorded at 1', 2.5', 4.0', 5.5' and 7.0'. Depths along the survey track varied from 9 - 28'.

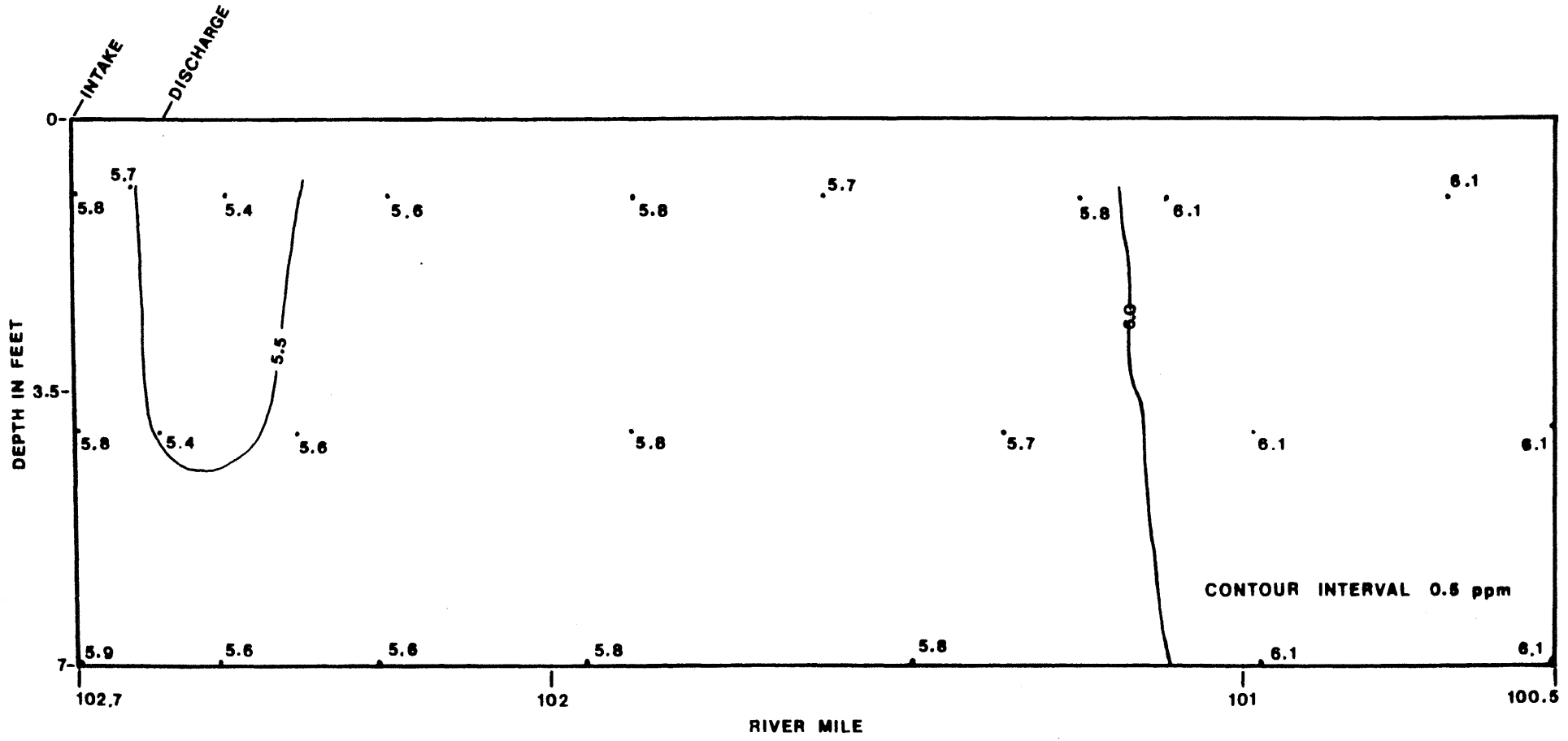


Figure 2. Dissolved oxygen distribution along axis of river channel. Data were recorded at 1', 4.0' and 7'. Depths along the survey track varied from 9 - 28'.

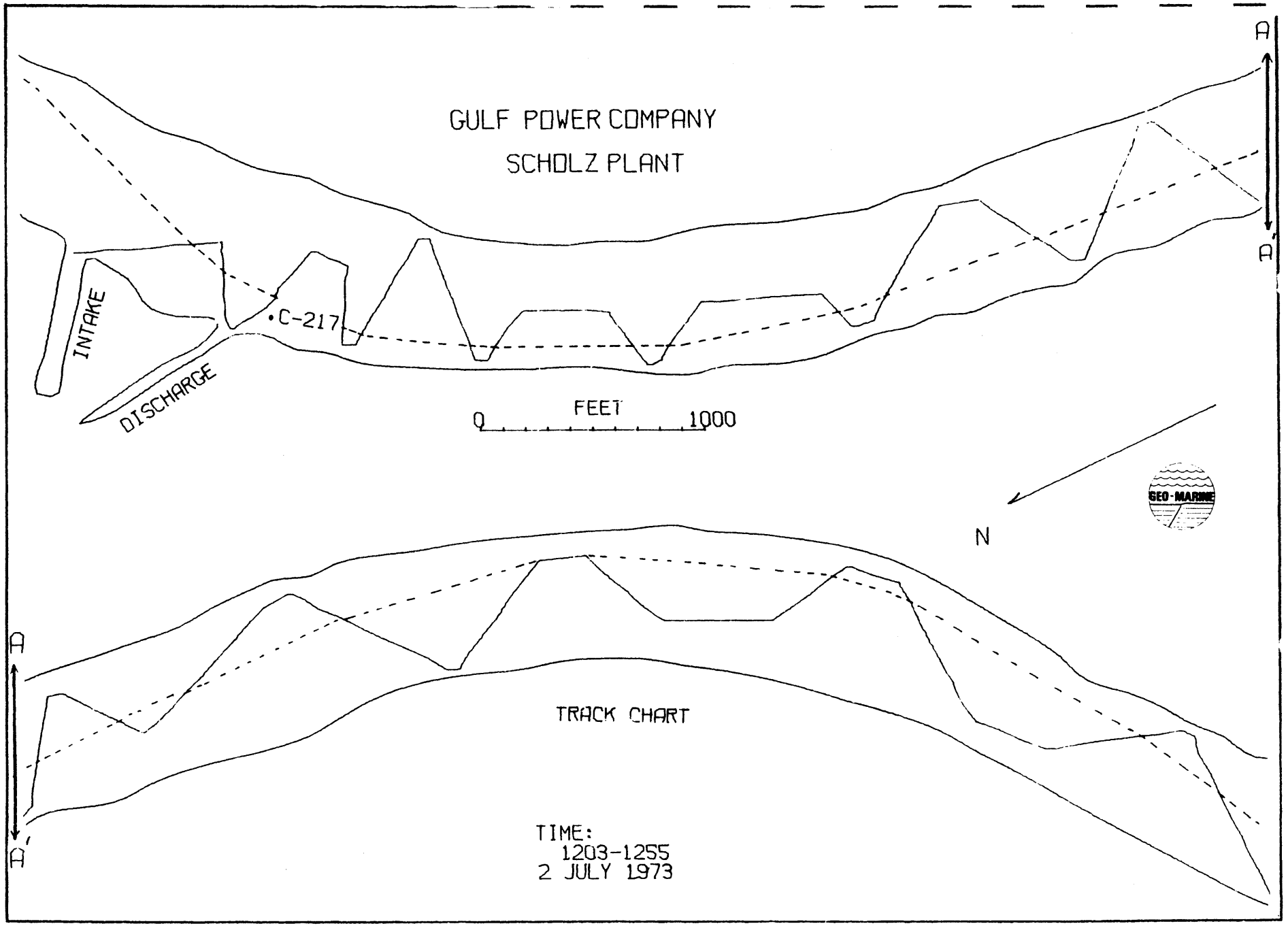


Figure 3. Survey Track Chart. Axis of river channel indicated by dotted line.

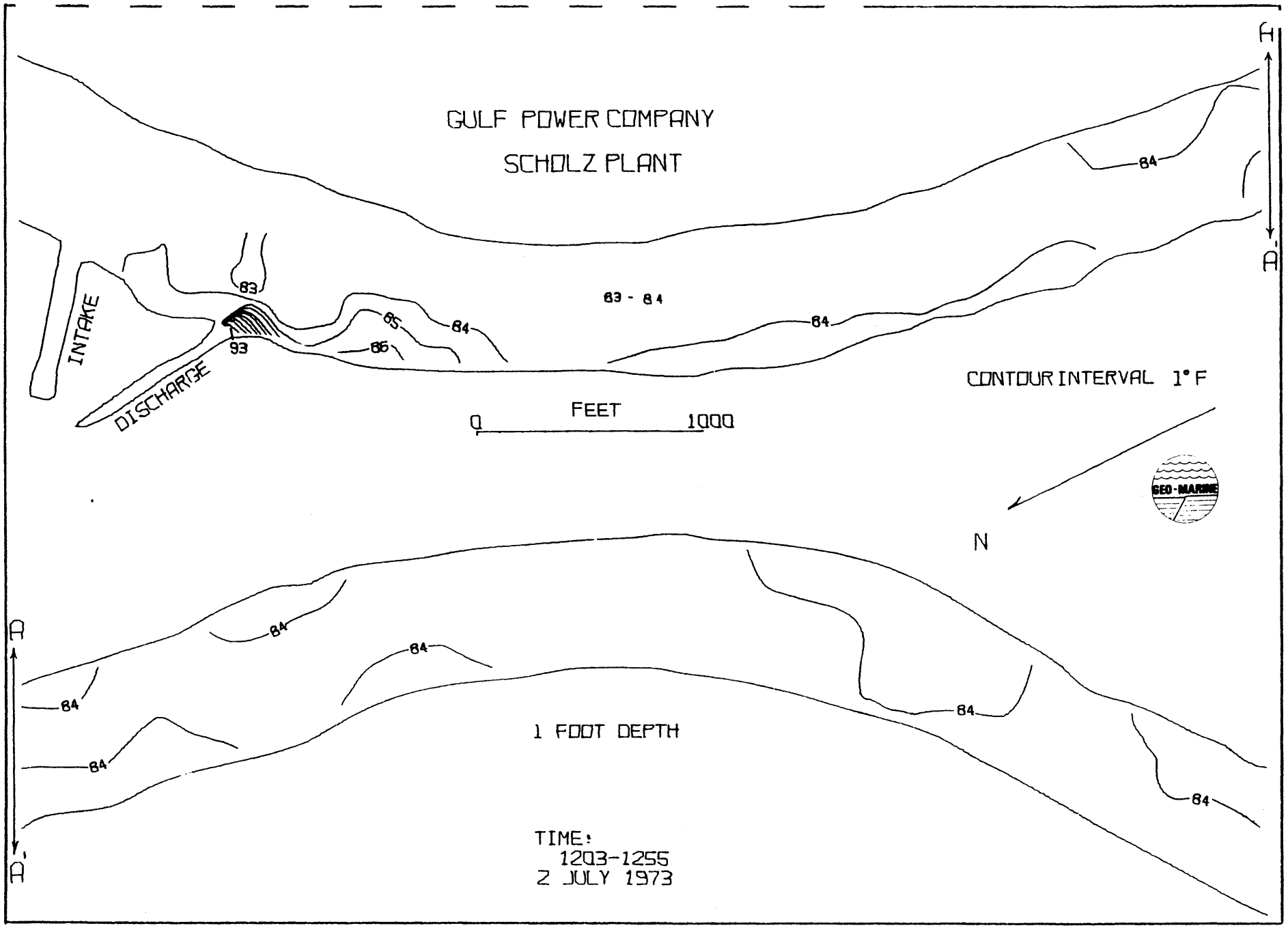


Figure 4. Temperature distribution at a depth of one foot.

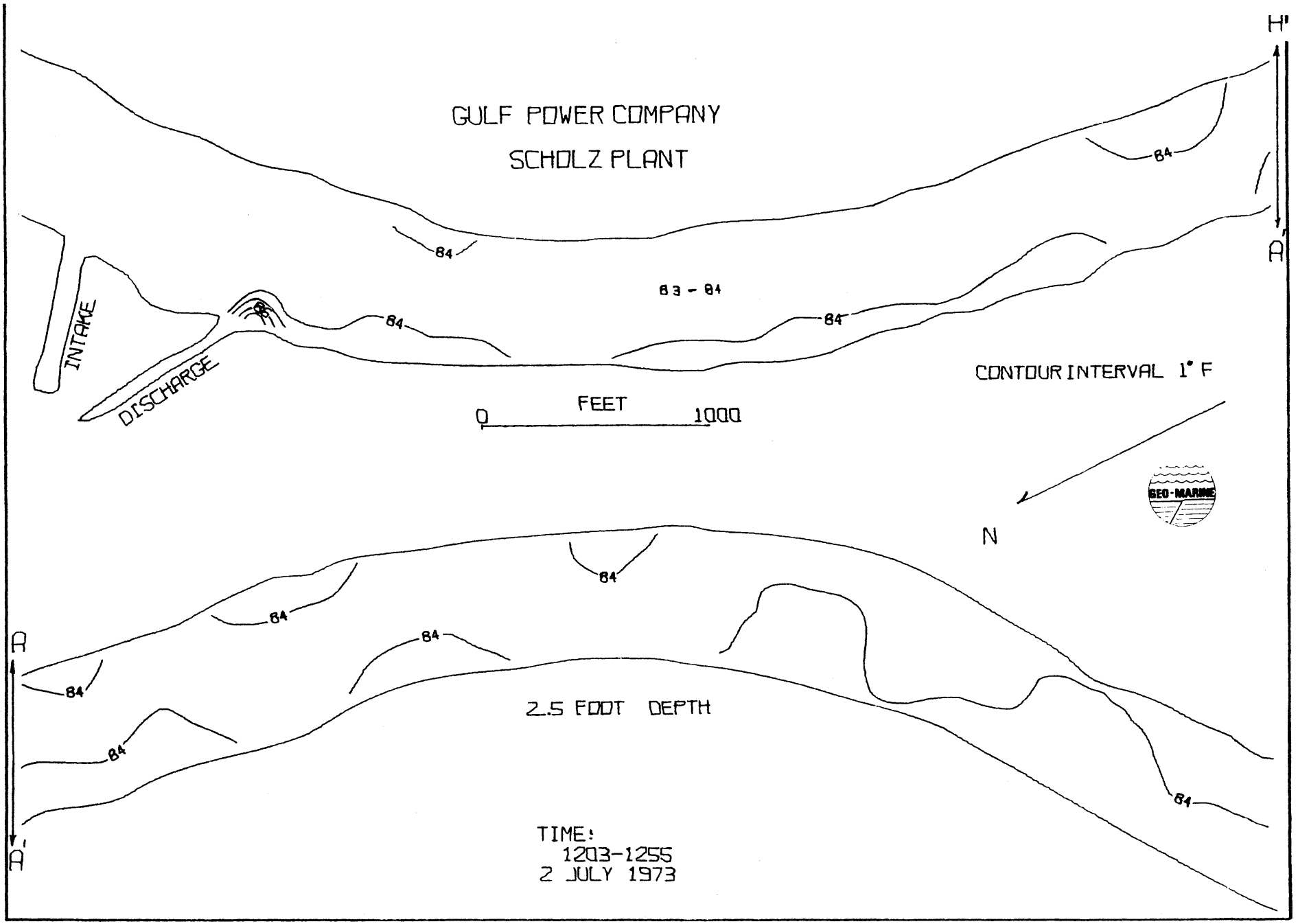


Figure 5. Temperature distribution at a depth of 2.5 feet.

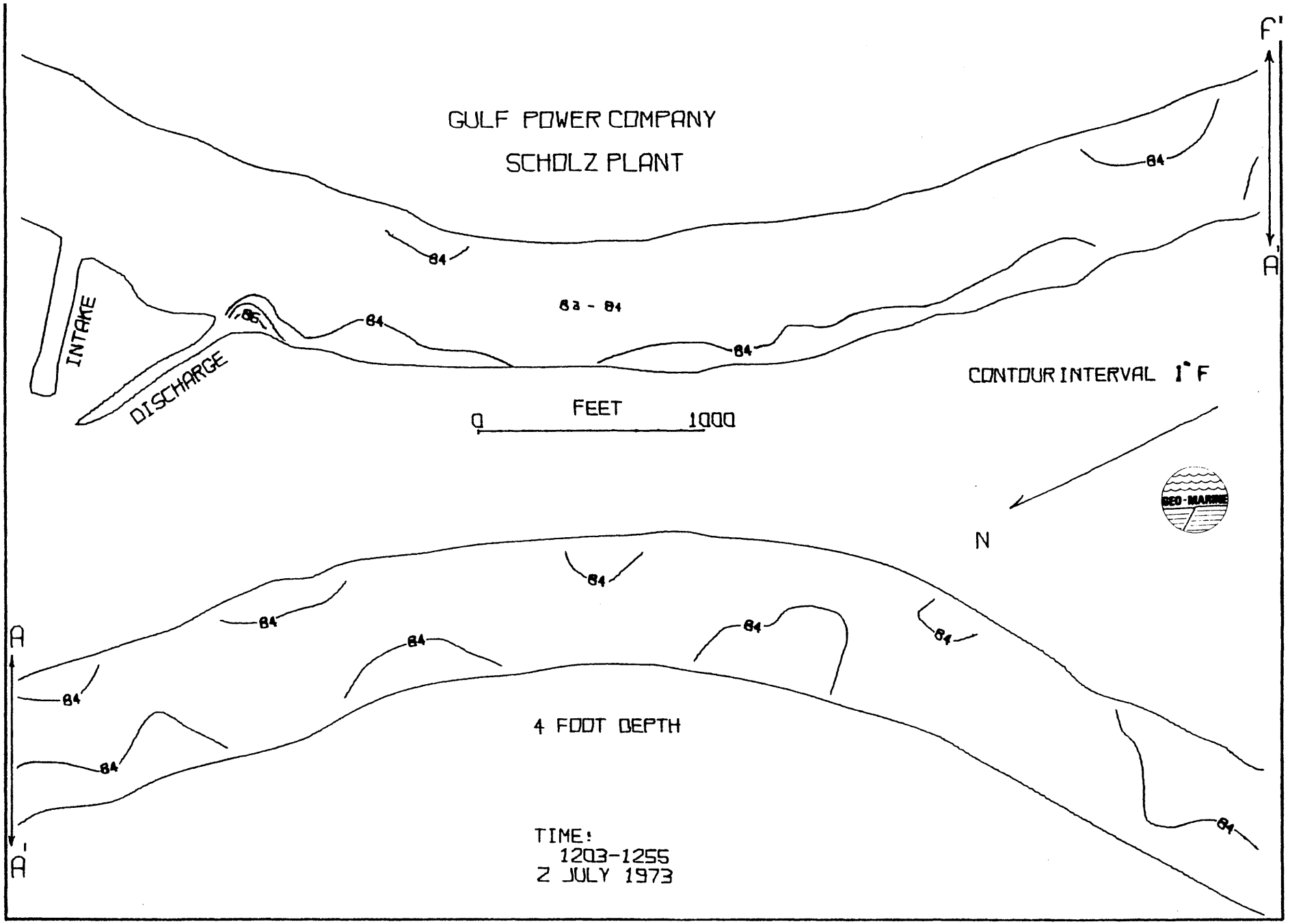


Figure 6. Temperature distribution at a depth of 4.0 feet.

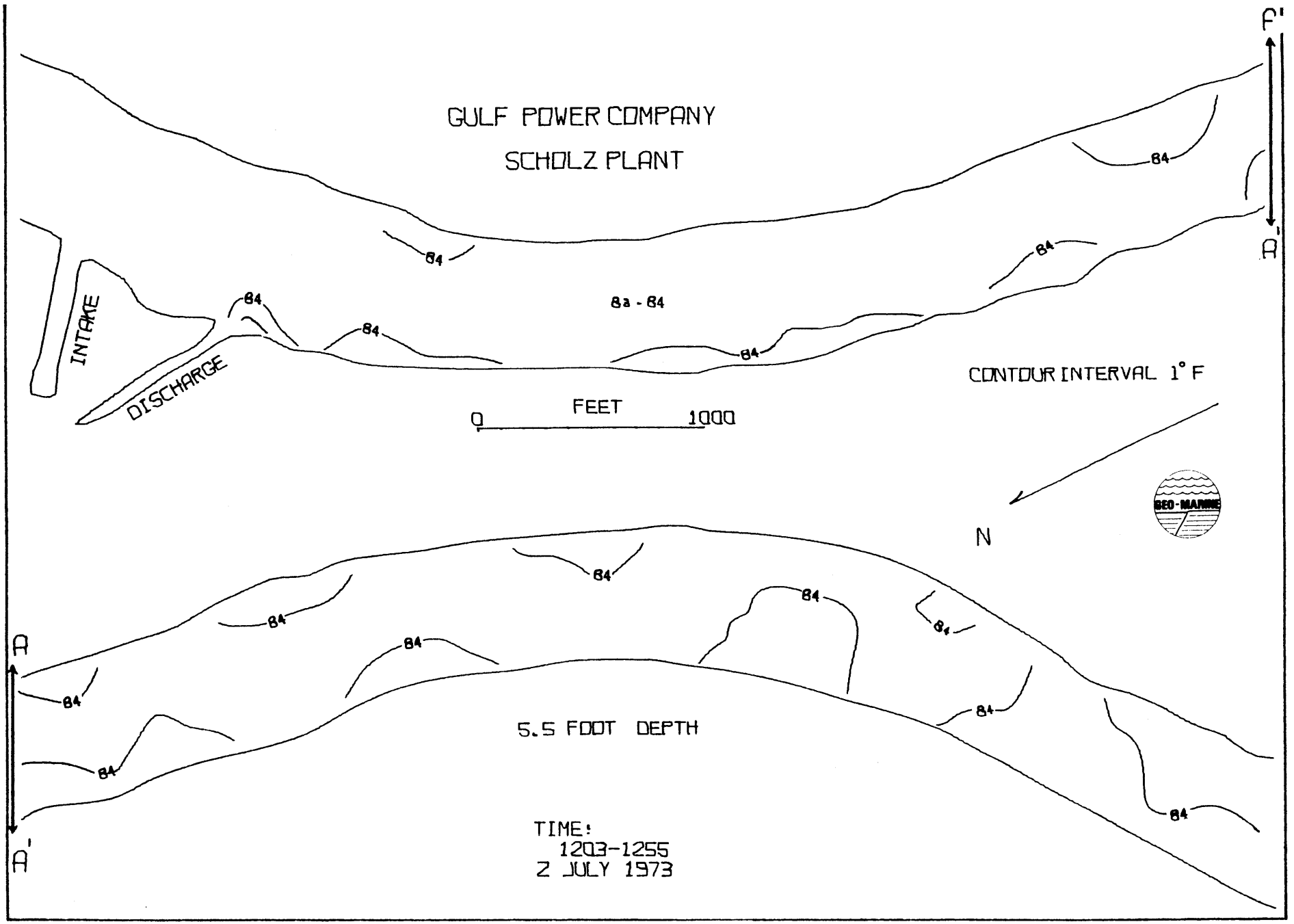


Figure 7. Temperature distribution at a depth of 5.5 feet.

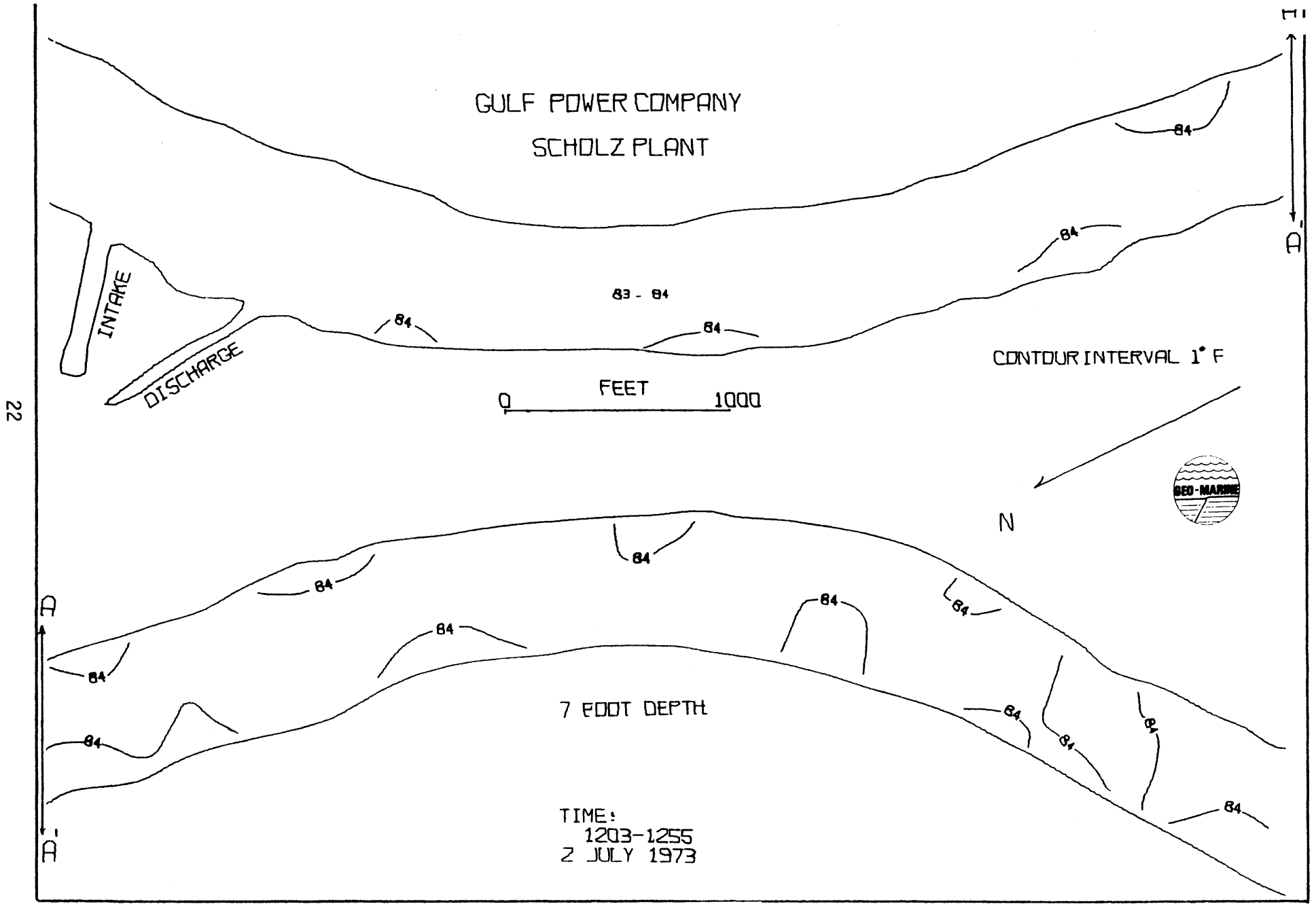


Figure 8. Temperature distribution at a depth of 7.0 feet.

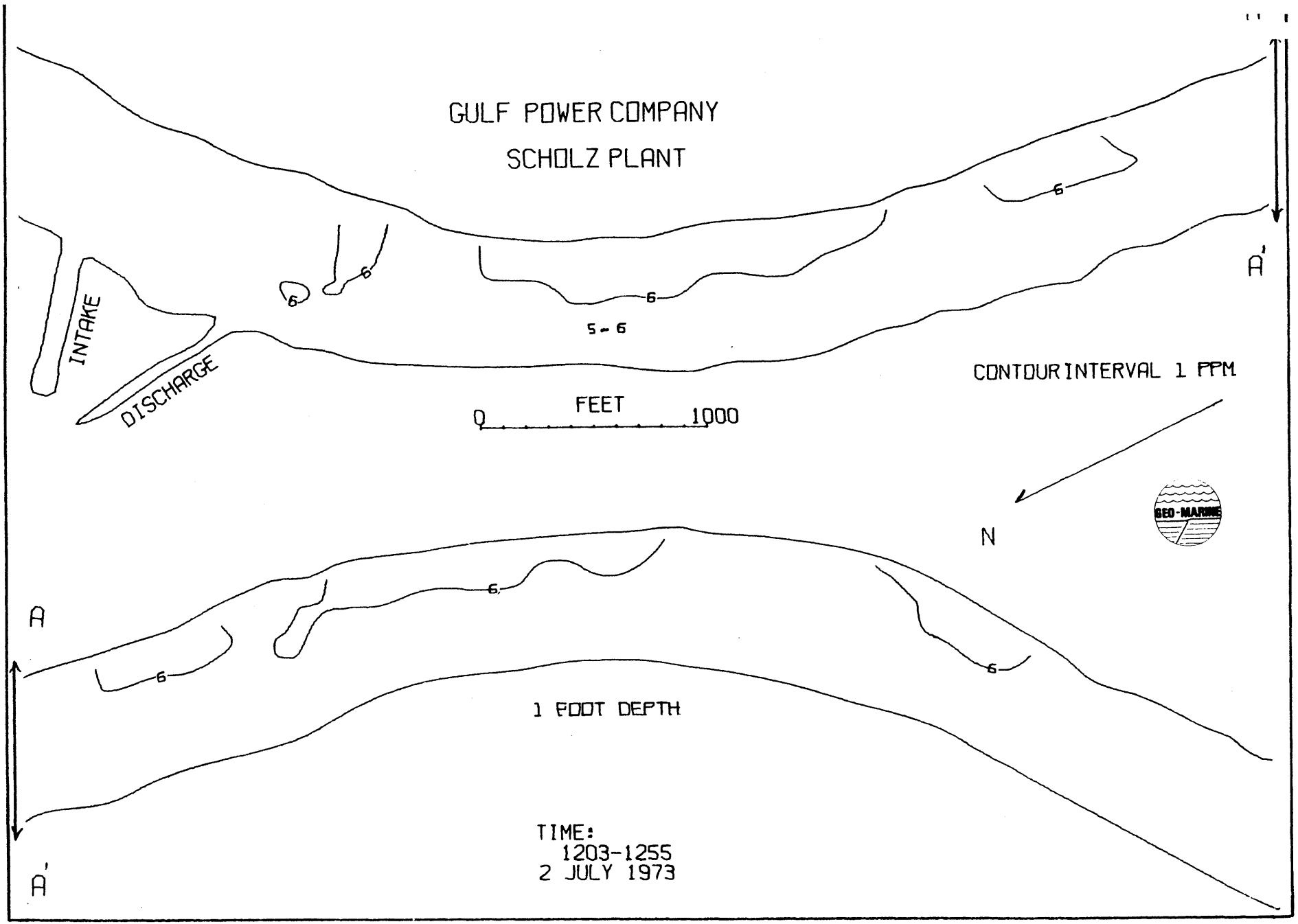


Figure 9. Dissolved oxygen distribution at a depth of one foot.

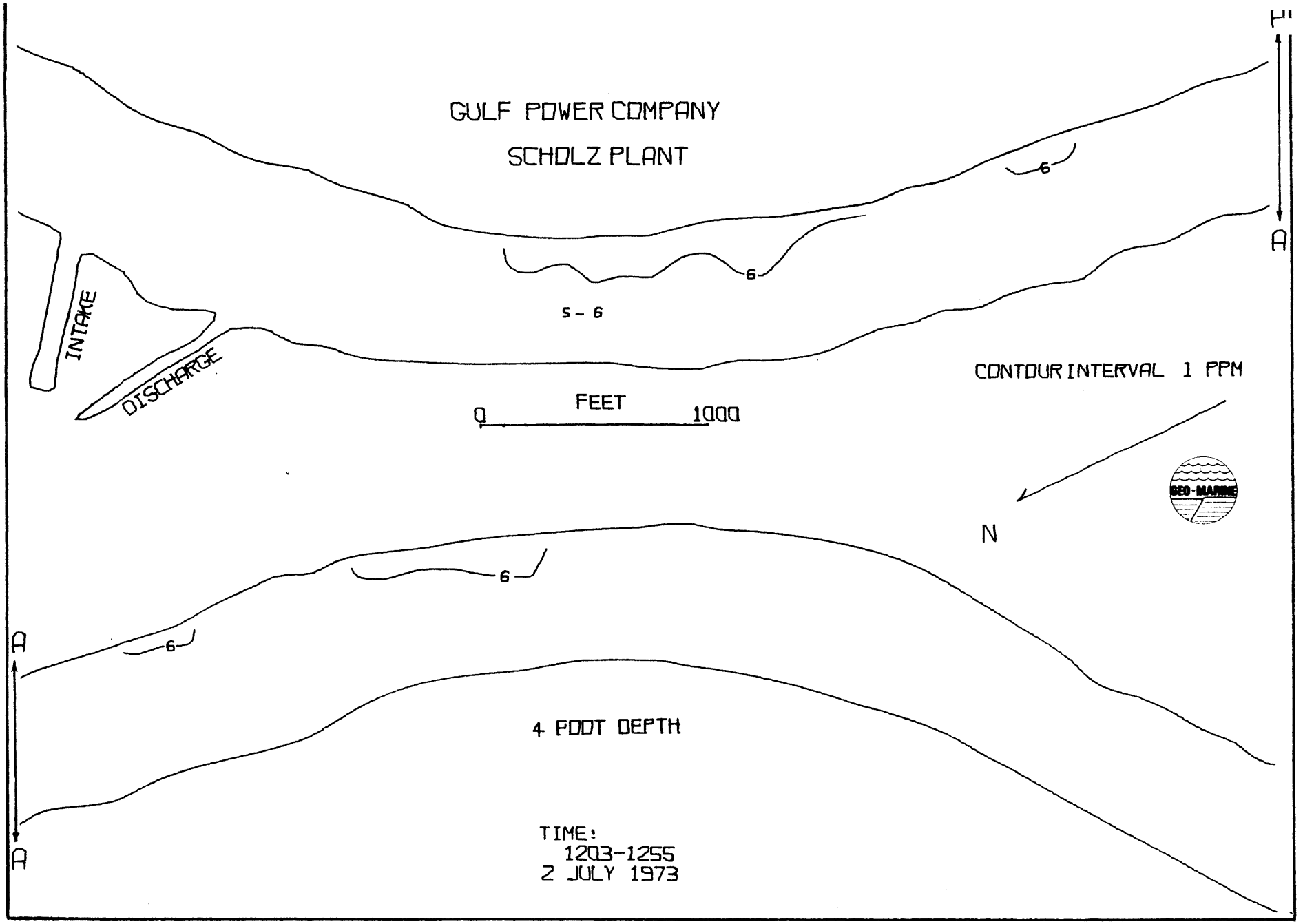


Figure 10. Dissolved oxygen distribution at a depth of 4.0 feet.

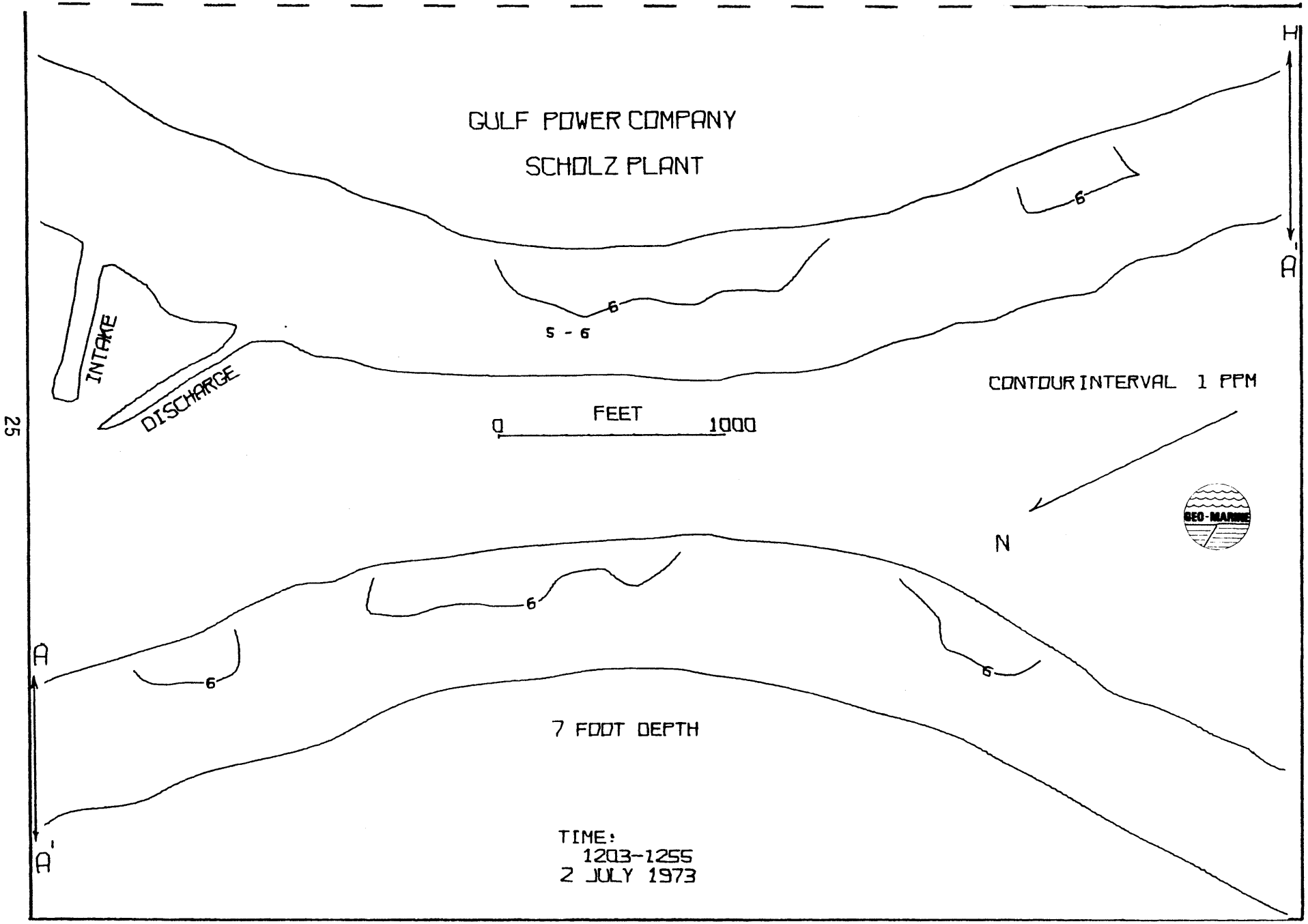


Figure 11. Dissolved oxygen distribution at a depth of 7.0 feet.