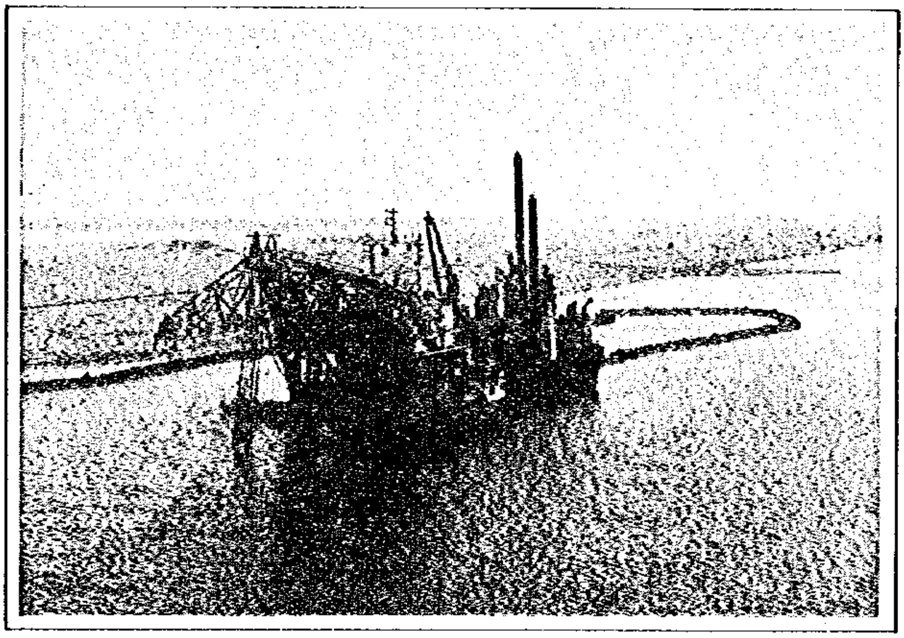
PART II. REVIEW OF CURRENT CANAL CONDITIONS



Dredger of SCA

PART II REVIEW OF CURRENT CANAL CONDITIONS

II-1 Canal Topography

(1) Canal Planning

The current Canal topography was reviewed based mainly on the "Suez Canal Plan and Cross Section", "Development of the Suez Canal –Widening and Deepening of the Canal–", "Depth of the Canal", "Measured Canal Cross Section", and other published charts and information provided by SCA.

Most of these data list the dimensions of the Canal as was planned for the First Stage Development Project and in this sense, it is evident that they do not represent the true topography of the current Canal. However, after checking the values of the drawings from various viewpoints, they are judged as acceptable and useful for this review.

Such fundamental dimensions of the Canal as width, depth and curvature are studied at intervals of 1 Km along the "Kilometer Base Line" fixed by SCA and between Hms 0 and 195 in the Mediterranean Sea, and between Hms 0 and 80.5 in the Red Sea.

The comprehensive results of the review are shown in Table II-1-(1)-1. Fig. II-1-(1)-1 shows the standard cross sections along the Canal which were planned and drawn for the First Stage Development Project.

Table II-1-(1)-1 Width, Depth and Curvature of the Canal by Hm and Km
Notes to Table II-1-(1)-1

1. The left half of the Table shows the dimensions of the West Channel and the right half shows those of the East Channel.
2. The dimensions, for sections of the Canal not separated into two channels, are written on the left side.
3. The numerals marked by an asterisk (*) are not provided by SCA, but are extrapolated from SCA data for this study.
4. Location: The chart reads from north to south.
   1) The locations indicate the distances based on the "Kilometer Base Line" along the East and West Channels.
   2) The point of Hm 0.00 in the Mediterrenean Sea is the same as of Km 0.000 and the point Hm 0.00 in the Red Sea is the same as Km 162.250.
5. Changing point
   1) This column shows the locations where some dimension of the Canal changes.
   2) The "from" means the beginnings of the change and the "to" means the end of the change (proceeding from north to south).
   3) In the case of putting the same numerals in both "fron" and "to", it means that the position is a point where some dimension changes its value abruptly.
6. Width:
   1) Widths listed are the bottom widths of channels at the planned depth and not the distance between the 11 m depth lines.
   2) A pair of lines between sections represents the sides of a channel.
   3) Calculated widths (marked *) take into consideration the slopes of banks.
7. Depth:
   1) The "Plan" shows the depths planned for the First Stage Development Project and the "Center" shows the results of the sounding conducted at the center line of the Canal on June 4, 1983.
   2) A pair of lines between sections represents the bottom and the water surface of the Canal.
8. Curvature:
   1) Curvatures are expressed as the radius of the curves.
   2) The "L" indicates that the channel curves to the left and the "R" to the right, when facing south.
   3) The "K-B", "E-Th" and "W-Th" show the curvatures of the "Kilometer Base Line", "East Theoretical Line" and "West Theoretical Line" respectively.

Location (Hm, Km)	Section (Hm, Km)		Width (m)	Depth (m)		Curvature (R: m)	Location (Hm^E, Km^E)	Section (Hm, Km)		Width (m)	Depth (m)		Curvature (R: m)
	from	to		Plan	Center			from	to		Plan	Center	
							195.00^{Hm}	195.00	195.00	745.00	20.00		
							190.00					21.00	
							180.00					20.70	
							170.00					20.60	
							160.00					20.30	
							150.00					20.20	
							140.00					19.70	
							130.00					20.20	
							120.00					20.40	
							110.00					19.10	
							100.00					19.40	
Juncture of Port Said Approach Channel							90.00					21.60	
80.00^{Hm}	80.00	80.00	*550.00	13.00			80.00					21.10	
70.00							70.00					20.20	
60.00							60.00					19.50	
50.00							50.00					19.80	
40.00							40.00					20.00	
30.00							30.00					20.60	
20.00					*14.80		20.00					21.00	
10.00	*10.00		*143.00	13.00	*15.00		10.00					19.60	
0.000^{Km}		*0.000		13.00	16.00		0.000^{Km}					21.10	
1.000	1.000		143.00	15.00	*15.60		1.000					22.00	
	*1.500					*K-B 3,050.00^{L}		1.333		120.00	20.00		
									*1.700	102.00	19.50		
2.000					*17.00		2.000					22.90	

Location (Hm,Km)	Section (Hm,Km) from	Section (Hm,Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)	Location (Hm^E,Km^E)	Section (Hm,Km) from	Section (Hm,Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)
3.000					*13.90		3.000					20.60	
4.000					16.60		4.000					21.50	
5.000					14.90		5.000					20.90	
6.000					14.60		6.000					20.20	
7.000					15.10		7.000					19.90	
8.000					13.10		8.000					19.90	
9.000					15.50		9.000					19.70	
10.000					15.70		10.000					20.30	
11.000					15.50		11.000					20.10	
12.000					15.90		12.000					20.90	
13.000					16.20		13.000					20.40	
14.000					16.70		14.000					20.90	
15.000					16.80		15.000					20.80	
								*15.120	*15.120	102.00	19.50		
									*15.470	*172.00	19.50		
16.000					16.70		16.000					19.60	
	16.500	16.500	143.00	15.00									
		16.663	131.00	19.00				Juncture of Port Said Bypass					
17.000				19.00	19.50		17.000					19.50	
		*17.005		19.50									
18.000	Juncture of Port Said Bypass				20.00		18.000					19.80	
19.000			107.00	19.50	19.90		19.000			107.00	19.50	19.90	
20.000					20.20								
21.000					20.50								
22.000					20.20								

Location (Hm, Km)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)
23.000					19.90	
24.000					20.30	
25.000					19.90	
26.000					20.40	
27.000					20.20	
28.000					20.10	
29.000					20.10	
30.000					20.30	
	30.427	30.427	107.00	19.50		
31.000					21.40	
32.000					21.00	
	32.350	32.350	234.00	19.50		
	32.950	32.950	234.00	19.50		
33.000					19.90	
34.000					21.20	
35.000					20.30	
		35.110	92.00	19.50		
36.000					20.70	
37.000					20.30	
38.000					21.10	
39.000					20.20	
40.000					21.00	
41.000					20.40	
42.000					19.80	
43.000					20.70	

Location (Hm^E, Km^E)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)

Location (Hm, Km)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)
44.000					20.60	
45.000					20.20	
46.000					19.20	
47.000					19.40	
48.000					18.90	
49.000			92.00	19.50	20.60	
	49.512		92.00	19.50		
	49.778					W-th 10,945.32R
50.000	Juncture of Ballah Bypass				19.60	
51.000					20.00	
	51.477	51.477	102.00	19.50		
	51.487	51.487	110.00	18.50		
	51.800	51.800	110.00	18.50		
		51.830	134.00	15.50		
52.000					16.20	
	52.054					E-th 4,840.00L
	52.405					W-th 3,080.00L
	52.497					K-B 1,969.00L
	*52.900	*52.900	*164.00			
53.000					15.30	
		53.069				K-B 1,969.00L
		53.298				W-th 3,080.00L
		53.512				E-th 4,830.00L
54.000					16.20	
		54.098	134.00			
55.000					15.60	

Location (Hm^E, Km^E)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)
	49.512		92.00	19.50		E-th 11,068.70L
50.000	Juncture of Ballah Bypass				19.60	
51.000					20.90	
	51.449	51.449	92.00	19.50		
	51.737					W-th 24,551.27L
	51.785		92.00	19.50		E-th 11,068.70L
52.000					21.20	
53.000					21.10	
54.000					20.90	
55.000					20.80	

Location (Hm, Km)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)	Location (Hm^E, Km^E)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)
56.000					16.70		56.000					20.80	
	56.871	56.871	134.00			E-th 4,830.00L							
57.000					16.10		57.000					20.40	
	57.238					W-th 3,125.91L							
	57.457					K-B 1,969.00L							
	*57.860	*57.860	164.00										
58.000					16.40		58.000					21.00	
	58.211					K-B 1,969.00L							
	58.429					W-th 3,044.91L							
	58.797					E-th 4,830.00L							
59.000					16.50		59.000					20.60	
		59.269	134.00						59.895	92.00	19.50		
	*59.870		134.00	15.50									
	59.900	59.900		18.50									
60.000					19.10		60.000					21,10	
	60.309			18.50		W-th 4,000.00R							
		60.800	134.00	19.50									
					(20.20) 19.90		61.000	Juncture of Ballah Bypass				19.90	
	61.125	Juncture of Ballah Bypass				K-B 2,100.00R							
	61.324					E-th 4,940.00R							
62.000					(19.60) 20.20		62.000						
	62.707					K-B 2,100.00R							
63.000					20.30		63.000						
	63.314					4,000.00R							
	63.419					E-th 4,940.00R							

Location (Hm, Km)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)
64.000	Juncture of Ballah Bypass				20.40	
	64.514		109.00	19.50		
65.000					20.90	
66.000					20.30	
67.000					20.20	
68.000					20.10	
69.000					20.30	
70.000					20.50	
71.000					20.30	
		71.146	109.00	19.50		
	71.964		139.00	19.50		E-th 6,190.00R
						W-th 6,000.00R
72.000					21.00	
73.000					20.60	
	73.103					K-B 2,001.00R
74.000					20.90	E-th 6,190.00R
	74.192	74.192				W-th 6,000.00R
						E-th 5,810.00L
						W-th 6,000.00L
	74.300	74.300				K-B 2,011.00R
						K-B 2,157.42L
75.000					21.40	
		75.311	139.00	19.50		E-th 5,810.00L
						W-th 6,000.00L

Location (Hm^E, Km^E)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)
64.000	Juncture of Ballah Bypass					
	64.514		109.00	19.50		

Location (Hm, Km)	Section (Hm, Km)		Width (m)	Depth (m)		Curvature (R: m)	Location (HmE, KmE)	Section (Hm, Km)		Width (m)	Depth (m)		Curvature (R: m)
	from	to		Plan	Center			from	to		Plan	Center	
		75.328				K-B 2,157.42L							
	75.948					K-B 2,110.15R							
76.000					21.60								
	76.033					W-th 2,375.55R							
	*76.050	*76.050	*139.00	19.50				*76.050	*76.050	*139.00	19.50		
	Juncture of Lake Timsah Bypass							76.557	Juncture of Lake Timsah Bypass				E-th 4,810.00L
								76.578					W-th 5,000.00L
	*76.940	*76.940	135.00	*13.50				*76.910	*76.910	139.00	19.50		
77.000					13.50		77.000					21.20	
	77.150					E-th 3,120.00R							
		77.253				K-B 2,110.15R							
		77.371				W-th 2,375.55R							
	77.653					K-B 1,261.00L							
	77.672		*209.58										
	77.912					E-th 2,001.50L							
78.000					15.70		78.000					21.40	
								78.400		139.00	19.50		
									78.900	139.00	19.50		
79.000			*275.00		15.60		79.000					20.50	
		79.649	*175.00			K-B 1,261.00L							
	79.943	79.943	*97.00			E-th 2,001.50L							
80.000					15.70		80.000			*309.00		19.50	
		80.313	*97.00					80.300		*339.00			
	80.385		83.00					Juncture of Lake Timsah Bypass					
81.000					15.80		81.000					20.00	

Location (Hm, Km)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)	Location (Hm^E, Km^E)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)
		81.140	*83.000	*13.50				Juncture of Lake Timsh Bypass					
82.000	Jancture of Lake Timsah Bypass				20.20		82,000					20.20	
	*82.576	*82.576	139.00	19.50				*82.576	*82.576	139.00	19.50		
83.000					20.20								
84.000					20.20								
85.000					20.30								
	85.027	85.027	139.00	19.50		E-th 5,190.00R							
						W-th 5,000.00							
	85.604					K-B 2,511.00R							
86.000					20.70								
	86.300	86.300	139.00	19.50		K-B 2,511.00R							
		86.782											
87.000					20.40								
		87.414	139.00			E-th 5,190.00R							
						W-th 5,000.00R							
88.000					20.30								
	88.814		113.25	19.50									
89.000					19.80								
90.000					19.90								
91.000					20.00								
92.000					20.00								
		92.950	113.25	19.50					92.950	113.25	19.50		
93.000	Juncture of				21.00		93.000	Juncture of				21.00	
94.000	Deversoir Bypass				20.20		94.00	Deversoir Bypass				20.40	
95.000			119.00	19.50	18.40		95.000			*234.55	19.50	20.90	

Location (Hm, Km)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)	Location (Hm^E, Km^E)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)
	95.023		*135.60	17.25				95.250		201.00	19.50		
	95.400	95.400	*135.60	17.25									
	95.418		*144.80	*15.50									
96.000					15.20		96.000			139.00	19.50	20.70	
97.000					15.30		97.000					20.60	
	Great Bitter Lake												
98.000					16.00		98.000					20.90	
99.000					15.40		99.000					20.90	
		97.700	143.000	15.50									
100.000					15.80		100.000					20.80	
	100.200		143.00	15.50									
		*100.210	*146.66	14.50									
101.000					15.60		101.000					20.10	
	101.050		454.00						101.050	139.00	19.50		
102.000					15.80		102.000					19.80	
								102.600		139.00	19.50		E-th 5,000.00L
									*102.610	145.00	18.50		
103.000					*16.00		103.000					19.80	
104.000					*15.80		104.000					19.40	
	104.160		229.00					104.160		455.00			
105.000					*15.70		105.000					19.50	
								105.250	105.250	361.00			*E-th 5,000.00L
106.000					*16.20		106.000					19.50	
107.000					16.00		107.000					19.60	
108.000					15.80		108.000					19.50	

Location (Hm, Km)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)	Location (HmE, KmE)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)
109.000					16.10		109.000					20.40	
110.000					16.30		110.000					20.80	
111.000					16.00		111.000					20.50	
112.000					15.70		112.000					19.60	
								*112.820	*112.820	361.00	18.50		
113.000					15.50		113.000					19.70	
								113.200	113.200	122.00	18.50		
								*113.205	*113.205	*422.40	19.00		
114.000					15.30		114.000					19.50	
								114.195	114.195	*498.60	19.00		
	114.200	114.200	229.00	14.50				142.200	114.200	499.00	19.50		
	114.750	114.750	439.00	14.50				114.800	114.800	219.00			
	114.957	114.957	389.00	14.50									
115.000					15.20		115.000					19.60	
	115.560	115.560	147.00	14.50				115.134	115.134	109.00	19.50		
	115.570	115.570	143.00	15.50									
116.000					15.20		116.000					19.40	
117.000					15.50		117.000					19.20	
118.000					15.40		118.000					19.20	
119.000					15.40		119.000					19.20	
120.000					15.20		120.000					19.40	
121.000					15.40		121.000					19.50	
								121.800	121.800	109.00	19.50		
								121.936					E-th 4,960.00R
122.000					17.60		122.000					20.20	

Location (HmKm)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)	Location (Hm^E, Km^E)	Section (Hm, Km) from	Section (Hm, Km) to	Width (m)	Depth (m) Plan	Depth (m) Center	Curvature (R: m)
	*122.060	*122.060	143.00	15.50				122.100	122.100	119.00	19.5		
		122.100	*119.00	*19.50									
	122.449					W-th 4,000.00R							
	122.780					K-B 3,000.00R							
123.000					20.00		123.000	Juncture of Kabrit Bypass				20.00	
124.000	Juncture of Kabrit Bypass				20.80		124.000						
125.000					20.40		125.000						
		125.004				K-B 3,000.00R							
		125.497				W-th 4,000.00R							
	125.507	125.507	139.00	19.50		E-th 4,960.00R			125.507	139.00	19.50		
126.000					20.20								
127.000					20.40								
128.000					20.30								
129.000					21.00								
	129.499					E-th 5,190.00R							
						W-th 5,000.00R							
130.000					21.00								
	130.077					K-B 2,620.65R							
131.000					21.20								
		131.357				K-B 2,620.65R							
	131.975	131.975 {	139.00			E-th 5,190.00R							
						W-th 5,000.00R							
132.000					21.00								
133.000					21.40								
	133.175	133.175	109.00	19.50									

Location (Hm, Km)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)	Location (Hm^E, Km^E)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)
134.000					21.10								
135.000					20.90								
136.000					21.30								
137.000					20.90								
138.000					20.20								
139.000					21.80								
140.000					21.40								
141.000					21.10								
142.000					20.70								
143.000					20.90								
144.000					21.70								
	144.714	144.714	109.00	19.50									
145.000					21.30								
	145.313					W-th 8,790.60L							
	145.631					K-B 3,000.00L							
	145.915	145.915	*181.00	19.50									
146.000					20.70								
		146.041				K-B 3,000.00L							
		146.512				W-th 8,790.60L							
147.000					20.70								
	147.146	147.146	109.00	19.50									
148.000					20.80								
149.000					20.80								
150.000					20.90								
151.000					20.60								

Location (Hm, Km)	Section (Hm, Km)		Width (m)	Depth (m)		Curvature (R: m)	Location (Hm^E, Km^E)	Section (Hm, Km)		Width (m)	Depth (m)		Curvature (R: m)
	from	to		Plan	Center			from	to		Plan	Center	
152.000					20.40								
153.000					20.10								
	153.524	153.524	109.00	19.50									
154.000					20.40								
	154.724	154.724	139.00	19.50		E-th 5,190.00R							
						W-th 5,000.00R							
	154.987					K-B 3,011.00R							
155.000					20.80								
		155.646				K-B 3,011.00R							
		155.724				E-th 5,190.00R							
		155.827				W-th 5,000.00R							
156.000					20.80								
	156.274					E-th 5,190.00R							
						W-th 5,000.00R							
157.000					20.90								
	157.006					K-B 3,200.00R							
		157.550	139.00	19.50									
158.000					21.10								
	158.300	158.300	*149.00										
159.000					20.60								
		159.327				K-B 3,200.00R							
		159.998	139.00			E-th 5,190.00R							
						W-th 5,000.00R							
160.000					20.60								
161.000					22.00								

Location (Hm, Km)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)
		161.050	139.00	19.50		
162.000					24.70	
162.250Km 0.000 Hm	0.00	162.250 0.00	300.00			
	1.00	1.00	*309.00	*19.50		
	3.09	3.09	265.00	23.50		
10.00					24.90	
	19.00	19.00	265.00			
20.00					24.40	
	21.00	21.00	285.00			
	*22.08	*22.08	265.00			
30.00						
40.00						
50.00						
60.00					24.20	
70.00					25.00	
80.00					24.90	
		80.50	265.00	23.50		

Location (Hm^E, Km^E)	Section (Hm, Km) from	to	Width (m)	Depth (m) Plan	Center	Curvature (R: m)

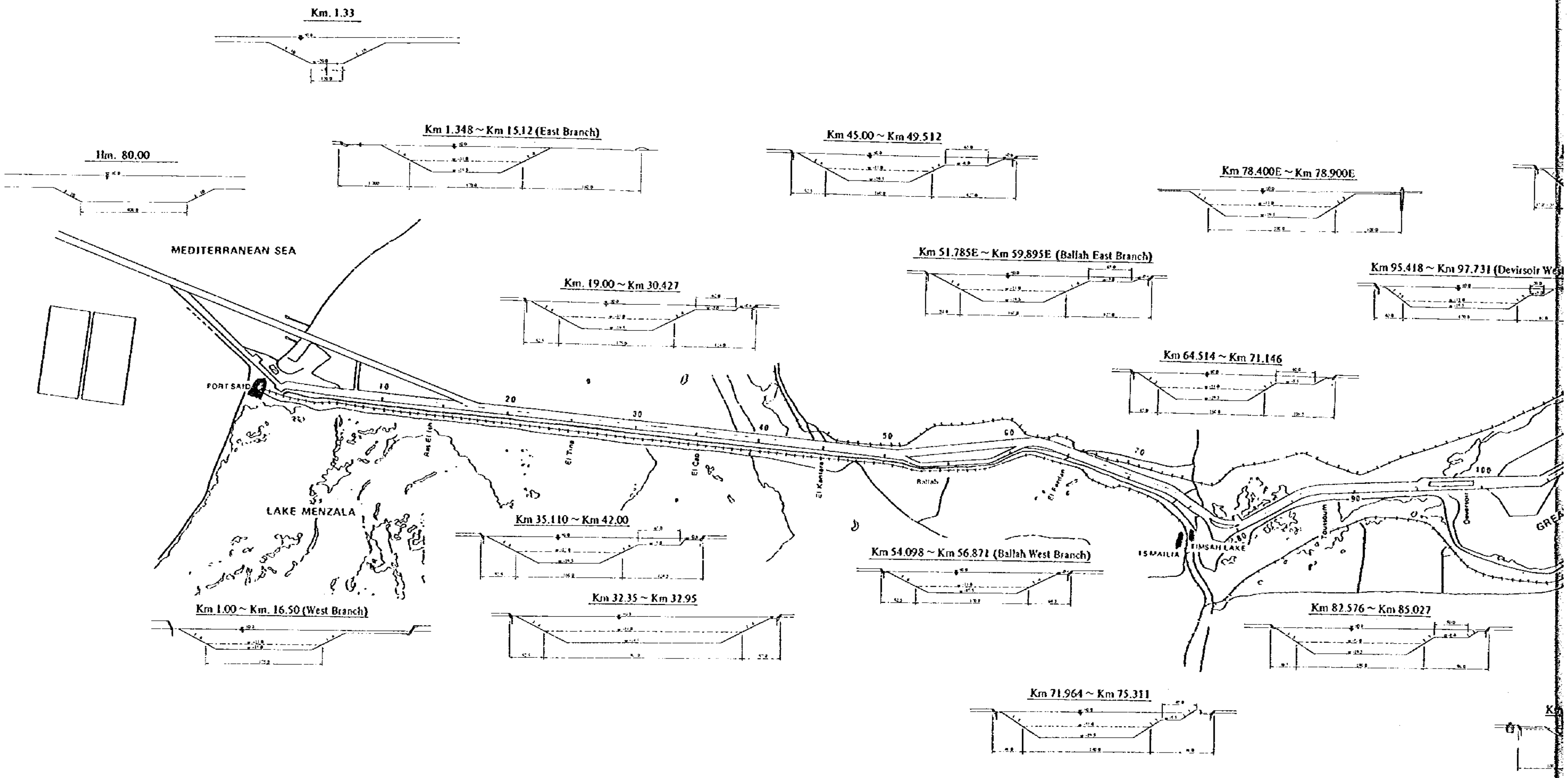


Fig. II-1-(1)-1 Standard Cross Section of the First Stage Development

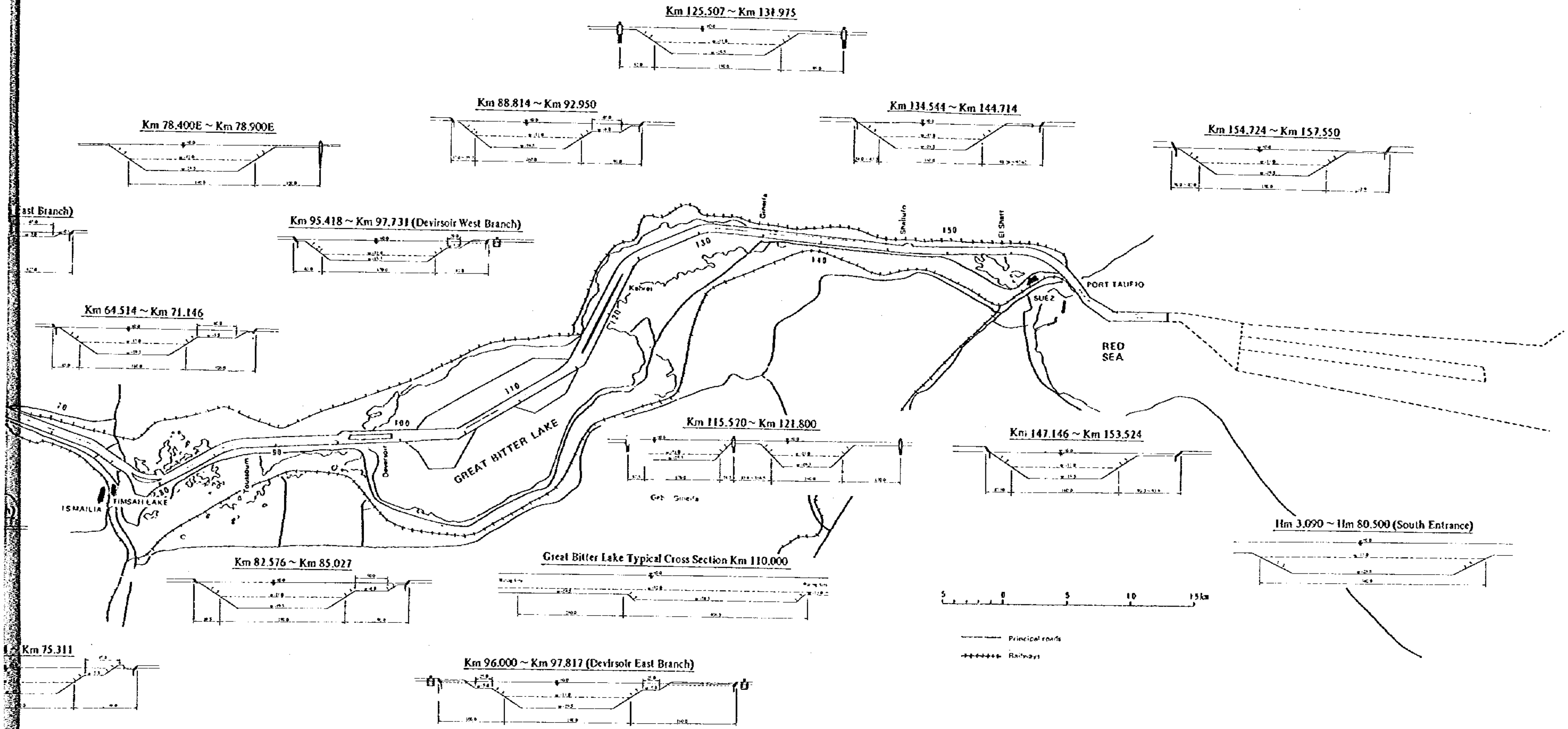


Fig. II-1-(1)-1 Standard Cross Section of the First Stage Development Project

(2) Width of the Canal

For waterways where vessels pass each other, generally speaking the width of the channel should be more than twice the length of the largest vessel which will pass through. However, there is no established standard for channels which are operated on a one-way system like the Suez Canal. Nonetheless, it may be useful to review the canal using the two-way standards particularly to allow for possible future expansion to a two-way system.

The largest ship which will usually transit the Canal is a fully loaded 150,000 DWT tanker with the average length of approximately 290 m (hereafter referred to as "L"). Although 370,000 DWT tankers can pass through the Canal in ballast, this is extremely rare, and it is not rational to utilize this exceptional case for considering width.

The actual Canal widths are compared with "L" in Table II-1-(1)-2, below.

Table II-1-(2)-1 Percent of the Canal with Different Widths

Compared to L (L = 290 m)	East Branch			West Branch			The Canal		
	Length (Km)	Aggregate (Km)	Aggregate (%)	Length (Km)	Aggregate (Km)	Aggregate (%)	Length (Km)	Aggregate (Km)	Aggregate (%)
Less than or equal to 0.5L	40.1	77.2	100.0	85.5	102.1	100.0	125.6	179.3	100.0
0.5L to 1.0L	14.5	37.1	48.1	16.3	16.6	16.3	30.8	53.7	29.9
1.0L to 1.5L	21.3	22.6	29.3	0.3	0.3	0.3	21.6	22.9	12.8
1.5L to 2.0L	1.3	1.3	1.7	–	0.0	0.0	1.3	1.3	0.7
Greater than 2.0L	–	0.0	0.0	–	0.0	0.0	–	0.0	0.0
Total Length	77.2 Km			102.1 Km			179.3 Km		

Note: 1. This table only considers channels which can accomodate 150,000 DWT vessels channels with a depth of 19.5 m or more.
2. The total length of the Canal is different from that in Table II-1-(1)-1 because this Table includes bypass lengths.

According to Table II-1-(2)-1, there is no place where the width of the channel is wider than 2L and only 12.8% of the Canal is wider than L. Comparing the length wider than L in the east branch with that of the west branch, it is clear that the east branch which was developed later than the west has better conditions for the transit of vessels, because while the portion of the east branch greater than L accounts for about 30%, that of the west branch is barely above zero.

(3) Depth of the Canal

The depths of the Canal were reviewed and analyzed by comparing the depths in the drawings with the records from actual soundings. The soundings were carried out on June 4th, 1984 by SCA. The records show the depths at the center of the channel and therefore it is impossible to study crossectionally. But as these are the latest measurement made using reliable methodology, and as the results have good continuity, it is reasonable to judge that these are representative values of the current Canal depth. Furthermore, SCA carried out a sounding survey of portions of the Canal in October, 1984. This survey showed no significant variation between depth at the center line and depth along the sides of the Canal.

The center line comparison was conducted at 1 Km intervals along the Canal and the places which were shallower than the depth listed in the drawings were carefully located.

The location of such places is shown in Table II-1-(3)-1.

Table II-1-(3)-1 Locations Shallower than Planned

Channel (E or W)	Total Locations (1)	Number of Locations Shallower than Planned			(2)/(1)
		Shallower	*Doubtful*	*Total (2)*	
East	82	3	0	3	0.0366
West	180	17	3	20	0.1111
Total	262	20	3	23	0.0878

Note: 1. Comparison between depths of the First Stage Development Project Plan and depths found by sounding at center line of the Canal.
2. Locations are at intervals of 1 Km or 10 Hm.
3. Doubtful locations are included when there is any probability that they are shallower than the Plan.

The reason why we applied the method of counting the number of points and not the length is that the line of the sounding records continues smoothly and so it is recognizable that the depth of the channel is represented by each of the central points 1 Km apart.

Table II-1-(3)-1 shows the about 9% of all locations which were checked, (amounting to 262 points in both the east and west channels) had a depth less than that which was planned and that the west channel is worse than the east. The areas which have the tendency to be shallow, according to Table II-1-(1)-1, are concentrated between Kms 3 and 8, Kms 95 and 99 and Kms 116 and 121 along the west channel and between Hms 60 and 10 along the east channel in the Mediterranean Sea.

If these areas had been cleared to a sufficient depth after the completion of the First Stage Development Project, there is a probability that they have been buried by some phenomena such as littoral drift, collapse of banks and/or influx of pollutants. It is interesting that those areas are in such places as the harbour, the estuary, and the places where the cross section changes suddenly. On this matter, it is important to continue careful sounding and detailed analysis to make these phenomena clear and the data obtained through the investigation will be very useful for materializing the working plan of the Second Stage Development Project.

(4) Curvature of the Canal

The curvature of the Canal was reviewed by following up radiuses. In the drawings of the plan, three kinds of base lines, "Kilometer Base Line", "East Theoretical Line" and "West Theoretical Line", are used for giving the curvatures and they are not always correlated with each other. Although two more base lines, the "East Bank Line" and the "West Bank Line", can be found in the drawings, they are less important than others from the viewpoint of theoretical analysis on the channel curvature.

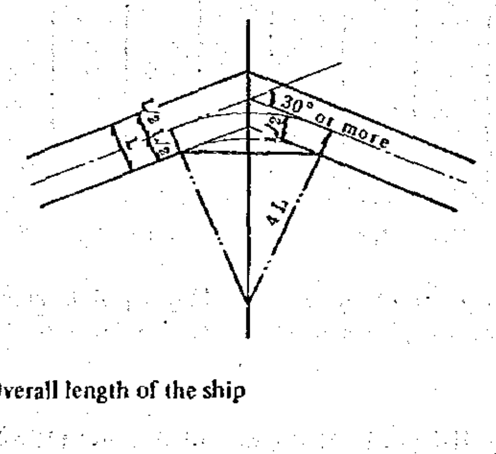
Table II-1-(1)-1 shows that the smallest radius is 1,261 m and the largest one is 24,551.27 m.

As to the curvature, the changes of course and the distance between those turning points must be given serious attention along with the lengths of the radiuses. This is because pilots are required to revolve steering wheels quickly clockwise or counterclockwise in order to keep ships on course. If the curve of the channel frequently changes direction, especially when turning points are located close together, this necessitates frequent turning and possible hazards.

At the point Km 74.192, by Table II-1-(1)-1, both the E-Th (East Theoretical Line) and the W-Th (West Theoretical Line) are at the same time changing direction from right to left towards the south, and at the point 74,300 Km, which is located just one hundred meters from the former point, the K-B (Kilometer Base Line) also changes its direction. A similar example can be found between Km 77.150 and Km 77.912, but this part of the west channel is not used by transiting vessels these days.

These places where several of the basic lines change their radiuses and directions are considered dangerous locations for navigation.

Fig. II-1-(4)-1 is an example of the reference standard for laying out waterways and shows that it is desirable that the intersection angle of center lines at a curve not exceed 30 degrees and that the radius of the curvature should be ≥4L when this angle exceeds 30 degrees.



L: Overall length of the ship

Fig. II-1-(4)-1 Layout of Waterways at Curves

II-2 Natural Conditions

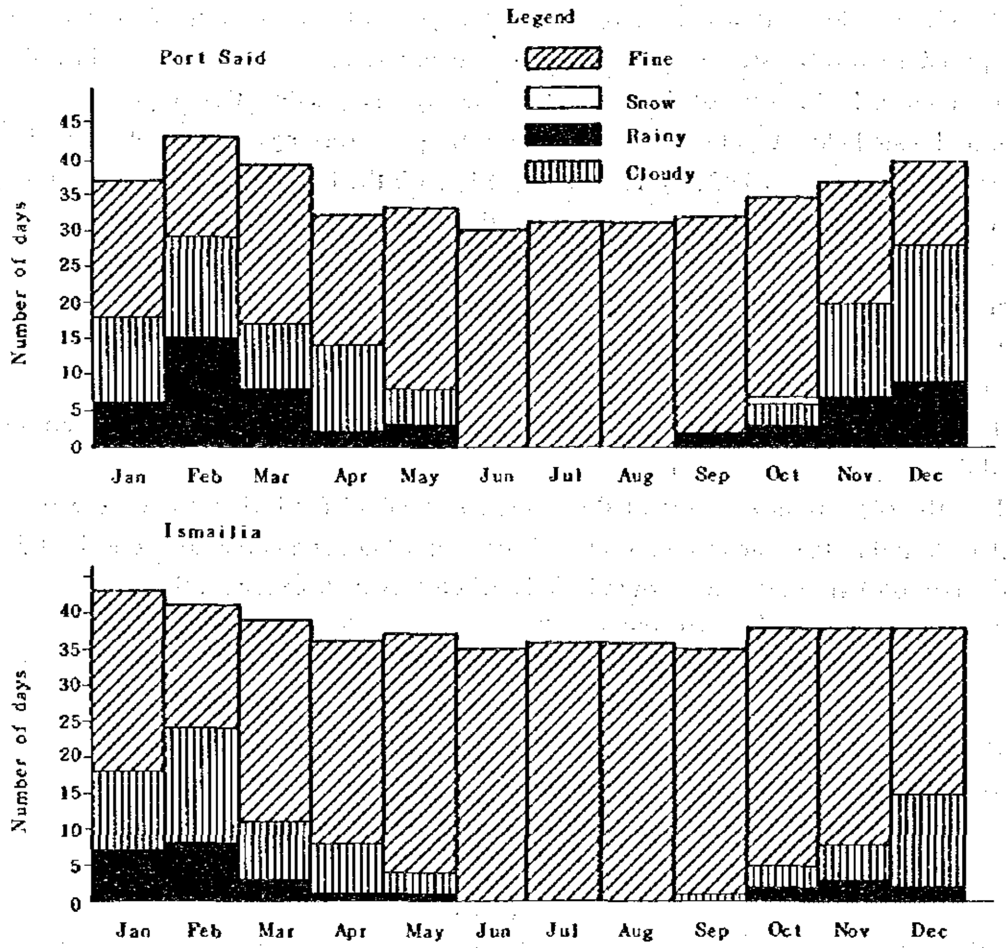
(1) Weather

Fig. II-2-(1)-1 shows the number of rainy days, cloudy days and fine days in 1982.

The number of rainy days is higher from November to March at Port Said and from January to February at Ismailia.

On the other hand, the number of rainy days from June to August is low at both areas.

The total number of rainy days is 55 days at Port Said and 27 days at Ismailia in 1982.



Note: The sum of the numbers of days does not always equal the number of the days in the month, because sometimes a day is counted twice, e.g. Jan. 1st is counted as a rainy day and as a cloudy day.

Fig. II-2-(1)-1 Histogram of Weather (1982)

(2) Temperature

Table II-2-(2)-1 shows the monthly maximum and minimum temperatures.

Table II-2-(2)-1 Maximum and Minimum Temperatures (1982)

(Unit: °C)

Item	Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Port Said	Maximum	20.0	19.4	22.4	33.4	26.4	31.1	30.5	32.4	31.2	32.6	25.4	20.5
	Minimum	11.1	6.2	9.0	14.7	16.0	19.8	20.8	23.2	22.6	14.5	12.0	10.4
Ismailia	Maximum	23.8	23.2	28.5	36.7	34.8	38.2	36.0	36.4	36.1	39.6	24.0	24.7
	Minimum	4.0	4.8	5.5	9.4	11.8	15.0	17.9	19.4	17.7	15.2	6.2	5.3
Suez	Maximum	23.6	21.8	26.3	32.6	38.7	39.4	38.3	39.5	37.7	35.4	28.5	22.2
	Minimum	6.4	6.8	9.0	12.4	14.5	19.6	20.2	21.2	20.1	19.6	9.4	8.0

(3) Humidity

Table II-2-(3)-1 shows the maximum and minimum humidity by month. Humidity is between 86% and 48% at Port Said, between 89% and 30% at Ismailia and between 81% and 27% at Suez.

Table II-2-(3)-1 Maximum and Minimum Humidity (1982)

(Unit: %)

Items	Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Port Said	Maximum	86	85	81	84	80	82	80	84	80	79	77	83
	Minimum	59	56	50	55	60	60	58	61	61	58	48	55
Ismailia	Maximum	87	85	78	73	80	81	85	89	88	86	89	84
	Minimum	47	46	32	30	32	30	34	39	38	41	42	44
Suez	Maximum	62	69	69	69	71	81	76	77	73	76	73	80
	Minimum	35	36	34	31	27	27	29	29	29	34	37	46

(4) Visibility

1) Frequency of Poor Visibility

Fig. II-2-(4)-1 shows the frequency of poor visibility. The occurrence of poor visibility under one kilometer increases from January to March at Port Said, and from October to April at Ismailia. Poor visibility rarely occurs at Suez.

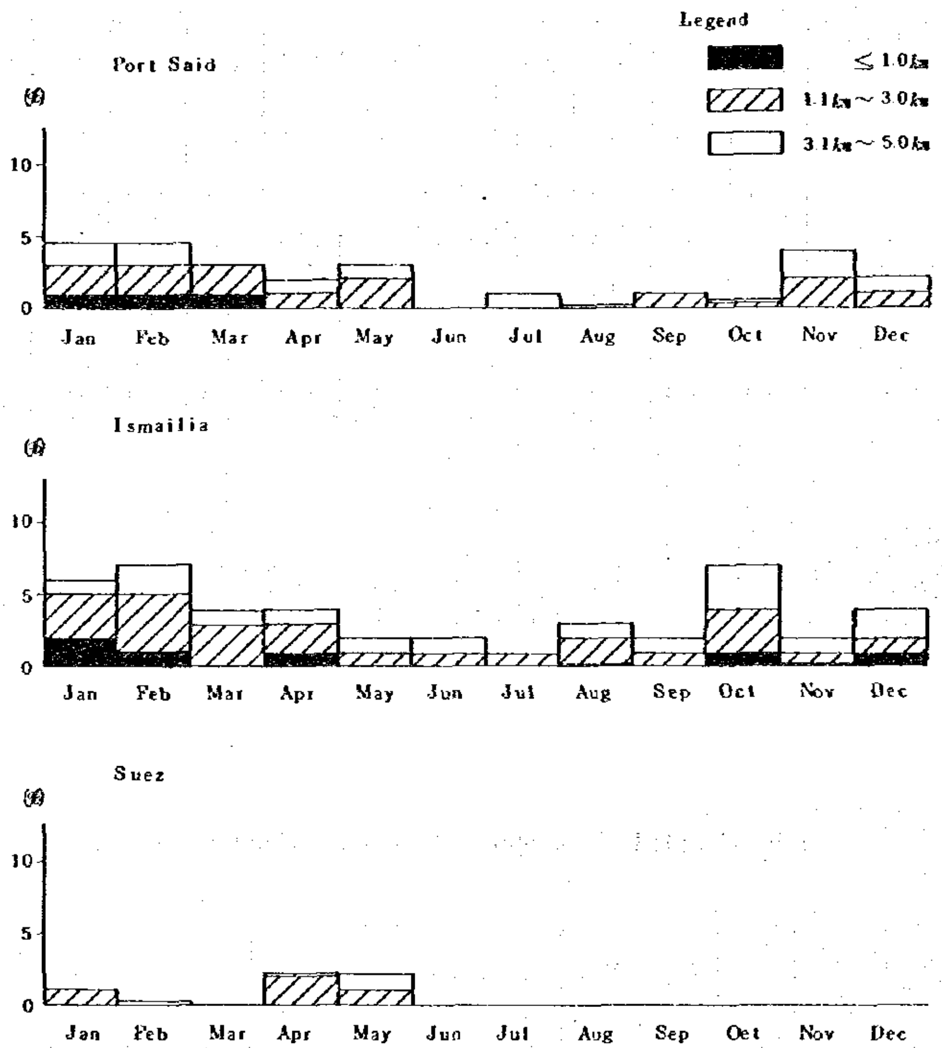


Fig. II-2-(4)-1 Histogram of Poor Visibility (1981 ~ 1982)

2) Duration of Poor Visibility

Poor visibility occurs due to fog and sandstorms. As shown in Fig. II-2-(4)-2, the duration of poor visibility on weak wind days caused by fog is usually shorter than six hours but poor visibility on strong wind days caused by sandstorms is frequently longer than ten hours.

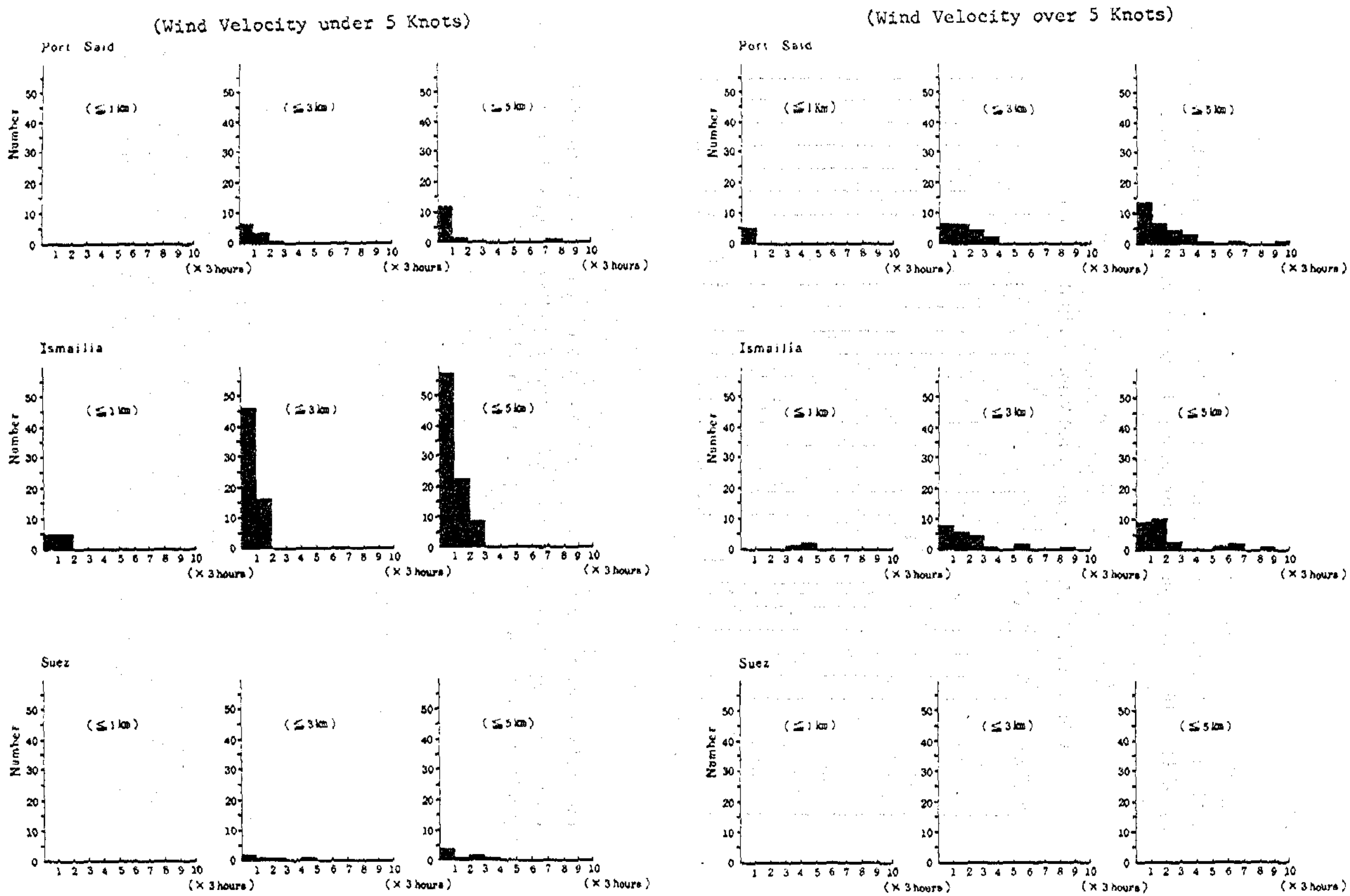


Fig. II-2-(4)-2 Histogram of Duration of Poor Visibility (1981 ~ 1982)

(5) Wind

1) Wind Velocity

Table II-2-(5)-1 shows the wind velocity observed most frequently in each month. Wind velocity of 11 ~ 16 knots occurs most frequently throughout the year at Port Said and Suez. That of 1 ~ 3 knots occurs most frequently at Ismailia.

Table II-2-(5)-1 Most Frequent Wind Velocity (1981 ~ 1982)

Month \ Velocity (Kn)	Calm	1 ~ 3	4 ~ 6	7 ~ 10	11 ~ 16	17 ~ 21	22 ~ 27	28 ~ 33	34 ~
January		×	△	○					
February		×		△	○				
March		×			○ △				
April			×		○ △				
May		×			○ △				
June		×			○ △				
July		×			○ △				
August		×			○ △				
September		×		○	△				
October		×			○ △				
November		×		○	△				
December		×		○ △					

○ Port Said × Ismailia △ Suez

The wind velocity at each of the three locations is shown graphically in Fig. II-2-(5)-1.

The occurrence of strong winds increases from January to May at Port Said, and from April to May at Suez. However, strong winds rarely occur at Ismailia.

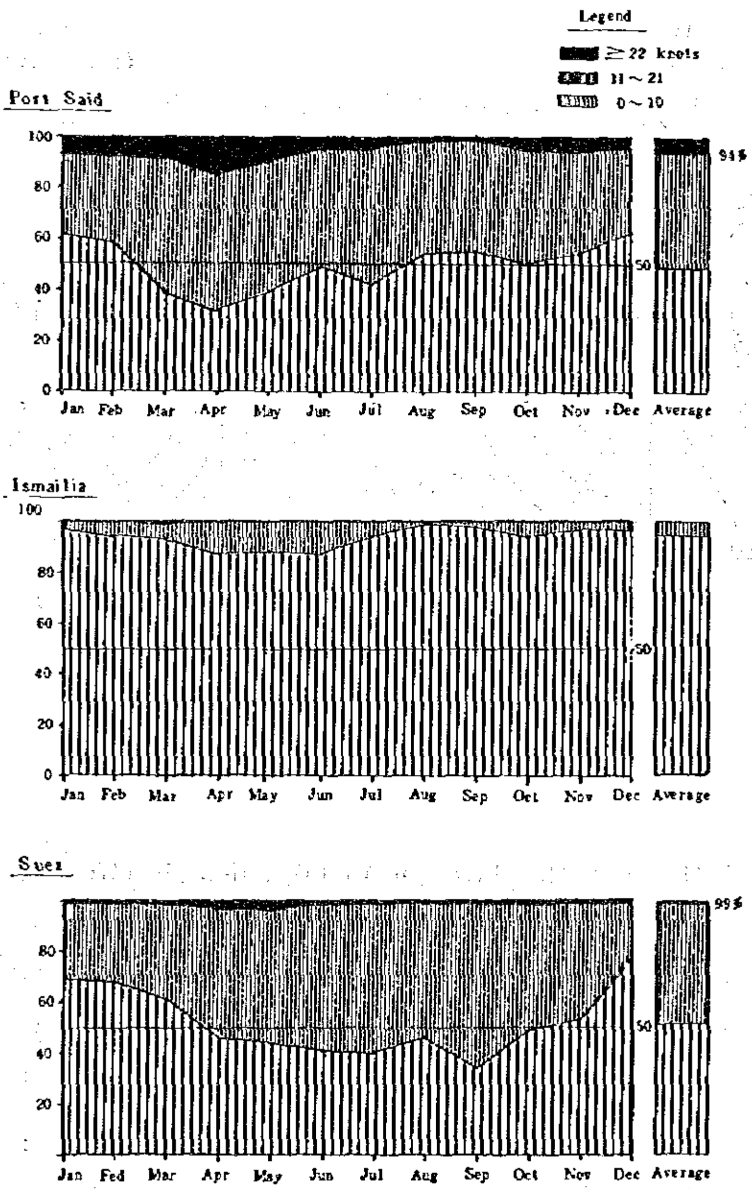


Fig. II-2-(5)-1 Histogram of Wind Velocity (1978 ～ 1980)

2) Wind Direction

Fig. II-2-(5)-2 shows the distribution of wind direction when wind velocity is over 21 knots. The direction of strong winds is generally between 240° and 330° from north at Port Said (about 65% of the time), and between 330° and 360° from north at Suez (about 50% of the time).

Table II-2-(5)-2 shows the most frequent wind direction when wind velocity is between 11 ～ 16 knots at Port Said and Suez (this wind velocity occurs most frequently throughout the year).

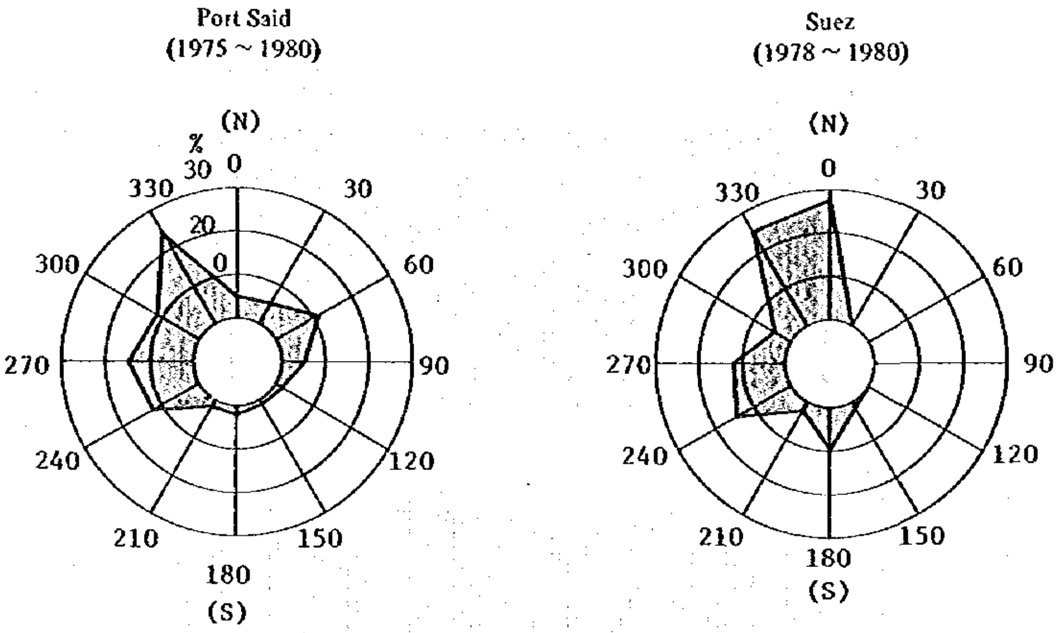


Fig. II-2-(5)-2 Wind Rose (over 21 knots)

Table II-2-(5)-2 Most Frequent Wind Direction when Wind Velocity is between 11 ~ 16 knots (1981 ~ 1982)

Month \ Direction	345° ~ 14°	15° ~ 44°	45° ~ 74°	75° ~ 104°	105° ~ 134°	135° ~ 164°	165° ~ 194°	195° ~ 224°	225° ~ 254°	255° ~ 284°	285° ~ 314°	315° ~ 344°
January									O			Δ
Februay									O			Δ
March			O									Δ
April												O Δ
May			O									Δ
June	Δ											O
July	Δ											O
August	Δ											O
September	Δ											O
October	O											Δ
November	O											Δ
December									O			Δ

O Port Said　　Δ Suez

Note: At Ismailia, wind is very weak.

(6) Tidal Currents

The tidal current observations were carried out using an automatic recording current meter (OC-1) and a direct reading current meter (MFK008-MK3) at five stations which are shown in Fig. II-2-(6)-1.

The period of the tidal current observations are listed in Table II-2-(6)-1.

Table II-2-(6)-1 Period of Tidal Current Observations

No.	Location	Type of Current Meter	Depth (m)	Period
1.	Port Said	Automatic Recording Type (OC-1)	-1	Sep. 25 ~ Oct. 5 (1983)
2.	– ditto –	– ditto –	-1	Feb. 25 ~ Mar. 10 (1984)
3.	Tousson	– ditto –	-1	Aug. 24 ~ Sep. 8 (1983)
4.	Port Taufiq	– ditto –	-1	Sep. 8 ~ Sep. 25 (1983)
5.	El-Kabrit	Direct Reading Type (MFK008-MK3)	-2, -6, -10	Sep. 22 ~ Sep. 23 (1983)

1) Frequency of Tidal Currents

Fig. II-2-(6)-2 shows the frequency of tidal current direction and velocity. The distinction of tidal current at each point is as follows.

At Port Said, current direction is southwestward in flood and northeastward in ebb. The occurrence of velocities over 0.2 m/sec is less than 2%. Generally the velocity is low.

At Tousson, the south southeastward current is predominant and the occurrence of velocity over 0.4 m/sec is 16.9%. The velocity is relatively high.

At El Kabrit, current direction is southwestward to west northwestward in flood and eastward to southeastward in ebb. Occurrence of velocities over 0.4 m/sec is about 35%. The velocity here is also relatively high.

At Port Taufiq, current direction is northeastward in flood and southwestward in ebb. The occurrence of velocities over 0.6 m/sec is 27.7% and that over 0.8 m/sec is 5.4%. The velocity is very high.

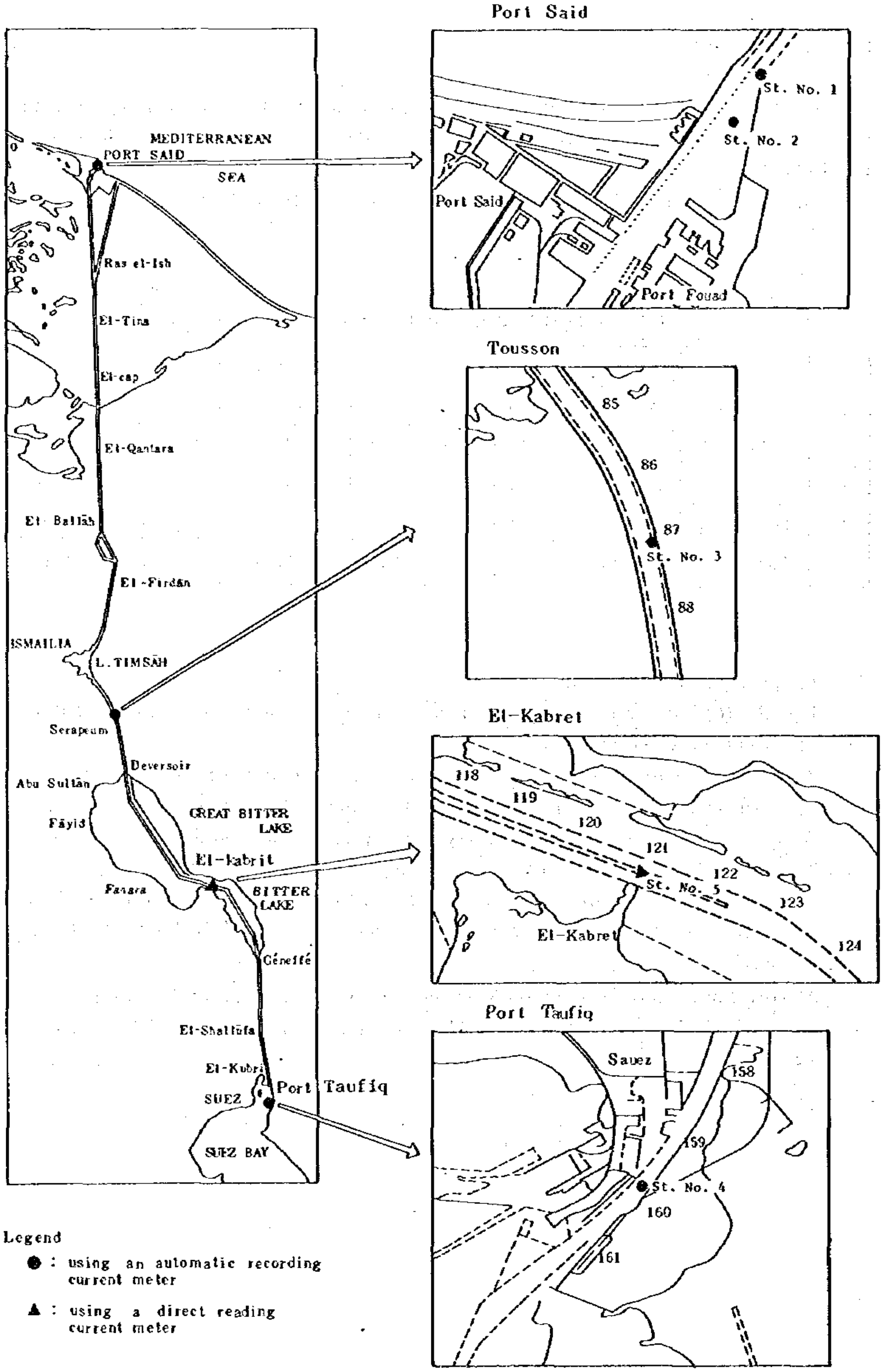
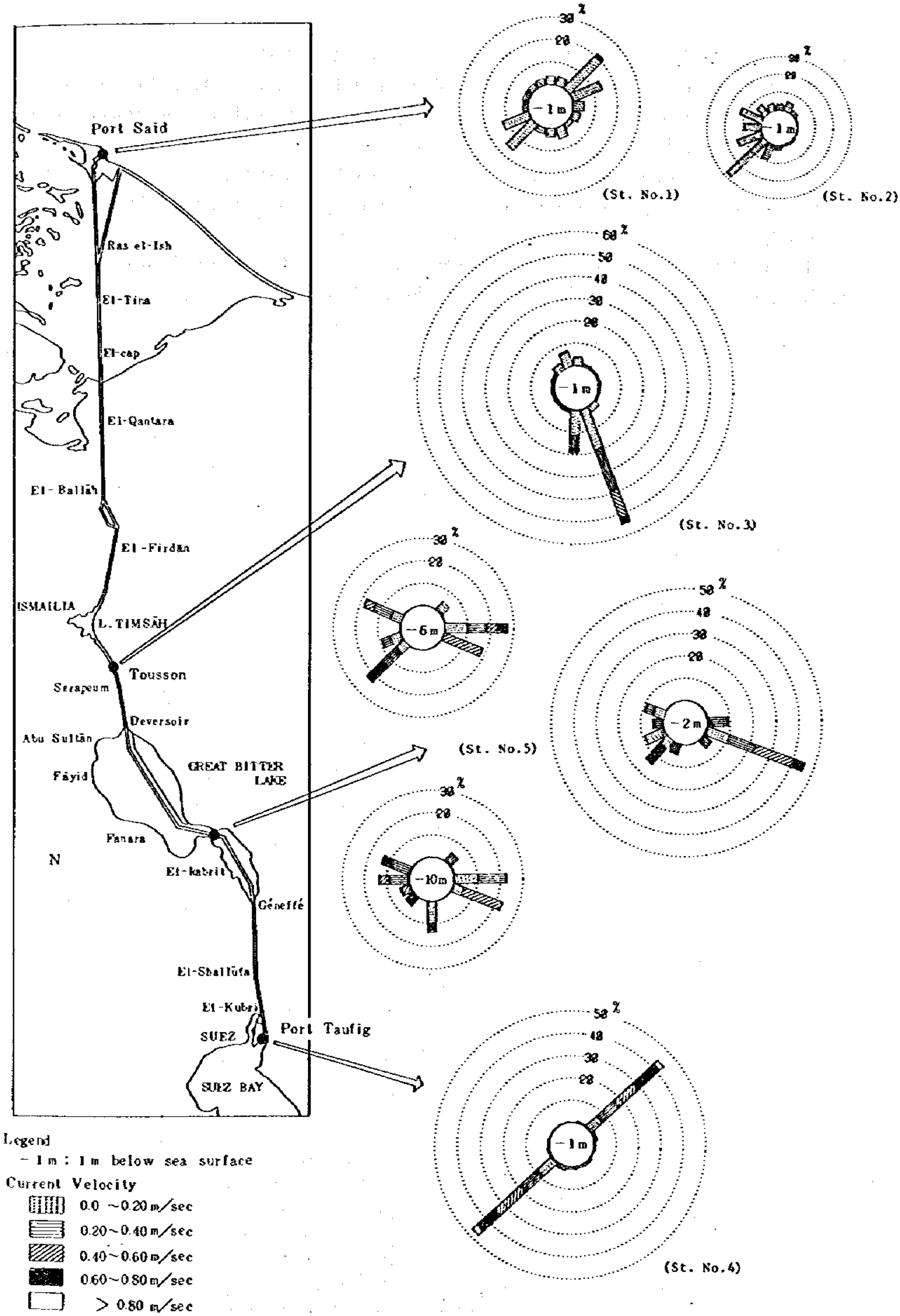


Fig. II-2-(6)-1 Location of Tidal Current Observation Stations



Legend
- 1m : 1m below sea surface
Current Velocity
0.0 ~0.20 m/sec
0.20~0.40 m/sec
0.40~0.60 m/sec
0.60~0.80 m/sec
> 0.80 m/sec

Fig. II-2-(6)-2 Frequency of Tidal Current Velocity and Direction

2) Harmonic Analysis of Tidal Current

The tidal current harmonic constants are shown in Table II-2-(6)-2. According to this Table, the M_2 constituent is predominant at Port Taufiq, and the M_2 and K_1 constituents are predominant at Port Said and Tousson.

The constant current, which is expressed as V_0 on Table II-2-(6)-2, is very small at Port Said and Port Taufiq, namely less than 3 cm/sec. However, that at Tousson is about 18 cm/sec which is relatively high.

The tidal current type is semi-diurnal periodicity at Port Taufiq, and is mixed periodicity (partly semi-diurnal and partly diurnal) at Port Said and Tousson.

Table II-2-(6)-2 Tidal Current Harmonic Constants

VEL ..... Velocity (m/sec.)
KAPPA ..... Phase lag (degree)
DIR ..... Clockwise from true north (degree)
VO ..... Constant Current

Port Said (St. No.2) Period: Feb. 25 ∿ Mar. 10 (1984)

	NORTH		EAST		MAJOR			MINOR			GENERAL	
	VEL	KAPPA	VEL	KAPPA	DIR	VEL	KAPPA	DIR	VEL	KAPPA	VEL	KAPPA
VO	0.002	***	-0.057	***	271	0.057	***	**	***	***	0.004	***
K1	0.028	170.7	0.016	290.1	159	0.029	341.0	249	0.013	71.0	0.028	169.2
P1	0.009	176.3	0.005	289.3	162	0.010	347.5	252	0.005	77.5	0.009	174.7
O1	0.007	245.1	0.002	279.0	193	0.007	67.1	283	0.001	157.1	0.007	244.6
Q1	0.001	281.9	0.000	273.5	195	0.001	101.3	285	0.000	11.3	0.001	282.1
M2	0.033	31.3	0.008	354.2	10	0.034	29.8	100	0.005	299.8	0.033	31.7
N2	0.006	336.4	0.002	355.1	12	0.007	337.3	102	0.000	67.3	0.006	336.2
S2	0.010	133.7	0.009	352.4	137	0.012	331.6	227	0.004	241.5	0.010	135.4
K2	0.003	142.0	0.002	352.2	137	0.003	336.0	227	0.001	246.0	0.003	143.3
M4	0.006	149.6	0.009	217.2	246	0.009	23.4	336	0.005	113.4	0.006	145.5
MS4	0.011	63.5	0.004	320.7	354	0.011	65.8	84	0.004	335.8	0.011	64.7

GENERAL DIRECTION ** 357 (POSITIVE) 177 (NEGATIVE)

Toussoun (St. No.3) Period: Aug. 24 ∿ Sep. 8 (1983)

	NORTH		EAST		MAJOR			MINOR			GENERAL	
	VEL	KAPPA	VEL	KAPPA	DIR	VEL	KAPPA	DIR	VEL	KAPPA	VEL	KAPPA
VO	-0.176	***	0.047	***	164	0.182	***	**	***	***	0.182	***
K1	0.095	2.2	0.032	185.1	351	0.100	2.5	71	0.002	272.5	0.100	182.5
P1	0.031	8.9	0.011	191.6	341	0.033	9.2	71	0.000	279.2	0.033	189.2
O1	0.033	91.8	0.011	272.3	342	0.035	91.9	72	0.000	1.8	0.034	271.9
Q1	0.006	136.3	0.002	315.5	342	0.007	136.2	72	0.000	226.2	0.007	316.2
M2	0.150	225.9	0.043	50.5	164	0.155	45.2	254	0.003	316.3	0.155	46.3
N2	0.029	206.6	0.008	35.0	164	0.030	27.2	254	0.001	297.3	0.030	27.3
S2	0.063	261.9	0.022	79.5	161	0.067	81.6	251	0.001	171.6	0.067	81.7
K2	0.017	264.8	0.006	81.8	161	0.018	84.5	251	0.000	174.5	0.018	84.5
M4	0.014	89.3	0.002	310.8	353	0.014	89.9	83	0.001	359.9	0.014	271.0
MS4	0.009	269.8	0.005	37.6	156	0.010	80.2	245	0.004	170.2	0.010	82.7

GENERAL DIRECTION ** 163 (POSITIVE) 343 (NEGATIVE)

Port Taufiq (St. No.4) Period: Sep. 8 ∿ Sep. 25 (1983)

	NORTH		EAST		MAJOR			MINOR			GENERAL	
	VEL	KAPPA	VEL	KAPPA	DIR	VEL	KAPPA	DIR	VEL	KAPPA	VEL	KAPPA
VO	0.013	***	0.014	***	133	0.019	***	**	***	***	0.001	***
K1	0.073	174.7	0.070	188.2	223	0.101	1.1	313	0.012	91.1	0.101	181.3
P1	0.024	175.4	0.023	188.6	223	0.033	1.7	313	0.004	91.7	0.033	181.8
O1	0.047	184.5	0.050	192.9	226	0.068	9.0	316	0.005	99.0	0.068	188.8
Q1	0.009	189.3	0.010	195.3	226	0.013	12.5	316	0.001	102.5	0.013	192.4
M2	0.451	75.8	0.448	76.9	44	0.636	76.4	134	0.006	166.4	0.636	76.4
N2	0.087	72.2	0.087	77.7	44	0.123	74.9	134	0.006	164.9	0.123	74.9
S2	0.130	82.5	0.131	75.6	45	0.184	79.0	135	0.011	349.0	0.184	79.0
K2	0.035	83.0	0.036	75.5	45	0.050	79.2	135	0.003	349.2	0.050	79.3
M4	0.002	190.5	0.016	166.8	261	0.016	347.3	351	0.001	257.3	0.013	169.9
MS4	0.014	143.2	0.027	153.1	62	0.030	151.0	152	0.002	241.0	0.029	149.7

GENERAL DIRECTION ** 45 (POSITIVE) 225 (NEGATIVE)

3) Simulation of Tidal Current and Drift Current

The purpose of simulations of tidal current and drift current are as follows:

(i) To calculate the current conditions for risk analysis.

(ii) To calculate the current conditions for computer simulations for oil diffusion.

The basic equation and conditions for the simulation are shown in Paragraph (10).

Fig. II-2-(6)-3 and Table II-2-(6)-3 show the results of the simulation. In this figure, tidal current is illustrated as the mean velocity between sea surface and sea bed, and also drift current is illustrated as the mean velocity between 0 meters and 1.5 meters below sea surface.

From these results, we see that the current often runs across the waterway at points near the junction of the bypasses, at El Kabrit and in the Port Said approach channel.

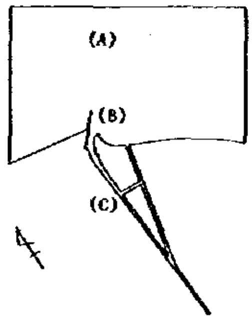
Table II-2-(6)-3 Results of Current Simulation

Port Said

Upper : Velocity
Lower : General Direction

Area	Offshore (A)	East side of West breakwater (B)	The Canal (C)
Drift Current	About 20 cm/sec South southeastward	10 - 15 cm/sec Southward	10 - 15 cm/sec Southward
Tidal Current (ebb)	10 - 15 cm/sec Northwestward	5 - 30 cm/sec Northward	10 - 15 cm/sec Northward
Tidal Current (flood)	10 - 15 m/sec Southeastward	5 - 10 cm/sec Making a circule clockwise	10 - 15 cm/sec Southward

Port Said



Great Bitter Lake and Little Bitter Lake

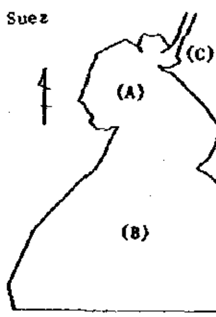
Area	Great Bitter Lake (A)	Near El-Kabrit (B)	Little Bitter Lake (C)
Drift Current	about 12 cm/sec South southeastward	15 - 25 cm/sec Eastward	about 10 cm/sec South southeastward
Tidal Current (ebb)	less than 5 cm/sec -	5 - 20 cm/sec Eastward	about 5 cm/sec South southeastward
Tidal Current (flood)	less than 5 cm/sec -	5 - 20 cm/sec Westward	about 5 cm/sec North northwestward

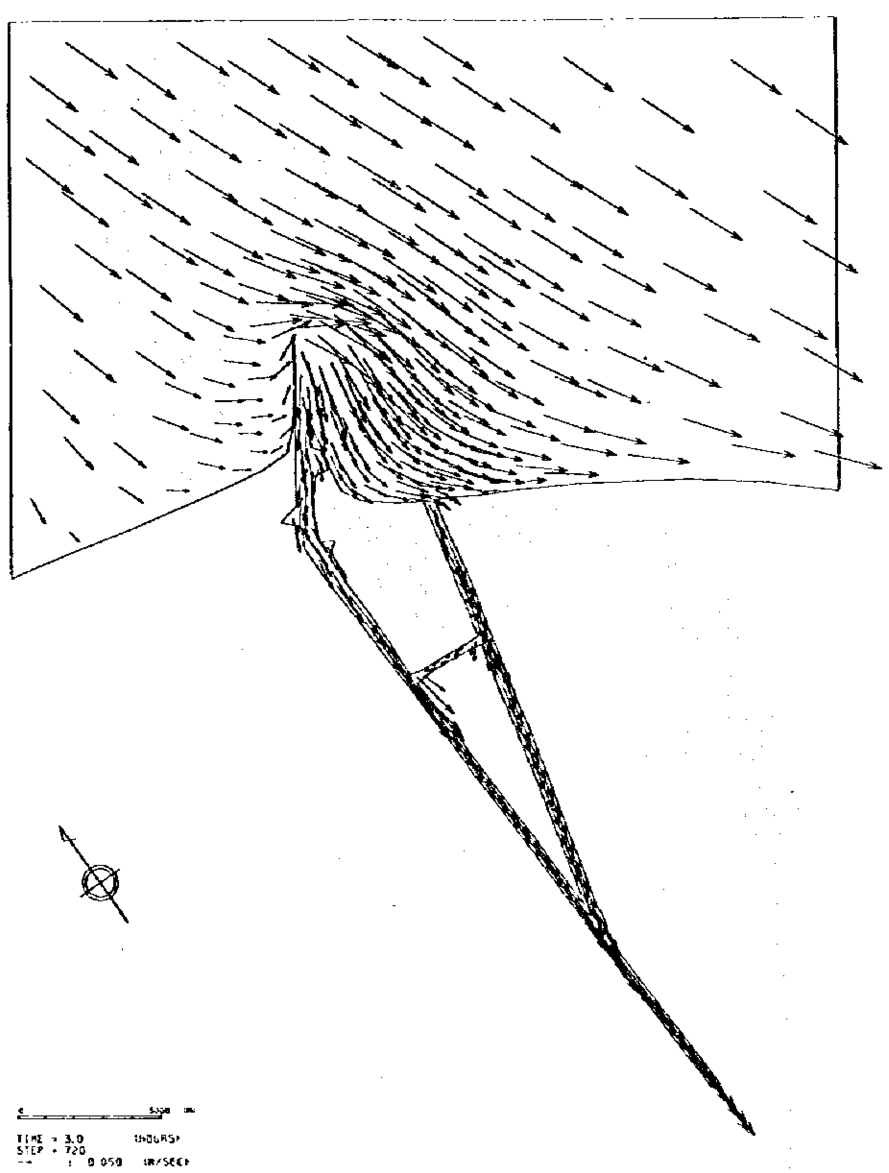
Great Bitter Lake and Little Bitter Lake

Suez

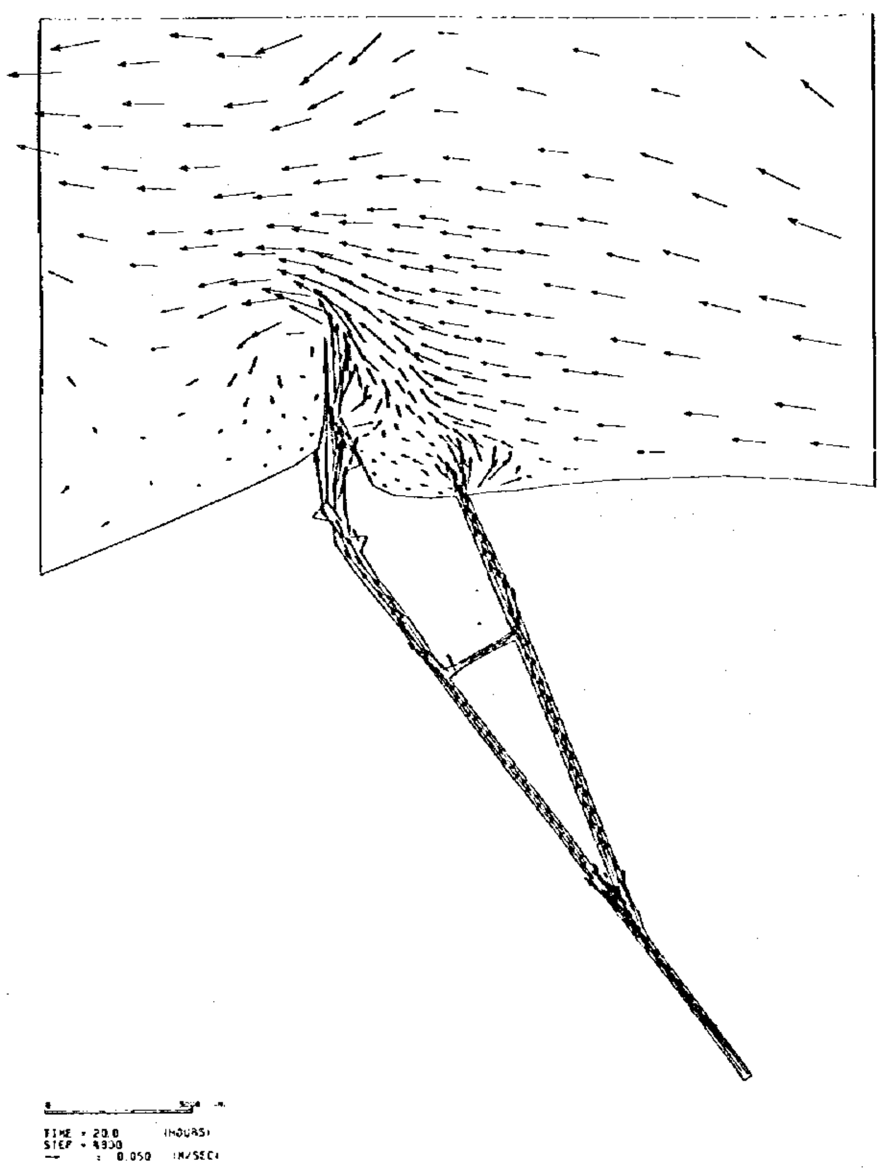
Area	Northern Area (A)	Southern Area (B)	The Canal (C)
Drift Current	5 - 15 cm/sec Southward	15 - 20 cm/sec Southward	15 - 25 cm/sec Southward
Tidal Current (ebb)	about 5 cm/sec Northward	less than 5 cm/sec —	50 - 70 cm/sec Northward Southward
Tidal Current (flood)	less than 5 cm/sec —	less than 5 cm/sec —	50 - 70 cm/sec Northward

Suez

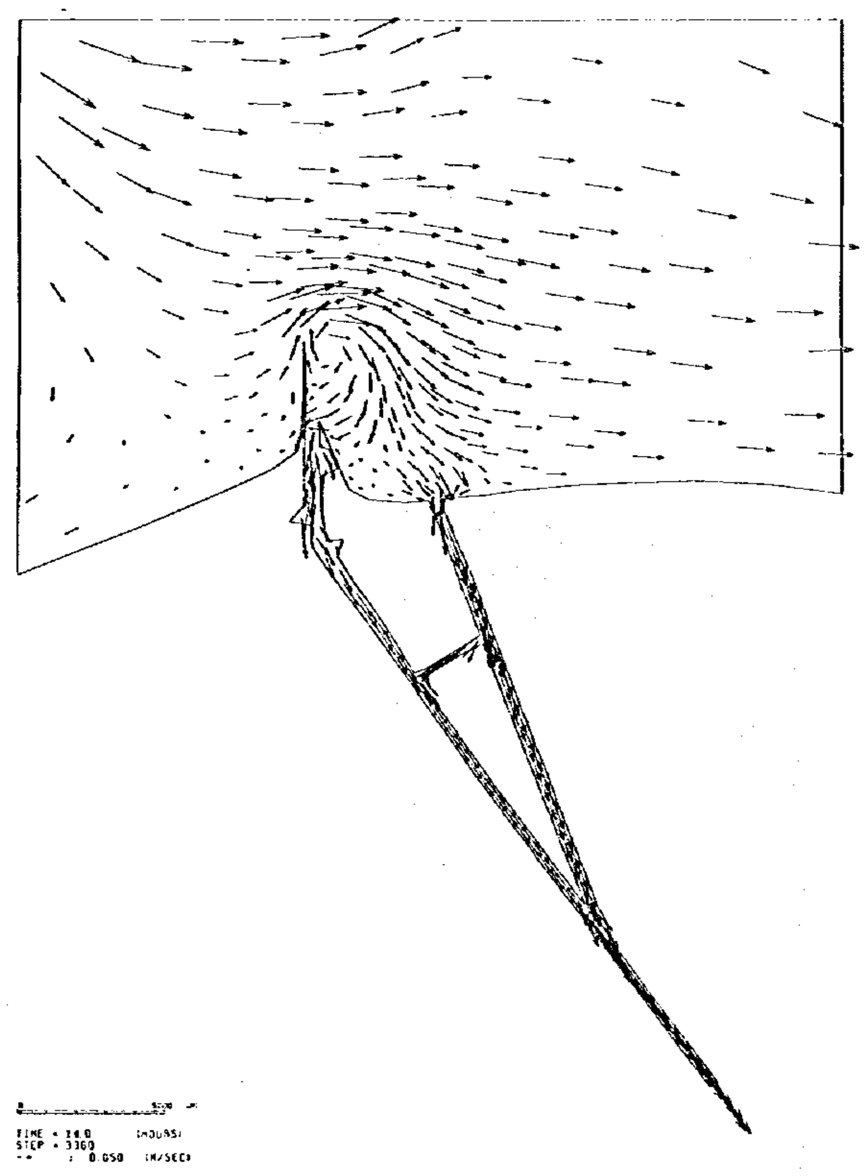




Drift Current (Port Said)

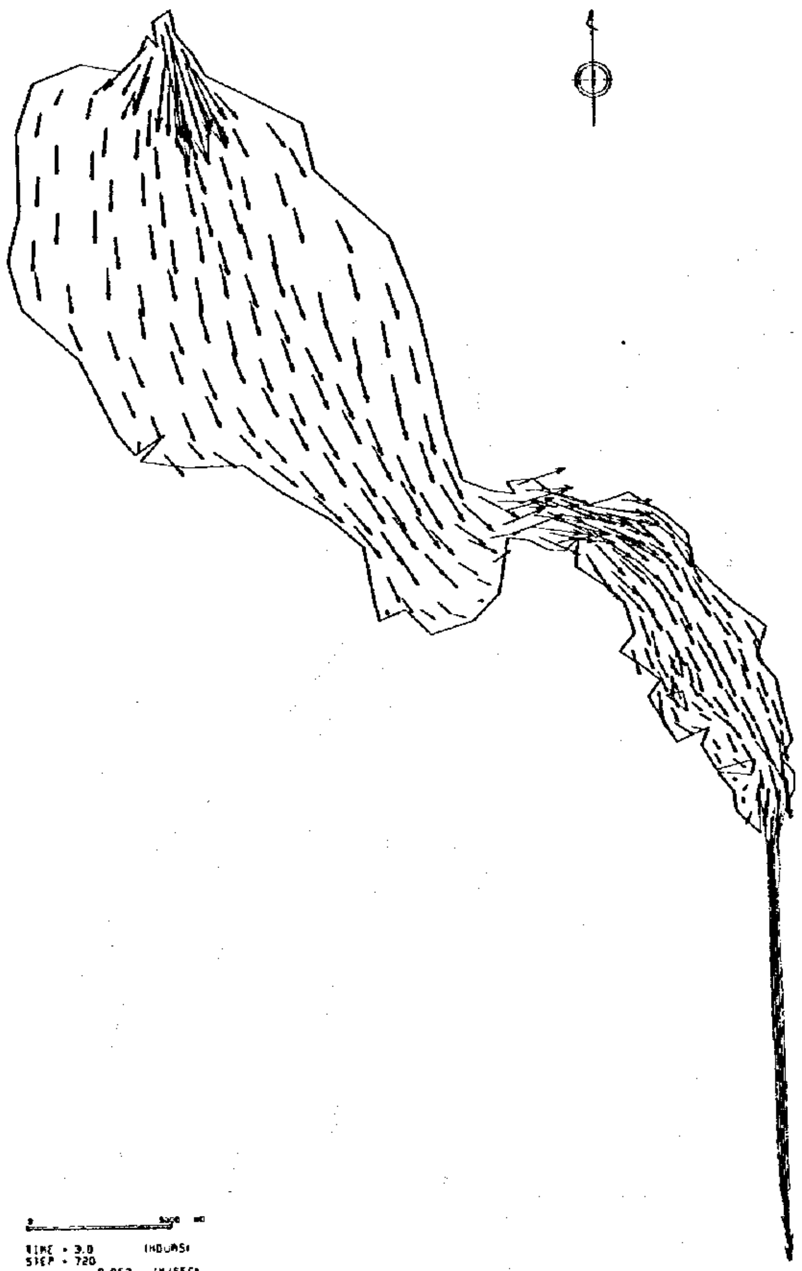


Tidal Current (Port Said, 2 Hours after High Water) (ebb)

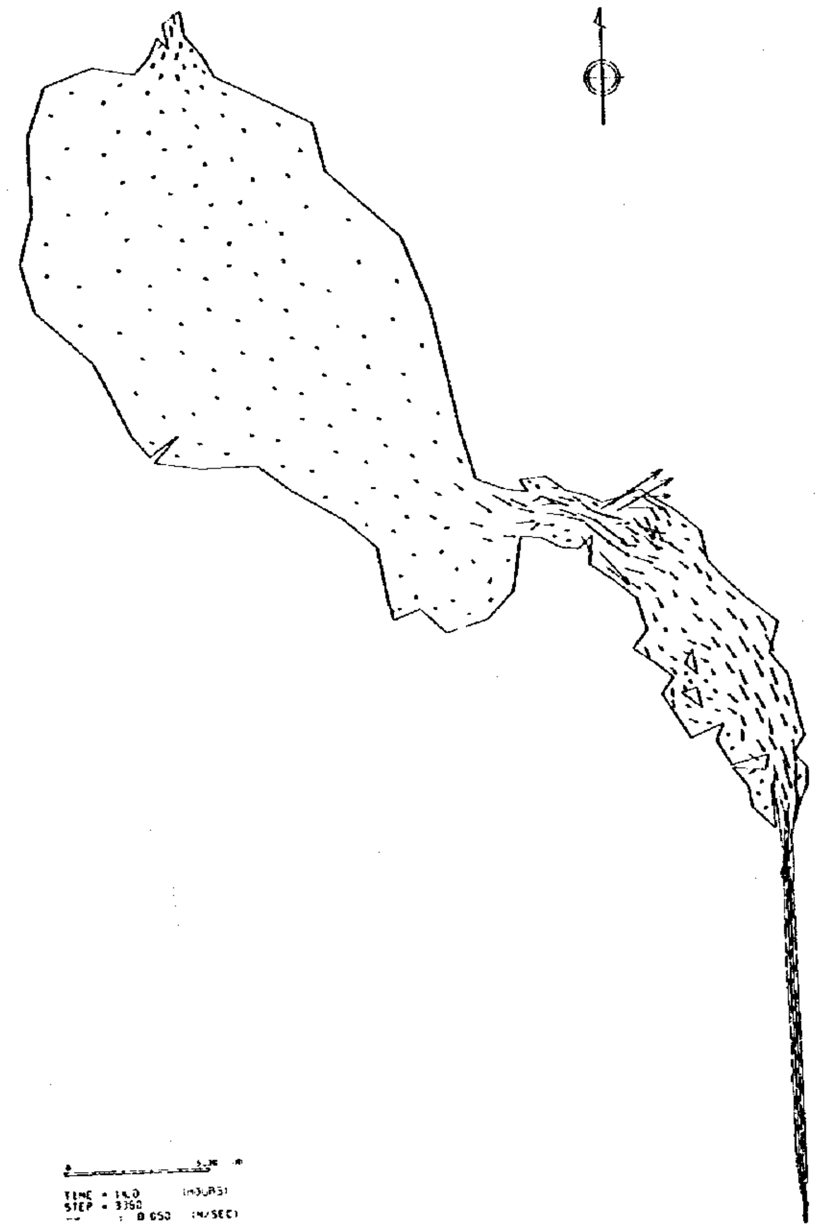


Tidal Current (Port Said, 2 Hours after Low Water) (flood)

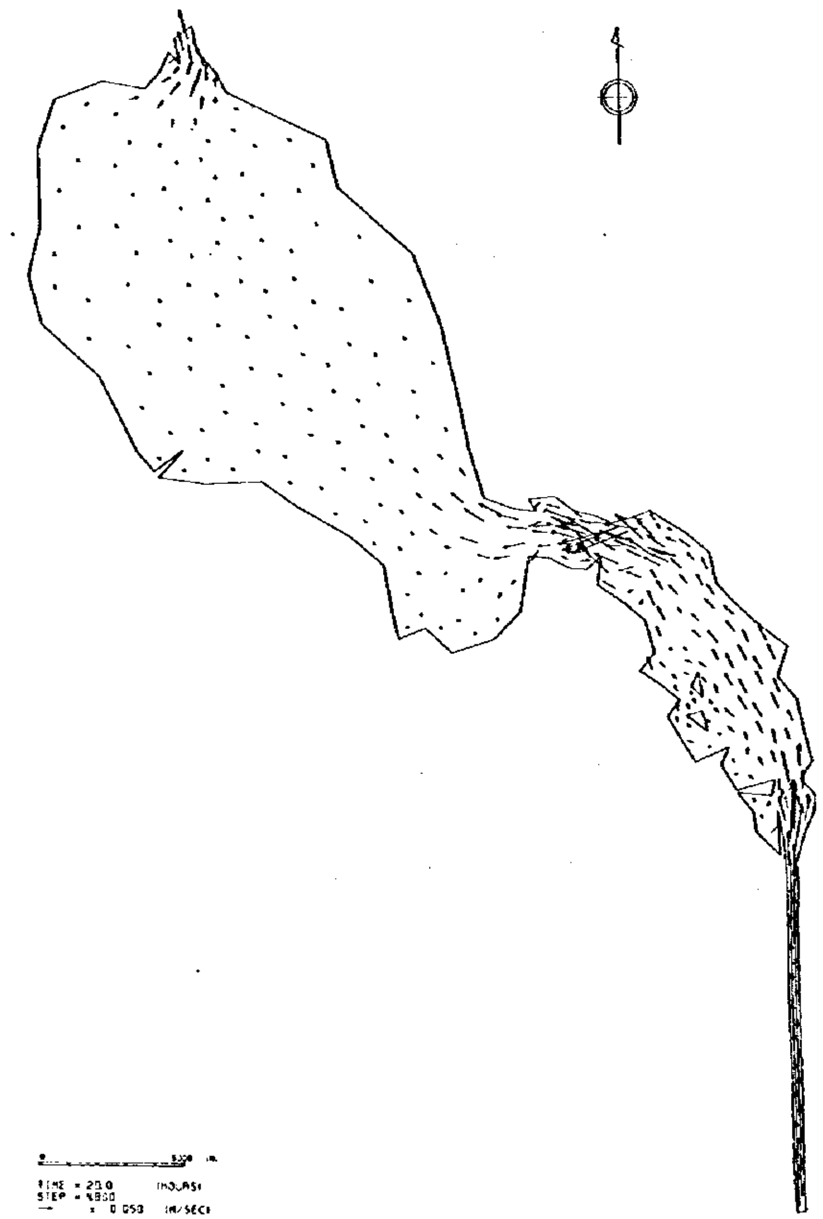
Fig. II-2-(6)-3(1) Results of Current Simulation (1)



Tidal Current (Great Bitter Lake)

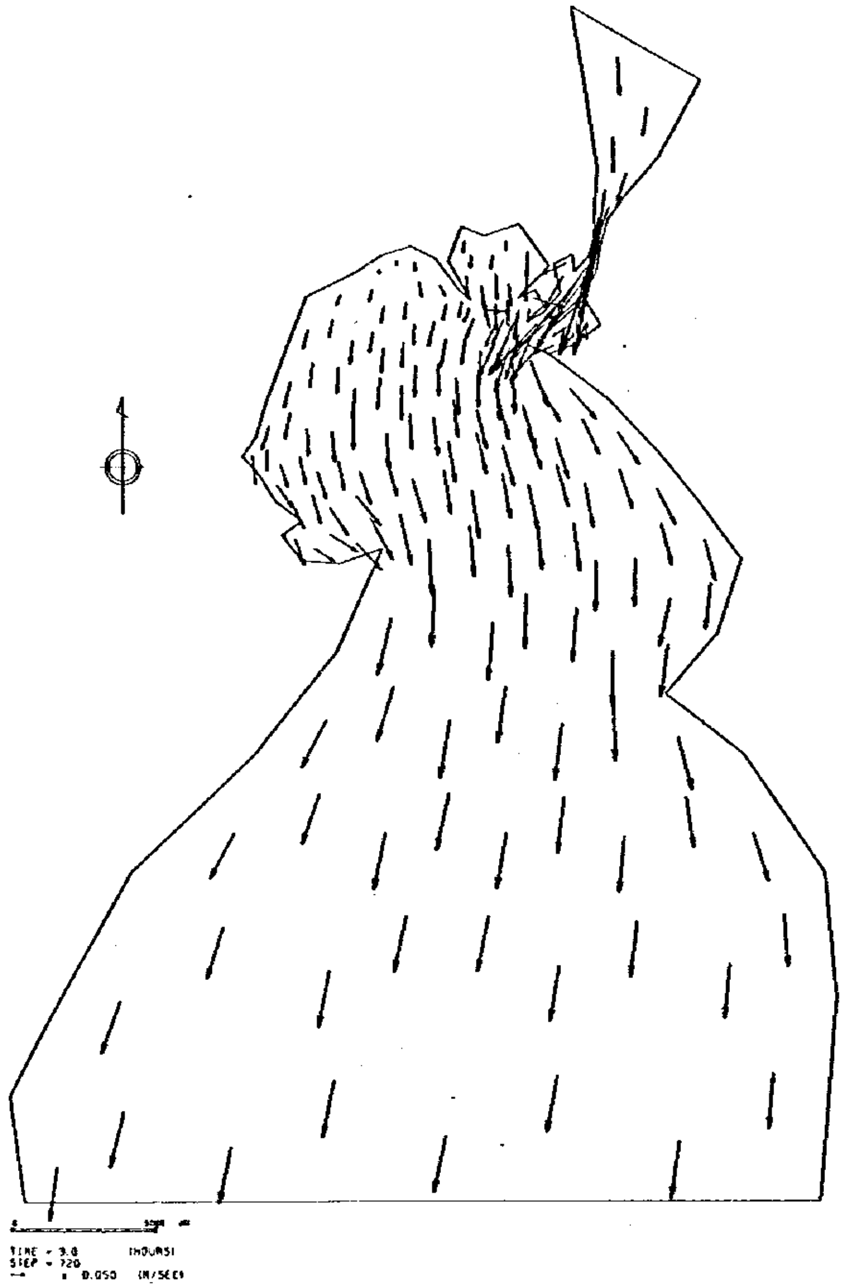


Tidal Current (Great Bitter Lake, 2 Hours after High Water) (ebb)

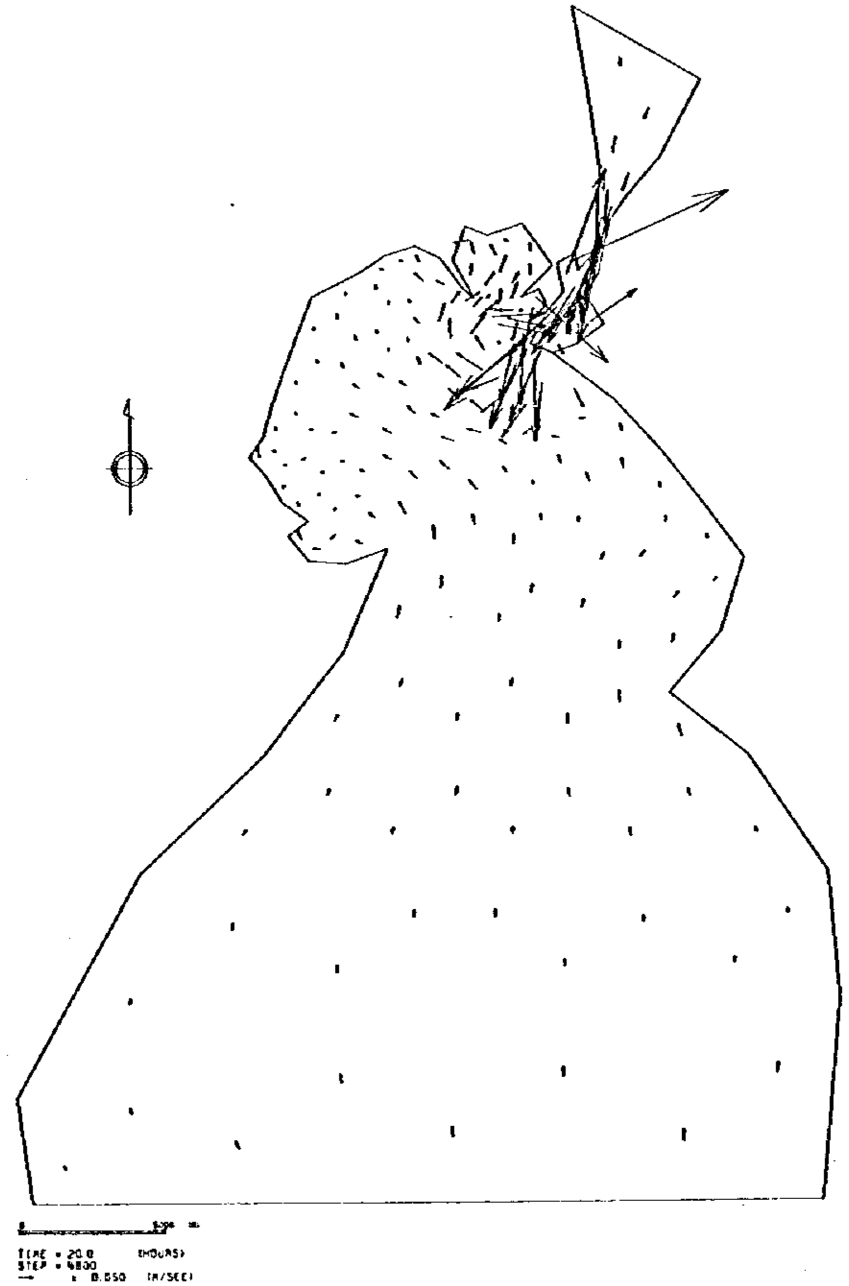


Tidal Current (Great Bitter Lake, 2 Hours after Low Water) (flood)

Fig. II-2-(6)-3(2) Results of Current Simulation (2)



Drift Current (Suez)



Tidal Current (Suez, 2 Hours after High Water) (ebb)

Tidal Current (Suez, 2 Hours after Low Waster) (flood)

Note: Coastline in the Canal is partly changed in order to get computation results to be consistent with the observed current.

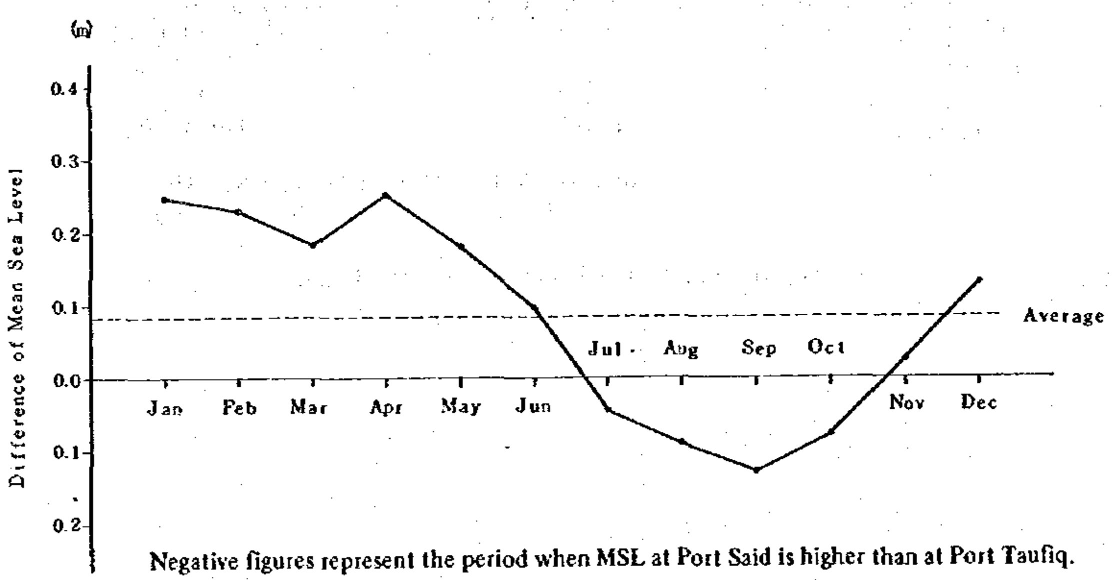
Fig. II-2-(6)-3(3) Results of Current Simulation (3)

(7) Tides

Tidal observations have been carried out by SCA at seven signal stations along the Canal.

1) Mean Sea Level at both ends of the Canal

As shown in Fig. II-2-(7)-1, the difference of Mean Sea Level (MSL) at both ends of the Canal varies periodically, with a maximum range of about 40 cm. MSL at Port Said is higher than that at Port Taufiq in the period from July to October.



Negative figures represent the period when MSL at Port Said is higher than at Port Taufiq.
Note
Source: Development of Suez Canal Feasibility Study Final Report (1976)

Fig. II-2-(7)-1 Difference of Mean Sea Level between Port Said and Port Taufiq (1956 ~ 1966)

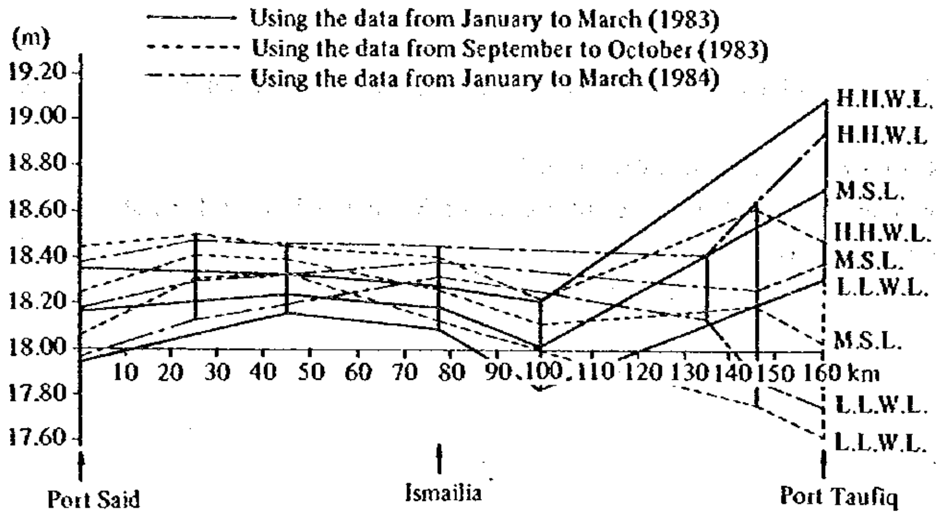
2) Harmonic Analysis of Tide

The tidal harmonic constants are calculated using hourly data over a 31 day period from January to March in 1983 and 1984, and from September to October in 1983.

Tables II-2-(7)-1 (1), (2) show the harmonic constants of tide at both ends of the Canal.

The Highest High Water Level (HHWL) owing to astronomical tide will be regarded as the level which is the sum of the amplitude of the major four tidal constituents, K_1, O_1, S_2 and M_2 above MSL and also the Lowest Low Water Level (LLWL) owing to astronomical tide will be regarded as the level which is the same value below MSL.

Fig. II-2-(7)-2 shows HHWL, LLWL and MSL at each station. The maximum tidal range owing to astronomical tide throughout the year is estimated at about 60 cm at Port Said, about 30 cm at Ismailia and about 150 cm at Suez.



Note: H.H.W.L. = MSL + (M_2 S_2 + K_1 + O_1)
L.L.W.L. = MSL − (M_2 +S_2 + K_1 + O_1)

Fig. II-2-(7)-2 Tidal Range along the Canal

Table II-2-(7)-1(1) Harmonic Constants of Tide (1)
(Port Said)

Note:
Height – Amplitude of constituent (METERS)
KAPPA – Phase lag used local time (DEGREES)
G – Phase lag used Greenwich time (DEGREES)

(Feb. ∿ Mar. 1983)

CONSTI-TUENT	HEIGHT IN METERS	KAPPA	G
S0	1.1459	0.00	0.0C
1) LONG PERIOD TIDE			
MM	0.0506	43.85	44.98
MSF	0.0186	90.59	92.62
2) DIURNAL TIDE			
Q1	0.0036	275.60	270.10
O1	0.0143	291.03	286.61
M1	0.0042	20.27	16.95
K1	0.0279	341.30	339.08
J1	0.0042	132.9C	131.77
OO1	0.0058	81.30	81.27
P1	0.0092	337.53	335.14
3) SEMI-DIURNAL TIDE			
μ2	0.0022	157.24	148.57
N2	0.0212	340.90	333.17
M2	0.0926	330.94	324.31
L2	0.0082	84.17	78.62
S2	0.0690	334.36	329.76
2SM2	- -	- -	- -
K2	0.0188	334.64	330.20
ν2	0.0041	339.56	331.98
T2	0.0041	334.22	329.54
4) THIRD-DIURNAL TIDE			
MO3	0.0011	47.14	36.08
M3	0.0043	143.99	134.04
MK3	0.0067	174.12	165.26
5) QUARTER-DIURNAL TIDE			
MN4	0.0036	331.25	316.88
M4	0.0052	28.85	15.57
SN4	0.0022	35.33	23.0C
MS4	0.0012	113.38	102.13
6) SIXTH-DIURNAL TIDE			
2MN6	0.0013	214.82	193.82
M6	0.0045	0.59	340.68
MSN6	0.0038	51.2C	32.23
2MS6	0.0057	63.74	45.86
2SM6	- -	- -	- -

(Sep. ∿ Oct. 1983)

CONSTI-TUENT	HEIGHT IN METERS	KAPPA	G
S0	1.2561	0.00	0.00
1) LONG PERIOD TIDE			
MM	0.0427	173.87	174.96
MSF	0.0150	292.84	294.87
2) DIURNAL TIDE			
Q1	0.0027	240.05	234.54
O1	0.0148	292.23	287.81
M1	0.0016	335.79	332.47
K1	0.0152	285.42	283.2C
J1	0.0037	322.65	321.52
OO1	0.0027	186.04	186.02
P1	0.0050	285.93	283.55
3) SEMI-DIURNAL TIDE			
μ2	0.0173	288.20	279.53
N2	0.0209	338.73	331.00
M2	0.1060	324.33	317.7C
L2	0.0035	351.02	345.47
S2	0.0582	334.27	329.66
2SM2	0.0065	192.68	190.11
K2	0.0158	335.07	330.63
ν2	0.0041	336.80	329.22
T2	0.0034	333.87	329.18
4) THIRD-DIURNAL TIDE			
MO3	0.0025	89.12	78.07
M3	0.0036	172.23	162.27
MK3	0.0026	327.48	318.63
5) QUARTER-DIURNAL TIDE			
MN4	0.0014	83.93	69.57
M4	0.0028	9.25	355.98
SN4	0.0007	355.05	342.72
MS4	0.0019	11.54	0.30
6) SIXTH-DIURNAL TIDE			
2MN6	0.0013	56.17	35.17
M6	0.0045	186.77	166.86
MSN6	0.0021	61.51	42.54
2MS6	0.0018	305.49	287.61
2SM6	0.0024	230.99	215.14

(Feb. ∿ March 1984)

CONSTI-TUENT	HEIGHT IN METERS	KAPPA	G
S0	1.1709	0.00	0.00
1) LONG PERIOD TIDE			
MM	0.0771	282.48	283.57
MSF	0.0231	77.66	79.69
2) DIURNAL TIDE			
Q1	0.0057	162.24	156.73
O1	0.0203	271.11	266.69
M1	0.0044	244.15	240.83
K1	0.0269	330.47	328.25
J1	0.0080	258.50	257.37
OO1	0.0033	303.87	303.85
P1	0.0029	326.01	323.63
3) SEMI-DIURNAL TIDE			
μ2	0.0078	319.20	310.53
N2	0.0251	316.24	308.51
M2	0.1007	293.46	286.82
L2	0.0042	223.09	217.54
S2	0.0645	303.61	299.01
2SM2	0.0079	122.43	119.96
K2	0.0175	304.43	299.99
ν2	0.0049	313.19	305.61
T2	0.0035	303.21	298.52
4) THIRD-DIURNAL TIDE			
MO3	0.0032	56.52	45.46
M3	0.0021	51.26	41.30
MK3	0.0057	235.77	226.91
5) QUARTER-DIURNAL TIDE			
MN4	0.0015	50.52	36.15
M4	0.0005	312.91	299.63
SN4	0.0013	88.55	76.22
MS4	0.0024	31.62	20.37
6) SIXTH-DIURNAL TIDE			
2MN6	0.0035	96.26	75.26
M6	0.0051	293.72	273.80
MSN6	0.0015	196.25	177.28
2MS6	0.0027	276.37	258.49
2SM6	0.0057	332.20	316.35

Table II-2-(7)-1(2) Harmonic Constants of Tide (2)
(Port Taufiq)

Note:

Height - Amplitude of constituent (METERS)
KAPPA - Phase lag used local time (DEGREES)
G - Phase lag used Greenwich time (DEGREES)

(Feb. ∿ Mar. 1983)

CONSTI-TUENT	HEIGHT IN METERS	KAPPA	G
S0	1.7160	0.00	0.00
1) LONG PERIOD TIDE			
MM	0.0391	280.69	281.78
MSF	0.1099	72.74	74.77
2) DIURNAL TIDE			
Q1	0.0051	232.50	226.73
O1	0.0121	186.28	181.60
M1	0.0013	163.16	159.58
K1	0.0408	227.91	225.43
J1	0.0048	358.63	357.23
OO1	0.0042	331.47	331.18
P1	0.0135	224.79	222.14
3) SEMI-DIURNAL TIDE			
μ2	0.0319	268.41	259.21
N2	0.0972	345.08	336.82
M2	0.2701	5.88	358.71
L2	0.0234	62.91	56.83
S2	0.0696	32.39	27.25
2SM2	0.0192	243.59	240.49
K2	0.0189	34.53	29.56
ν2	0.0189	-12.14	339.75
T2	0.0041	31.33	26.11
4) THIRD-DIURNAL TIDE			
MO3	0.0078	126.18	114.33
M3	0.0016	63.69	52.94
MK3	0.0036	21.34	11.69
5) QUARTER-DIURNAL TIDE			
MN4	0.0180	189.53	174.10
M4	0.0244	223.06	208.72
SN4	0.0087	265.65	252.25
MS4	0.0118	250.52	238.21
6) SIXTH-DIURNAL TIDE			
2MN6	0.0026	21.81	359.21
M6	0.0018	308.10	286.59
MSN6	0.0048	354.17	333.60
2MS6	0.0036	307.79	288.31
2SM6	0.0027	283.04	265.59

(Sep. ∿ Oct. 1983)

CONSTI-TUENT	HEIGHT IN METERS	KAPPA	G
S0	1.0424	0.00	0.00
1) LONG PERIOD TIDE			
MM	0.1224	276.72	277.85
MSF	0.0291	258.46	260.50
2) DIURNAL TIDE			
Q1	0.0038	11.85	6.08
O1	0.0145	211.25	206.57
M1	0.0033	69.88	66.30
K1	0.0499	216.24	213.76
J1	0.0111	307.02	305.62
OO1	0.0106	28.17	27.88
P1	0.0165	215.87	213.22
3) SEMI-DIURNAL TIDE			
μ2	0.0349	229.47	220.27
N2	0.0958	26.44	18.18
M2	0.2801	49.14	41.97
L2	0.0252	60.67	54.55
S2	0.0715	68.72	63.58
2SM2	- -	- -	- -
K2	0.0194	70.31	65.33
ν2	0.0186	29.48	21.37
T2	0.0042	67.94	62.72
4) THIRD-DIURNAL TIDE			
MO3	0.0043	45.65	33.75
M3	0.0041	128.83	118.07
MK3	0.0173	256.87	247.21
5) QUARTER-DIURNAL TIDE			
MN4	0.0198	300.79	285.36
M4	0.0219	320.12	305.78
SN4	0.0064	18.72	5.32
MS4	0.0102	340.91	328.60
6) SIXTH-DIURNAL TIDE			
2MN6	0.0040	275.61	253.01
M6	0.0082	346.09	324.58
MSN6	0.0038	347.29	326.72
2MS6	0.0043	66.71	47.23
2SM6	- -	- -	- -

(Feb. ∿ Mar. 1984)

CONSTI-TUENT	HEIGHT IN METERS	KAPPA	G
S0	1.3619	0.00	0.00
1) LONG PERIOD TIME			
MM	0.2178	209.19	210.28
MSF	0.1163	154.19	156.22
2) DIURNAL TIDE			
Q1	0.0078	181.38	175.60
O1	0.0095	192.70	188.01
M1	0.0073	1.09	357.51
K1	0.0417	217.59	215.10
J1	0.0039	258.11	256.72
OO1	0.0058	254.58	254.29
P1	0.0138	215.72	213.07
3) SEMI-DIURNAL TIDE			
μ2	0.1600	84.11	74.91
N2	0.0963	42.39	34.13
M2	0.4031	353.03	345.86
L2	0.1649	294.21	288.13
S2	0.1420	30.19	25.05
2SM2	0.0351	338.61	335.51
K2	0.0386	33.20	28.23
ν2	0.0187	395.77	27.66
T2	0.0084	28.71	23.49
4) THIRD-DIURANAL TIDE			
MO3	0.0143	112.05	100.20
M3	0.0075	169.92	159.17
MK3	0.0059	89.12	79.46
5) QUARTER-DIURNAL TIDE			
MN4	0.0056	46.95	31.52
M4	0.0029	63.79	49.45
SN4	0.0106	303.11	289.72
MS4	0.0109	151.90	139.59
6) SIXTH-DIURNAL TIDE			
2MN6	0.0127	196.24	173.64
M6	0.0086	169.79	148.28
MSN6	0.0027	174.48	153.91
2MS6	0.0031	66.92	47.44
2SM6	0.0073	244.93	227.48

(8) Waves

1) Port Said

Table II-2-(8)-1 and Fig. II-2-(8)-1 show the frequency of wave direction and height. Waves of 1.0 ~ 1.5 m in height and 290 ~ 340° in direction occur most frequently. The occurrence of wave heights over 3 meters is about 4%, with a maximum height of 6 ~ 7.5 meters.

Generally, the wave height is high.

Table II-2-(8)-1 Frequency of Wave Direction and Wave Height (Port Said)

Upper: Number of Occurrences
Lower: Percentage of Occurrence

Port Said

Hight \ Direction	260~280°	290~310°	320~340°	350~10°	20~40°	50~70°	Total
≦0.75 m	279 (4.0)	528 (7.2)	533 (7.2)	267 (3.6)	151 2.1)	118 (1.6)	1,876 (25.5)
1 ~ 1.5 m	590 (8.0)	1,272 (17.3)	1,318 (17.9)	496 (6.7)	205 (2.9)	155 (2.1)	4,036 (54.8)
2 ~ 2.5 m	200 (2.7)	371 (5.0)	398 (5.4)	117 (1.6)	29 (0.4)	25 (0.3)	1,140 (15.5)
3 ~ 3.5 m	41 (0.6)	60 (0.8)	78 (1.1)	24 (0.3)	1 (0.0)	3 (0.0)	207 (2.8)
4 ~ 5.5 m	13 (0.2)	37 (0.5)	29 (0.4)	8 (0.1)			87 (1.2)
6 ~ 7.5 m	1 (0.0)	8 (0.1)	6 (0.1)				15 (0.2)
Total	1,124 (15.3)	2,276 (30.9)	2,362 (32.1)	912 (12.4)	386 (5.2)	301 (4.1)	7,361 (100.0)

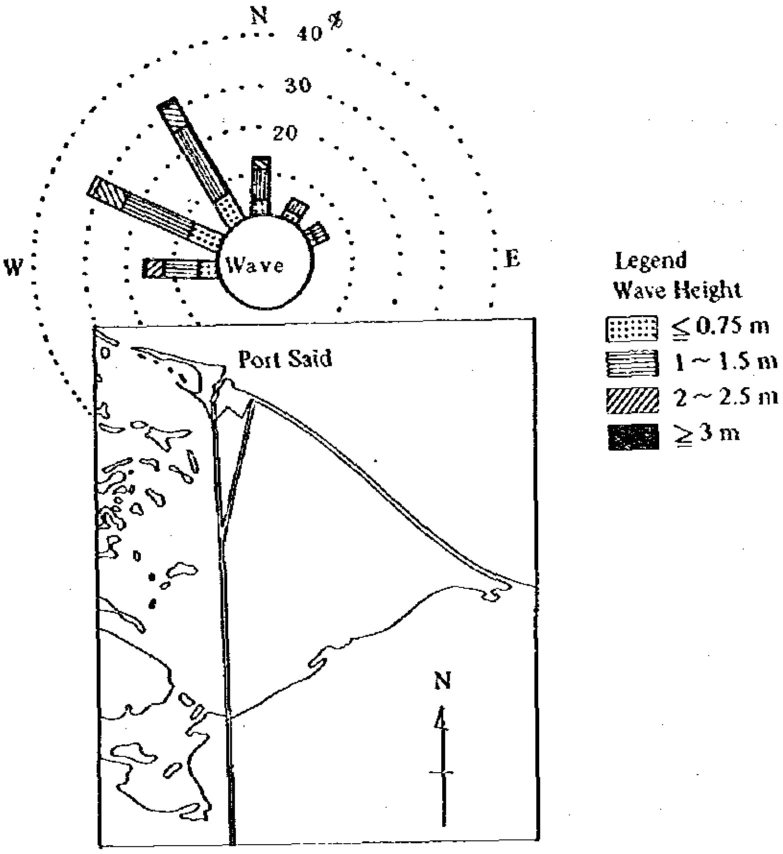


Fig. II-2-(8)-1 Frequency of Wave Direction and Wave Height (Port Said)

2) Suez

As no observation data are available for Suez, the wave conditions were predicted using the following formula which is called the S-M-B method.

$$\frac{gH_{1/3}}{U^2} = 0.30\left[1 - \frac{1}{\left\{1 + 0.004\left(\frac{gF}{U^2}\right)^{1/2}\right\}^2}\right]$$

$$\frac{gT_{1/3}}{2\pi U} = 1.37\left[1 - \frac{1}{\left\{1 + 0.008\left(\frac{gF}{U^2}\right)^{1/3}\right\}^5}\right]$$

where
- $H_{1/3}$: Significant wave height (m)
- $T_{1/3}$: Significant wave period (sec)
- U : Wind velocity at 10 m above sea surface (m/sec)
- F : Fetch length (m)
- g : Acceleration of gravity (m/sec^2), $g = 9.8$ m/sec^2

Table II-2-(8)-2 and Fig. II-2-(8)-2 show the frequency of wave conditions which are calculated using wind velocities above sea surface and effective fetch lengths. Wind velocity on sea surface is sually 20 ~ 60% more than velccity on land according to observed data at Osaka Bay in Japan. For this study, wind velocity on the sea is assumed to be 40% above observed velocity on the land. Overall, the Suez area is very calm.

Table II-2-(8)-2 Frequency of Wave Direction and Wave Height (Suez)

Upper: Wave Height (m)
Middle: Wave Period (sec)
Lower: Percentage of Occurrence

Wind Velocity (knots) \ Direction / Fetch Length		105 ~135°	135 ~164°	165 ~194°	195 ~224°	225 ~254°
		33.05 Km	52.09 Km	59.46 Km	48.62 Km	20.52 Km
2 (1 ~ 3)	x 1.4	0.05 1.05 (1.4)	0.06 1.10 (0.9)	0.06 1.11 (0.7)	0.06 1.09 (0.3)	0.05 1.00 (0.3)
5 (4 ~ 6)	x 1.4	0.25 2.06 (1.4)	0.27 2.21 (1.0)	0.28 2.26 (0.7)	0.27 2.19 (0.2)	0.22 1.89 (0.2)
8.5 (7 ~10)	x 1.4	0.54 2.86 (0.4)	0.61 3.13 (1.2)	0.64 3.21 (1.1)	0.60 3.01 (0.4)	0.46 2.59 (0.3)
13.5 (11 ~ 16)	x 1.4	0.99 3.71 (0.1)	1.17 4.11 (1.4)	1.22 4.23 (1.8)	1.14 4.05 (0.4)	0.83 3.31 (0.4)
19.0 (17 ≈ 21)	x 1.4	1.52 4.42 (0.0)	1.81 4.94 (0.1)	1.90 5.10 (0.7)	1.76 5.86 (0.1)	1.25 3.91 (0.1)
24.5 (22 ~)	x 1.4	2.05 5.00 (0.0)	2.47 5.62 (0.0)	2.60 5.81 (0.1)	2.40 5.53 (0.0)	1.68 4.40 (0.1)

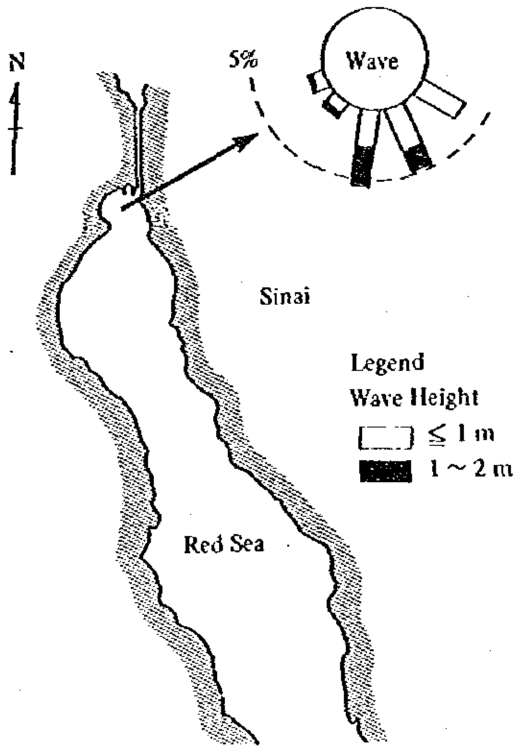


Fig. II-2-(8)-2 Frequency of Wave Direction and Wave Height (Suez)

(9) Sediment

1) Port Said

On the seashore, littoral drift moves eastward by high waves coming from the west to north.

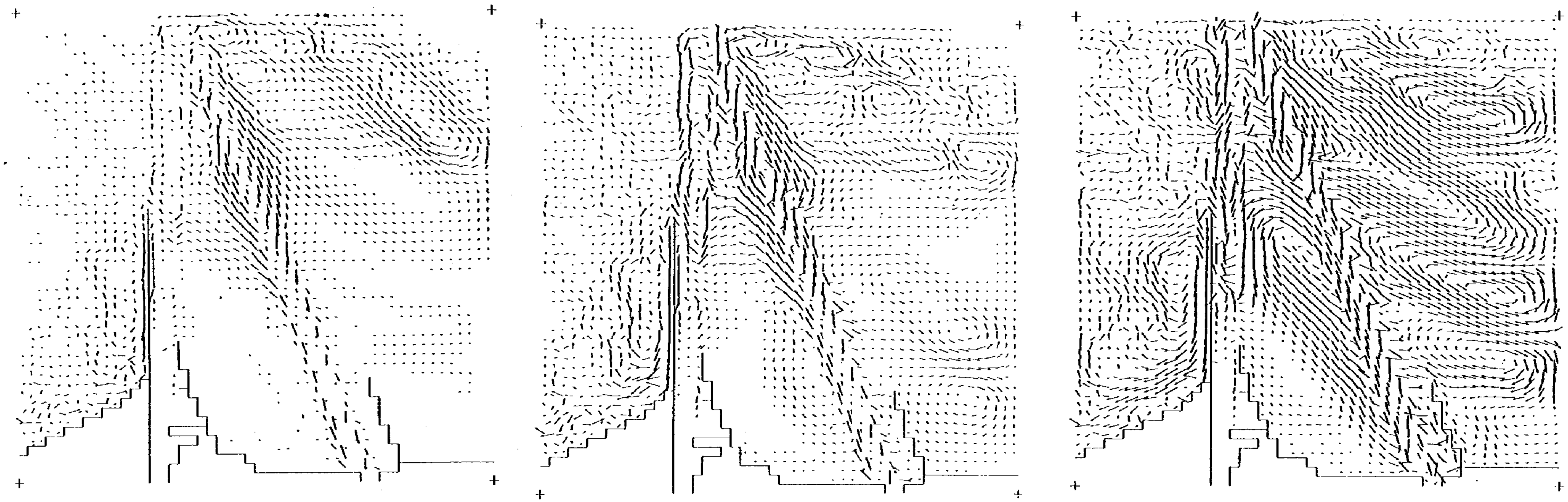
Fig. II-2-(9)-1 shows the results of nearshore current simulation and Fig. II-2-(9)-2 shows the results of littoral drift simulation. The basic equation and conditions for the simulation are shown in paragraph (10). According to these figure, siltation is seldom induced by waves less than 1.5 meters high. Moreover, in the case of waves of 4.5 meters, sediment is locally deposited at a rate of about 0.35 meters/day in maximum thickness at the entrance of the east branch and at the point 10 kilometers offshore in the approach channel of the east branch.

From the results of this simulation and figures on the frequency of wave height (see Table II-2-(8)-1), the volume of sediment in and nearby both approach channels is roughly estimated at $4 \sim 5 \times 10^6$ m^3/year.

However, we recommend that continuous observation be carried out.

2) Suez

Sedimentation has not become an issue in the Canal and its approach channel. The sediment is supposed to be insignificant.

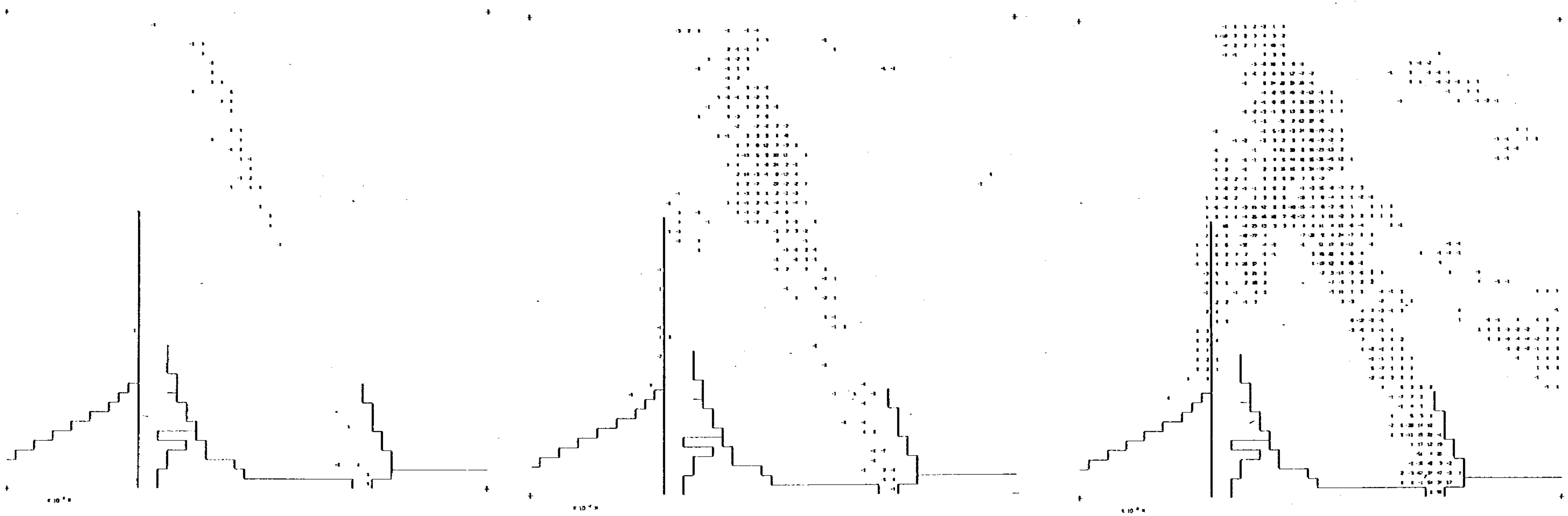


Wave Direction : 330.0 (Deg.)
Period : 5.00 (sec)
Height : 1.5 (m)

Wave Direction : 330.0 (Deg.)
Period : 6.00 (sec)
Height : 2.5 (m)

Wave Direction : 330.0 (Deg.)
Period : 8.00 (sec)
Height : 4.0 (m)

Fig. II-2-(9)-1 Results of Near Shore Current Simulation



Wave Direction : 330.0 (Deg.)
Period : 5.00 (sec)

Wave Direction : 330.0 (Deg.)
Period : 6.00 (sec)

Wave Direction : 330.0 (Deg.)
Period : 8.00 (sec)

Note: Thickness of Sedimentation per 2 days ($\times 10^{-2}$ m)

Fig. II-2-(9)-2 Results of Littoral Drift Simulation

(10) Computer Simulation

1) Basic Equations

The governing equations for the tidal current model, drift current model, nearshore current model and littoral drift model are expressed as follows.

(i) Tidal Current Model

i) Equation of motion

$$\frac{\partial u}{\partial t} = -g\frac{\partial \zeta}{\partial x} - u\frac{\partial u}{\partial x} - v\frac{\partial u}{\partial y} + A_h\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) - \frac{\gamma_b^2 u\sqrt{u^2 + v^2}}{(\zeta + h)} + fv$$

$$\frac{\partial v}{\partial t} = -g\frac{\partial \zeta}{\partial y} - u\frac{\partial v}{\partial x} - v\frac{\partial v}{\partial y} + A_h\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) - \frac{\gamma_b^2 v\sqrt{u^2 + v^2}}{(\zeta + h)} - fu$$

ii) Equation of continuity

$$\frac{\partial \zeta}{\partial t} = \frac{\partial}{\partial x}[(\zeta + h)\cdot u] - \frac{\partial}{\partial y}[(\zeta + h)\cdot v]$$

(ii) Drift Current Model

i) Equation of motion

$$\frac{\partial u}{\partial t} = -g\frac{\partial \zeta}{\partial y} - u\frac{\partial u}{\partial x} - v\frac{\partial u}{\partial y} + A_h\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) - \frac{\gamma_b^2 u\sqrt{u^2 + v^2}}{(\zeta + h)} + fv + \frac{\tau_S(x)}{\rho_W(\zeta + h)}$$

$$\frac{\partial v}{\partial t} = -g\frac{\partial \zeta}{\partial y} - u\frac{\partial v}{\partial x} - v\frac{\partial v}{\partial y} + A_h\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) - \frac{\gamma_b^2 v\sqrt{u^2 + v^2}}{(\zeta + h)} - fu + \frac{\tau_S(y)}{\rho_W(\zeta + h)}$$

ii) Equation of continuity

$$\frac{\partial \zeta}{\partial t} = -\frac{\partial}{\partial x}[(\zeta + h)\cdot u] - \frac{\partial}{\partial y}[(\zeta + h)\cdot v]$$

(iii) Nearshore Current Model

i) Equation of motion

$$\frac{\partial u}{\partial t} = -g\frac{\partial \zeta}{\partial x} - u\frac{\partial u}{\partial x} - v\frac{\partial u}{\partial y} + A_h\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) - \frac{\gamma_b^2 u\sqrt{u^2 + v^2}}{(\zeta + h)} + fv + Mx$$

$$\frac{\partial v}{\partial t} = -g\frac{\partial \zeta}{\partial y} - u\frac{\partial v}{\partial x} - v\frac{\partial v}{\partial y} + A_h\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right)) - \frac{\gamma_b^2 v\sqrt{u^2 + v^2}}{(\zeta + h)} - fu + My$$

ii) Equation of continuity

$$\frac{\partial \zeta}{\partial t} = -\frac{\partial}{\partial x}[(\zeta + h)\cdot U] - \frac{\partial}{\partial y}[(\zeta + h)\cdot V]$$

(iv) Littoral Drift Model (Watanabe's Model)

i) Equation of rate of littoral transport

(a) Littoral transport by nearshore current

$$q_{cx} = Q_c U$$

$$q_{cy} = Q_c V$$

$$Q_c = A_c \, [\, f_c (U^2 + V^2) + U^{*2} - U_c^{*2} \,]/g$$

(b) Littoral transport by waves

$$q_{wx} = Q_w \cdot U^* \cos Q$$

$$q_{wy} = Q_w \cdot U^* \sin Q$$

$$Q_w = A_w \, [\, U^{*2} - U_c^{*2} \,](1 + a\,|i|)/g$$

ii) Equation of continuity

$$\frac{\partial Z}{\partial t} = \frac{\partial}{\partial x}(q_{cx} + q_{wx}) - \frac{\partial}{\partial y}(q_{cy} + q_{wy})$$

Symbols used in the above euqations represent as follows.

x, y cartesian coordinates (see Fig. II-2-(10)-1)

ζ water surface elevation (m)

u, v constituet velocities in the x, y directions (m/sec)

$\tau_s(x) (= \rho_a \gamma^2 W_x \sqrt{W_x^2 + W_y^2})$ surface stress in the x direction (kg/m·sec²)

$\tau_s(y) (= \rho_a \gamma^2 W_y \sqrt{W_x^2 + W_y^2})$ surface stress in the y direction (kg/m·sec²)

ρ_a, ρ_w air and water density (($\rho_a = 1.2$ kg/m³, $\rho_w = 1030$ kg/m³))

W_x, W_y constituent wind velocities in the x, y directions (m/sec)

A_h turbulent viscosity

γ, γ_b wind friction coeffcient, bottom friction coefficient respectively (($\gamma^2 = \gamma_b^2 = 0.0026$))

$M_x = \frac{1}{\rho_w (\zeta + h)} (\frac{\partial}{\partial x} S_{xx} + \frac{\partial}{\partial y} S_{xy})$ radiation stress in the x direction (m/sec²)

$M_y = \frac{1}{\rho_w (\zeta + h)} (\frac{\partial}{\partial x} S_{xy} + \frac{\partial}{\partial y} S_{yy})$ radiation stress in the y direction (m/sec²)

$$S_{xx} = E\,[\, n(1 + \cos^2\alpha) - \frac{1}{2} \,]$$

$$S_{yy} = E\,[\, n(1 + \sin^2\alpha) - \frac{1}{2} \,]$$

$$S_{xy} = E\,[\, \frac{1}{2} n \sin 2\alpha \,]$$

radiation stress tensor (kg/sec²)

$E = \frac{1}{8} \rho_w g H^2$ average energy of waves (kg/sec²)

$$n = \frac{C_G}{C}$$

C wave velocity (m/sec)

C_G group velocity of waves (m/sec)

H	wave height (m)	given by the calculation of wave refraction
α	wave direction	and wave diffraction

f_c	current friction factor ((f_c = 0.01))
$U^* = \sqrt{f_w/2} \cdot \hat{U}$	friction velocity for wave (m/sec)
f_w	jonsson's wave friction factor
$\hat{U} = \rho_w H/2 \sinh k(h + \zeta)$	velocity of water particle by wave (m/sec)
k	wave number (m^{-1})
U_c^*	critical friction velocity for movement ((U_c^* = 0.019 m/sec))
$i = \frac{\partial^2 h}{\partial^2 x}$	gradient of sea bed
t	time (sec)
h	water depth (m)
g	acceleration of gravity ((g = 9.8 m/sec^2))
f	coriolis parameter (sec^{-1})
a	coefficient ((a = 10))
A_w	coefficient ((A_w = −5.0))
A_c	coefficient ((A_c = −1.0))

note: (( )): valve used in this study

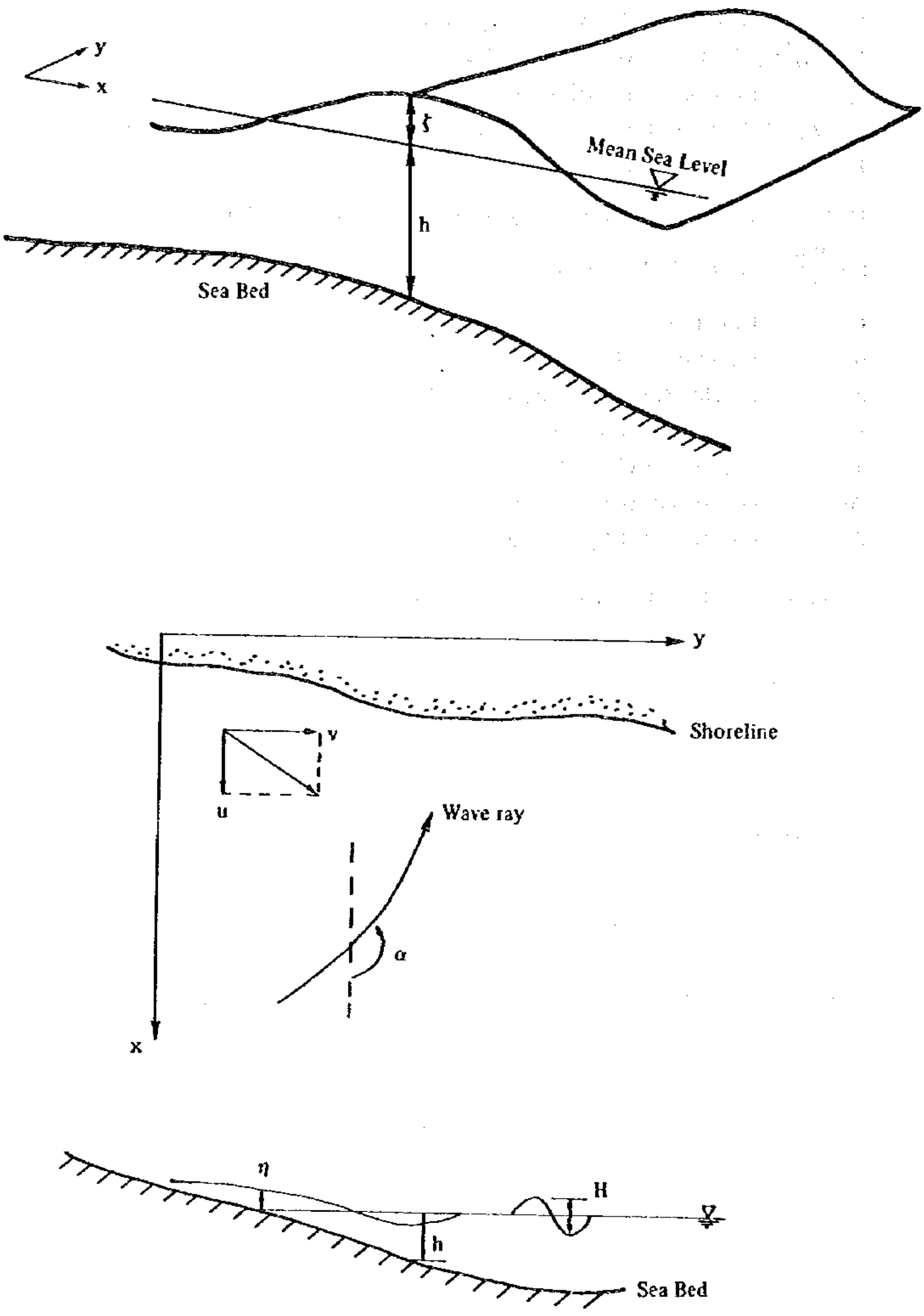


Fig. II-2-(10)-1 Coordinate System

2) Conditions for the Simulation

(i) Depth

Depth data are from the sounding map owned by SCA.

(ii) Tide (for Tidal Current Simulation)

Boundary condition for tidal current simulation is given by

$$\zeta_B = A \sin \left(\frac{2\pi}{T} t + \frac{\pi}{180} \psi\right)$$

Where ζ_B tidal elevation on the boundary element

A tidal range (M2 constituent, see Fig. II-2-(10)-2)

ψ phase lag (M2 constituent, see Fig. II-2-(10)-2)

t tidal period (M2 constituent, see Fig. II-2-(10)-2)

(iii) Wind (for Drift Current Simulation)

Drift current is caused by the friction between sea surface and atmosphere.

i) Velocity

Wind velocity of 11 ~ 16 knots occurs most frequently throughout the year at Port Said and Suez. Generally, wind velocity on the sea surface is stronger than that on the land. By considering this, wind velocity is determined as 8 m/sec (≒ 16 knots).

ii) Direction

The most frequent wind direction under condition of 11 ~ 16 knots wind velocity is concentrated 315° and 344° at Port Said. Therefore, wind direction northwest (= 337.5°) is determined.

On the other hand wind direction is concentrated between 315° and 14° at Suez.

In the vicinity of the Canal, there are by far more houses and facilities on the west bank than on the east bank. Therefore, wind direction north (= 0°) is chosen taking into account the influence of nearby structures in the case of oil diffusion.

(iv) Waves (for Nearshore Current and Littoral Drift Simulation)

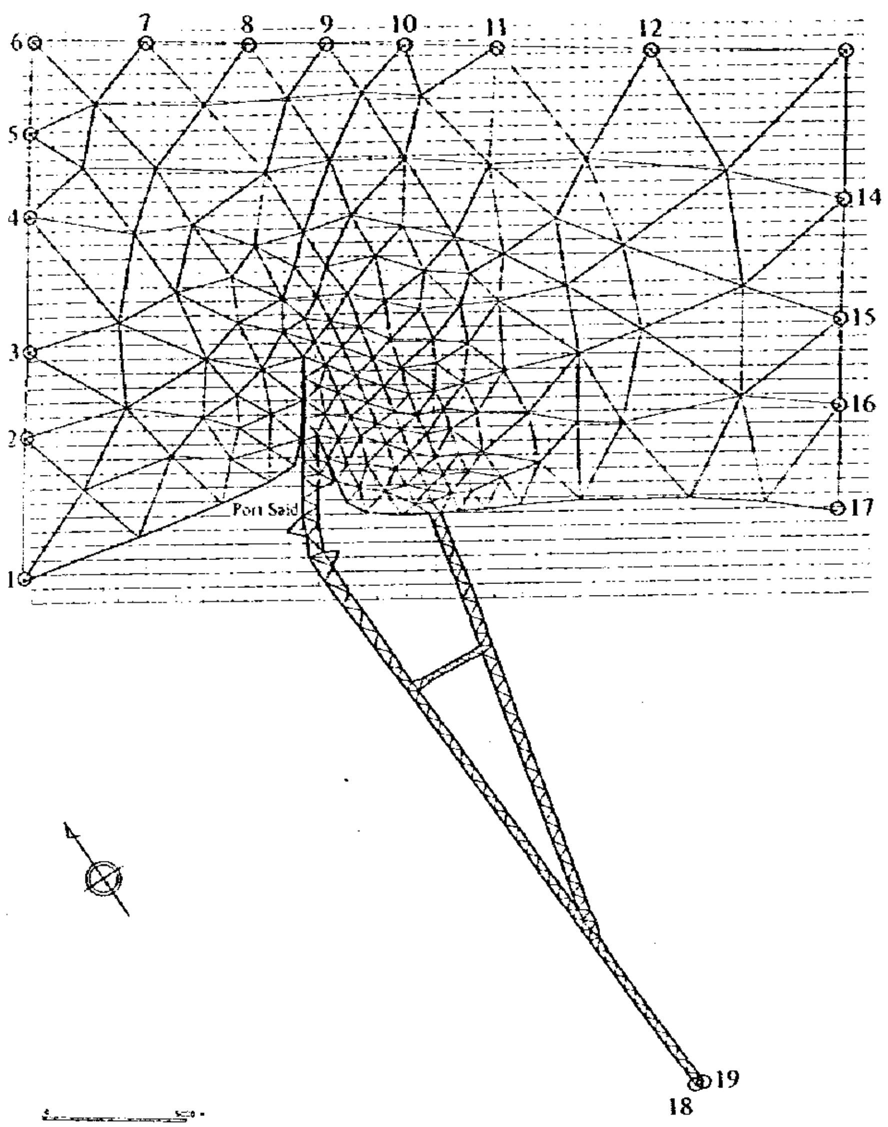
i) Height

According to the trials of littoral drift simulation, siltation is seldom induced by waves less than 1.5 meters high. Therefore, the following three cases are chosen as wave height: i.e. 1.5, 2.5 and 4.0 meters.

ii) Direction

High waves come from west to north most frequently. Therefore, north northwest (= 330°) of wave direction is chosen.

(1) Port Said

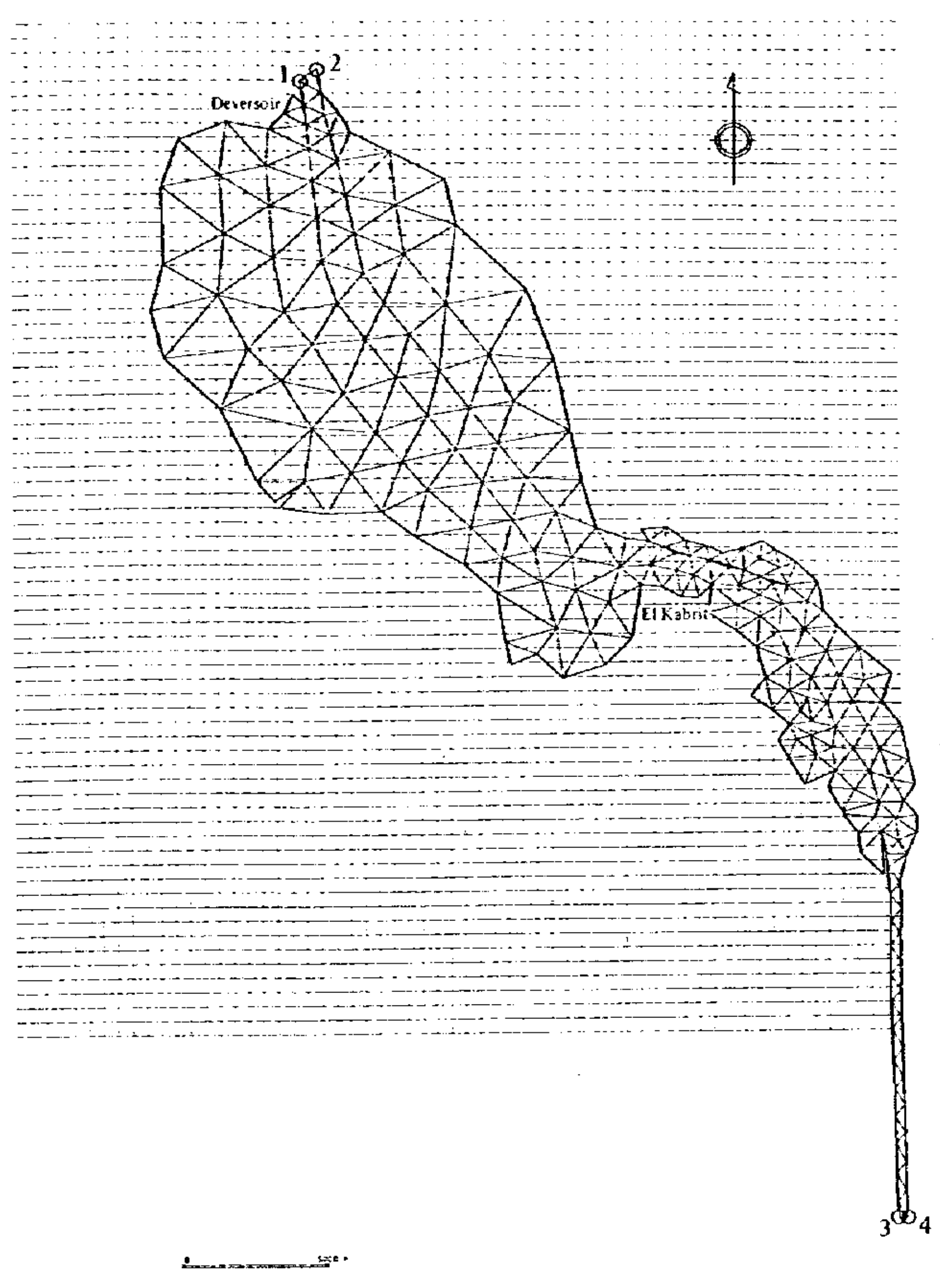


Boundary Condition for Tidal Current

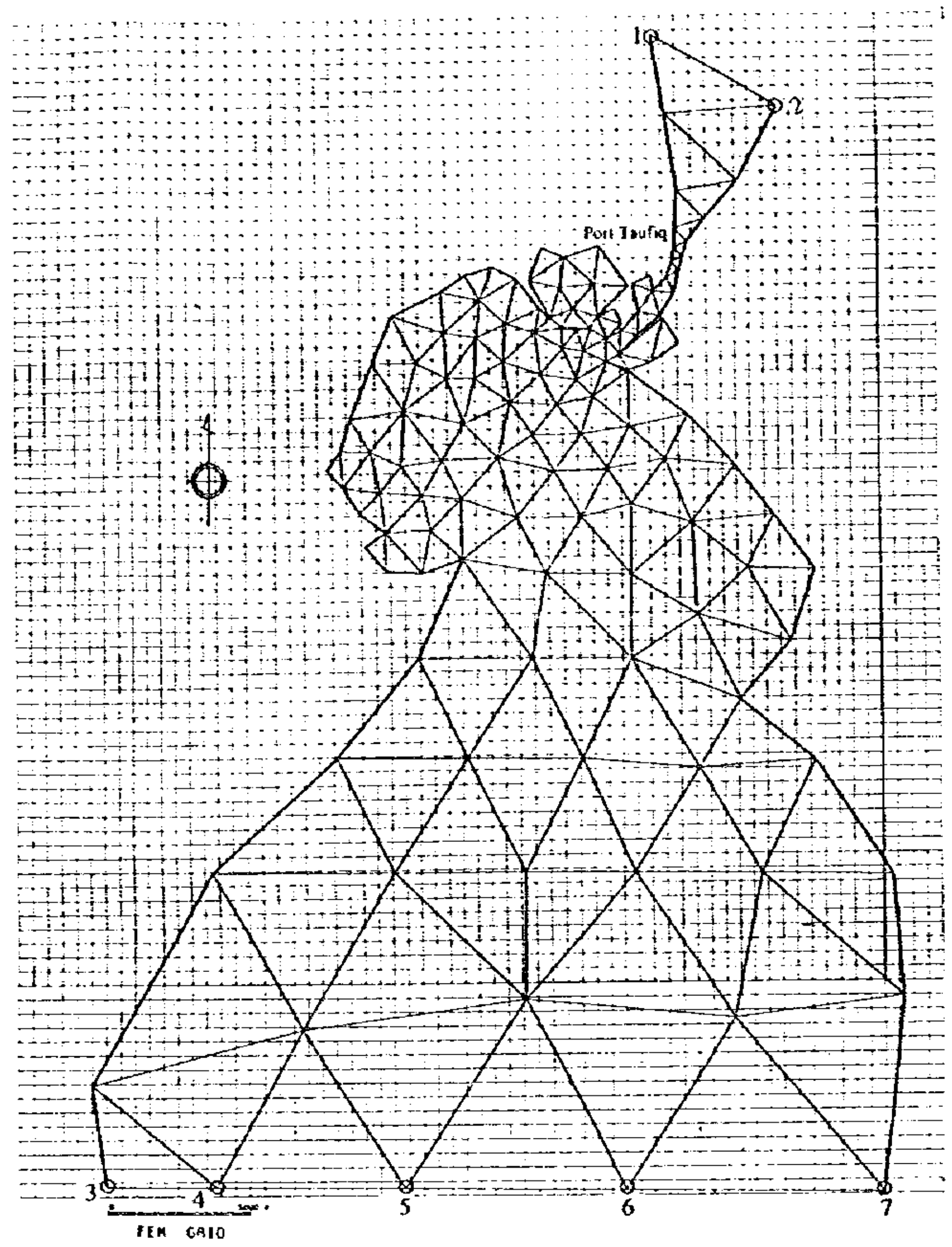
Node No.	Port Said Sea Area		Great Bitter Lake and Little Bitter Lake		Suez Sea Area	
	Tidal Range (m)	Phase Lag (Degree)	Tidal Range (m)	Phase Lag (Degree)	Tidal Range (m)	Phase Lag (Degree)
1	0.13	314.33	0.08	87.38	0.20	40.00
2	0.13	314.33	0.08	87.38	0.20	40.00
3	0.13	314.33	0.20	203.43	0.50	49.14
4	0.13	314.33	0.20	203.43	0.50	49.14
5	0.13	314.33	-	-	0.50	49.14
6	0.13	314.33	-	-	0.50	49.14
7	0.12	319.33	-	-	0.50	49.14
8	0.12	319.33	-	-	-	-
9	0.11	324.33	-	-	-	-
10	0.11	324.33	-	-	-	-
11	0.11	324.33	-	-	-	-
12	0.10	329.33	-	-	-	-
13	0.10	329.33	-	-	-	-
14	0.09	334.33	-	-	-	-
15	0.09	334.33	-	-	-	-
16	0.09	334.33	-	-	-	-
17	0.09	334.33	-	-	-	-
18	0.05	334.76	-	-	-	-
19	0.05	334.76	-	-	-	-

Note: Position of Node No. are illustrated in Figure

(2) Great Bitter Lake and Little Bitter Lake



(3) Suez



Note: Coastline in the Canal is partly changed in order to get computation results to be consistent with the observed current.

Fig. II-2-(10)-2 Element Division for Tidal Current and Drift Current Simulation

II-3 Traffic Flow

(1) Current Status of Canal Transit

The transit volumes of vessels through the Suez Canal by tankers and other vessels are shown in Table II-3-(1)-1 for the year of 1966 immediately before the Canal was closed until the recent year after completion of the First Stage Development Project of the Canal.

Also, the transit volumes by type of vessels other than tankers during the recent six years (1978 ~ 1983) are shown in Table II-3-(1)-2.

As seen from Table II-3-(1)-1, what is noticeable throughout the transit volumes before closure of the canal and in the recent years is an appreciable decrease in the number of tankers in proportion to the number of total transit vessels. This greatly influences the volume of cargoes through the Canal. The tankers accounting for nearly 50 percent of all transit (or about 75 percent of the SCNT volume) before the closure account for only 12 to 16 percent (or about 30 to 40 percent in SCNT) of all the transits after the reopening. Although they have shown an increasing trend recently, when compared with the pre-closure time, they are only about 35 percent in the number (or about 65 percent in SCNT).

The transits of tankers during the last 4 years (1980 ~ 1983) are classified by size and direction as shown in Table II-3-(1)-3, II-3-(1)-4 and II-3-(1)-5.

As seen, of the northbound vessels, transit of tankers of 100,000 DWT or greater is increasing in and after 1980 and particularly in 1982 to 279 in number and 35,701,000 in DWT with the vessels of the size of 100,000 ~ 150,000 DWT, or about seven times those in 1980. Also, with the vessels of the size of 150,000 ~ 200,000 DWT, the increase is particularly noticeable in 1983 to 31 in number and 5,020,000 in DWT, or about ten times more than in 1980. Furthermore, tankers of the size of 200,000 DWT or more, which were not noted up until 1980, numbered 46 (including 2 unloaded) or 11,350,000 DWT (566,000 DWT unloaded in

Table II-3-(1)-1 Transit Volume of Tankers and Non-Tankers

Year	Tankers				Non-Tankers				Total			
	Number		SCNT (1,000T)		Number		SCNT (1,000T)		Number		SCNT (1,000T)	
		%		%		%		%		%		%
1966	9,930	47	206,134	75	11,320	53	68,116	25	21,250	100	274,250	100
1976	2,610	15	77,903	41	14,196	85	109,856	59	16,806	100	187,759	100
1977	2,620	13	75,568	34	17,083	87	144,909	66	19,703	100	220,477	100
1978	2,489	12	73,924	30	18,777	88	174,336	70	21,266	100	248,260	100
1979	2,698	13	86,278	32	17,665	87	179,893	68	20,363	100	266,171	100
1980	2,921	14	88,870	31	17,874	86	192,435	69	20,795	100	281,305	100
1981	3,438	16	135,164	40	18,139	84	207,192	60	21,577	100	342,356	100
1982	3,548	16	133,655	37	18,997	84	229,883	63	22,545	100	363,538	100
1983	3,602	16	136,472	36	18,622	84	241,754	64	22,224	100	378,226	100

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Table II-3-(1)-2 Non-Tankers Transit Volume by Type (1978 ~ 1983)

		1978		1979		1980		1981		1982		1983	
Combined Carriers	1,000 SCNT	5,518	(3,563)	4,853	(2,463)	4,262	(1,514)	6,238	(1,533)	14,170	(5,389)	17,752	(7,369)
	number	144	((69)	122	(55)	105	(34)	152	(33)	309	(103)	394	(152)
General Cargo Vessels	1,000 SCNT	74,521	(11,049)	69,380	(8,422)	69,874	(8,538)	69,245	(10,437)	70,313	(11,038)	63,589	(9,266)
	number	11,721	(2,180)	10,562	(1,678)	10,185	(1,548)	9,952	(1,785)	9,880	(1,860)	8,910	(1,591)
Bulk Carriers	1,000 SCNT	36,783	(5,282)	36,390	(5,673)	41,993	(7,645)	44,339	(8,819)	52,187	(12,601)	58,335	(13,335)
	number	2,513	(386)	2,393	(343)	2,711	(470)	2,809	(564)	3,188	(772)	3,465	(799)
Containerships	1,000 SCNT	29,795	(2,358)	33,798	(2,790)	35,565	(2,709)	39,099	(2,690)	41,629	(2,833)	47,062	(3,501)
	number	1,497	(285)	1,666	(307)	1,798	(308)	1,926	(257)	2,027	(263)	2,232	(297)
Ro/Ro ships	1,000 SCNT	11,673	(2,487)	16,328	(4,708)	18,158	(4,099)	20,937	(4,483)	25,300	(6,357)	26,384	(5,953)
	number	1,398	(342)	1,292	(435)	1,261	(354)	1,370	(350)	1,737	(489)	1,652	(457)
Car Carriers	1,000 SCNT	9,805	(1,592)	12,315	(2,122)	14,979	(3,272)	19,106	(3,961)	17,931	(3,247)	20,636	(4,054)
	number	373	(60)	444	(79)	487	(107)	581	(129)	528	(112)	600	(135)
Others	1,000 SCNT	6,241	(1,363)	6,829	(1,252)	7,604	(798)	8,228	(1,078)	8,353	(1,087)	6,921	(1,153)
	number	1,131	(331)	1,186	(336)	1,327	(287)	1,349	(324)	1,328	(333)	1,187	(353)
TOTAL	1,000 SCNT	174,336	(27,694)	179,893	(25,520)	192,435	(28,575)	207,192	(33,001)	229,883	(42,552)	240,679	(44,631)
	number	18,777	(3,653)	17,665	(3,233)	17,874	(3,108)	18,139	(3,442)	18,997	(3,932)	18,440	(3,784)

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Note: Figures in the brackets show the values "in ballast"

Table II-3-(1)-3 Tankers Traffic Volume by Size and Direction (1980 ~ 1983)

(Northbound)

D.W.T. (1,000T)	1980 No.	1980 D.W.T (1,000)	1981 No.	1981 D.W.T (1,000)	1982 No.	1982 D.W.T (1,000)	1983 No.	1983 D.W.T (1,000)
up to 50	883 (396)	20,232 (8,332)	1,011 (492)	24,782 (11,723)	950 (406)	23,793 (9,663)	947 (406)	23,363 (9,023)
50 ~ 100	354 (29)	25,695 (1,776)	386 (36)	28,561 (2,278)	437 (46)	33,962 (3,623)	373 (21)	27,972 (1,174)
100 ~ 150	42 (2)	5,042 (260)	53 (9)	6,705 (1,191)	155 (7)	19,486 (896)	279 (0)	35,701 (0)
150 ~ 200	3 (1)	487 (173)	10 (1)	1,555 (155)	42 (0)	6,714 (0)	31 (1)	5,020 (186)
200 ~ 250	0 (0)	0 (0)	2 (1)	456 (238)	29 (2)	6,603 (473)	31 (0)	7,232 (0)
250 ~ 300	0 (0)	0 (0)	2 (2)	533 (533)	14 (4)	3,749 (1,099)	12 (2)	3,227 (566)
over 300	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0)	900 (0)
Total	1,282 (428)	51,456 (10,541)	1,464 (541)	62,592 (16,118)	1,627 (465)	94,307 (15,754)	1,676 (430)	103,415 (10,949)

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Note. Figures in the brackets for the respective years show the values "in ballast".

Table II-3-(1)-4 Tankers Traffic Volume by Size and Direction (1980 ~ 1983)

(Southbound)

D.W.T. (1,000T)	1980 No.	1980 D.W.T (1,000)	1981 No.	1981 D.W.T (1,000)	1982 No.	1982 D.W.T (1,000)	1983 No.	1983 D.W.T (1,000)
up to 50	842 (196)	19,900 (5,156)	908 (197)	22,164 (5,242)	912 (169)	22,494 (4,843)	922 (146)	22,219 (4,531)
50 ~ 100	379 (311)	27,455 (23,217)	366 (276)	27,227 (20,649)	459 (348)	35,472 (27,586)	405 (353)	30,557 (27,366)
100 ~ 150	123 (120)	15,886 (15,518)	127 (122)	16,706 (16,075)	183 (177)	23,131 (22,381)	300 (295)	38,653 (38,014)
150 ~ 200	63 (63)	10,296 (10,296)	62 (62)	10,016 (10,016)	54 (54)	8,590 (8,590)	42 (42)	6,736 (6,736)
200 ~ 250	224 (224)	51,009 (51,009)	148 (148)	34,007 (34,007)	82 (80)	18,571 (18,291)	59 (59)	13,624 (13,624)
250 ~ 300	8 (8)	2,174 (2,174)	306 (306)	82,142 (82,142)	190 (190)	50,740 (50,740)	159 (158)	45,097 (44,837)
over 300	0	0	57 (57)	19,149 (19,149)	41 (41)	13,787 (13,787)	39 (39)	12,717 (12,717)
TOTAL	1,639 (922)	126,720 (107,370)	1,974 (1,168)	211,412 (187,281)	1,921 (1,059)	172,965 (146,218)	1,926 (1,092)	169,603 (147,825)

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Note: Figures in the brackets for the respective years show the values "in ballast".

Table II-3-(1)-5 Classification of Transiting Tankers by Dead Weight Tonnage in 1983

DWT (1,000)	Northbound				Southbound			
	Laden		In Ballast		Laden		In Ballast	
	No.	DWT (1,000)	No.	DWT (1,000)	No.	DWT (1,000)	No.	DWT (1,000)
up to 50	541 (43.4)	14,340 (15.5)	406 (94.4)	9,023 (82.4)	776 (93.1)	17,688 (81.2)	146 (13.4)	4,531 (3.1)
50 ∿ 100	352 (28.3)	26,798 (29.0)	21 (4.9)	1,174 (10.7)	52 (6.2)	3,191 (14.7)	353 (32.3)	27,366 (18.5)
100 ∿ 150	279 (22.4)	35,701 (38.6)	- (-)	- (-)	5 (0.6)	639 (2.9)	295 (27.0)	38,014 (25.7)
150 ∿ 200	30 (2.4)	4,834 (5.2)	1 (0.2)	186 (1.7)	- (-)	- (-)	42 (3.8)	6,736 (4.6)
200 ∿ 250	31 (2.5)	7,232 (7.8)	- (-)	- (-)	- (-)	- (-)	59 (5.4)	13,624 (9.2)
250 ∿ 300	10 (0.8)	2,661 (2.9)	2 (0.5)	566 (5.2)	1 (0.1)	260 (1.2)	158 (14.5)	44,837 (30.3)
over 300	3 (0.2)	900 (1.0)	- (-)	- (-)	- (-)	- (-)	39 (3.6)	12,717 (8.6)
TOTAL	1,246 (100.0)	92,466 (100.0)	430 (100.0)	10,949 (100.0)	834 (100.0)	21,778 (100.0)	1,092 (100.0)	147,825 (100.0)

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1982). This is because the first extension work of the Canal permitted transit of vessels up to 150,000 DWT when fully loaded or 370,000 DWT when unloaded in and after 1981, and the sharp increase in 1982 is attributable to the fact that some restriction was imposed on transits as a tentative measure immediately after completion of the First Stage Development Project of the Canal during 1981.

Of the southbound vessels, the change is not so appreciable as that in the case of the northbound vessels, except that the tankers of 100,000 ~ 150,000 DWT are tending to increase although slightly but that large vessels or, more particularly, tankers of 150,000 DWT or more are decreasing considerably in 1983 compared with the previous year.

Now, the volume of transits through the canal by the number of vessels marked a total of 21,250 (or 274,250 SCNT) in 1966 immediately before the closure, the highest up to that time, or 58.2 in daily average. In and after 1975 when the Canal was reopened, the transit increased gradually and marked a total of 21,266 or 58.3 in daily average in 1978, exceeding the record of 1966 before closure. In 1983, it came up to a total of 22,224 or 60.9 in daily average.

(2) Traffic Volumes and Composition of Cargoes

As stated above, in the number of vessels, the transit came up to the record (in 1966) of the pre-closure time in 1978, but for SCNT, it did not come to exceed the level of 1966 before 1980. Seeing the cargo volume, it is still below the level of 1966 in 1982, as seen from Table II-3-(2)-1. This is because of the appreciable decrease of tanker transit as compared with the pre-closure time. Consequently, the traffic volume of tanker cargo coming up as high as 73 percent of the whole in 1966 has declined to the level of 22 ~ 24 percent recently. After completion of the First Stage Development Project of the Canal, it showed a trend of recovery at about 28 percent in 1981 and about 36 ~ 38 percent in 1982 ~ 1983 but is still far below the level in the period before the closure.

Now, considering this situation in reference to world maritime trade, about 18.5 percent of the world maritime transport of crude oil and oil products passed through the Canal in 1966 before closure of the Canal, but the percentage of recent transports after reopening of the Canal are as shown in Table II-3-(2)-1.

As seen, in 1978 ~ 1979, the volume is only about 2 percent of the whole, and in and after 1980, although the proportion is relatively improved on account of the decline of world oil trade on the one hand and effects of the completion of the First Stage Development Project on the other, the level is still low at 2.6 ~ 6.5 percent as compared with the pre-closure time. This may be accounted for by the fact that tankers have come to be designed in progressively greater size so that a transport system not dependent on the Canal has been established and also that because of the depression of the tankers market after the oil shock, there have been increasing cases of transport via the Cape of Good Hope by slow steaming vessels regardless of size.

The traffic volumes by direction of the principal cargoes during 1978 to 1983 are shown in detail in Table II-3-(2)-2.

Table II-3-(2)-1 Traffic Volume of Cargo by Direction

(1,000 M/T)

Year	Tanker Cargo			Dry Cargo			Total		
	Northbound	Southbond	Total	Northbound	Southbound	Total	Northbound	Southbound	Total
1966	166,718 (85.9%)	8,953 (18.8%)	175,671 (72.6%)	27,450 (14.1%)	38,772 (81.2%)	66,222 (27.4%)	194,168 (100.0%)	47,725 (100.0%)	241,893 (100.0%)
1976	29,855 (41.5)	3,969 (8.7)	33,824 (28.7)	42,165 (58.5)	41,664 (91.3)	83,829 (71.3)	72,020 (100.0)	45,633 (100.0)	117,653 (100.0)
1977	30,878 (42.5)	4,067 (7.3)	34,945 (27.2)	41,752 (57.5)	51,996 (92.7)	93,748 (72.8)	72,630 (100.0)	56,063 (100.0)	128,693 (100.0)
1978	28,363 (40.8)	4,816 (6.0)	33,179 (22.2)	41,234 (59.2)	75,366 (94.0)	116,600 (77.8)	69,597 (100.0)	80,182 (100.0)	149,779 (100.0)
1979	27,284 (34.7)	8,970 (10.9)	36,254 (22.6)	51,446 (65.3)	72,949 (89.1)	124,395 (77.4)	78,730 (100.0)	81,919 (100.0)	160,649 (100.0)
1980	28,474 (32.9)	13,994 (15.6)	42,468 (24.1)	58,073 (67.1)	75,735 (84.4)	133,808 (75.9)	86,507 (100.0)	89,729 (100.0)	176,276 (100.0)
1981	36,566 (38.9)	18,211 (17.8)	54,777 (27.9)	57,330 (61.1)	84,321 (82.2)	141,651 (72.1)	93,896 (100.0)	102,532 (100.0)	196,428 (100.0)
1982	63,139 (50.6)	20,312 (19.1)	83,451 (36.1)	61,666 (49.4)	86,276 (80.9)	147,942 (63.9)	124,805 (100.0)	106,588 (100.0)	231,393 (100.0)
1983	81,223 (57.6)	17,010 (14.7)	98,233 (38.3)	59,779 (42.4)	98,693 (85.3)	158,472 (61.7)	141,002 (100.0)	115,703 (100.0)	256,705 (100.0)

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Table II-3-(2)-2 Proportion of Cargo Volume via Suez Canal to World Trade Volume

(1,000 M/T)

Year	Tanker Cargo			Dry Cargo			Grand Total		
	World Volume A	Via Suez Canal B	B/A (%)	World Volume C	Via Suez Canal D	D/C (%)	World Volume E	Via Suez Canal F	F/E (%)
1978	1,727,000	33,179	1.92	1,764,000	116,600	6.61	3,491,000	149,779	4.29
1979	1,817,000	36,254	2.00	1,938,000	124,395	6.42	3,755,000	160,649	4.28
1980	1,638,000	42,468	2.59	2,010,000	133,808	6.66	3,648,000	176,276	4.83
1981	1,482,000	54,777	3.70	2,024,000	141,651	7.00	3,506,000	196,428	5.60
1982	1,328,000	83,451	6.28	1,921,000	147,942	7.70	3,249,000	231,393	7.12
1983	1,292,000	98,233	7.60	1,873,000	158,472	8.46	3,165,000	256,705	8.11

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Table II-3-(2)-3 Traffic Volume of Cargo by Category of Commodities

1,000 tons

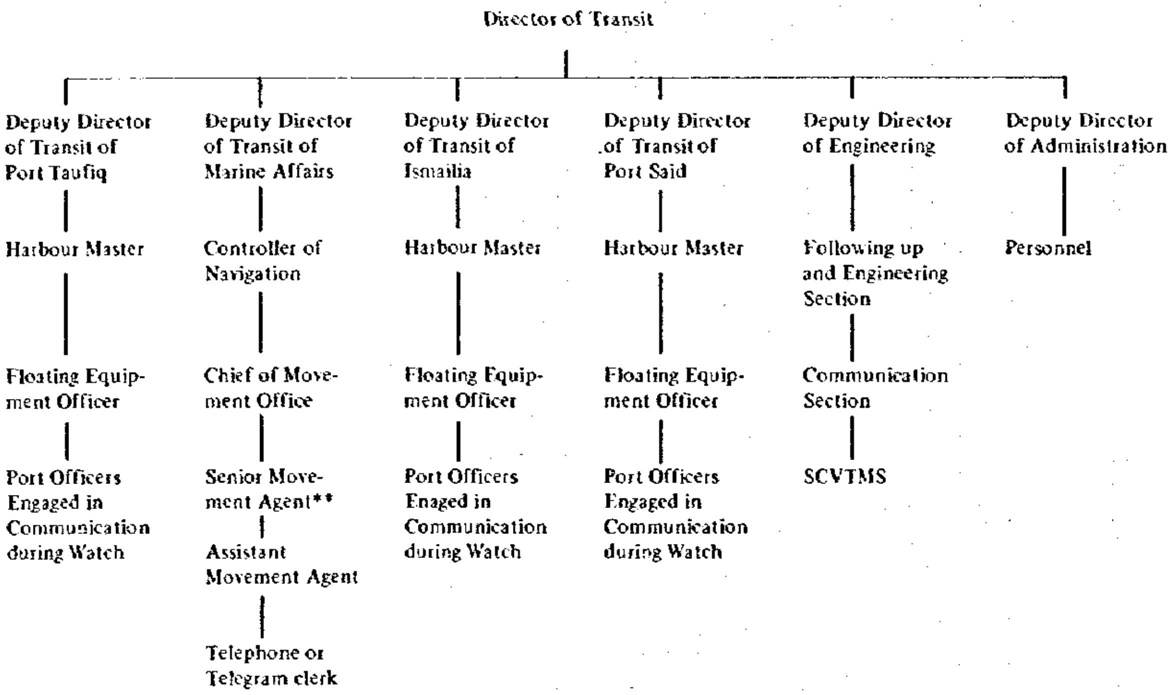
Year / Goods	1978		1979		1980		1981		1982		1983	
	N. bound	S. bound	N. bound	S. bound	N. bound	S. bound	N. bound	S. bound	N. bound	S. bound	N. bound	S. bound
Petroleum & Products												
Crude Oil	20,997	619	20,225	839	19,077	2,541	25,624	4,269	49,074	6,353	63,753	2,831
Gas Oil & Diesel Oil	345	1,672	675	3,872	1,475	6,455	927	8,251	1,003	7,373	1,784	5,323
Others	7,021	2,525	6,384	4,259	7,922	4,998	10,015	5,691	13,062	6,586	15,686	8,856
Total	28,363	4,816	27,284	8,970	28,474	13,994	36,566	18,211	63,139	20,312	81,223	17,010
Cereals	1,139	5,221	2,461	4,985	4,745	6,066	3,350	8,825	4,563	9,091	3,331	11,383
Fertilizers	1,475	9,025	1,534	8,982	1,840	11,204	201	11,013	1,911	11,575	2,223	11,547
Iron Ore	3,901	-	4,892	-	6,621	-	4,996	-	6,262	-	5,319	-
Fabricated Metals	3,054	7,894	3,154	6,677	2,513	5,973	1,817	7,324	2,804	6,059	1,922	10,413
Cement	-	11,226	-	9,517	-	11,797	-	12,569	-	12,107	-	13,180
Others	31,665	42,000	39,405	42,788	42,354	40,695	46,966	44,610	46,126	47,444	46,984	52,170
Total	41,234	75,366	51,446	72,949	58,073	75,735	57,330	84,341	61,666	86,276	59,779	98,693
Total Traffic	69,597	80,182	78,730	81,919	86,547	89,729	93,896	102,552	124,805	106,588	141,002	115,703

II-4 Traffic and Anchorage Conditions

(1) Canal Traffic

1) Organization

The transit of vessels in the Canal is managed and operated by the following organization of the SCA based on the Rules of Navigation.



** Watch supervisor marine traffic control

Fig. II-4-(1)-1 Organization of Transit Department

2) Traffic Management

Traffic of the Canal is, as shown in the organization chart, managed by the Harbour Offices provided in Port Said, Suez and Ismailia, the Main Office within the headquarters, and further by those signal stations provided at the intervals of approximately 10 km on the west bank of the Canal, and pilots serving on board vessels transiting the Canal with close communications held among them.

The list of those vessels scheduled to transit the Canal which is prepared by the Harbour Offices in Port Said and Suez through VHF communications of the pilot boat with incoming vessels is transferred to the Main Office after the closing, then a transit convoy is organized there with pilotage arrangements made accordingly.

Each transit vessel commences its passage in accordance with the instructions given by the Harbour Office, and during the passage, each office, signal station and each pilot serving on board the transit vessels in a convoy are closely linked through mutual communications by VHF and UHF radiotelephony. At the Main Office, recording is made on the Traffic Diagram (Movement of vessels in the Canal) based on the vessel movement information given mainly by the signal stations for monitoring the total picture of the transiting vessels within the Canal area for eventual assurance of their safety in their passages.

Transit vessels are subjected to the obligatory requirements of stationing radio watch throughout their passage, and any messages of importance are communicated by radiotelegraph.

3) Present Conditions of Canal Traffic

(i) Convoy Transit System

Under the established convoy transit system, two southbound convoys and one northbound convoy are handled a day.

Those vessels desiring to transit the Canal are to book with at least a 4-day notice before the scheduled day of transit, and further they are requested to advise ETA, drafts and whether they carry dangerous goods on board or not etc. within 48 hours prior to their arrivals.

Further, they are requested to get anchorage instructions from the Harbour Master after making liaisons therewith through VHF radiotelephony when they reach the point of 10 miles before the approach buoy in Port Said or 5 miles before No. 1 buoy of the traffic separation zone of Suez.

(ii) Southbound Vessels

Although it depends on vessel's breadth, vessels with a maximum draft of 42 feet can southbound transit through the Canal at present. However, it is possible to make special arrangement for vessels having more than 42 feet draft by passing through the eastern channel.

The reception of applications for the first southbound convoy is closed at 1800 hours every day for subsequent building up and organizing of a convoy. Those vessels with their drafts not exceeding 38 feet proceed to Suez after being moored temporarily at the waiting buoy berth within the harbour water via the west branch, and VLCCs, 3rd generation containerships and others with drafts exceeding 38 feet proceed threreto from the VLCC waiting anchorage via the Port Said Bypass. Vessels proceeding to the Canal from the harbour water commence their passage at or later than 2330 hours after the last vessel of northbound vessel passes the 17 km point, thence those vessels departed from the VLCC anchorage bound for the Port Said Bypass follow.

The reception of applications for the second convoy is closed at 0230 hours, and their passage is commenced at 0600 hours via the west branch where only those with drafts of 38 feet or less other than VLCCs or 3rd generation containerships not carrying dangerous goods on board are permitted to join the convoy.

The first convoy waits the passage of northbound vessels at the Western Anchorage in the Great Bitter Lake after passing through the Ballah East Branch, Timsah East Branch and Deversoir West Channel, whereas the second convoy waits the passage of the northbound vessels being tied up at the Ballah West Branch. Note, however, that if the number of vessels in the second convoy is four or less, saving of time in the passage is made by proceeding to the Lake Timsah and anchoring there.

When passage is started from the anchorage in the Great Bitter Lake, the convoy is reorganized in order from 3rd generation containerships, VLCCs in ballast and other type of vessels. The foremost vessel in the convoy makes speed adjustment so that the last vessel in the northbound convoy comes abeam with the foremost vessel at Kabrit Station.

(iii) Northbound Vessels

The northbound passage, as is the case in the southbound passage, is available for vessels with a maximum draft of 53 feet at present though it depends on vessel's breadth.

As aforementioned, only a passage of one convoy a day is available, the reception of applications for transiting the Canal is closed at 2400 hours every day for those VLCCs, 3rd generation containerships and others with drafts exceeding 38 feet, and at 0230 hours every day for others, and a convoy is organized in sequence from 3rd generation containerships, loaded VLCCs, LPG carriers, conventional tankers and then to vessels of other types.

The convoy proceeds to Port Said starting in such a way that the foremost vessel of the convoy passes the km 160 point at 0520 hours, with VLCCs etc. departed from their waiting area and others once shifted to the inner anchorage then departed therefrom, passing through the East Kabrit Channel Eastern Dredged Channel in the Great Bitter Lake, Deversoir East Channel, Lake Timsah East Channel and Ballah East Bypass.

As a rule, those loaded tankers are permitted to proceed without stoppage on condition that the first tanker reaches Km 95 after passage of the last ship of the first southbound convoy by this point, but others must wait the passage of the southbound convoy by anchoring at the East Anchorage in the Great Bitter Lake.

Although vessels calling at Port Said enter the Port Said West Branch, all others proceed directly to the Mediterranean Sea through the Port Said Bypass.

Incidentally, 36 buoy berths are now under construction at the southern part of the Port Said West Branch for accommodating southbound vessels, and when this project is completed and operation begins, those northbound vessels will pass via the Port Said Bypass without exception. Thus, even those vessels calling at Port Said will have to proceed to the Mediterranean Sea once, then enter Port Said from the water lying in the north.

(iv) Transit Speed

The Rules of Navigation list the following requirements for transit speed:

The first and second southbound convoys		14 km/h (7.56 knots)
Northbound convoy	Loaded VLCCs, etc.	13 km/h (7.02 knots)
	Other vessels	14 km/h (7.56 knots)

(v) Time Intervals between Vessels

Although there are no established regulations on ship-to-ship time intervals in the Rules of Navigation, the SCA specifies the standards as below:

Deadweight tons	Minimum time intervals in minutes
Up to 30,000	6
30,000 to 60,000	10
60,000 to 140,000	16
140,000 to 250,000	20
Larger than 250,000	25
VLCC in ballast	16

(vi) Traffic Diagram

As aforementioned, recording is made on the Traffic Diagram at the Central Operation Center of the Main Office in Ismailia on the information reported from each signal station for the overall control and management of all vessels transiting the Canal. On the specific traffic diagrams covering the 1-month period of August, 1983, and the particular day of May 4, 1982 representing the day of the heaviest traffic density during the year 1982, studies were made on vessel speed, time interval between vessels, distribution of times required for temporary anchorage and tie-up, time required for completing the transit through the Canal, and the results were tabulated as given in the following tables and figures.

Table II-4-(1)-1 Average Speed, Average Hours for Tying Up and Anchoring for One Month

Southbound

	Port Said to Great Bitter Lake		Anchored at Great Bitter Lake		Great Bitter Lake to Suez		Port Said to El Ballah		Port Said to Lake Timsah		Tied up at El Ballah		El Ballah to Suez		El Ballah to Lake Timsah		Tied up at Lake Timsah		Lake Timsah to Suez	
	No. of vessels and average speed		No. of vessels and hours anchored		No. of vessels and average speed		No. of vessels and average speed		No. of vessels and average speed		No. of vessels and hours tied up		No. of vessels and average speed		No. of vessels and average speed		No. of vessels and hours tied up		No. of vessels and average speed	
Container	133	8.412	132	04^{h}-48^{m}	133	8.439	20	8.136	3	8.201	20	07^{h}-18^{m}	15	9.156	2	8.443	3	06^{h}-37^{m}	5	9.564
Tanker	131	8.523	131	04 -08	131	8.280	19	8.162	4	8.205	19	07 -59	12	9.146	-	-	4	06 -48	4	9.210
Others	437	8.507	444	05 -17	446	8.355	118	8.186	27	8.256	118	07 -21	107	9.036	16	7.947	27	08 -13	21	9.385
Total	701	8.492	707	04 -59	710	8.340	157	8.178	34	8.245	157	07 -20	134	9.056	18	8.002	34	07 -55	30	9.391

Northbound

	Suez to Port Said		Suez to Great Bitter Lake		Anchored at Great Bitter Lake		Great Bitter to Port Said	
	No. of vessels and average speed		No. of vessels and average speed		No. of vessels and hours anchored		No. of vessels and average speed	
Container	84	8.108	34	8.178	34	01^{h}-38^{m}	34	8.415
Tanker	60	8.466	129	8.745	129	01 -09	129	9.052
Others	203	8.466	347	8.923	347	03 -34	346	8.675
Total	347	8.418	510	8.824	510	02 -53	509	8.746

Table II-4-(1)-2 Average Speed, Average Hours for Tying Up and Anchoring for the Most Congested Day in 1982

Southbound

	Port Said to Great Bitter Lake		Anchored at Great Bitter Lake		Great Bitter to Suez		Port Said to El Ballah		Tied up at El Ballah		El Ballah to Suez		Port Said to Lake Timsah		Anchored at Lake Timsah		Lake Timsah to Suez	
	No. of vessels and average speed		No. of vessels and hours anchored		No. of vessels and average speed		No. of vessels and average speed		No. of vessels and hours tied up		No. of vessels and average speed		No. of vessels and average speed		No. of vessels and hours anchored		No. of vessels and average speed	
Container	5	8.925	5	6^h40^m	5	8.665	4	8.406	4	8^h48^m	4	10.956	0	/	0	/	0	/
Tanker	4	8.604	4	5 -51	4	8.190	0	/	0	/	0	/	0	/	0	/	0	/
Others	16	8.135	16	5 -18	16	8.732	8	8.624	8	9 -03	8	10.572	2	8.584	2	6^h45^m	2	8.639
Total	25	8.368	25	5 -40	25	8.632	12	8.551	12	8 -58	12	10.700	2	8.584	2	6 -45	2	8.639

Northbound

	Suez to Port Said		Suez to Great Bitter Lake		Anchored at Great Bitter Lake		Great Bitter to Port Said	
	No. of vessels and average speed		No. of vessels and average speed		No. of vessels and hours anchored		No. of vessels and average speed	
Container	0	/	8	9.268	8	0^h57^m	8	9.382
Tanker	1	8.158	3	8.490	3	0 -38	3	8.318
Others	2	8.107	24	8.706	24	4 -04	24	9.368
Total	3	8.124	35	8.816	35	3 -04	35	9.268

Table II-4-(1)-3 Average Total Transit Hours for One Month by Kind of Vessel

Direction / Kind of vessel	Northbound		Southbound	
	Number of Vessels	Average Total Transit hrs.	Number of Vessels	Average Total Transit hrs.
Tanker	117	10^{h}-58^{m}	165	13^{h}-48^{m}
Container	190	10^{h}-25^{m}	158	15^{h}-06^{m}
Others	555	11^{h}-46^{m}	636	15^{h}-25^{m}

Table II-4-(1)-4 Average Total Transit Hours for the Most Congested Day in 1982 by Kind of Vessel

Direction / Kind of Vessel	Northbound		Southbound	
	Number of Vessels	Average Total Transit hrs.	Number of Vessels	Average Total Transit hrs.
Tanker	4	10^{h}-50^{m}	4	16^{h}-03^{m}
Container	8	10^{h}-12^{m}	9	15^{h}-11^{m}
Others	26	13^{h}-30^{m}	26	15^{h}-03^{m}

Table II-4-(1)-5 Average Time Intervals between Vessels for One Month by Kind of Vessel

Direction Position / Kind of Vessel		Northbound		Southbound	
		P. Said	Suez	P. Said	Suez
Container		9.56	9.45	12.50	8.85
Tanker	Less than 60,000 G.T.	16.95	13.88	13.82	8.95
	60,000 G.T. and more	21.89	17.96	19.53	10.80
Others		10.15	9.07	11.44	8.85

(minutes)

Table II-4-(1)-6 Average Time Intervals between Vessels for the Most Congested Day in 1982 by Kind of Vessel

Direction Position / Kind of Vessel		Northbound		Southbound	
		P. Said	Suez	P. Said	Suez
Container		7.14	7.00	16.67	8.60
Tanker	Less than 60,000 G.T.	24.00	32.50	25.50	30.00
	60,000 G.T. and more	14.00	25.00	18.00	–
Others		10.58	7.12	10.08	8.88

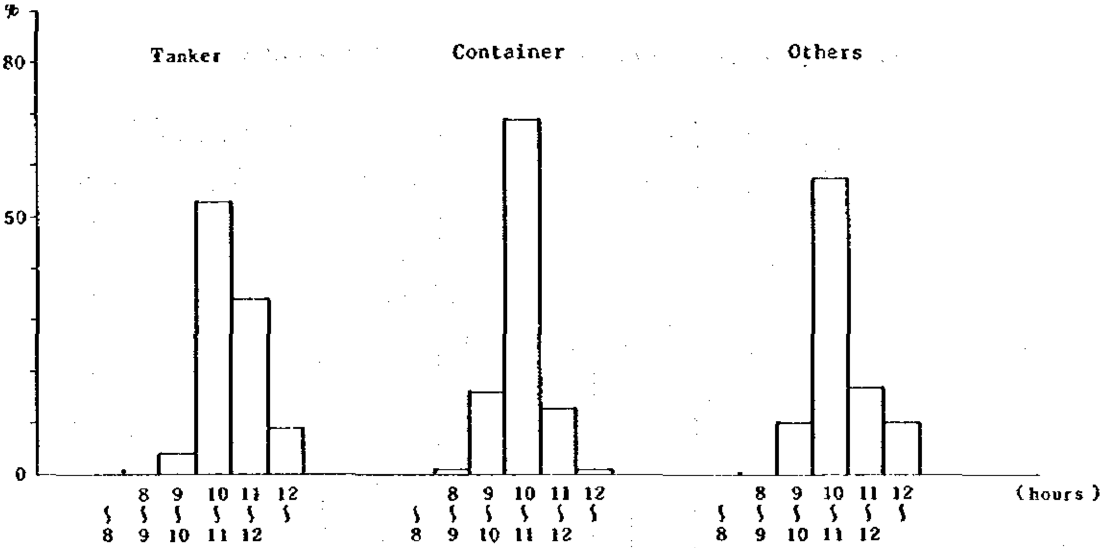


Fig. II-4-(1)-2 Distribution of Average Total Transit Hours for One Month by Kind of Vessel (Northbound)

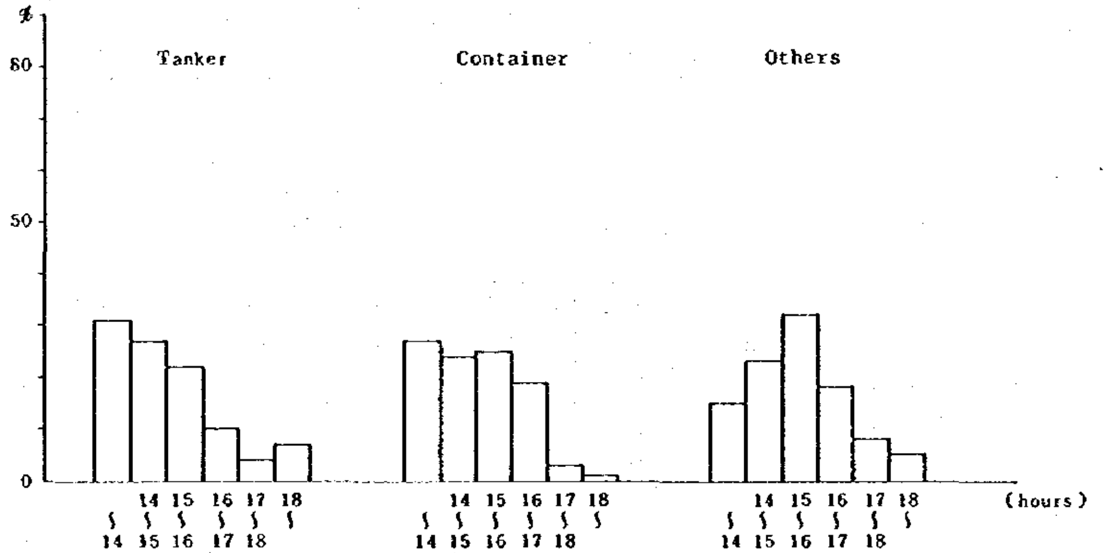


Fig. II-4-(1)-3 Distribution of Average Total Transit Hours for One Month by Kind of Vessel (Southbound)

(vii) Arrival and Waiting Conditions

A special request was directed to the SCA for obtaining the recorded arrival and departure data in Port Said and Suez on vessels transiting the Canal for the period from September 12 to October 2, 1983, and the data was analyzed for determining the statistical arrival distribution and waiting time distribution as given in Tables II-4-(1)-7 through II-4-(1)-12.

Table II-4-(1)-7 Distribution of Arrival Time by Kind of Vessel

Arrival Time	Tanker		Bulk C.		Container		Cargo		Unknown		Total	
	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.
0 ~ 2	3	7		3	8	3	29	19			40	32
2 ~ 4	6	7		3	6	3	17	19			29	32
4 ~ 6	3	6		1	2	2	11	24			16	33
6 ~ 8	18	6	3	6	5	1	26	26			52	39
8 ~ 10	10	10	2	12	14	8	26	27			52	58
10 ~ 12	12	19	1	8	12	2	25	29			50	58
12 ~ 14	14	18	1	3	14	16	51	24			80	61
14 ~ 16	9	17	1	7	8	20	38	44			56	88
16 ~ 18	14	16	1	13	9	18	30	47			54	94
18 ~ 20	4	5	1	5	6	8	32	24			43	42
20 ~ 22	15	8	3	4	16	1	22	16			56	29
22 ~ 24	11	8	2	12	8	1	30	23			51	44
Unknown									15	3	15	3
Total	119	128	15	77	108	83	337	322	15	3	594	613

Table II-4-(1)-8 Distribution of Arrival Time by Dangerous Goods Loaded Vessel

Arrival Time	D.G. Loaded		D.G. Not Loaded		Unknown		Total	
	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.
0 ~ 2	3	9	35	22			38	31
2 ~ 4	4	12	19	21			23	33
4 ~ 6	2	7	18	24			20	31
6 ~ 8	3	12	48	29			51	41
8 ~ 10	8	17	50	41			58	58
10 ~ 12	5	25	41	36			46	61
12 ~ 14	9	30	64	29			73	59
14 ~ 16	9	39	47	44			56	83
16 ~ 18	7	38	50	56			57	94
18 ~ 20	2	14	39	29			41	43
20 ~ 22	13	10	44	23			57	33
22 ~ 24	12	12	47	31			59	43
Unknown					15	3	15	3
Total	77	225	502	385	15	3	594	613

Table II-4-(1)-9 Distribution of Arrival Time by Gross Tonnage of Vessel

Arrival Time	Less than 10,000		10,000 ~ 50,000		50,000 ~ 100,000		100,000 ~ 500,000		Unknown		Total	
	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.
0 ~ 2	16	11	21	13	1	6					38	30
2 ~ 4	12	11	14	19	2	2		1			28	33
4 ~ 6	7	8	10	19		2		1			17	30
6 ~ 8	14	16	32	23	3	1	1	1			50	41
8 ~ 10	19	13	23	41	5	3	1	3			48	60
10 ~ 12	13	13	38	35	2	6		5			53	59
12 ~ 14	20	20	45	31	10	7		4			75	62
14 ~ 16	17	20	30	45	7	14	2	1			56	80
16 ~ 18	18	27	33	56	5	6		5			56	94
18 ~ 20	15	19	22	24	4	1		1			41	45
20 ~ 22	8	14	36	15	11	2		1			55	32
22 ~ 24	13	17	39	23	8	3					60	43
Unknown									17	4	17	4
Total	172	189	343	344	58	53	4	23	17	4	594	613

Table II-4-(1)-10 Distribution of Waiting Hours by Kind of Vessel

Waiting Hours	Tanker		Bulk C.		Container		Cargo		Unknown		Total	
	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.
0 ~ 2								1				1
2 ~ 4				1				1				2
4 ~ 6		3		2			1	4			1	9
6 ~ 8	4	5		3	7	6	1	18			12	32
8 ~ 10	12	11	1	7	8	10	15	30			36	58
10 ~ 12	10	26	2	17	9	27	34	54			55	124
12 ~ 14	11	23	1	10	11	25	21	49			44	107
14 ~ 16	11	16	2	10	11	5	33	36			57	67
16 ~ 18	10	18		8	9	7	37	22			56	55
18 ~ 20	7	12	1	8	13	3	27	19			48	42
20 ~ 22	9	6	1		11	3	31	18			52	27
22 ~ 24	8	7	1	5	11	2	19	22			39	36
24 ~ 26	8	5		2	8		28	4			44	11
26 ~ 28	5	1		3	1	1	24	6			30	11
28 ~ 30	13	4	1		6		42	13			62	17
Over 30	5	2	2		7		29	8			43	10
Unknown									15	4	15	4
Total	113	139	12	76	112	89	342	305	15	4	594	613

Table II-4-(1)-11 Distribution of Waiting Hours by Dangerous Goods Loaded Vessel

Waiting Hours	D.G. Loaded		D.G. Not Loaded		Unknown		Total	
	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.
0～2								
2～4		1		1				2
4～6		2	1	5			1	7
6～8	4	9	8	23			12	32
8～10	11	18	25	39			36	57
10～12	7	48	48	76			55	124
12～14	7	46	37	59			44	105
14～16	13	28	44	41			57	69
16～18	6	24	50	29			56	53
18～20	8	17	40	27			48	44
20～22	6	6	45	21			51	27
22～24	26	27	193	62			219	89
Unknown					15	4	15	4
Total	88	226	491	383	15	4	594	613

Table II-4-(1)-12 Distribution of Waiting Hours by Gross Tonnage of Vessel

Waiting Hours	Less than 10,000		10,000 ～50,000		50,000 ～100,000		100,000 ～500,000		Unknown		Total	
	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.	N.B.	S.B.
0～2												
2～4				2								2
4～6	1	2		5		1					1	8
6～8	1	12	7	15	5	5					13	32
8～10	10	22	20	29	6	4		2			36	57
10～12	12	28	36	74	6	17		4			54	123
12～14	16	28	23	66	3	10		2			42	106
14～16	12	27	37	33	7	5	1	3			57	68
16～18	13	12	32	32	7	7	1	4			53	55
18～20	13	10	33	26	4	3		1			50	40
20～22	9	10	36	17	3	2					48	29
22～24	13	15	24	18	3	2	2	2			42	37
24～26	14	6	25	5	2	1					41	12
26～28	8	5	20	6							28	11
28～30	5	2	16	2	2	1	1				24	5
Over 30	42	12	39	11	4	1					85	24
Unknown									20	4	20	4
Total	169	191	348	341	52	59	5	18	20	4	594	613

(viii) Computer Analysis of SCVTMS Magnetic Tapes

Figs. II-4-(1)-4 through II-4-(1)-33 are drawn by computer analysis of the magnetic tapes containing the data on a total of 224 transitted vessels for the period from September 10 to November 27, 1983.

The corrections from the positions of CORT units to those of vessels' centerline are made as half of the vessel's breadth on these figures.

Figs. II-4-(1)-4 through II-4-(1)-13 are the distribution of the number of vessels passed the gate line and Figs. II-4-(1)-14 through II-4-(1)-23 are the distribution of the vessels breadth occupying the water at the gate line, drawn at the five gates in the Canal, and separated into two groups, less than 50,000 tons and 50,000 tons or more.

Note, however, vessels of 500 meters or more of the off-track distance are neglected.

Figs. II-4-(1)-24 through II-4-(1)-33 are the track charts, drawn on the map prepared in 1982 by SCA at the five locations in the Canal and separated into the same two groups mentioned above.

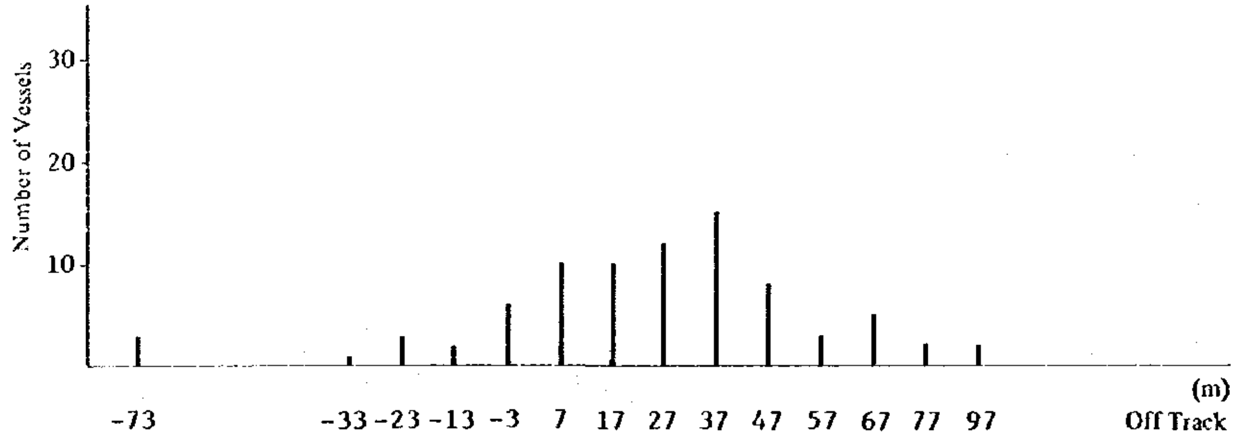


Fig. II-4-(1)-4 Distribution of Number of Vessels Passed Gate Line at Km 32 (89 vessels, less than 50,000 tons)

Note: Off Track Data more than 500 meters are Neglected in All Figures

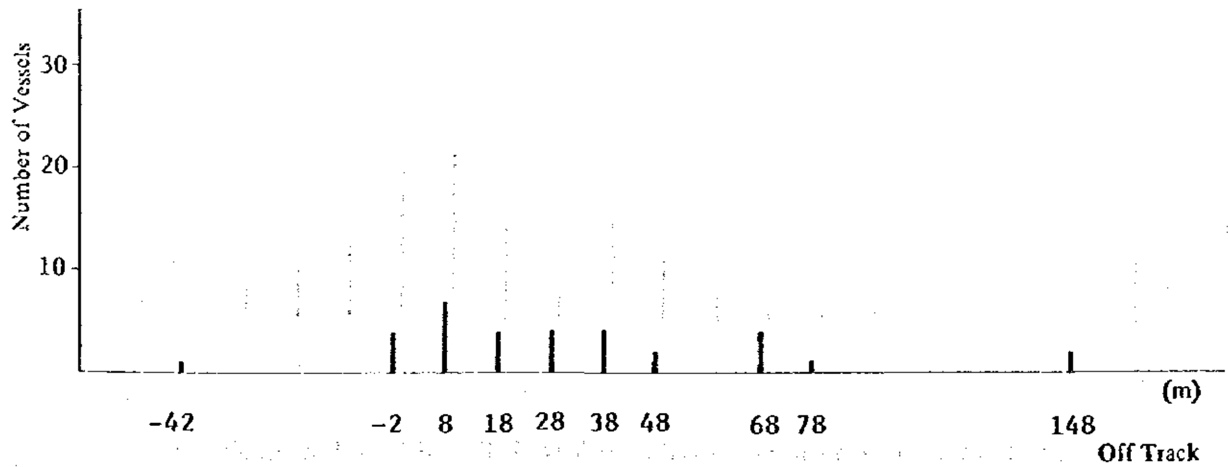


Fig. II-4-(1)-5 Distribution of Number of Vessels Passed Gate Line at Km 32 (36 vessels, 50,000 tons or more)

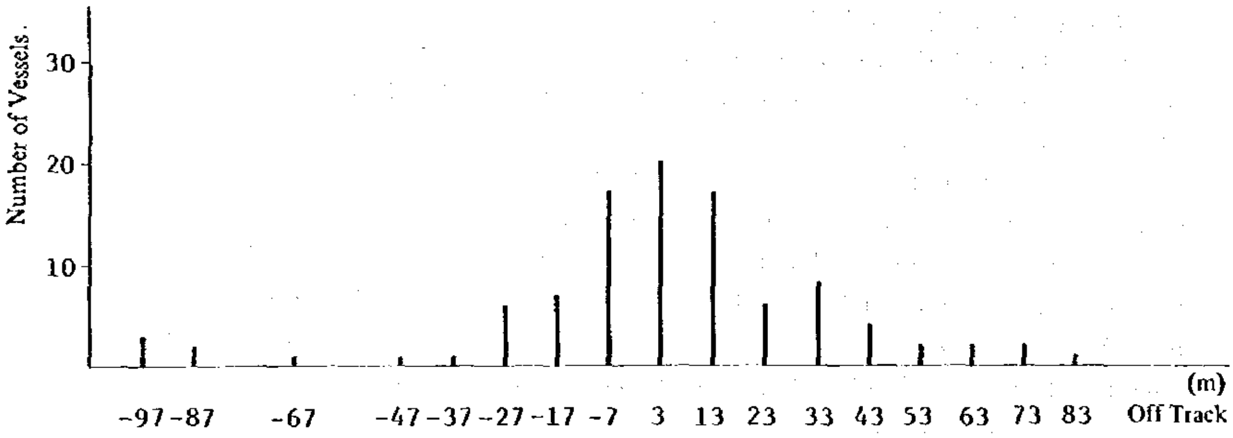


Fig. II-4-(1)-6 Distribution of Number of Vessels Passed Gate Line at Km 50 (107 vessels, less than 50,000 tons)

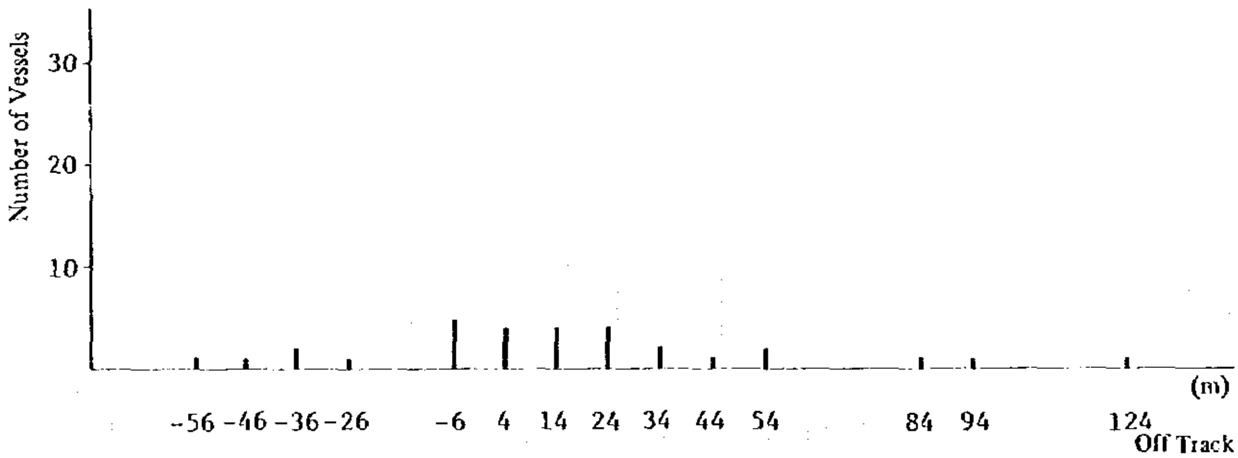


Fig. II-4-(1)-7 Distribution of Number of Vessels Passed Gate Line at Km 50 (33 vessels, 50,000 tons or more)

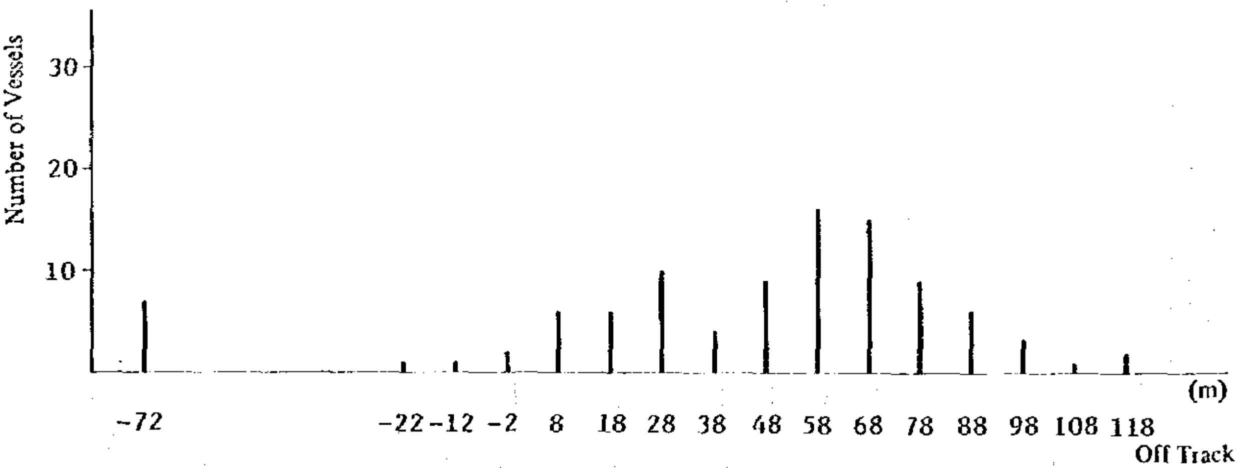


Fig. II-4-(1)-8 Distribution of Number of Vessels Passed Gate Line at Km 78 (101 vessels, less than 50,000 tons)

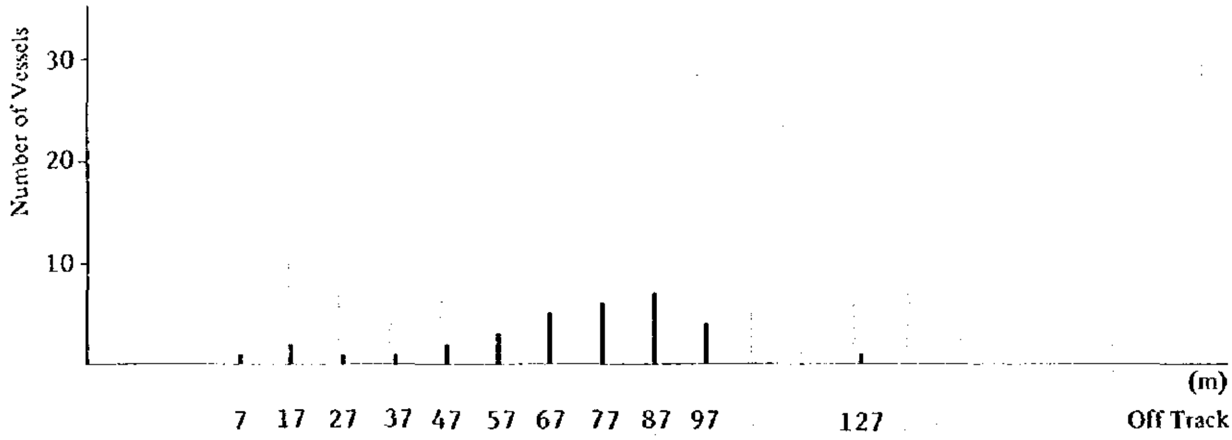


Fig. II-4-(1)-9 Distribution of Number of Vessels Passed Gate Line at Km 78
(36 vessels, 50,000 tons or more)

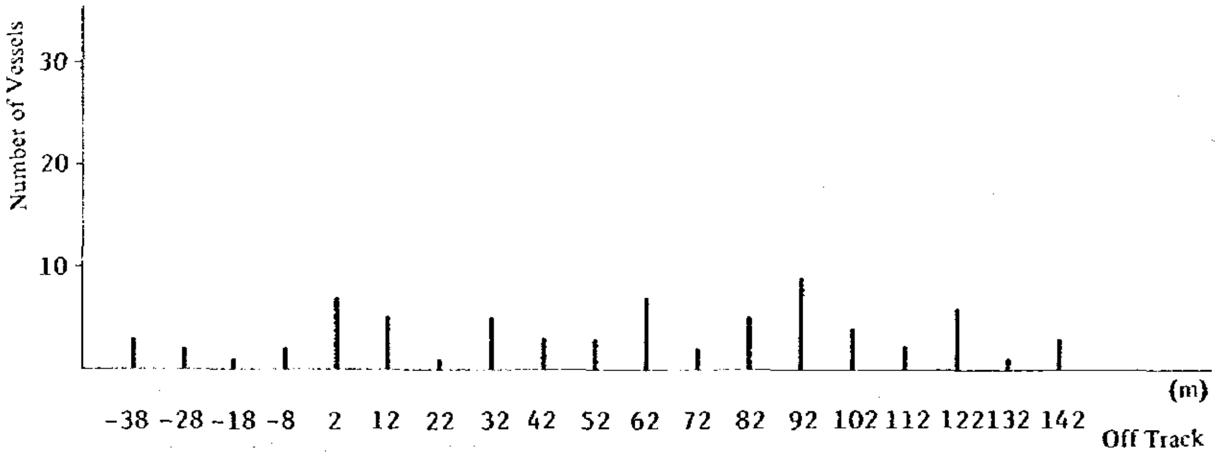


Fig. II-4-(1)-10 Distribution of Number of Vessels Passed Gate Line at Km 121
(76 vessels, less than 50,000 tons)

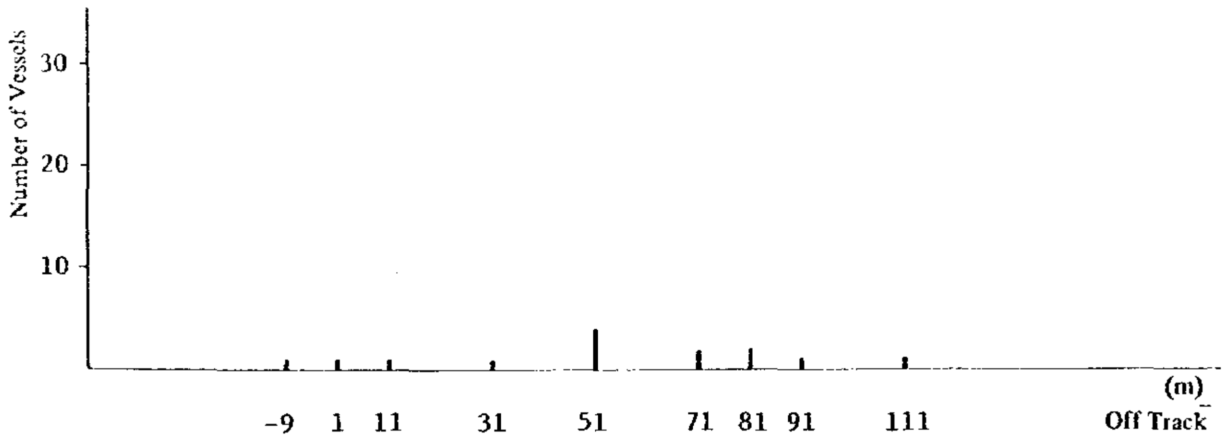


Fig. II-4-(1)-11 Distribution of Number of Vessels Passed Gate Line at Km 121
(15 vessels, 50,000 tons or more)

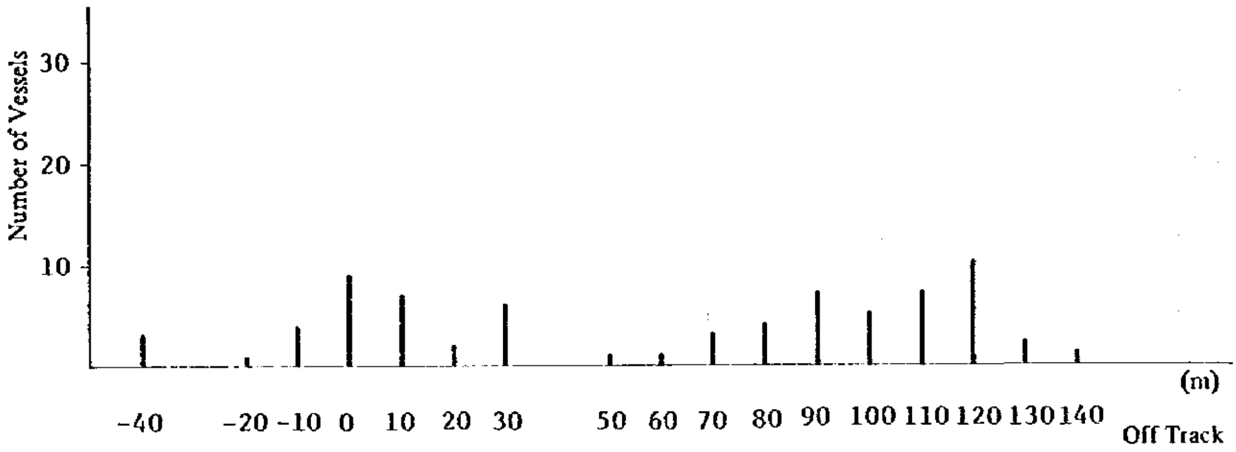


Fig. II-4-(1)-12 Distribution of Number of Vessels Passed Gate Line at Km 155
(77 vessels, less than 50,000 tons)

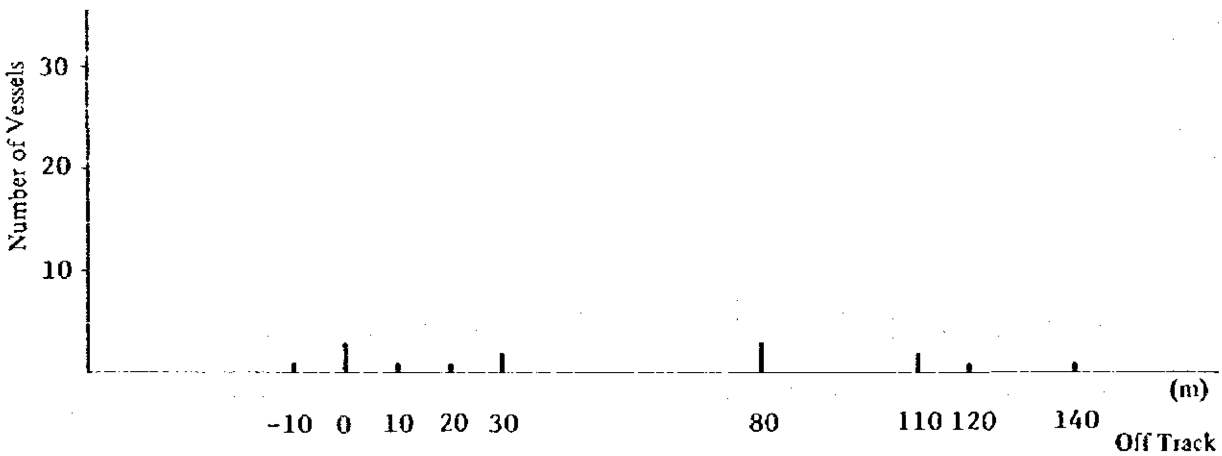


Fig. II-4-(1)-13 Distribution of Number of Vessels Passed Gate Line at Km 155
(16 vessels, 50,000 tons or more)

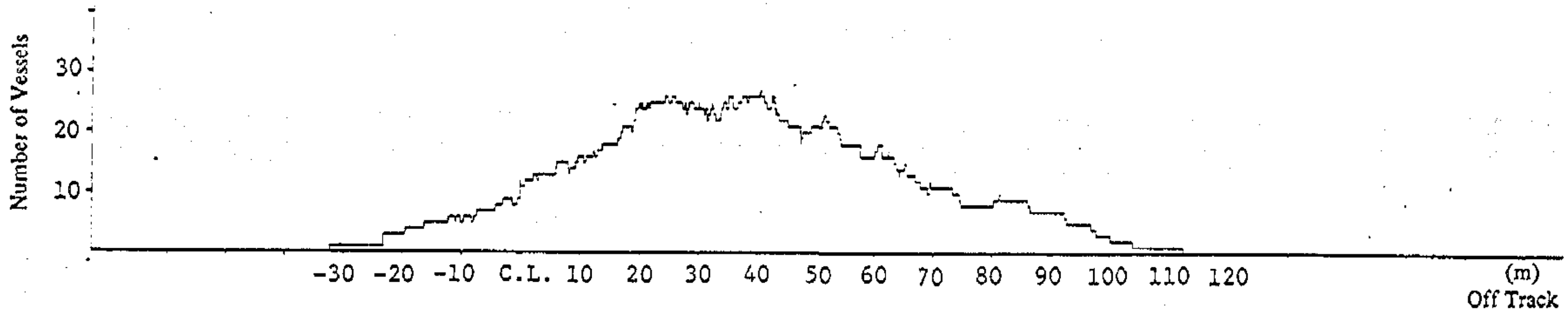


Fig. II-4-(1)-14 Distribution of Vessels' Breadths Occupying Water at Km 32 Gate Line
(89 vessels, less than 50,000 tons)

Fig. II-4-(1)-15 Distribution of Vessels' Breadths Occupying Water at Km 32 Gate Line
(36 vessels, 50,000 tons or more)

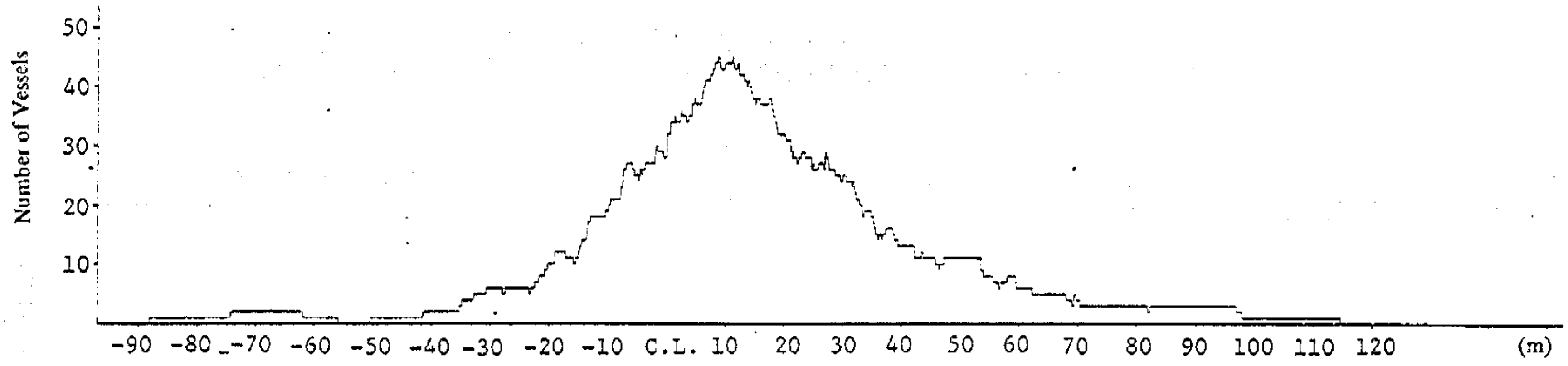


Fig. II-4-(1)-16 Distribution of Vessels' Breadths Occupying Water at Km 50 Gate Line
(107 vessels, less than 50,000 tons)

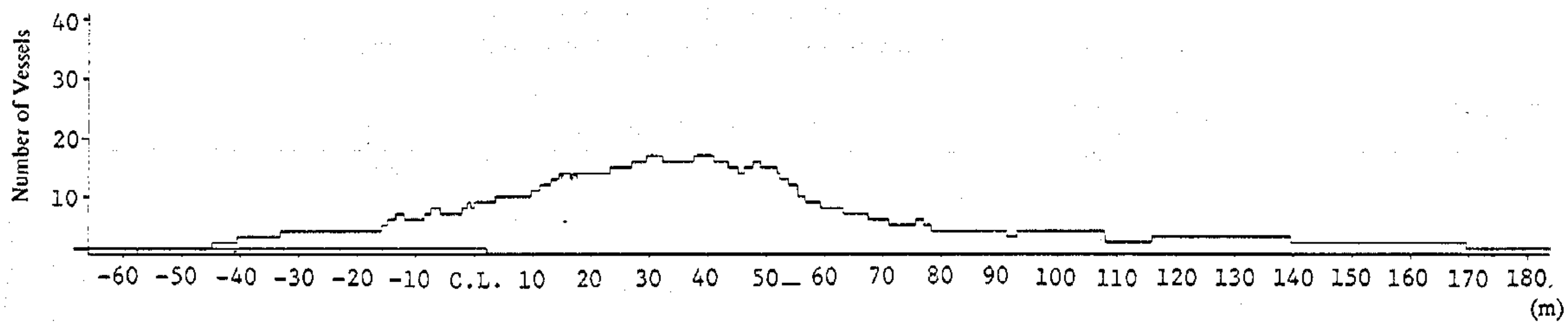


Fig. II-4-(1)-17 Distribution of Vessels' Breadths Occupying Water at Km 50 Gate Line
(33 vessels, 50,000 tons or more)

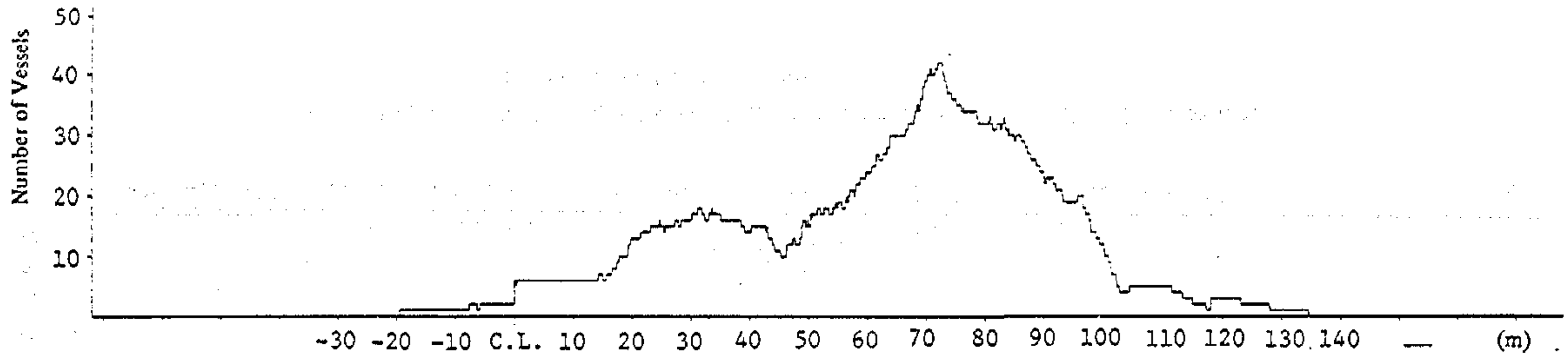


Fig. II-4-(1)-18 Distribution of Vessels' Breadths Occupying Water at Km 78 Gate Line
(101 vessels, less than 50,000 tons)

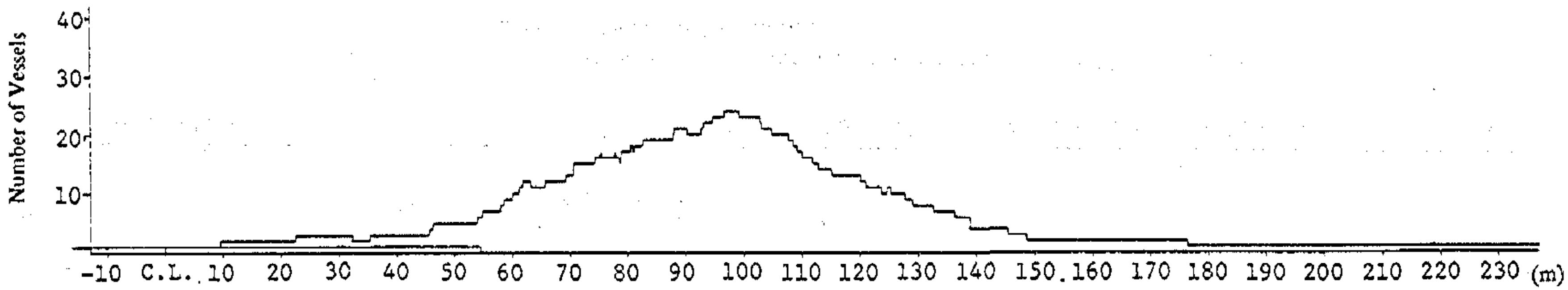


Fig. II-4-(1)-19 Distribution of Vessels' Breadths Occupying Water at Km 78 Gate Line
(36 vessels, 50,000 tons or more)

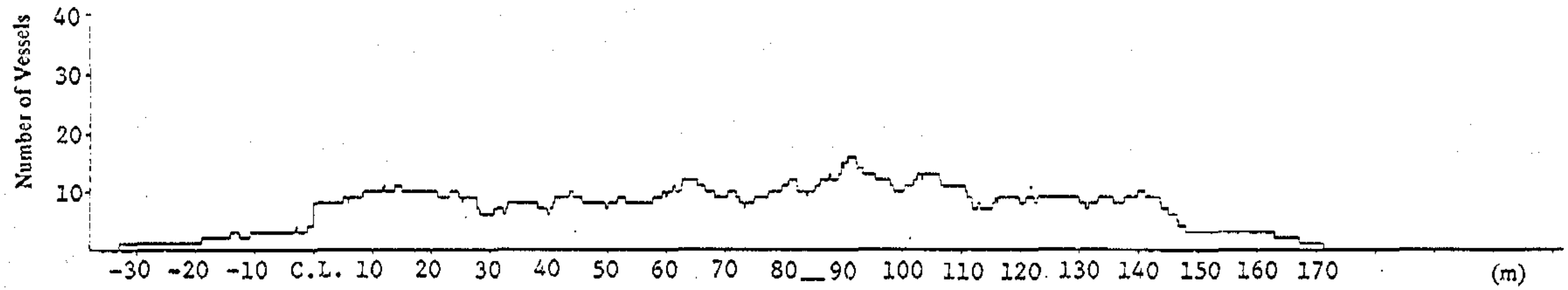


Fig. II-4-(1)-20 Distribution of Vessels' Breadths Occupying Water at Km 121 Gate Line
(76 vessels, less than 50,000 tons)

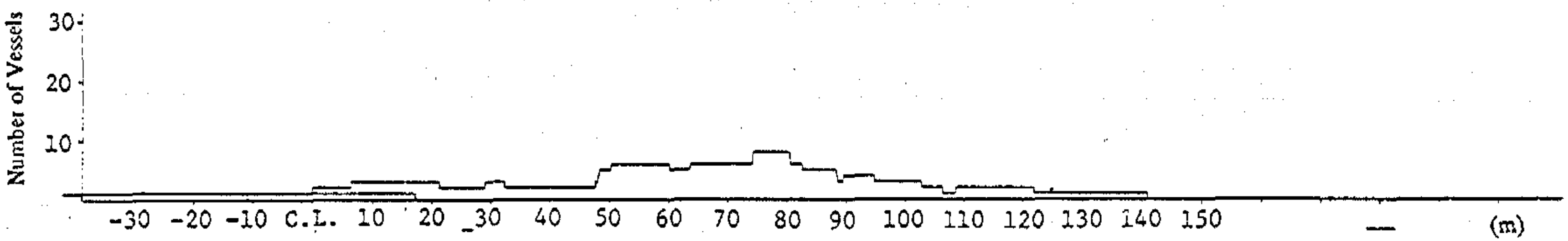


Fig. II-4-(1)-21 Distribution of Vessels' Breadths Occupying Water at Km 121 Gate Line
(15 vessels, 50,000 tons or more)

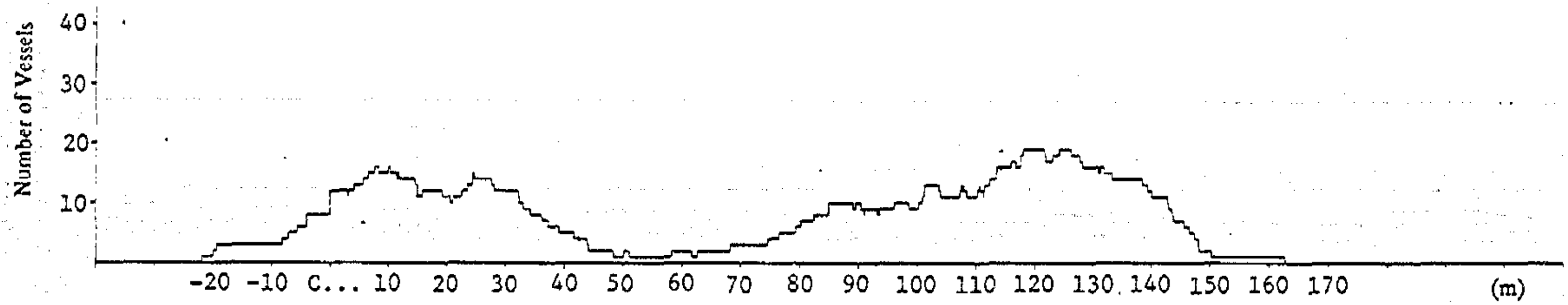


Fig. II-4-(1)-22 Distribution of Vessels' Breadths Occupying Water at Km 155 Gate Line
(77 vessels, less than 50,000 tons)

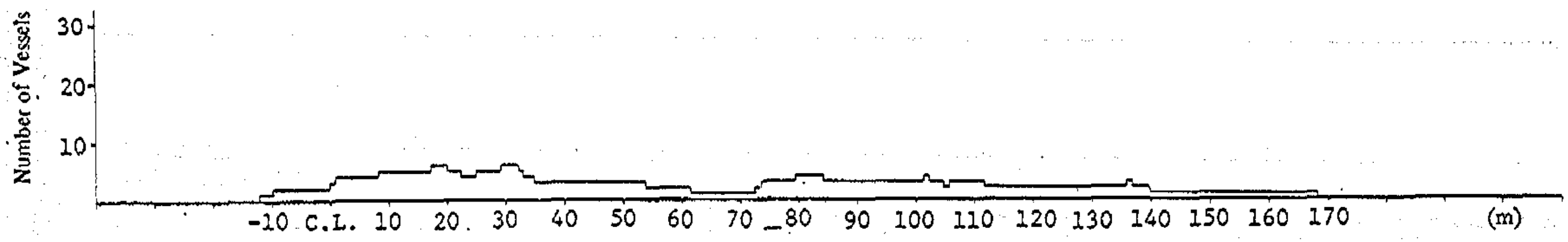


Fig. II-4-(1)-23 Distribution of Vessels' Breadths Occupying Water at Km 155 Gate Line
(16 vessels, 50,000 tons or more)

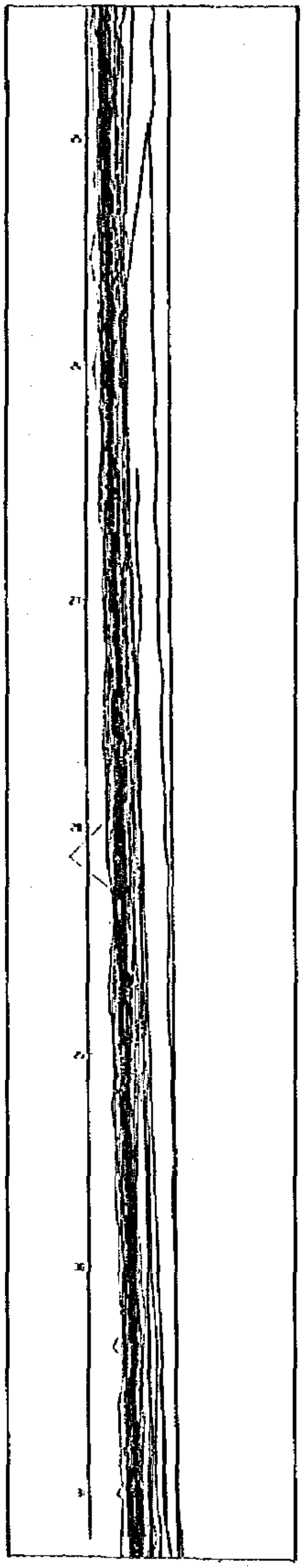


Fig. II-4-(1)-24 Track Chart-1 (at Km 30)
(89 vessels, less than 50,000 tons)

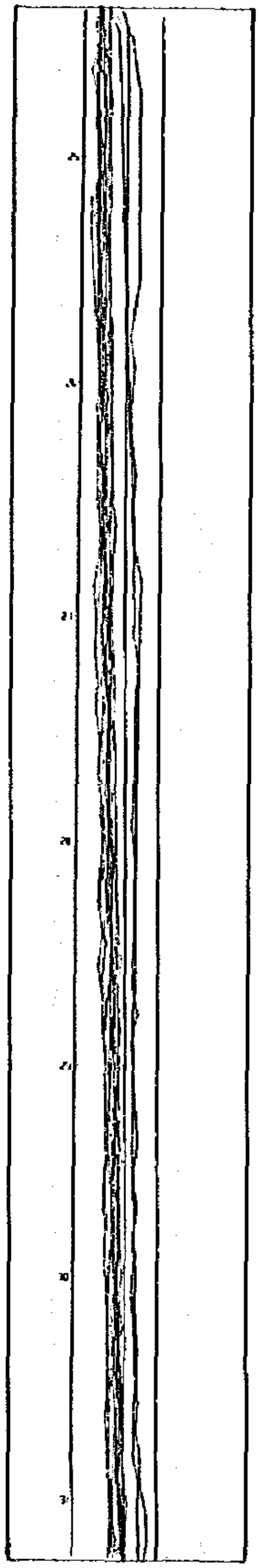


Fig. II-4-(1)-25 Track Chart-2 (at Km 30)
(36 vessels, 50,000 tons or more)

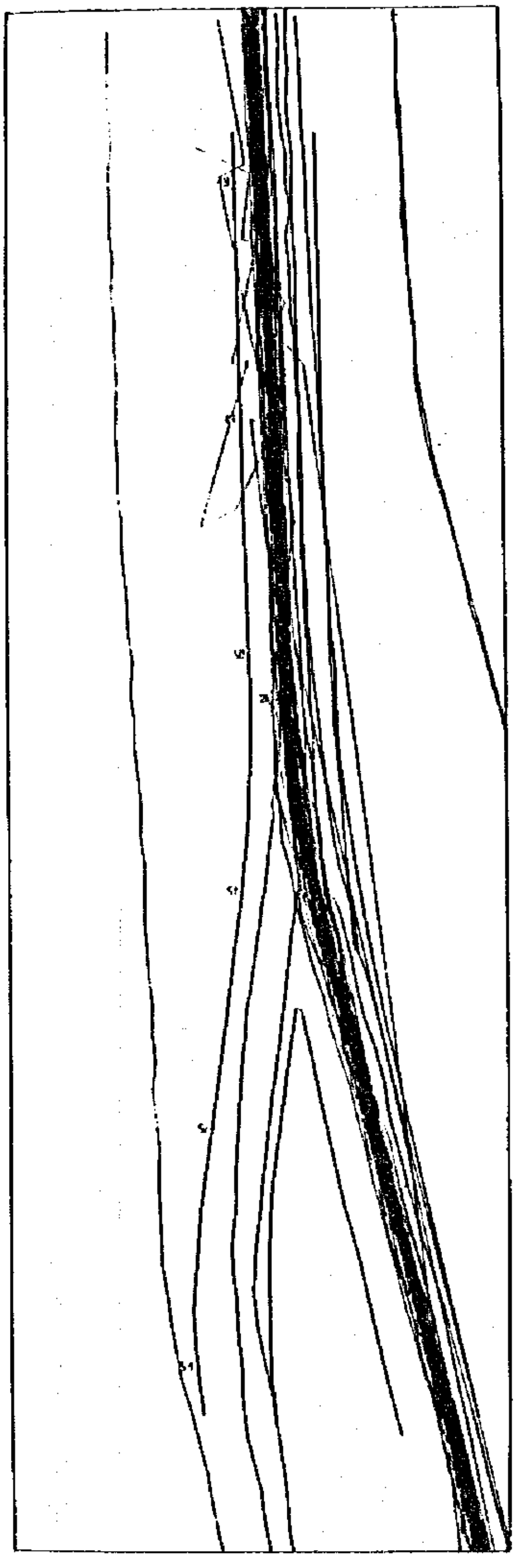


Fig. II-4-(1)-26 Track Chart-3 (El Ballah)
(107 vessels, less than 50,000 tons)

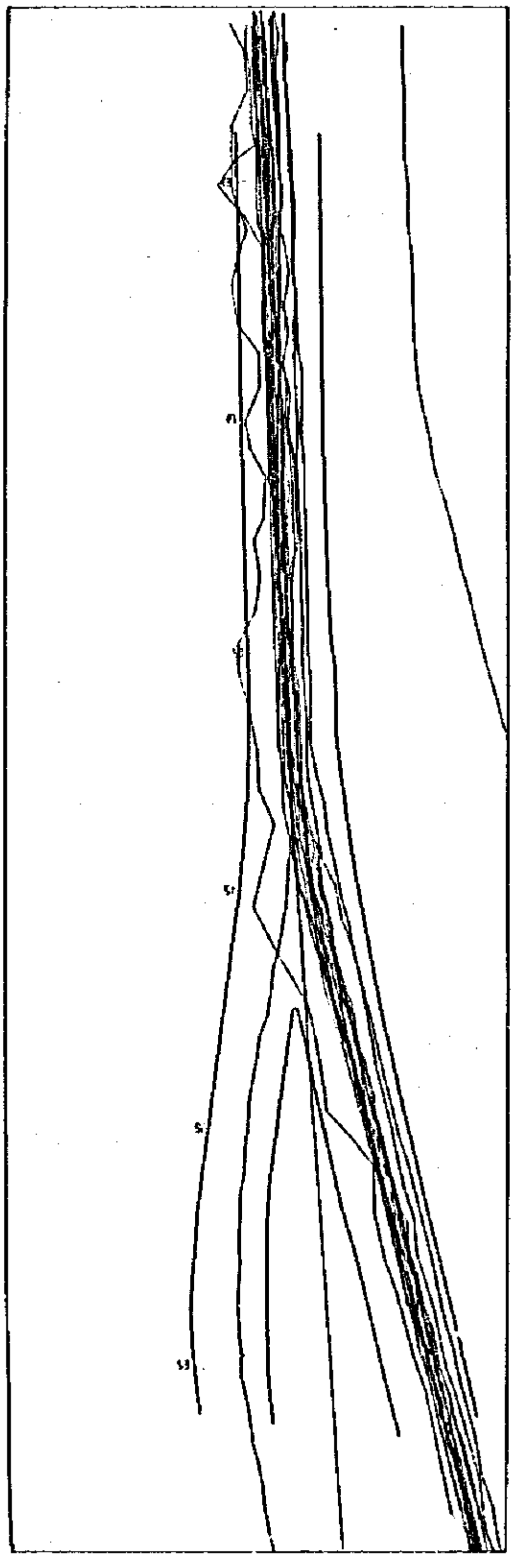


Fig. II-4-(1)-27 Track Chart-4 (El Ballah)
(33 vessels, 50,000 tons or more)

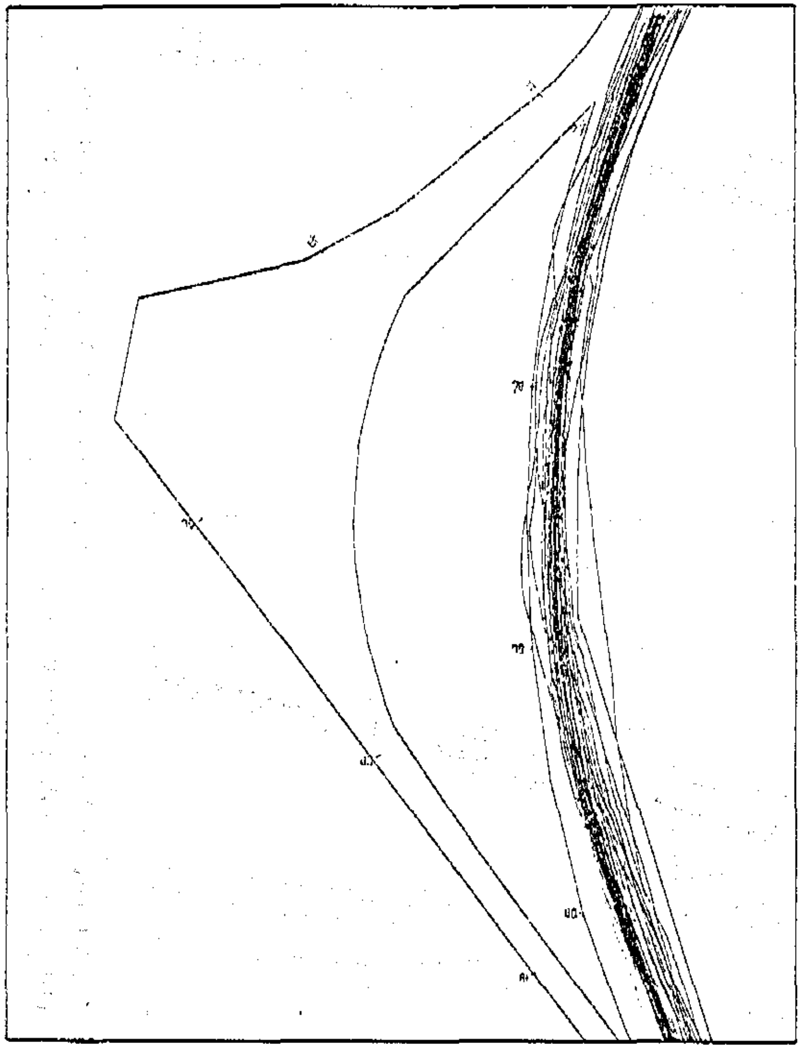


Fig. II-4-(1)-28 Track Chart-5 (Lake Timsah)
(101 vessels, less than 50,000 tons)

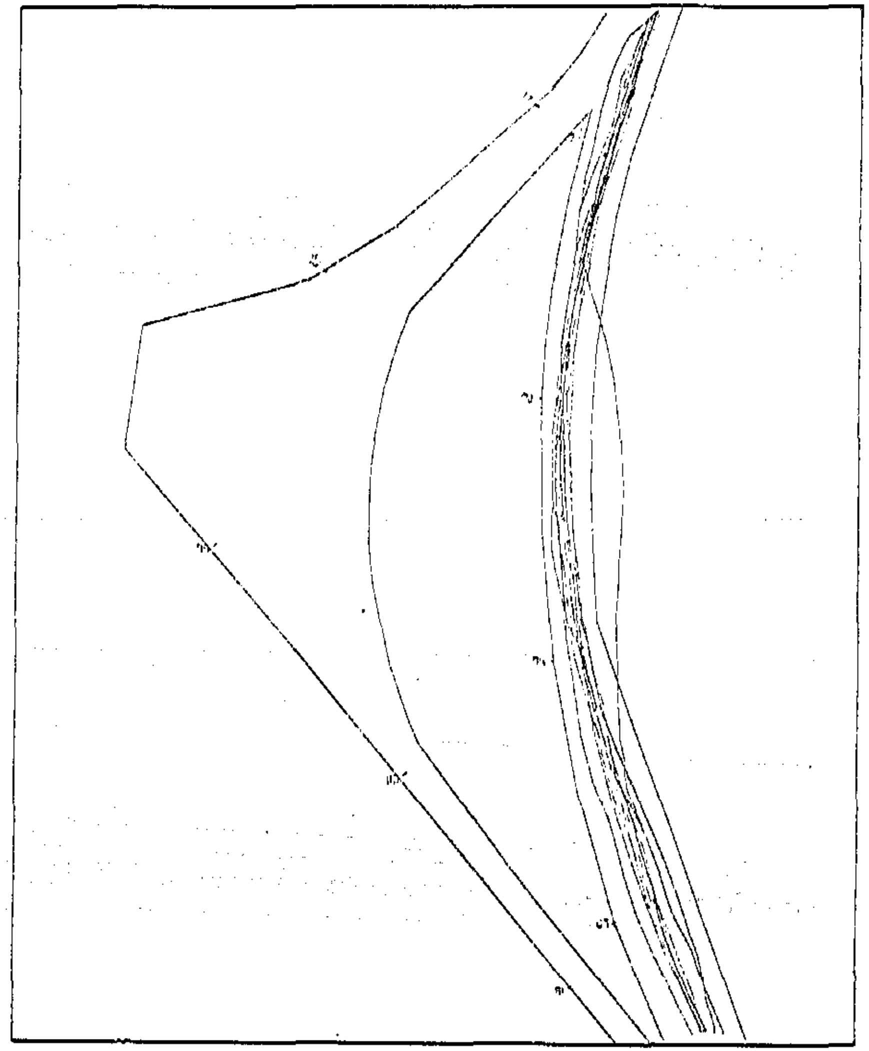


Fig. II-4-(1)-29 Track Chart-6 (Lake Timsah)
(36 vessels, 50,000 tons or more)

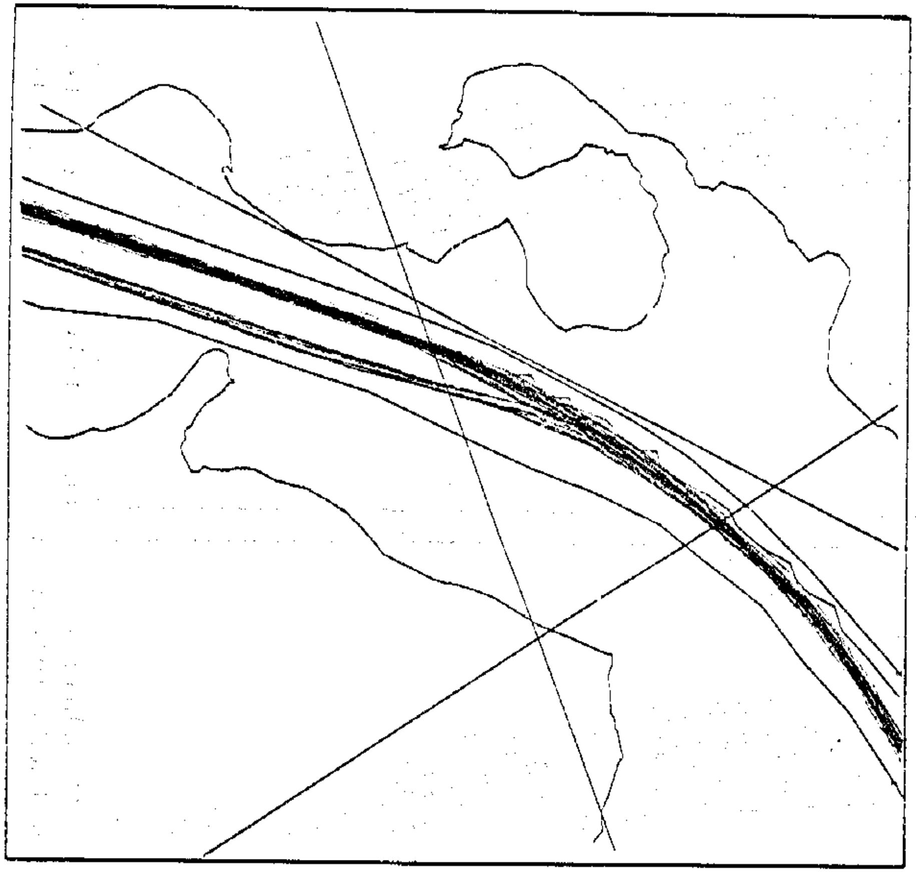


Fig. II-4-(1)-30 Track Chart-7 (El Kabrit)
(76 vessels, less than 50,000 tons)

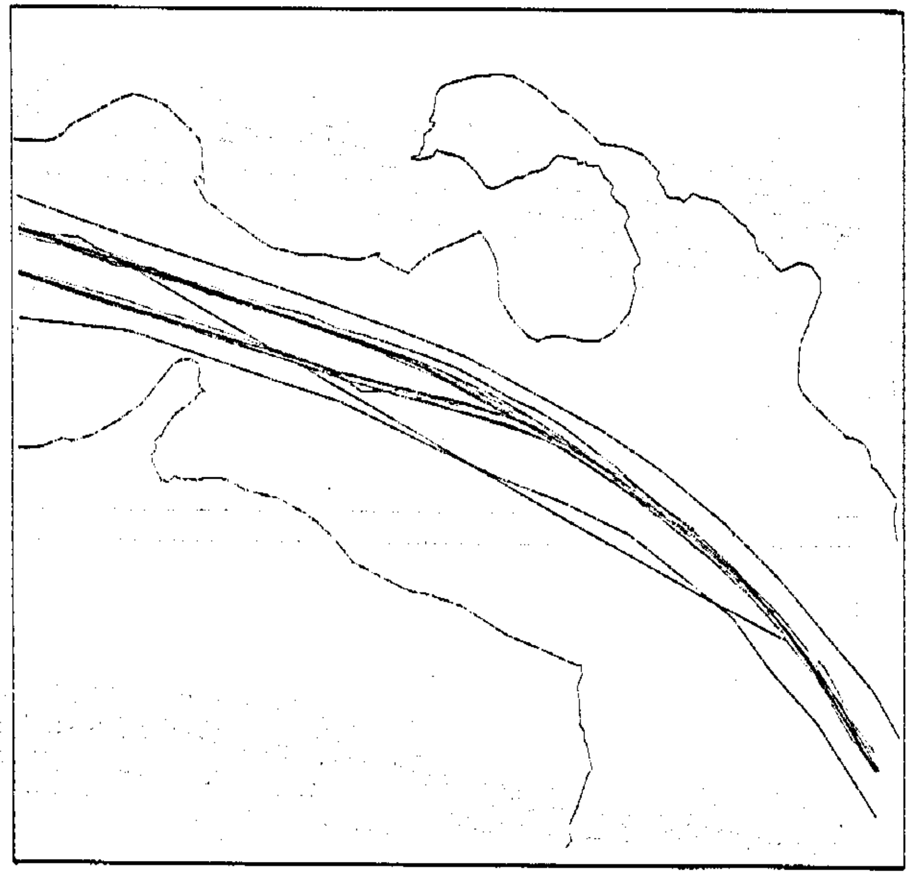


Fig. II-4-(1)-31 Track Chart-8 (El Kabrit)
(15 vessels, 50,000 tons or more)

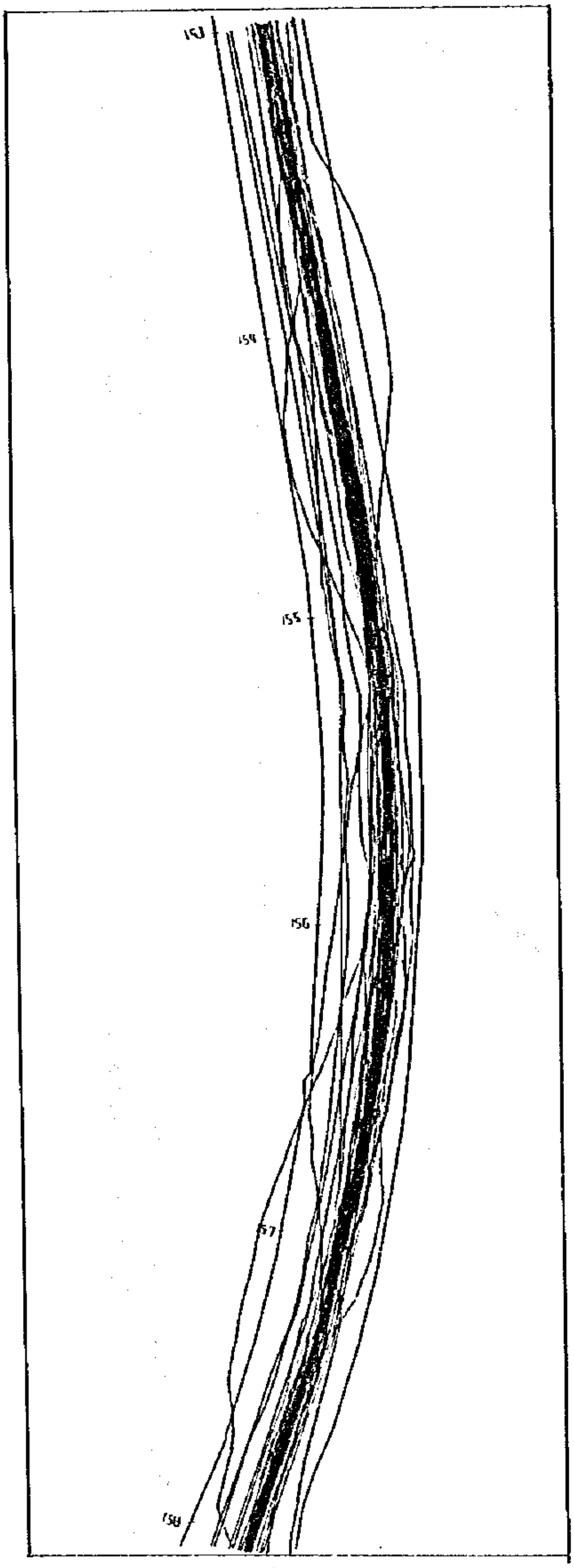


Fig. II-4-(1)-32 Track Chart-9 (at Km 155)
(77 vessels, less than 50,000 tons)

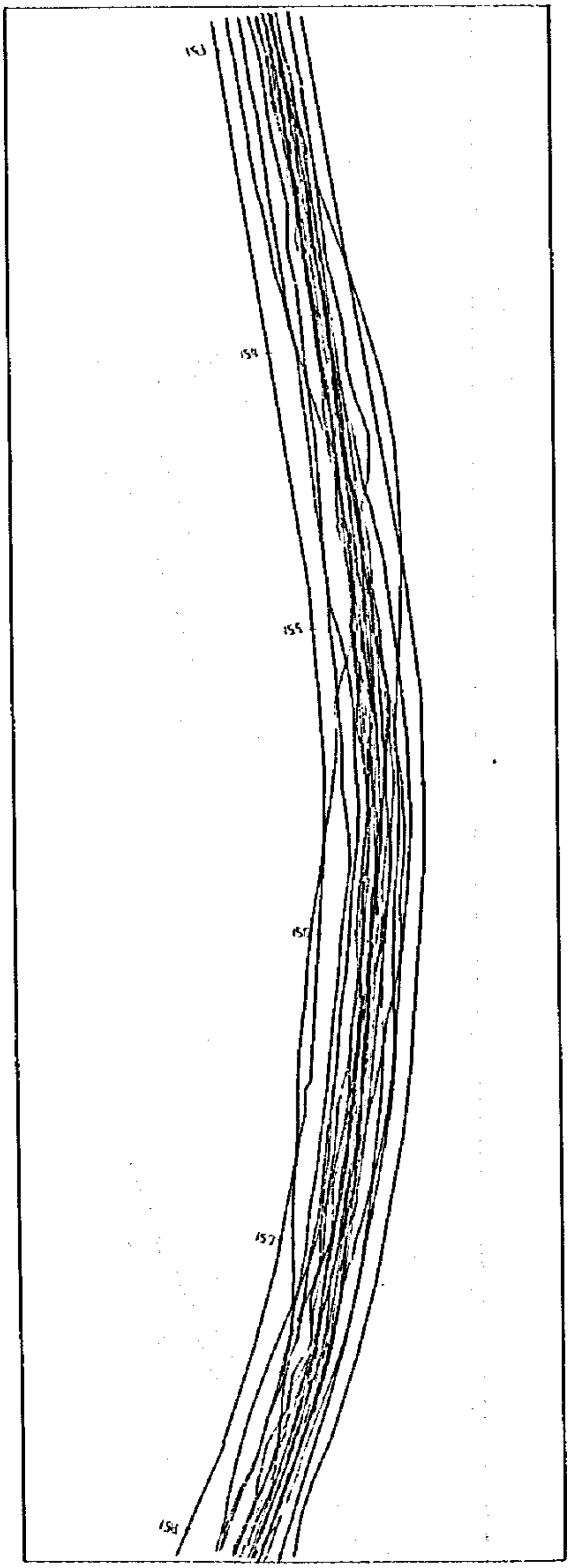


Fig. II-4-(1)-33 Track Chart-10 (at Km 155)
(16 vessels, 50,000 tons or more)

4) Manoeuvrability

(i) Stopping Distance in the Canal

Table II-4-(1)-13 is a summary of the data of the stopping trials which were carried out by the SCA in the Canal by using the following tanker in July, 1978.

Name of Tanker	M.S. Daphne
Length Over All	243.84 m
Breadth	33.58 m
Depth	13.26 m
Gross Tonnage	39,482
Net Tonnage	25,946
Main Engine	Diesel, 18,900 HP at 104 RPM
Dead Weight	71,000
Built	1966
Draft	11.6 m

Table II-4-(1)-14 is the detail of manoeuvring of trial No. 1.

Table II-4-(1)-13 Summary of Stopping Trials in the Canal

Trial No.	1	2	3	4	5	Average
Direction	N	S	N	S	N	
Stopping distance	1,069	575	1,260	975	1,255	1,026.8
Stopping time	9m27s	7m13s	12m45s	11m12s	11m26s	10m24.6s
Current	0.5 m astern	11.0 m ahead	0.6 m astern	11.0 m ahead	0.5 m astern	
Wind	24 kt 15 dgs	nil	14 kt 360 dgs	nil	21 kt 15 dgs	
Initial speed	6.98 kt	5.68 kt	6.78 kt	5.03 kt	7.01 kt	6.296 kt
Tugs						
No.	2	2	2	1	1	
Kind	Duckpeller	do.	do.	do.	do.	
Position	On quarter	do.	do.	Bridle	do.	
Length of wire	35 m	30 m	do.	do.	do.	
Draft	F11.6 m A11.6 m	do.	do.	do.	do.	

Table II-4-(1)-14 Detail of Manoeuvring of Trial No. 1

Time	Helm Angle (degrees)	Heading (degrees)	Main Engine Orders	RPM	Towline Force (tons)		Towline Angle (degrees)	
					p.	s.	p.	s.
14.20.30	–	359.8		54.3				
21.00	–	359.8		54.9			30	30
30	15°p	359.9		53.1				
22.00	20°p	000.2		54.1				
30	8°p	359.4	Stop Engines	52.1				
23.00	20°p	359.6		0				
30	33°p	000.1	DS ahead	1 64.5				
24.00	33°p	000.5	Stop Engines	50.7				
30	0	350.1	Slow Astern	–28.8				
25.00	0	357.9		–61.8				
30	0	357.4		–57.9	1	–	0	30
26.00	0	358.3	Stop	–52.8	21.5	–	10	30
30	30°p	001.0		+33.6	7.5	19	20	45
27.00	33°p	002.9	Slow ahd	+59.1	15	18	45	45
30	33°p	002.0	Stop	+43.7	12	15	15	45
28.00	0	359.5	DS ast	–51.0	9	27.5	20	20
30	0	357.5		–59.3	17	8	10	20
29.00	0	357.0		–57.4	19	9.5	0	45
30	0	357.7		–56.5	8.5	6.5	–10	30
30.00	0	359.4	Stop	–53.2	9.5	10.5	10	30
30	0	002.1		+65.7	13.5	9.5	–5	15
31.00	33°p	003.4		+60.1	15	7	0	20
30	33°p	002.8		+ 2.1	14	8	–5	20
32.00	33°p	000.9	Slow ast	+ 1.0	15	14	–10	45
30	33°p	357.5		–58.1	20	25	–10	40
33.00	0	355.0	DS ast	–76.2	9.5	17	5	5
30	0	353.8		–76.4	18	17	10	10
34.00	0	353.5	Stop	–49.7	18.5	21.5	20	–5
30	0	354.0		–49.3	20	20.5	20	–5
35.00	0	355.4		– 1.0	20	21	–5	15
30	0	357.0		+ 1.0	14	10	0	15
36.00	30°p	358.2		+54.5	1.5	2	30	30
30	30°p	359.5		+57.7	1	6	30	30
37.00	0	359.5			–	–	30	30
30	12°s	359.0			–	–	35	0
38.00		358.8			–	–	35	–5

(ii) Results of Analysis on Data of the "Kamakura Maru"

When boarded on the "Kamakura Maru" on her northbound passage, one CORT was placed on each the fore and after part, and the track data were recorded on magnetic tape. The results of analysis of the magnetic-tape-recorded data are shown in Figs. II-4-(1)-34 through II-4-(1)-38 where the manoeuvring charts are drawn on the map prepared in 1982 by SCA.

The principal dimensions of the Kamakura Maru are as follows:

Kind of Vessel	Container Ship
Length Over All	261.00 m
Breadth	32.20 m
Depth	24.00 m
Gross Tonnage	51,069
Net Tonnage	30,870
Main Engine	Diesel 27,600 ps x 2
Dead Weight	34,437
Built	1971
Draft	Fore 10.93 m
	Aft 11.56 m

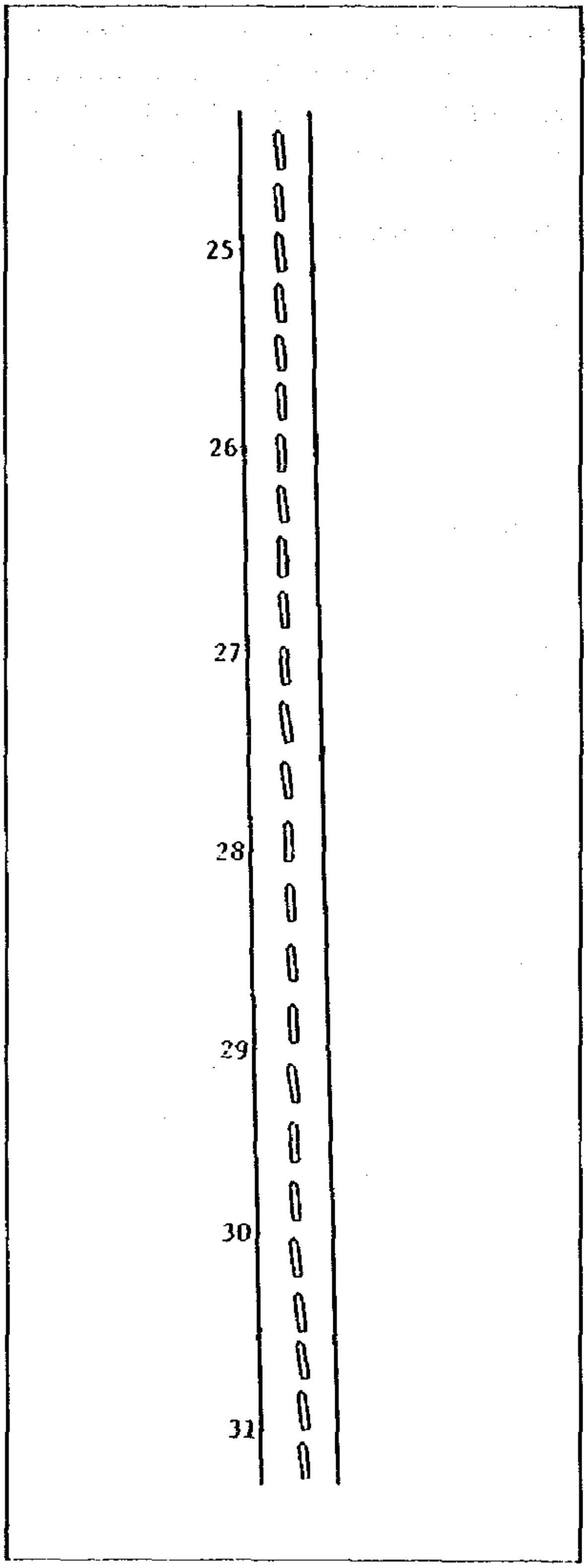


Fig. II-4-(1)-34 *Manoeuvring Chart of* **Kamakura Maru at Km 30**

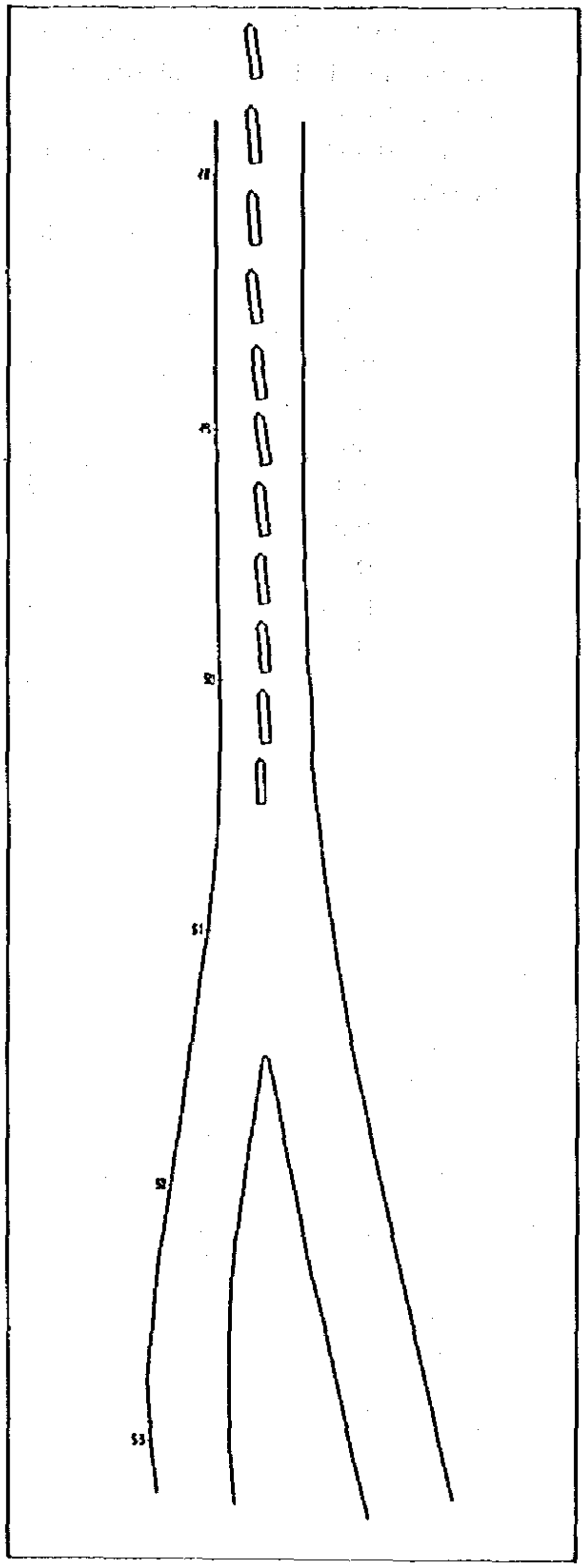


Fig. II-4-(1)-35 *Manoeuvring Chart of* **Kamakura Maru at El Ballah**

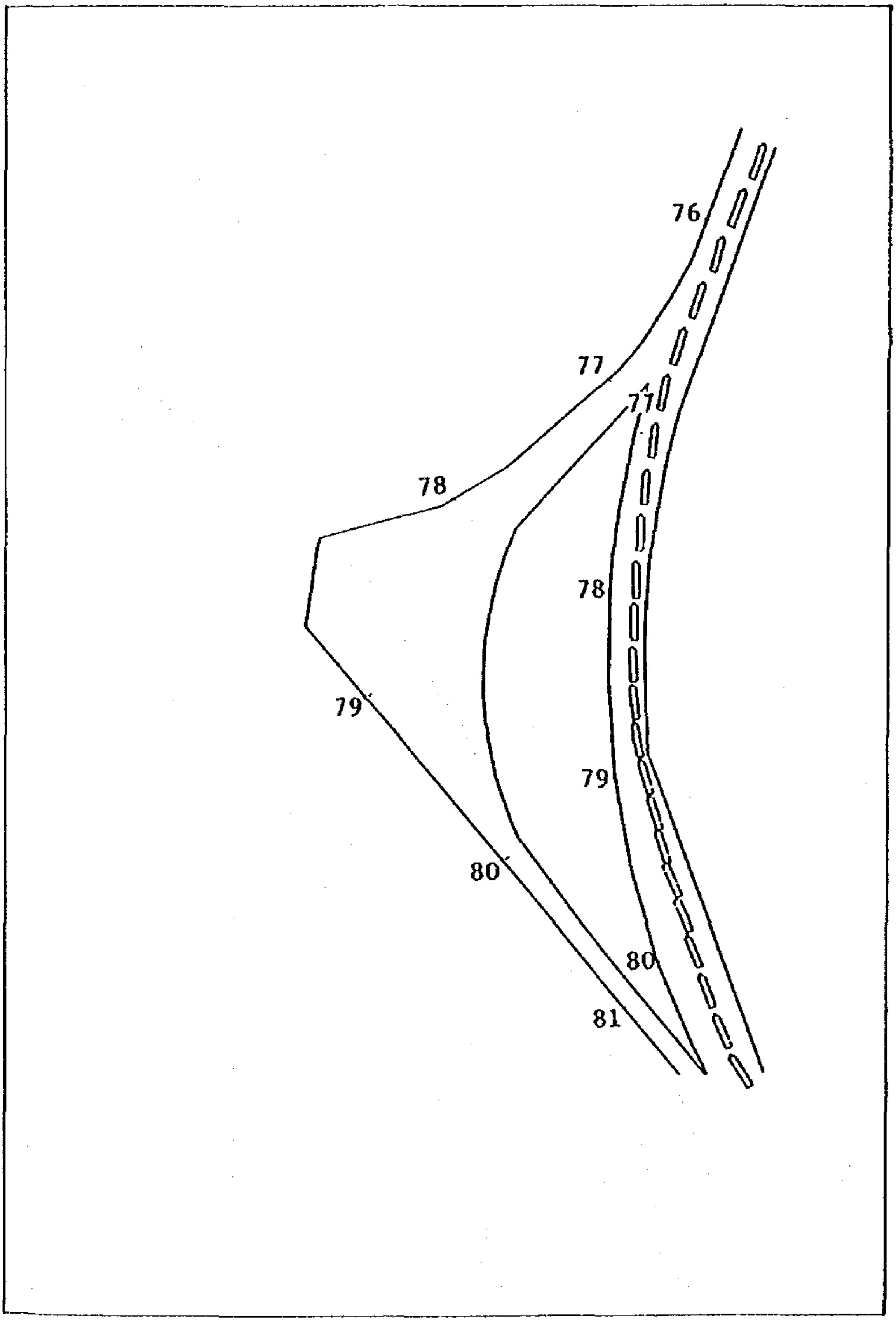


Fig. II-4-(1)-36 Manoeuvring Chart of Kamakura Maru at Lake Timsah

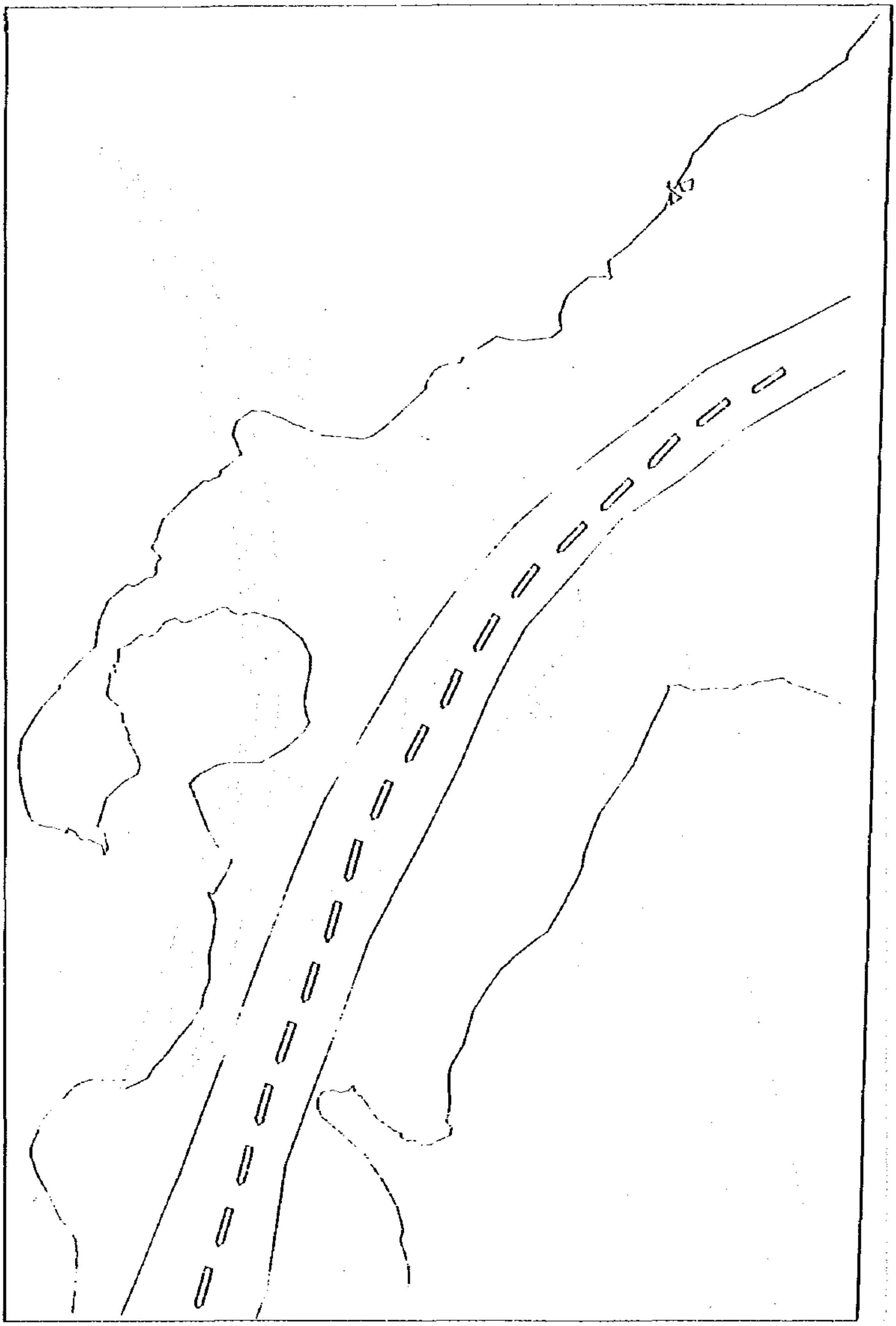


Fig. II-4-(1)-37 Manoeuvring Chart of Kamakura Maru at El Kabrit

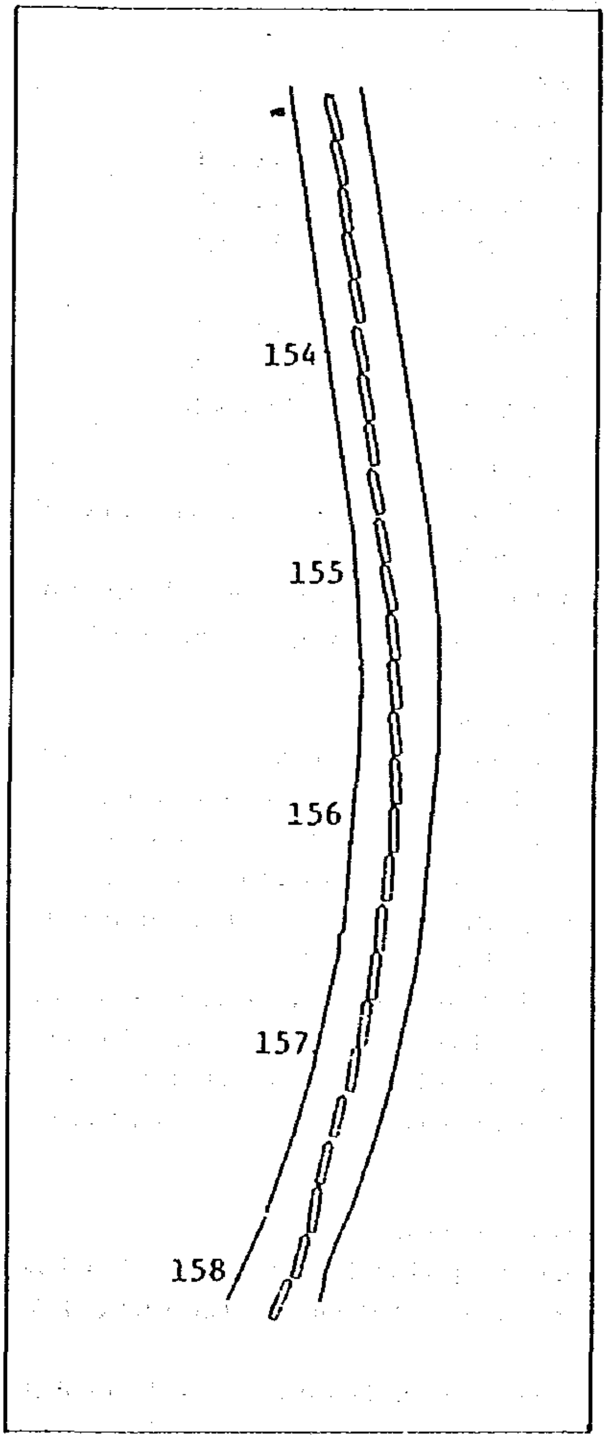


Fig. II-4-(1)-38 Manoeuvring Chart of Kamakura Maru at Km 155

(2) Anchoring and Berthing Conditions

1) Anchoring Conditions

(i) Capacity of Each Anchorage

Port Said Waiting Area:	
VLCC Anchorage	8 vessels
General Anchorage	15 vessels
Great Bitter Lake Anchorage	60 vessels
Lake Timsah Anchorage	5 vessels
Suez Waiting Area:	
VLCC Anchorage	9 vessels
General Anchorage	29 vessels
Inner Harbour Anchorage	39 vessels

(ii) Bottom Conditions of Each Anchorage

The bottom conditions of each anchorage are reportedly either mud or silt and normal levels of holding power of anchor are available.

It must be noted, however, that the bottom of the Great Bitter Lake includes areas of rock salt thus offering extremely bad holding characteristics.

2) Analysis of Anchoring Conditions

(i) Analysis on Magnetic Tape-recorded Data

In order to survey the actual status of anchorings in the waiting areas of Port Said and Suez, and each anchorage of the Great Bitter Lake and Lake Timsah, attempts were made to collect magnetic tape-recorded radar data at each anchorage for study, processing and analysis, but it was found that recording of radar data on all transiting vessels is materially impossible at present.

Because of this inability of analysis on the basis of tape-recorded radar data, another attempt was made for analyzing the manually entered records on times of casting off anchors, heaving in anchors, anchor positions, and others on each vessel. To our regret, this alternative was also found unsuccessful due to incompleteness in the entries of anchoring positions.

(ii) Analysis of Image Photos of Radar

The failures in our attempts have led us to think of the following procedures.

The actual radar images of Port Said, the Great Bitter Lake radar stations are video-tape-recorded.

During the same time period, the names of vessel arrived at each anchorage, times of heaving in anchors and others are to be manually recorded.

From these records, movement of vessels at each anchorage and its peripheral areas, status of use of the anchorage and others are subjected to analysis and evaluation.

The video camera work was arranged on Mar. 15, Oct. 15 and from 24 to 28 Oct., 1984, for the Great Bitter Lake, and on Mar. 17, and from 17 to 23 Oct. for Port Said.

Figs. II-4-(2)-1 through II-4-(2)-24 are the results of these analytical studies.

i) Maps Showing Vessels at Anchor

Figs. II-4-(2)-1 through II-4-(2)-4 show those vessels at anchor in the Great Bitter Lake at 1200 hours and 1500 hours on March 15, and 1300 hours and 1500 hours on Oct. 24, 1984 respectively.

Figs. II-4-(2)-5 through II-4-(2)-8 show those vessels at anchor in the Port Said Waiting Anchorage at 2200 hours on March 17, 1984 and 0600 hours on the subsequent day, and 2200 hours on 19 Oct., and 0600 hours on the subsequent day respectively.

ii) Maps Showing Density of Vessels at Anchor

Figs. II-4-(2)-9, 11 show all vessels at anchor in the Great Bitter Lake during the period from 0000 to 2400 hours on March 15 and Oct. 24, 1984, whereas Figs. II-4-(2)-10, 12 show the number of vessels in a mesh when all the area of anchorage of the Great Bitter Lake is meshed into a one kilometer width.

Figs. II-4-(2)-13, 15 show, likewise, those vessels at anchor within the Port Said Waiting Anchorage during the period from 2200 hours on March 17 to 1400 hours on the subsequent day and from 1400 hours on Oct. 19, 1984 to 1400 hours on the subsequent day, whereas Figs. II-4-(2)-14, 16 show the number of vessels in a mesh when all the area of the Port Said Waiting Anchorage is meshed into a one kilometer width.

iii) Track Charts

Figs. II-4-(2)-17, 19 show the tracks of all vessels arrived and anchored within the anchorage of the Great Bitter Lake during the period from 0000 to 2400 hours on March 15 and Oct. 24, 1984, and Figs. II-4-(2)-18, 20 show the tracks of these vessels after heaving up anchors.

Figs. II-4-(2)-21, 23 show, likewise, the tracks of all vessels arrived and anchored within the Port Said Waiting Anchorage during the same period as the maps showing density of vessels at anchor, and Figs. II-4-(2)-22, 24 show the tracks of these vessels after heaving up anchors.

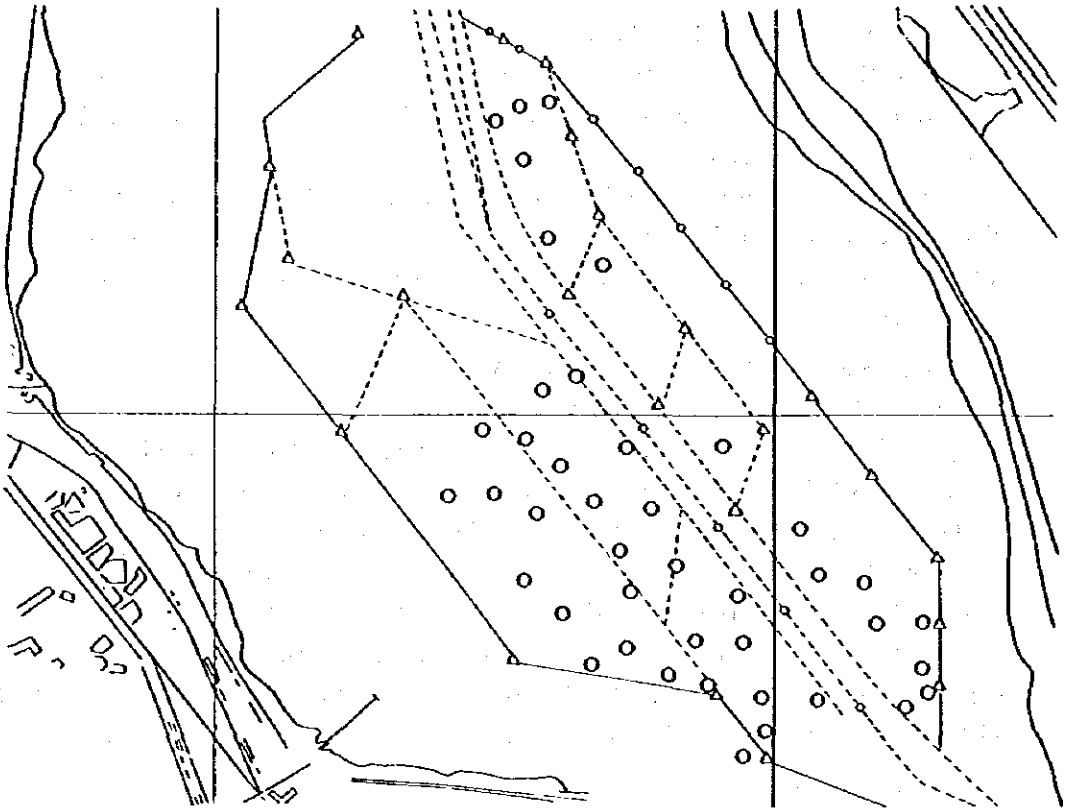


Fig. II-4-(2)-1 Anchoring Condition of Great Bitter Lake Anchorage at 1200, 15th March, 1984

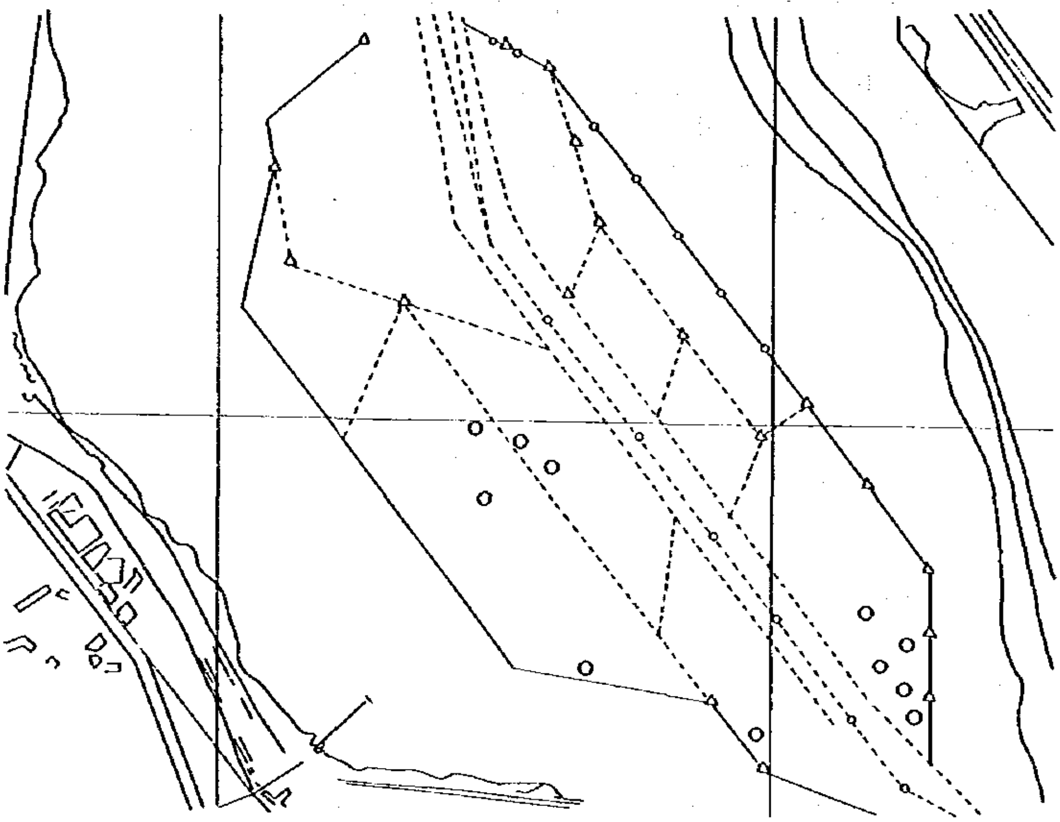


Fig. II-4-(2)-2 Anchoring Condition of Great Bitter Lake Anchorage at 1500, 15th March, 1984

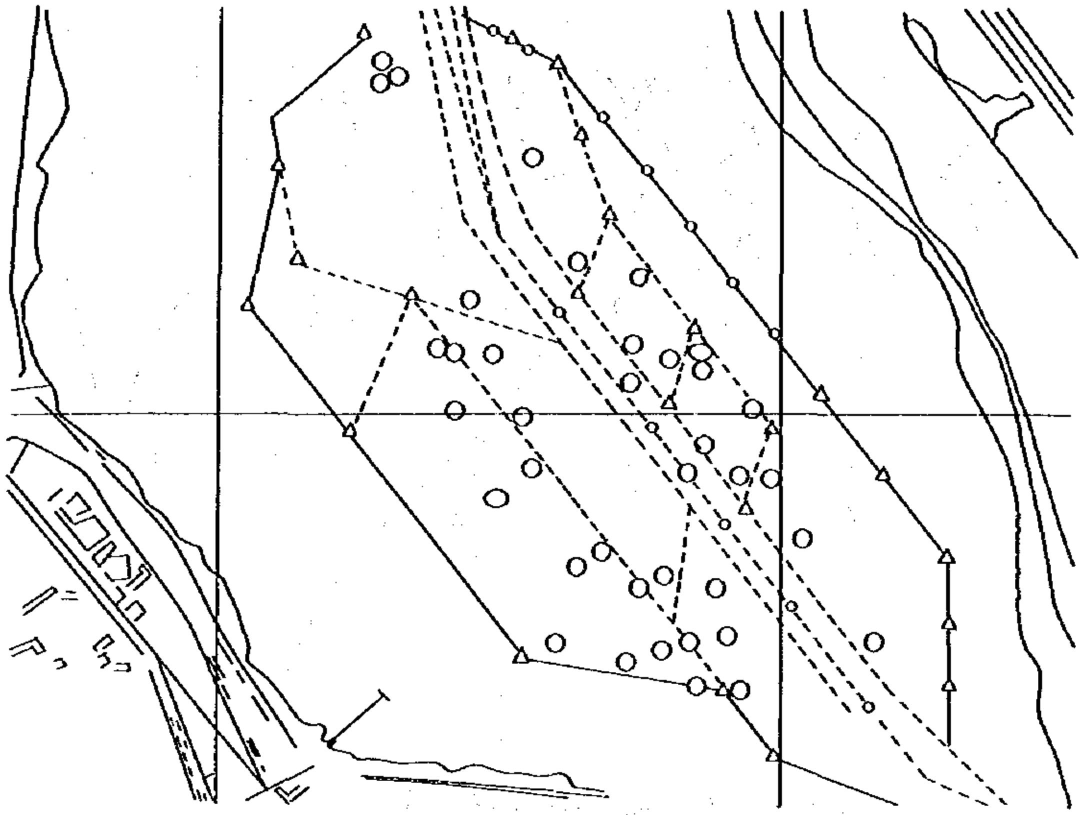


Fig. II-4-(2)-3 Anchoring Condition of Great Bitter Lake Anchorage at 1300, 24th Oct., 1984

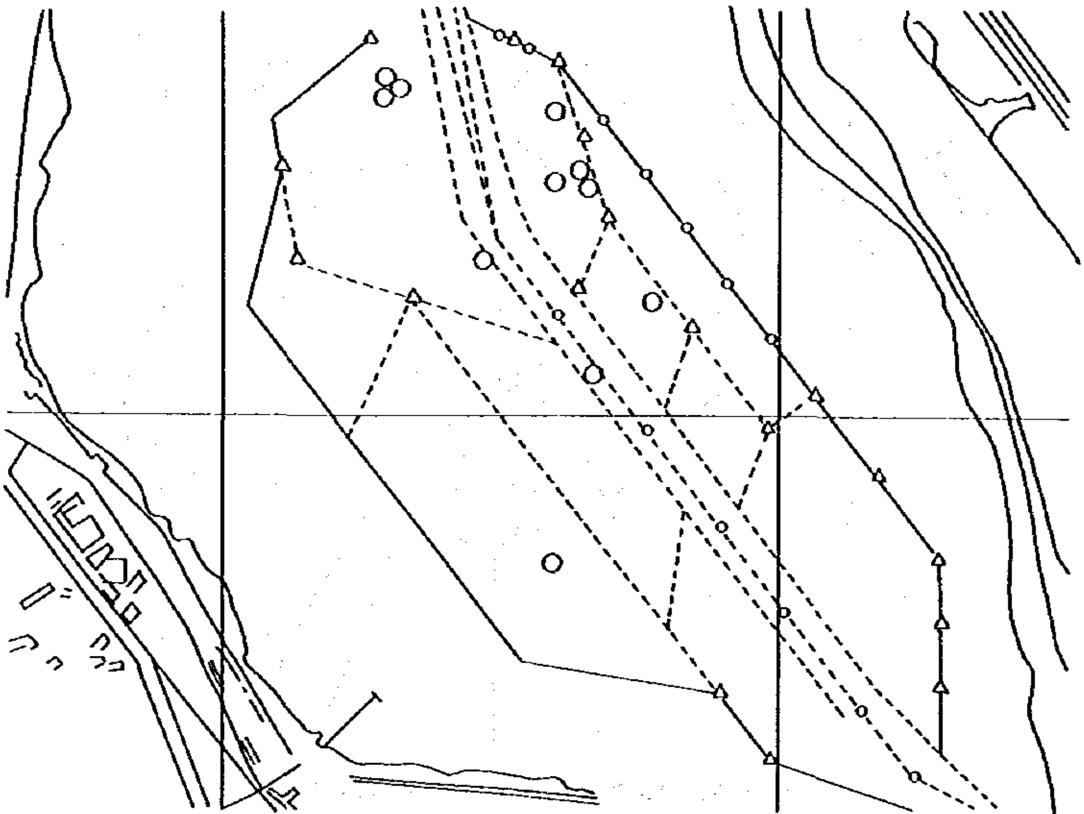


Fig. II-4-(2)-4 Anchoring Condition of Great Bitter Lake Anchorage at 1500, 24th Oct., 1984

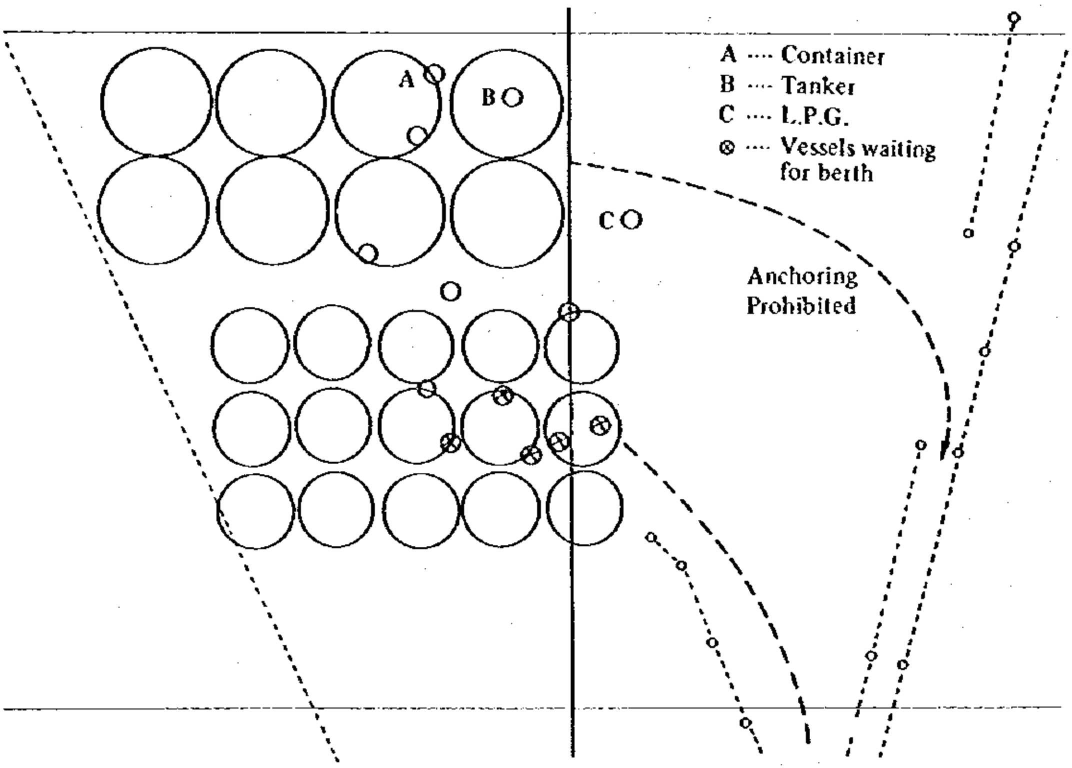


Fig. II-4-(2)-5 Anchoring Condition of Port Said Waiting Area at 2200, 17th March, 1984

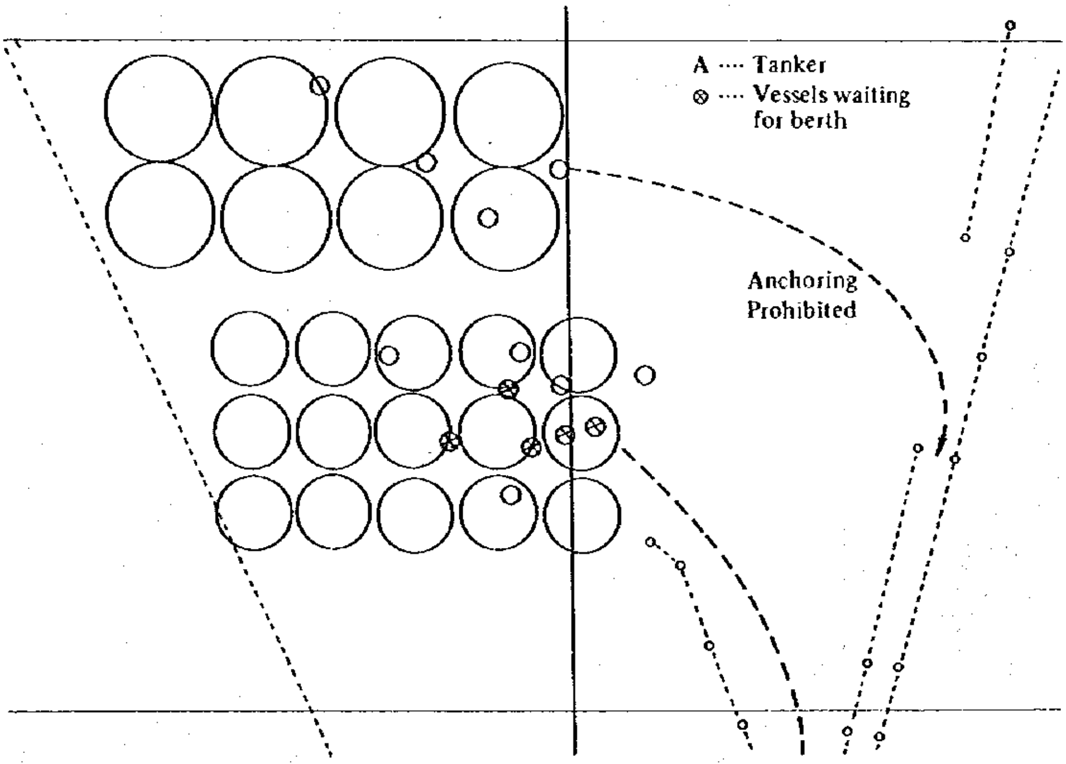


Fig. II-4-(2)-6 Anchoring Condition of Port Said Waiting Area at 0600, 18th March, 1984

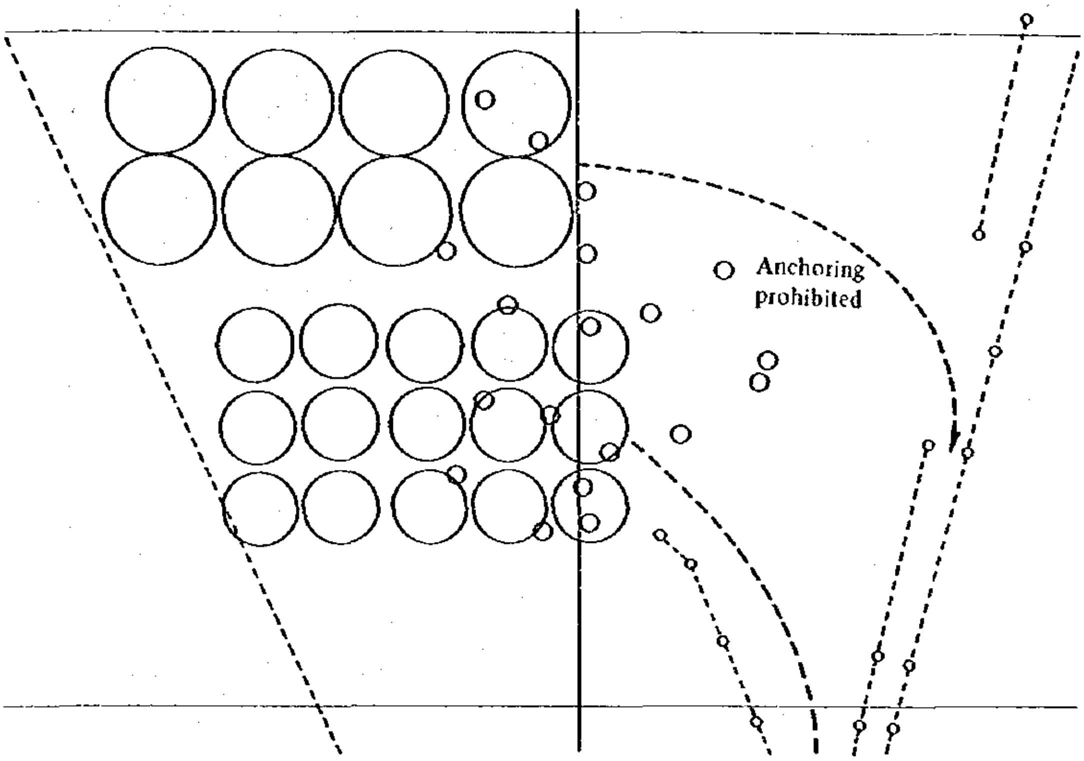


Fig. II-4-(2)-7 Anchoring Condition of Port Said Waiting Area at 2200, 19th Oct., 1984

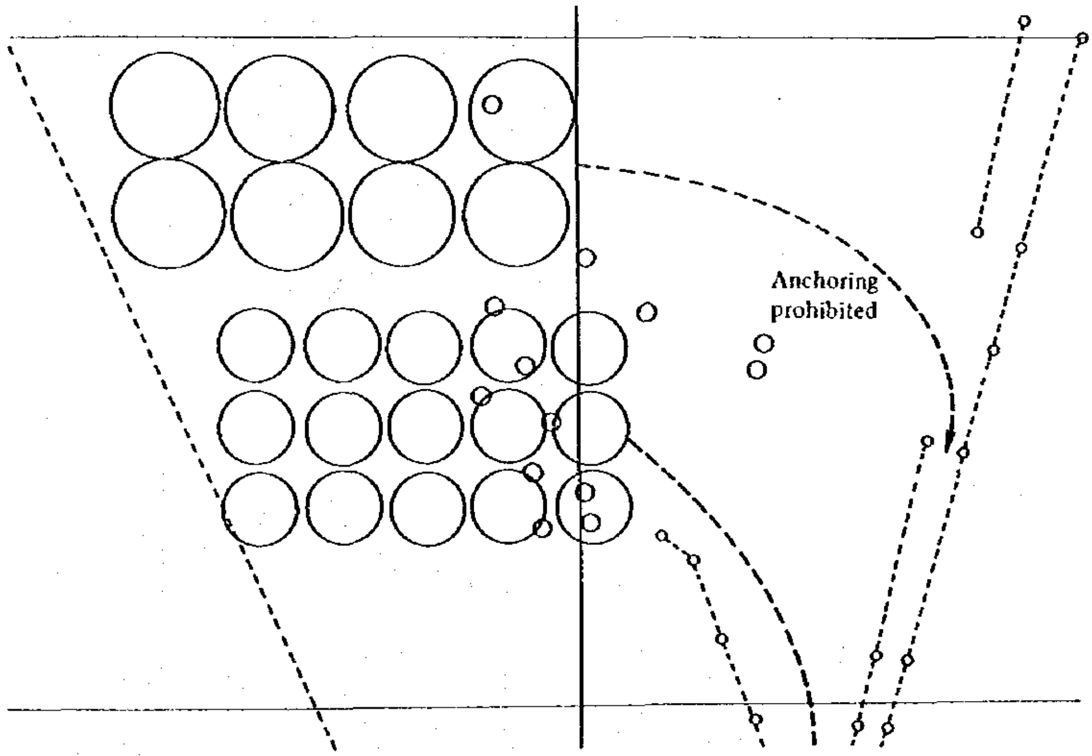


Fig. II-4-(2)-8 Anchoring Condition of Port Said Waiting Area at 0600, 20th Oct., 1984

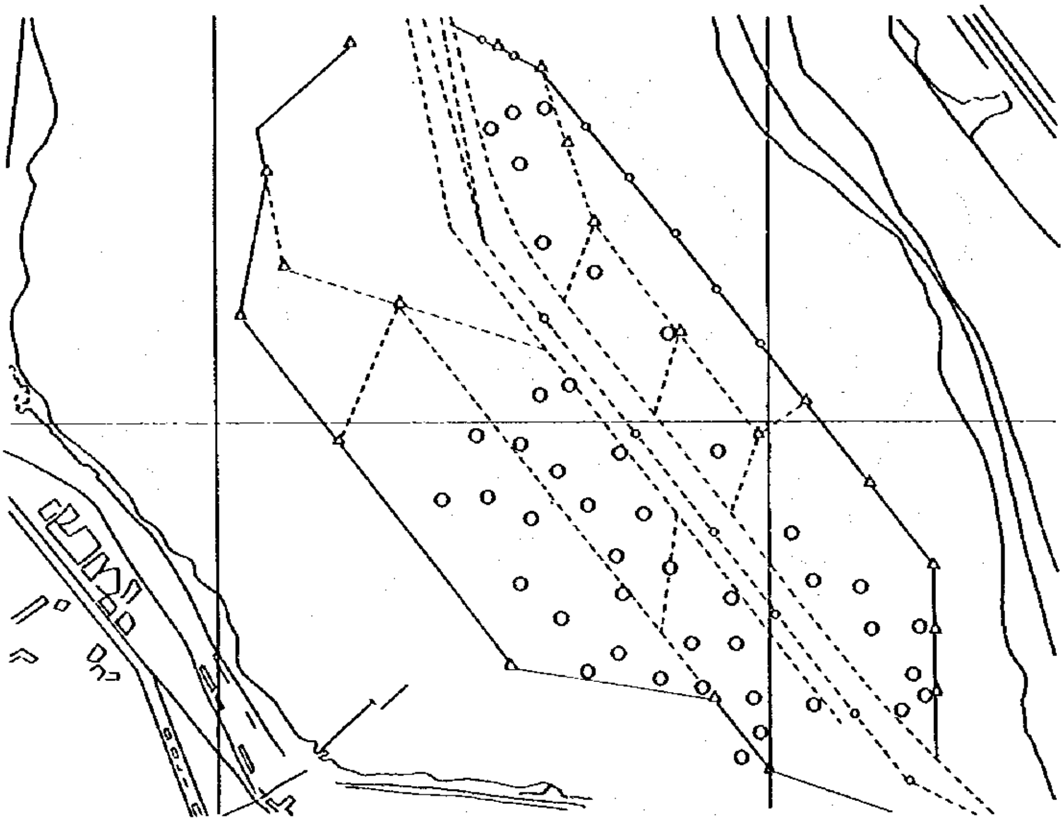


Fig. II-4-(2)-9 Anchoring Condition of Great Bitter Lake Anchorage for All Anchored Vessels from 0000 to 2400, 15th March, 1984

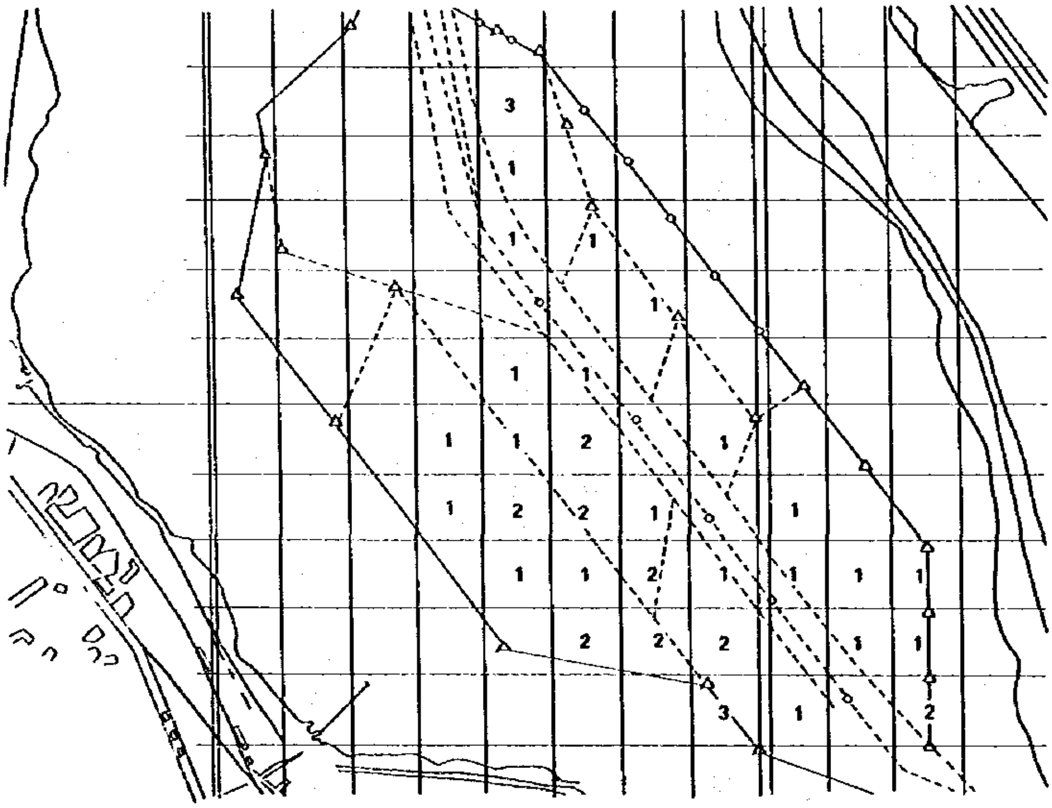


Fig. II-4-(2)-10 Density of Vessels at Great Bitter Lake Anchorage on 15th March, 1984

Fig. II-4-(2)-11 Anchoring Condition of Great Bitter Lake Anchorage for All Anchored Vessels from 0000 to 2400, 24th Oct., 1984

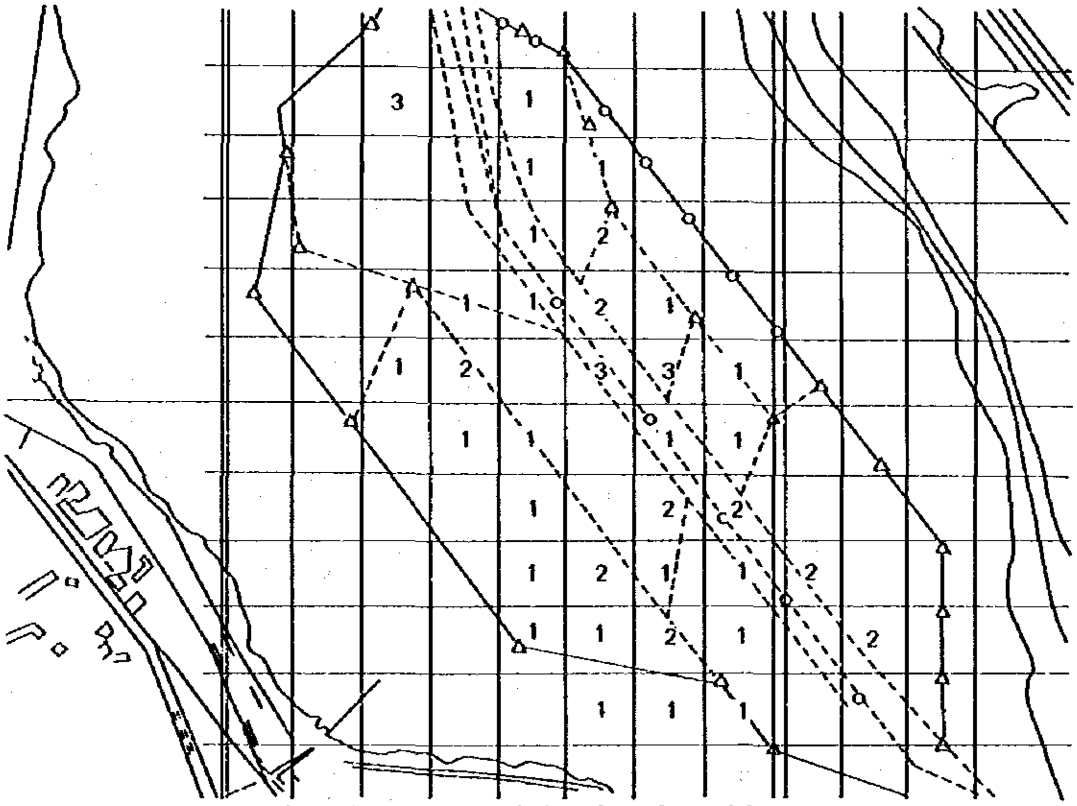


Fig. II-4-(2)-12 Density of Vessels at Great Bitter Lake Anchorage on 24th Oct., 1984

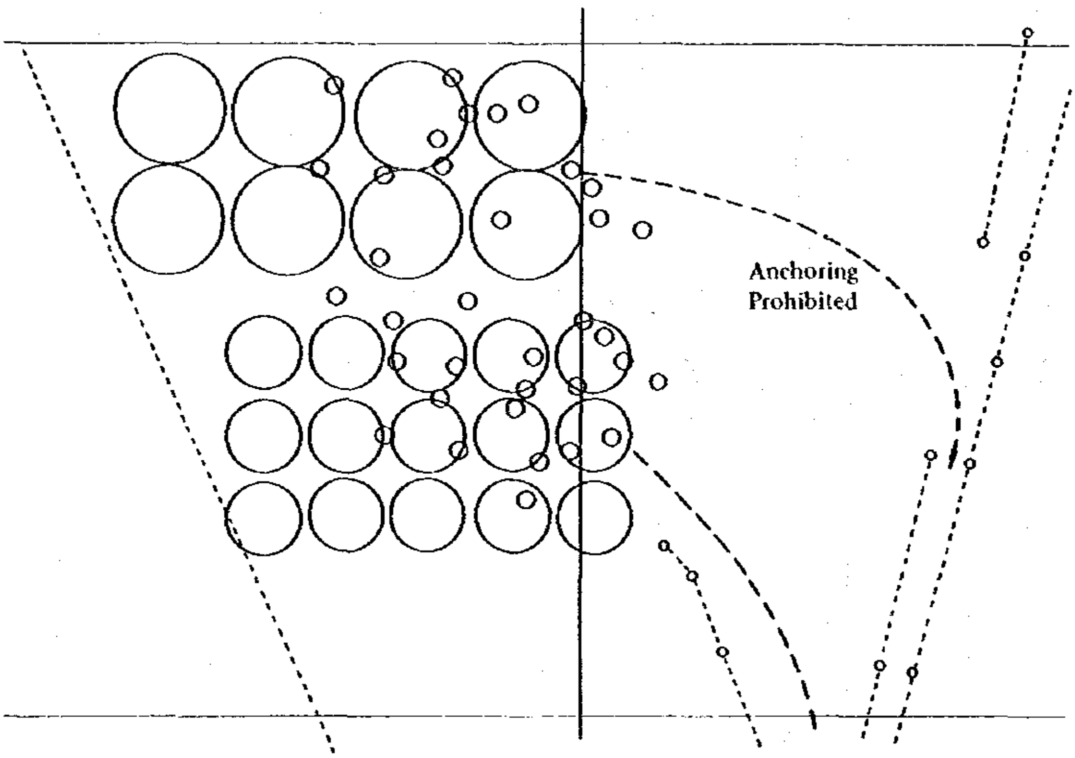


Fig. II-4-(2)-13 Anchoring Condition of Port Said Waiting Area for All Anchored Vessels from 2200, 17th to 1400, 18th March, 1984

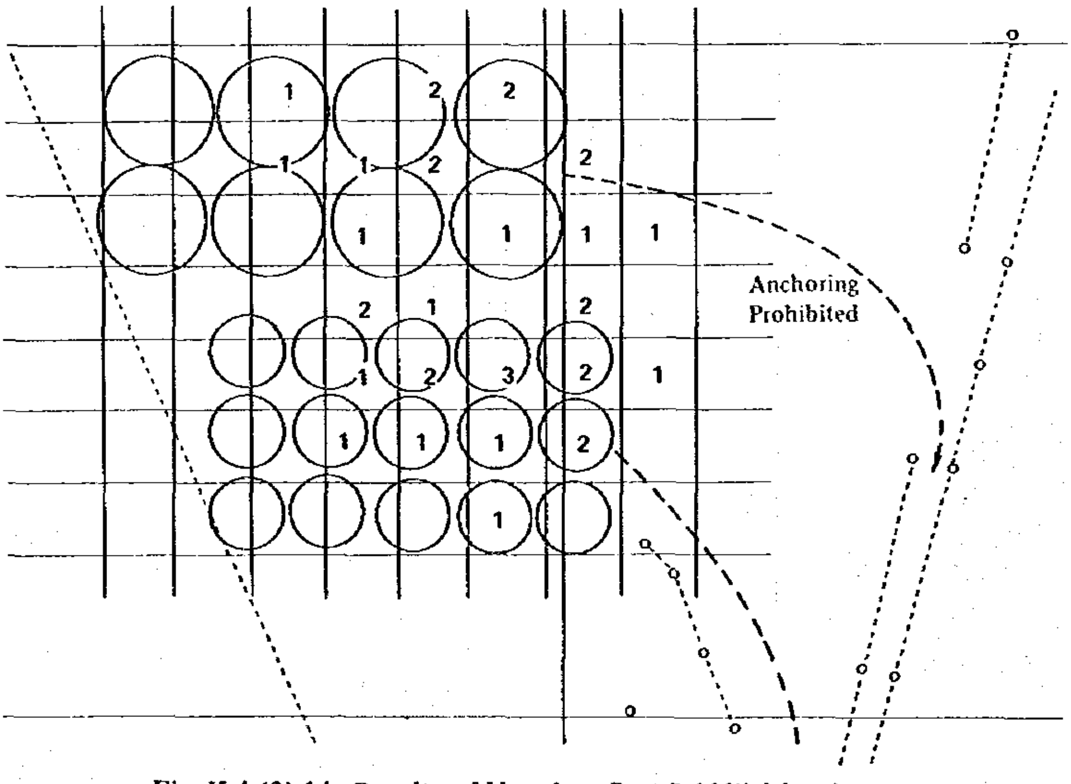


Fig. II-4-(2)-14 Density of Vessels at Port Said Waiting Area from 2200, 17th to 1400, 18th March, 1984

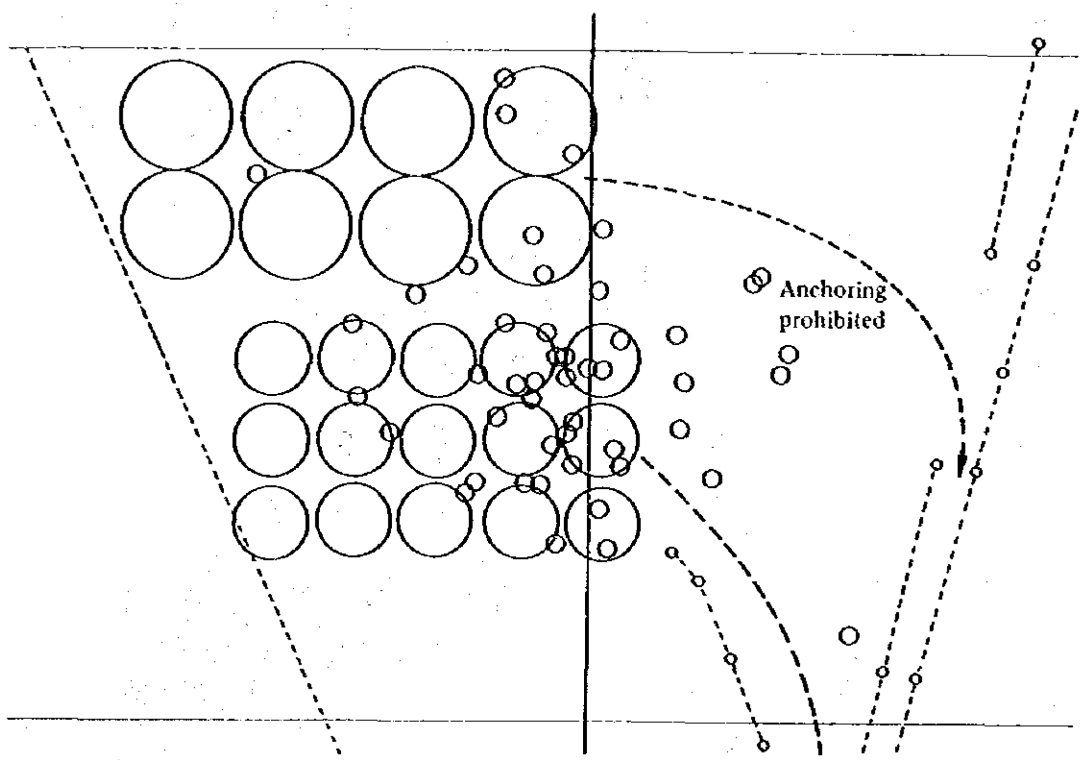


Fig. II-4-(2)-15 Anchoring Condition of Port Said Waiting Area for All Anchored Vessels from 1400, 19th to 1400, 20th Oct., 1984

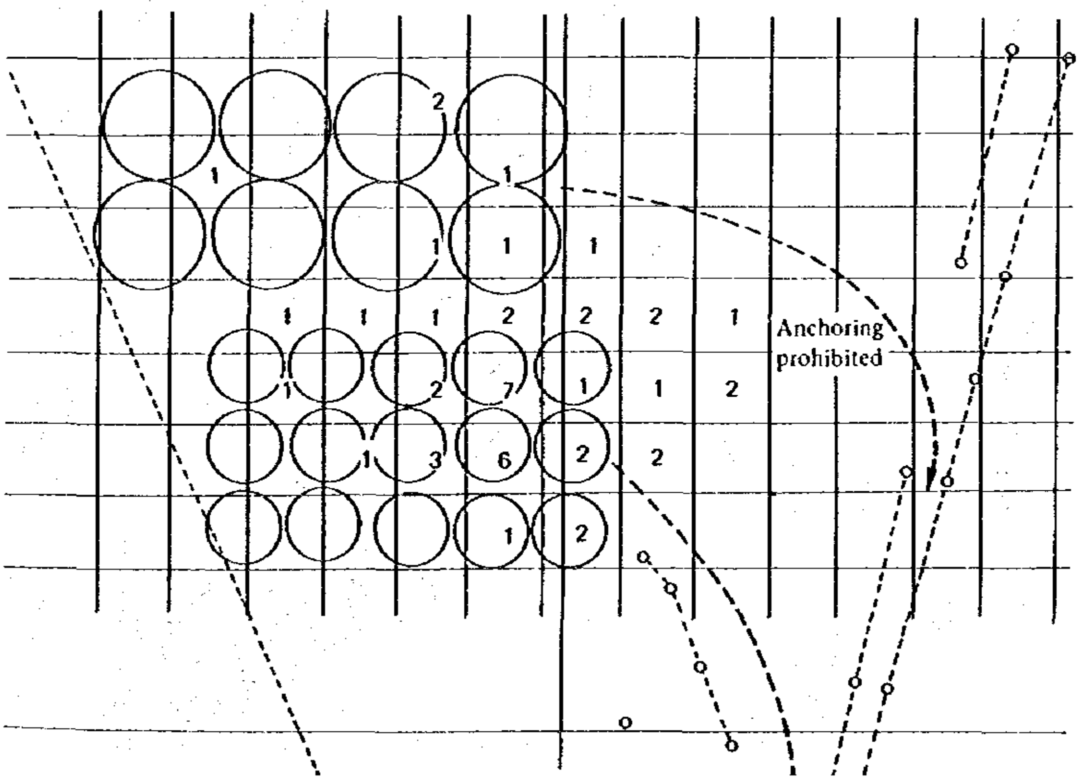


Fig. II-4-(2)-16 Density of Vessels at Port Said Waiting Area from 1400, 19th to 1400, 20th Oct., 1984

Fig. II-4-(2)-17 Track Chart at Great Bitter Lake Anchorage on 15th March, 1984

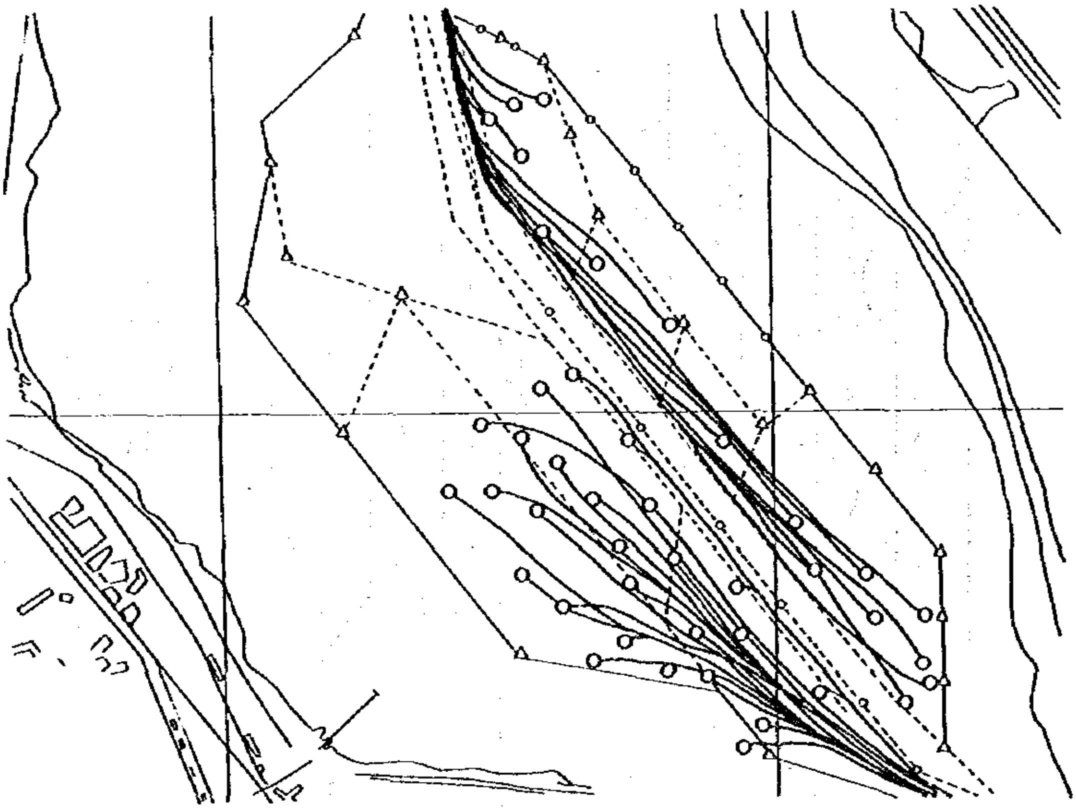


Fig. II-4-(2)-18 Track Chart at Great Bitter Lake Anchorage on 15th March, 1984

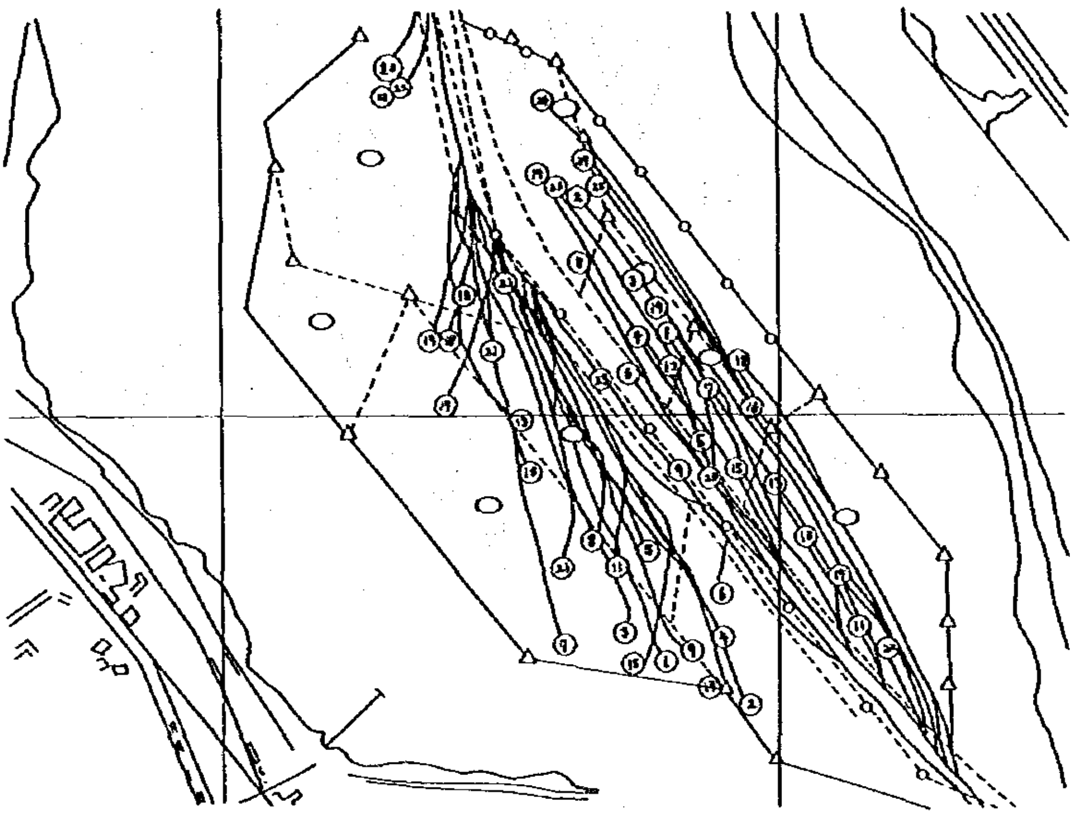


Fig. II-4-(2)-19 Track Chart at Great Bitter Lake on 24th Oct., 1984

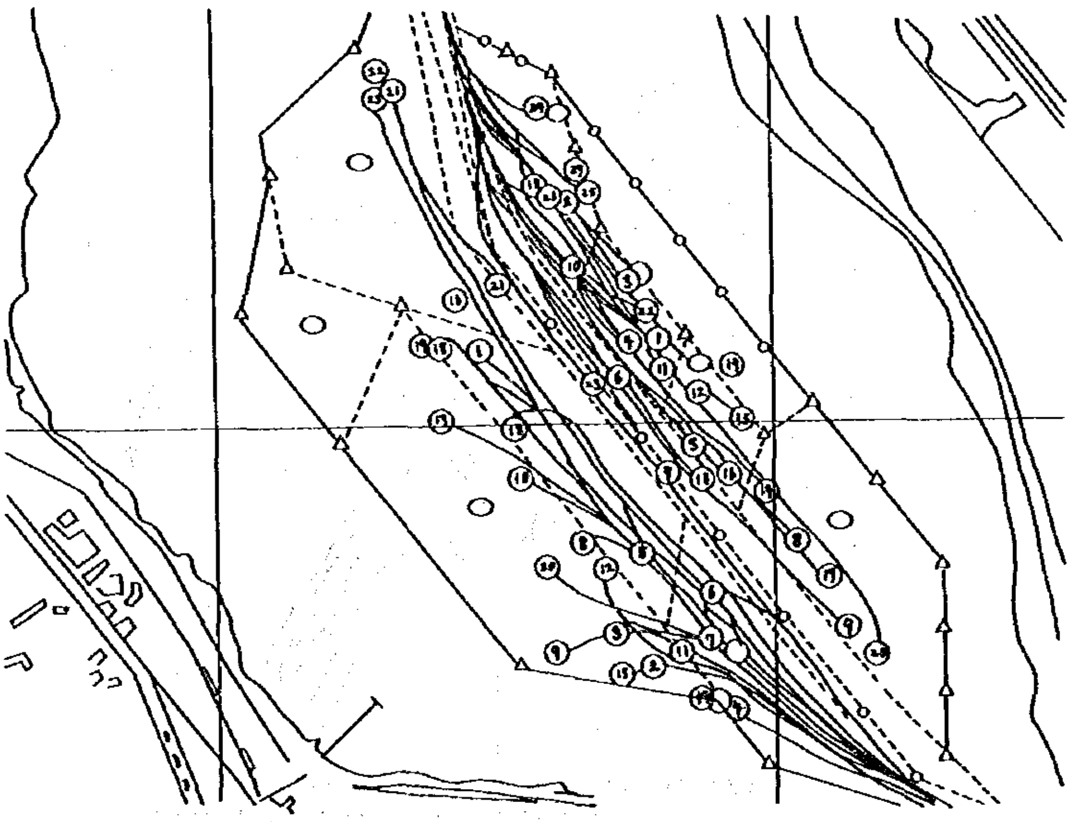


Fig. II-4-(2)-20 Track Chart at Great Bitter Lake on 24th Oct., 1984

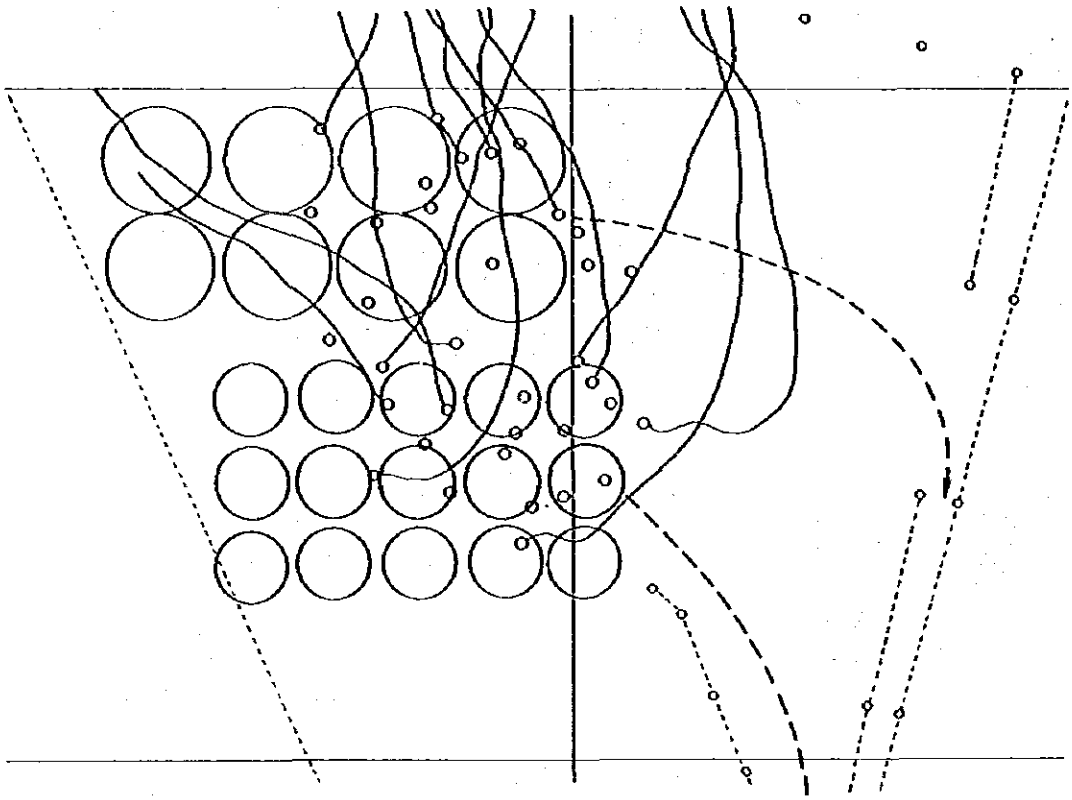


Fig. II-4-(2)-21 Track Chart at Port Said Waiting Area
from 2200, 17th to 1400, 18th March, 1984

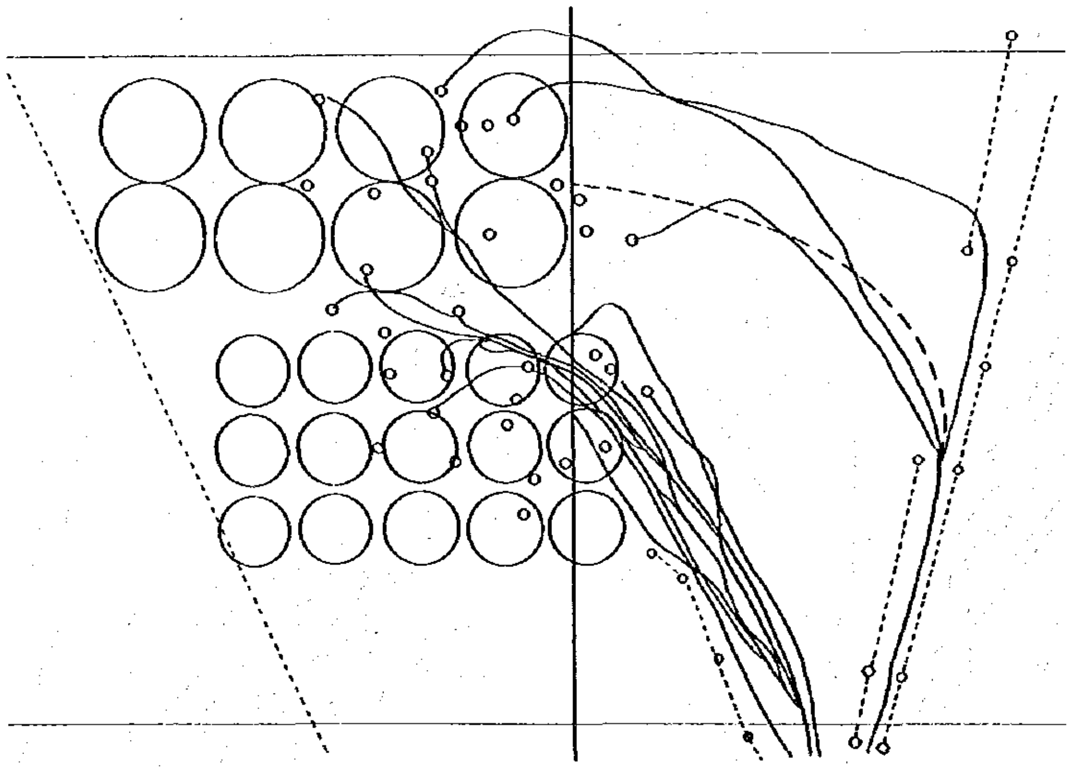


Fig. II-4-(2)-22 Track Chart at Port Said Waiting Area
from 2200, 17th to 1400, 18th March, 1984

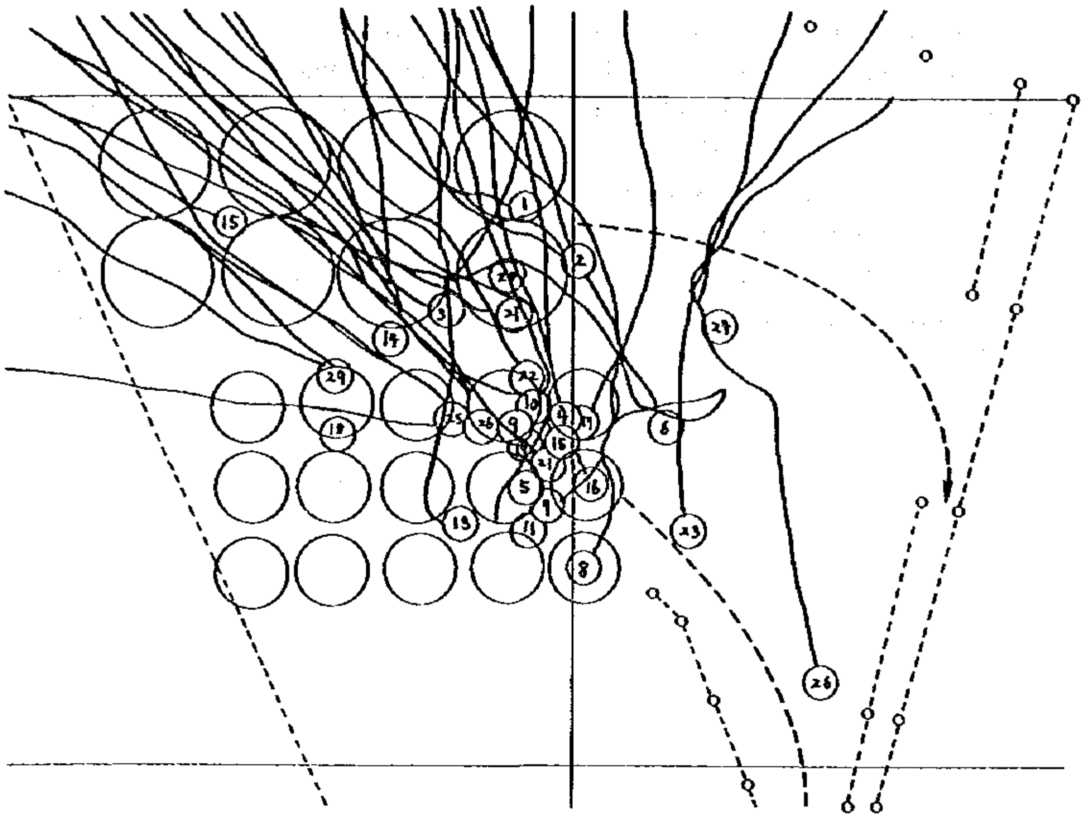


Fig. II-4-(2)-23 Track Chart at Port Said Waiting Area from 1400, 19th to 1400, 20th Oct., 1984

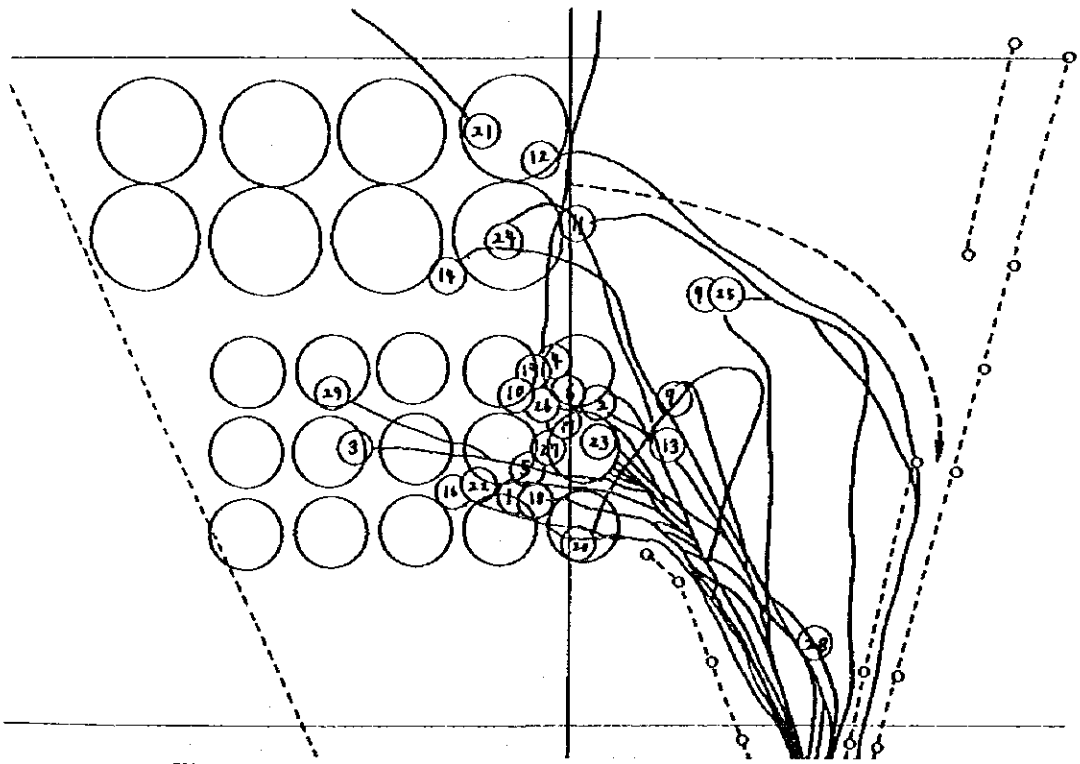


Fig. II-4-(2)-24 Track Chart at Port Said Waiting Area from 1400, 19th to 1400, 20th Oct., 1984

(vi) Ships at Anchor Classified by Length of Anchoring Period

Figs. II-4-(2)-25 shows the anchoring period of northbound vessels at anchor in the Eastern Anchorage of the Great Bitter Lake during the period from 0000 to 2400 hours on March 15, 1984.

Fig. II-4-(2)-26 shows, likewise, the anchoring period of southbound vessels at anchor in the Western Anchorage of the Great Bitter Lake during the same period as above.

Fig. II-4-(2)-27 shows the anchoring period of vessels at anchor in the waiting anchorage of Port Said during the period from 1400 hours on March 17, 1984 to 1400 hours on the subsequent day.

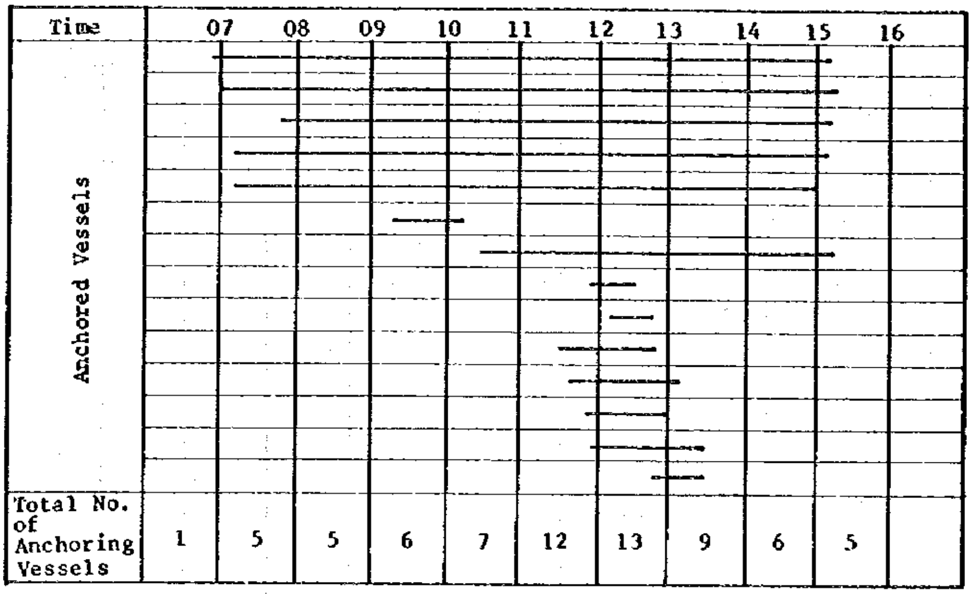


Fig. II-4-(2)-25 Anchoring Period of Northbound Vessels at Great Bitter Lake Eastern Anchorage on 15th March, 1984

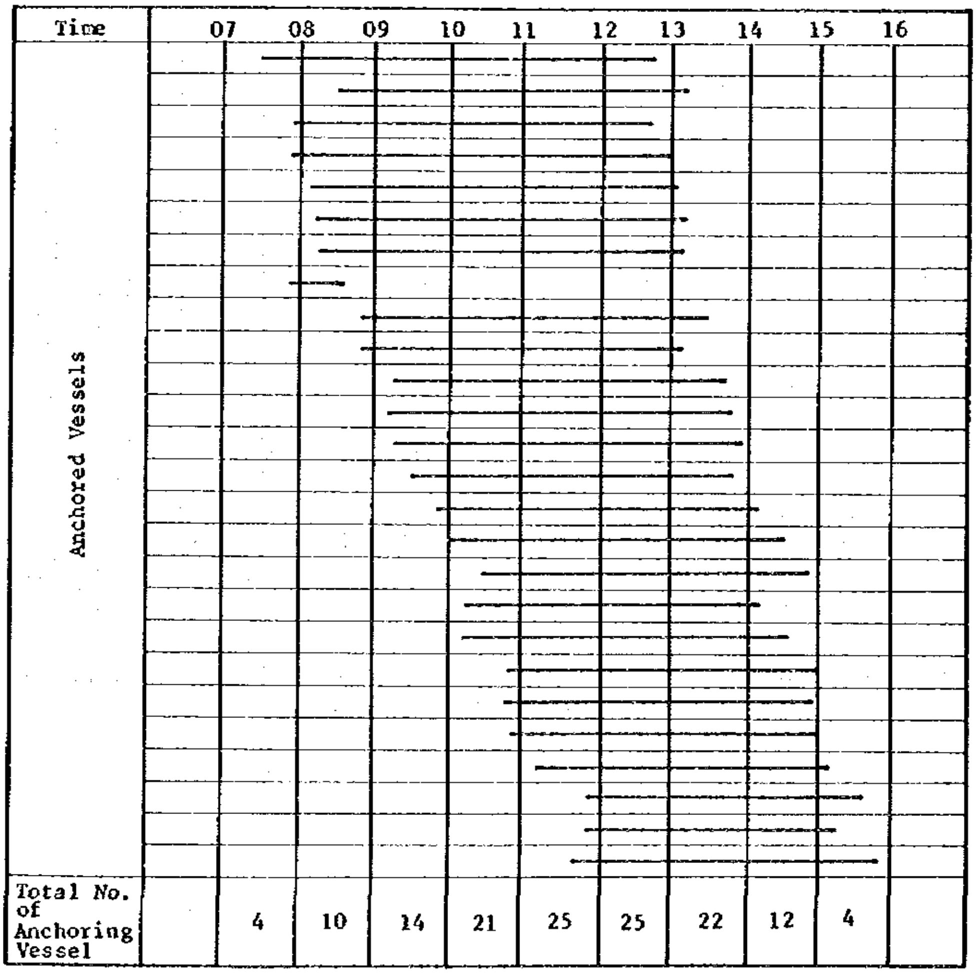


Fig. II-4-(2)-26 Anchoring Period of Southbound Vessels at Great Bitter Lake Western Anchorage on 15th March, 1984

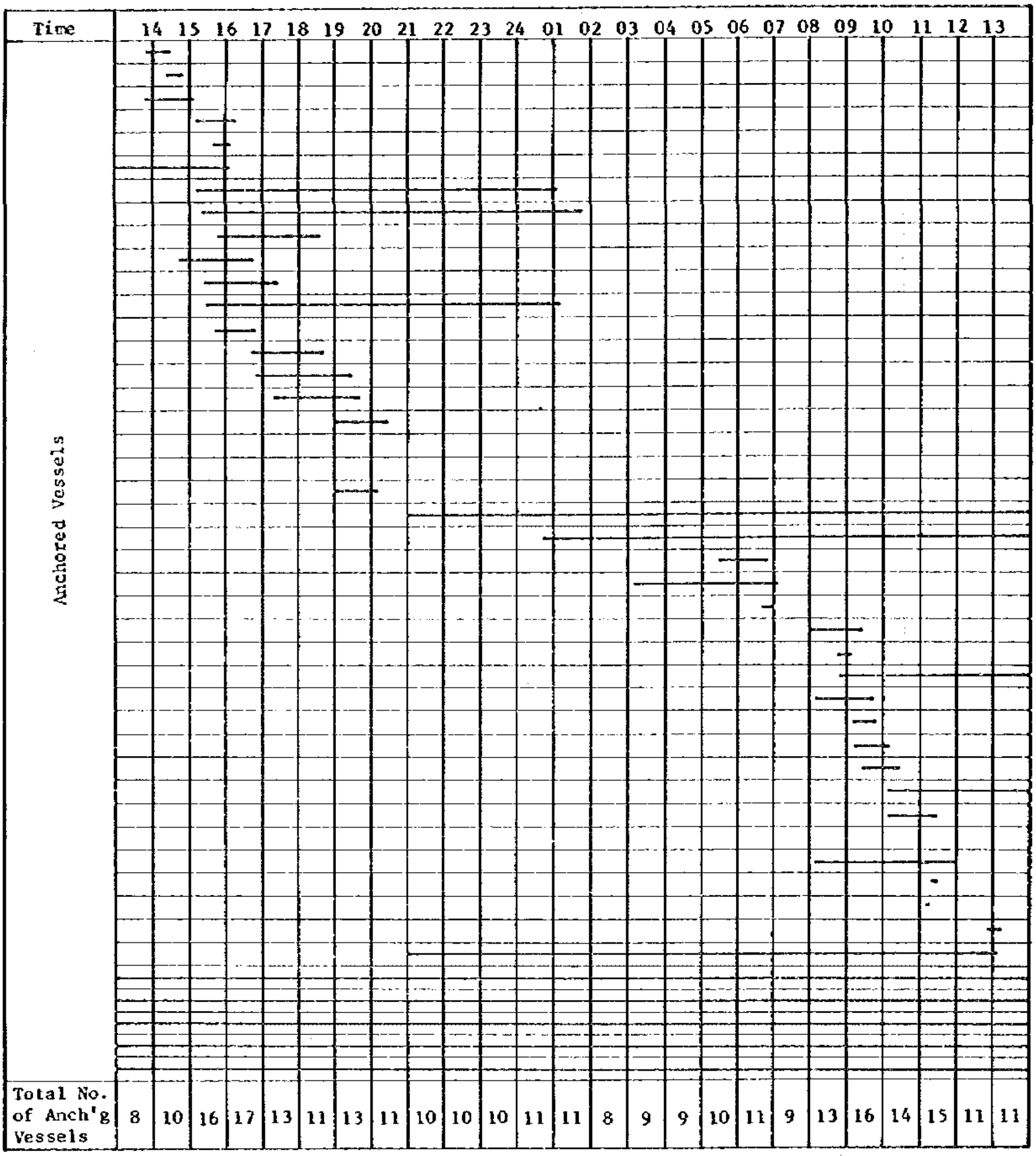


Fig. II-4-(2)-27 Anchoring Period of Vessels at Anchor in the Port Said Waiting Area from 1400, 17th to 1400, 18th March, 1984

3) Berthing Facilities

(i) Port Said

Table II-4-(2)-1 Port Said Berthing Facilities

Places or Names	Number of Berths	Nos.	Length of Berth (m)	Length of Berth (ft)	Length of Vessel (m)	Length of Vessel (ft)	Remarks
Isolated Berths	3	1I	280	919	232	761	
		2I	250	820	202	662	
		3I	314	1,030	266	872	
Outer Harbour Basin	10	1A	245	803	197	646	
		2A	300	984	252	827	
		3A					
		4A					
		5A	without limitation				Vessel heading 270°
		6A					
		7A					
		8A					
		9A.N.					
		9A.S.					
	5	4A.E.					
		5A.E.					
		6A.E.	....		197	350	Vessel heading 090°
		8A.E.					
		9A.E.					
Red Berths	7	OR	140	459	92	301	On the Eastern side of channel
		1R	245	804	197	646	
		2R	290	951	242	794	
		3R	238	780	190	623	
		4R	295	968	297	975	
		5R	162	532	114	374	
		6R	280	919	232	761	
Black Berths	7	1N	270	886	193	633	On the Eastern side of channel
		2N	170	558	122	400	
		3N	270	886	222	728	
		4N	205	672	157	515	
		5N	220	721	172	563	
		6N	225	738	177	580	
		7N	230	754	182	596	

Places or Names	Number of Berrth	Nos.	Length of Berth (m)	(ft)	Length of Vessel (m)	(ft)	Remarks
Navy House	6	1			61	200	
		2			61	200	
		3			101	330	
		4			168	550	
		5			168	550	
		6			168	550	
Cheril Quay	1		500				Depth 27 ft
Abbas Quay	1		720				
Hussein Basin	17				91	300	South of the inflection pt.
					to	to	
					180	620	North of the inflection pt.
E Berths	4	1E	325	1,066	277	879	Depth 28 ft
		2E	280	919	232	742	Depth 31 ft
		3E	250	820	202	662	Depth 32 ft
		4E	220	721	172	563	

(ii) Suez

Table II-4-(2)-2 Suez Berthing Facilities

Name	No. of Berths	Depth of Berth	Length of Berth	Length of Vessel	Remarks
Port Ibrahim					
North Basin	8	6.8 ~ 8.8 m	2,415 ft	–	
South Basin	4	5.3 ~ 8.2 m	–	–	
El-Mina					
El-Gedida					
Harbour	Mooring buoys	–	–	–	Not in use because of shallow water
Petroleum					
Basin					
Stone quays	2	7.6 m	490 m	–	
	–	7.6 m	419 m	–	
	–	7.6 m	685 m	–	Not in use
Fueling	2	8.5 m	–	–	
Tanker	4	6.1 m	–	–	
Adabiya	4	26'06"	300 m		Under control of Navy
Oil Berth	2	38 ft	–	45,000 GT	

II-5 Current Safety Measures

(1) Navigation Aids and Traffic Control

1) Aids to Navigation

(i) Lighthouse, Light Beacon

Name	Construction
Port Said High Light	White 8-sided stone tower, black stripes
Port Said East Break Water Light	Metal framework tower
Port Said Ldg Lights	Grey metal framework tower
Suez Creek Light	Metal beacon
Port Ibrahim Ldg Lts	Red metal structure
Port Ibrahim Detached Breakwater W End Lt	Metal beacon
Port Ibrahim Detached Breakwater E End Lt	Red metal structure on white pedestal
Port Ibrahim N Mole Head Lt	White tower, black bands
Port Ibrahim S Mole Head Lt	White tower, black bands
Port Ibrahim Petroleum Basin, Ldg Lts	Masts
Kalah Kebira Green Island Lt	Metal framework tower
Ataqa Reef Lt	Red square wooden tower, black bands
Newport Rock Lt	Grey metal framework tower

The SCA is planning to construct the following four lighthouses in the approach area of Suez

S_1:	Latitude	29°41'18" N
	Longitude	32°41'36" E
S_2:	Latitude	29°48'30" N
	Longitude	32°38'00" E
S_3:	Latitude	29°49'30" N
	Longitude	32°29'06" E
S_4:	Latitude	29°55'00" N
	Longitude	32°35'00" E

(ii) Axis Light in the Canal

Kind	Construction	No.
For southbound convoy	Framework	6
For northbound convoy	Framework	7

(iii) Buoyage in the Canal and Approaches

Position	Type of buoy	No.
Port Said approaches	Approach buoy	3
West limit of Port Siad anchorage area	Approach buoy	3
Port Said sea channel (East)	Sea channel buoy	24
Port Said sea channel (West)	Sea channel buoy	13
Port of Suez approaches	Approach buoy	6
Port of Suez separation zone	Approach buoy	2
Port of Suez sea channel	Sea channel buoy	14
Port Said west branch	Canal buoy	23
Port Said east branch	Canal buoy	20
Main Canal	Canal buoy	56
Ballah west branch	Canal buoy	15
Ballah west branch	Conical	8
Ballah east branch	Canal buoy	16
Main Canal	Canal buoy	34
Main Canal	Conical	9
Timsah Lake	Canal buoy	25
Timsah east branch	Canal buoy	12
Main Canal	Canal buoy	25
Main Canal	Conical	2
Deversoir west branch	Canal buoy	17
Deversoir east branch	Canal buoy	19
Great Bitter Lake	Approach buoy	28
Kabrit west branch	Canal buoy	15
Kabrit east branch	Canal buoy	13
Main Canal	Canal buoy	93
Main Canal	Conical	9

2) Maintenance of Aids to Navigation

The maintenance of the electrical installations and equipment of the lighthouses, axis lights and buoys is directly arranged by the SCA, whereas non-electrical maintenance work including steel work, painting, renewal and replacement of buoys are sublet to Timsah Shipbuilding Company.

(i) Maintenance of Electrical Installations and Equipment

One each section incorporating four electricians, one or two service boats properly manned with crewmembers is provided in Port Said, Ismailia and Suez respectively, and two electricians make regular tours of inspection every day boarding on a service boat for checking batteries and their electrical connections with necessary remedial steps taken as necessary.

Two other electricians are engaged in such maintenance services as battery charging, checks on lamps and solar panels, cleaning and other miscellaneous work.

It is obligatory to complete one cycle of checks on all approach buoys, channel buoys and Canal buoys in 45 days.

Also, spot checks and repairs are effected aside from the abovementioned regular checks when a notice is received from signal stations or pilots.

(ii) Maintenance of Non-Electrical Installations and Equipment

The maintenance of non-electrical installations and equipment is, as aforementioned, sublet to Timsah Shipbuilding Company, and the maintenance service contract on the aids to navigation concluded between the SCA and Timsah Shipbuilding Company may be summarized as below:

i) Quarterly Maintenance and Annual Maintenance

(a) Quarterly Maintenance

All underwater parts of buoys are to be checked, repaired and defective parts to be replaced as necessary by divers. Tower portions above water, solar panels and gimbals are to be checked, repaired or adjusted as found necessary.

(b) Annual and Biennial Maintenance

All buoys within the Canal are to be lifted up for inspection whereby repairs, adjustments and painting are to be carried out as found necessary once every two years, whereas those buoys provided in the approach and the Great Bitter Lake are to be maintained annually.

ii) Repairs

Items found damaged or missing are to be replaced with new ones at prices quoted in the specific price list.

iii) Services to be Offered by Timsah Shipbuilding Company

(a) Provide service boats equipped with water jets and cranes and manned with necessary crewmembers serviceable for 9 months a year.

(b) Provide a service boat operated with a supply boat, which is serviceable in a team, manned with two divers, and crewmembers for making checks, investigations and maintenance on all buoys quarterly under the specified operating schedule.

(c) Procure all necessary equipment and materials for maintenance work.

(d) Provide necessary offices, stores, workshops, etc.

(e) All maintenance work is to be undertaken by qualified engineers, workers and divers.

(f) All defective parts replaced are to be submitted to the SCA.

iv) *Items Undertaken by the SCA*

(a) Prepare two self-propelled barges or two barges plus two tugs for carrying buoys.

(b) Supply all necessary steel parts and plastic floats to Timsah Shipbuilding Company.

(c) Furnish a crane for lifting up sinkers.

(d) Supply replacement sinkers and chains.

(e) Supply fresh water and electric power at the same rates as applied to the SCA.

v) Refix of Buoys

(a) Buoys not subjected to maintenance service

Those buoys which are not maintained according to the specified maintenance schedule are temporarily lifted up for altering installed position and depth or for checking, then refixed when specific instructions are given by the SCA.

(b) Buoys subjected to maintenance service

Even on those buoys subjected to maintenance service, some are lifted up and refixed at the specified service rates when instructions are given by the SCA.

vi) Responsibility

(a) Timsah Shipbuilding Company is solely responsible for all loss of and damage to tug boats, barges, buoys and other installations and equipment.

(b) The SCA is solely responsible for the maintenance of the tug boats and barges serving with Timsah Shipbuilding Company.

vii) Penalty

Timsah Shipbuilding Company shall pay the specified amount of penalty as provided for in the Maintenance Contract for any uncompleted maintenance work of buoys and others.

Note, however, that if such delay in the required maintenance service is caused by force majeure, maintenance service may be carried out at times other than the specified periods.

viii) Validity

The Contract is valid for two full years, and one year of extension may be accepted.

ix) Price

The prices indicated in the Contract are valid for one full year, and may increase at an annual rate of 8% thereafter.

x) Cancellation of Contract

The SCA reserves the right of cancelling the Contract any time if percentage of completion of the maintenance work is 60% or less of the contracted work volume.

(iii) Cost of Maintenance

The amounts paid by the SCA to Timsah Shipbuilding Company in 1982 were 634,247

Egyptian pounds plus US$260,000 with an additional charge covering the spare parts furnished.

The charges incurred for the purchase of solar panels, lamps, etc., for the 4-year period from October, 1983 to September, 1987 paid by the SCA for the maintenance of the electrical installations and equipment were DM 405,437 plus US$595,522.

(iv) Maintenance Facilities

The SCA owns the following facilities for the maintenance of the aids to navigation:

3 Buoy laying floating cranes 25 t each complete with crew (8 persons).

6 Buoy service boats (2 x 350HP + 4 x 140 HP) for repairs and services of aids to navigation each complete with 3 persons crew and 2 technicians.

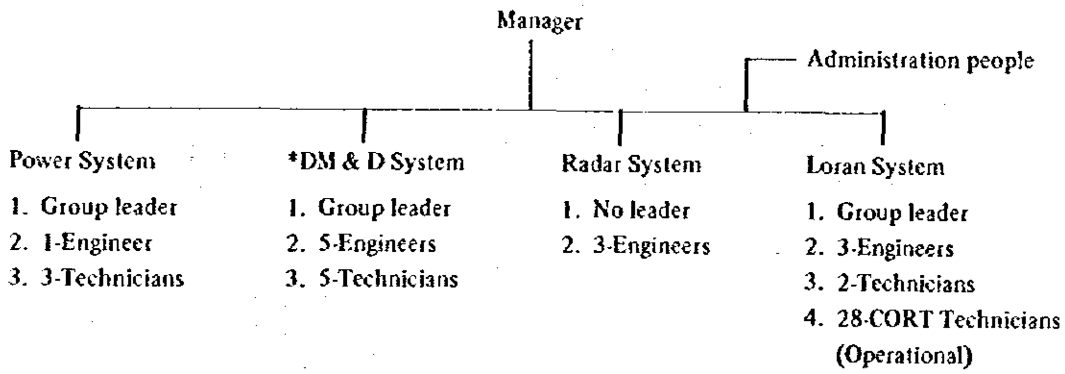
3 Buoy workshops fully equipped for repairs and maintenance, one in each section (Port Said, Ismailia and Suez).

3) Suez Canal Vessel Traffic Management System(SCVTMS)

(i) Brief Description of the SCVTMS

The Suez Canal Vessel Traffic Management System, an integrated control and management system of vessels transiting the Canal, comprises the tracking radars, Loran-C position fixing chain, computer network and communications network, and has the functions of graphical display of vessel's position, course and speed, automatic issue of alarms for abnormal off-track, speed and ship-to-ship distance.

The system operation is effected by the organization as shown in the following organization chart:



Note*: DM & D signifies Data Management and Display.

Fig. II-5-(1)-1 Organization of SCVTMS Engineering

The major system components of the SCVTMS are arranged as depicted in Fig. II-5-(1)-2.

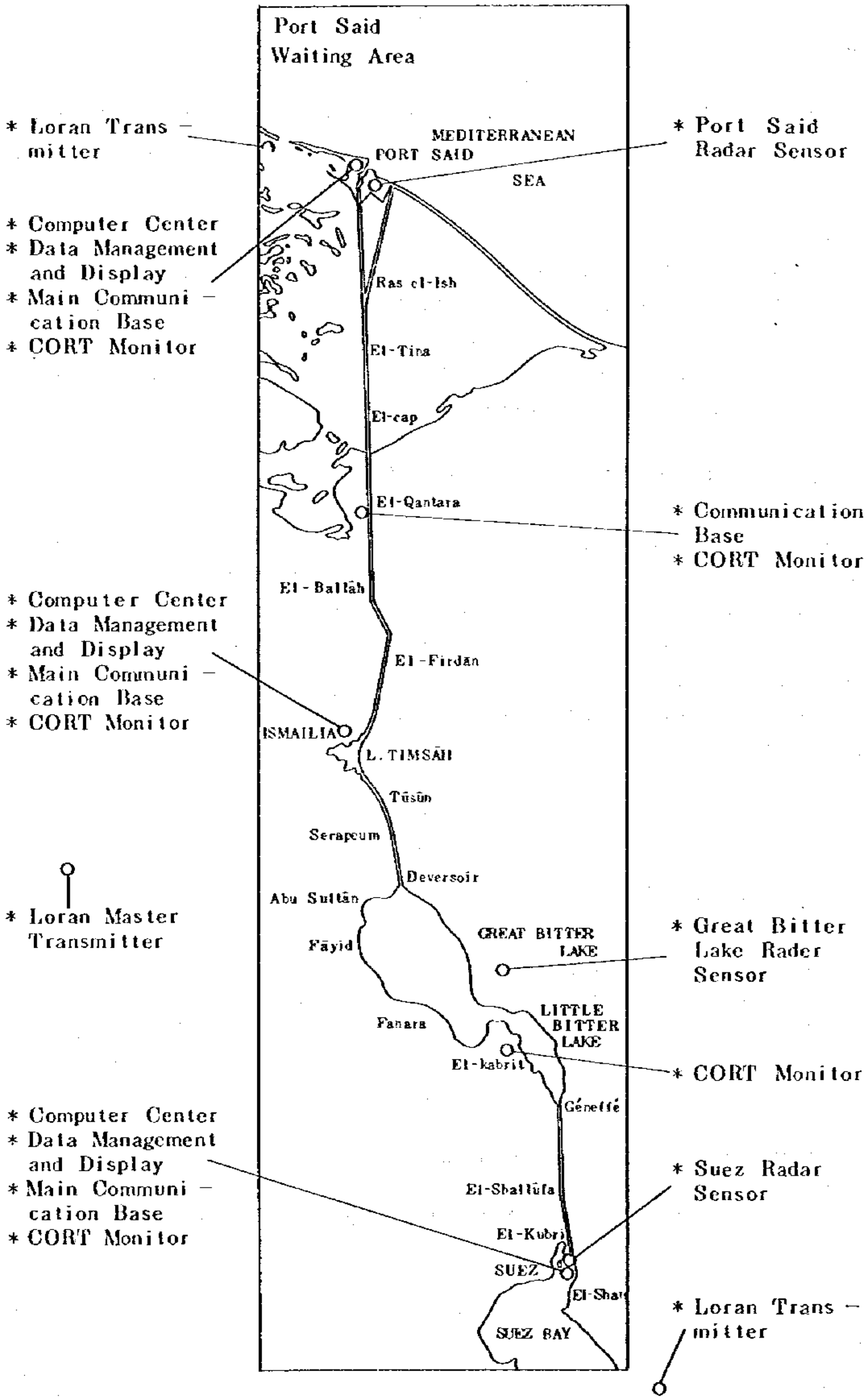


Fig. II-5-(1)-2 Arrangement of SCVTMS Equipment

i) Tracking Radar

The tracking radars are provided at three locations, Port Said, Great Bitter Lake and Suez as shown in Fig. II-5-(1)-2, and the Port Said radar and Suez radar cover the whole waiting area and the area to the 17 Km point of the Canal, whereas the Great Bitter Lake radar covers the areas of Great Bitter Lake, Little Bitter Lake, Lake Timsah and Deversior bypass.

The vessels' tracking information from the Port Said radar and Suez radar is transmitted to respective operation centers and the Central Operation Center in Ismailia, while the information from the Great Bitter Lake radar is transmitted directly to the Central Operation Center in Ismailia for subsequent conversion of radar information into video picture with simultaneous conversion into digital signals whereby vessel's position, courses, speed, etc., are displayed on the CRT.

ii) Loran-C Vessel's Position Fixing System

Radio waves from the Loran transmitting stations at the three locations shown in Fig. II-5-(1)-2 are received by the CORT (Carry On Receiver Transmitter) placed in vessels transiting the Canal for fixing vessel's position, and the vessel's positional information thus obtained is transmitted from the CORT to the Central Operation Center for subsequent computer processing with conversion into digital signals, and as is the case in radar information, the items of information such as vessel's position, course and speed are displayed on the CRT.

It is said that vessel's position fixing accuracy can be upgraded to a range of 7 to 12 meters by being subjected to differential correction in the sub-stations provided at five locations.

iii) Computer Network System

As mentioned above, radar information and vessel's positional information by Loran-C are subjected to conversion into digital signals through computer processing for displaying on the CRTs of the operation centers in Port Said, Suez and the Central Operation Center in Ismailia with those items of information such as vessel's position, course, speed and off-track recorded on magnetic tapes. Therefore, both output of the information on the recording paper and playback on the CRT are available.

iv) Communication Network System

Each operation center, communication bases in Kantara and Kabrit, and the pilot serving on each vessel transiting the Canal are linked with a VHF and UHF radio-telephone communication network whereby information on items such as vessel's position, speed, vessel-to-vessel distance and off-track can be exchanged all the time under the special features of the system.

(ii) Current Status of the SCVTMS Operation

Although the SCVTMS initiated operation in the middle of 1981, its operation is still in the stage of system trials and training of personnel, and actual vessel control and management by this system has not yet been commenced for vessels transiting the Canal.

Actual control and management of transiting vessels through the Canal are presently carried out by means of telephone, UHF and VHF radiotelephone communications between pilots on board transiting vessels and signal stations, and also the Central Operation Center involving the work of manual preparation of traffic diagrams.

On the CORT, a total of 150 units are reportedly in readiness for service, but the results of our checks on the service frequency of this unit made during the 1-month period of August, 1983 indicate that the average number of cases of carrying such units on board transiting vessels was only 9 per day, and it was found further that even when the units are placed on board vessels, some were not in good working order.

On the other hand, information on items such as vessel's position, course, speed and off-track obtained after subjected to computer processing at the operation centers is not given to the pilots serving on board transiting vessels, and it seems that there is no positive desire on the part of the pilots concerned for an active utilization of the forementioned information service.

The Suez radar is not in service at present. According to available information, there is no specific time schedule to bring the Suez radar into service.

4) Pilots and Extra Pilots

(i) For vessels of 300 SCGT or more, assignments of both harbour pilots and Canal pilots are compulsory.

i) Harbour Pilots

(a) Port Said

For vessels anchoring at the VLCC anchorage, pilots embark at their anchorage, and taking-over of pilotage service is effected at the Km 4.5 point of the Port Said bypass by the Canal pilot.

For other vessels, embarkation of pilots is effected at water in the vicinity of the fairway buoy for subsequent pilotage service up to the buoy berth within the harbour via the west channel.

For northbound vessels, pilots join them at water in the vicinity of the Km 4.5 point for subsequent pilotage service up to the point of Hm 80, but in practice, most of pilots seemingly disembark vessels at water in the vicinity of Km 0.

(b) Suez

For vessels anchoring at the VLCC anchorage, pilots join them at the anchorage, and transfer is made at the entrance of the Canal with the Canal pilots.

For other vessels, pilotage is made for the passage between the waiting area and the inner anchorage.

Southbound vessels are piloted from the entrance up to the Hm 80.5 point, but it seems to be the practice on most of the cases that pilots leave the vessel at a point far before this point.

ii) Canal Pilots

For the passage between Port Said and Suez, Canal pilots undertake the pilotage service, and taking-over is effected in both the northbound and southbound at Ismailia.

iii) Extra Pilot

In the following cases, additional pilots must be assigned:

(a) Vessels of 80,000 SCGT or more

(b) Third generation containers and aircraft carriers

(c) Vessels with restricted fore sight

(d) Vessels of low speed

(e) Vessels not provided with accommodations for pilots to rest

(f) In any case when the master of the vessel or the SCA specifically considers extra pilots necessary

(ii) Qualification and Training of Pilots

i) Harbour Pilots

Any candidate for a harbour pilot must be a holder of the Master Certificate (Foreign-going).

After successfully passing the medical examination, the newly appointed pilot begins his training at Port Said Harbour on vessels calling at various berths within the harbour.

After having piloted 60 vessels, a trial examination is held by two Chief pilots.

Meanwhile the candidate attends several lectures on the Suez Canal (theoretical aspects) and on the Rules of Navigation.

Having successfully passed the examination, the pilot is enrolled in the "day service" list for 15 days to pilot vessels not exceeding 10,000 tons, after which he is enrolled in the "night service" list for another 15 days.

Then he is registered in the "full service" list of harbour pilots.

His limit of tonnage is increased by 5,000 tons every 6-months after passing a successful trial examination.

ii) Canal Pilots

Once the 25,000 tons of limit tonnage is reached, the harbour pilot may be sent for a 2-month training course in Canal pilotage, during which he has to pilot 36 vessels (9 in each direction (N and S) per each section of the Canal); at the end of this period he has to pass a trial examination held by two Chief pilots.

His Canal tonnage limit is increased by 5,000 tons every 6-month period; at the end of each period a trial examination is required till he reaches a tonnage limit of 30,000 tons.

The limit of tonnage is increased by 10,000 tons every 6-month period after that.

Then it becomes possible to promote the pilot, when his turn arrives, to a Major pilot and his tonnage limit is increased by 10,000 tons every 6-month period up to 80,000 tons.

When his turn comes, he will be promoted to Distinguished pilot class and his limit of tonnage will be increased on the same basis until it reaches 120,000 tons.

Then he is promoted to a Chief pilot and he is thereafter able to pilot vessels of all tonnages in the Canal.

iii) Distribution of Careers and Age of Canal Pilots

The distributions of careers and ages of canal pilots are as given in Table II-5-(1)-1.

Table II-5-(1)-1 Distribution of Careers and Age of Canal Pilots

Kind of Pilot	Careers	Age	Number	Remarks
Pilot	Less than 5 years	30 ~ 40	120	
Major Pilot	More than 5 years	35 ~ 39	24	
		40 ~ 44	14	
	Less than 10 years	45 ~ 49	7	
		50 ~ 59	0	
		Over 60	1	Contracted
Distinguished Pilot	More than 10 years	45 ~ 49	15	
		50 ~ 54	17	
	Less than 15 years	55 ~ 59	16	
		Over 60	2	Contracted
Chief Pilot	More than 15 years	50 ~ 54	6	
		55 ~ 59	29	
		Over 60	13	Contracted
Total			264	

5) Harbour Master and Tug Master

(i) Qualification and Training of Harbour Masters

Any candidate for a harbour master must be a holder of the Master Certificate and trained in Port Said Harbour during the training period, and has to attend lectures on the Suez Canal (theoretical aspects) and the Rules of Navigation.

(ii) Qualification and Training of Tug Masters

The candidates are to be trained at the SCA Marine Institute for Tug Masters.

After two years of studies (theoretical aspects) they obtain a certificate of graduation.

They do not make deep sea navigation, but navigation of the SCA tug boats for one year and a half in the different parts of the Canal after which they undergo a practical trial examination before an examination Commission.

6) Practices at Signal Stations

A total of 11 signal stations are arranged at intervals of approximately 10 km on the western bank of the Canal where the following duties are undertaken at present:

i) Reporting of the passing time of vessels transiting the Canal to the Central Operation Center

ii) Monitoring of the movements of small craft in the vicinity, and taking precautionary measures so as not to disturb the passage of vessels transiting the Canal

iii) Reporting of failures and malfunctions of buoys and other aids to navigation, if any, to the Central Operation Center

iv) Reporting of damage to the Canal bank, if any, to the Central Operation Center

v) Relaying of instructions given by the Central Operation Center to vessels transiting the Canal

vi) Reporting of observed results of wind direction, wind velocity and flow direction of current to the pilots and Research Center.

7) Tugs and Escort Tugs

(i) Arrangement of Escort Tugs

In the following cases, tugs must be arranged for vessels transiting the Canal, and tuggage paid:

i) When the SCA considers that tug service is necessary

ii) LPG carriers and LNG carriers of 80,000 SCGT or more

iii) Disabled vessels

iv) Vessels with restricted fore sight

v) Vessels with defective indicators or without indicators

vi) Any vessels with a bower anchor on either side of the vessel unserviceable

VLCCs and vessels within the same category will have an escort tug or tugs on the following occasions:

i) Any loaded vessel of 110,000 DWT or less for which the SCA considers that arrangement of escort tugs is necessary under the technical reasons	1 tug
ii) When the draft is 44 ft or more	1 tug
iii) Loaded vessels between 110,000 and 150,000 DWT	1 tug
iv) Loaded vessels of 150,000 DWT or more	2 tugs
v) Vessels in ballast of 200,000 DWT or more	1 tug

(ii) Tug Boat Assistance at El Ballah

Three tug boats assist at El Ballah West Branch for tying up the second southbound convoy.

(iii) Salvage, Escort, Harbour Tugs and Pilot Boats Owned by SCA

The SCA owns salvage tugs, escort tugs, harbour tugs and pilot boats as enumerated in Table II-5-(1)-2, and stations them in Port Said, Ismailia and Suez.

Table II-5-(1)-2 Salvage, Escort, Harbour Tugs and Pilot Boats

	Port Said			Ismailia			Suez		
	HP	Speed	No.	HP	Speed	No.	HP	Speed	No.
Salvage Tug	4,500	15	1	6,400	15	1	6,400	15	1
Escort Tug	3,200	13	2	3,200	13	2	3,200	13	2
	3,700	13	1	3,700	13	4	3,700	13	3
	3,400	13	2						
Harbour Tug	2,600	13	2	3,700	13	2	1,600	11.5	2
	1,600	12	6	1,600	12	3			
Pilot Boat	300	13	8	300	13	6	300	13	12
	390	15	1	390	15	7	400	15	6
	740	14	1	740	14	2	740	14	3
	1,300	25	2	1,300	25	2	650	22	4
	650	22	6				1,300	25	3
							350	13	2
Total			32			29			38

8) Traffic Control

(i) Outline of Traffic Control

As stated in II-4 Traffic and Anchorage Conditions, traffic control is carried out in accordance with the SCA's Rules of Navigation by organization shown in Fig. II-4-(1)-1.

Vessels within the Canal and associated waters must observe all the requirements laid down in the Rules of Navigation.

The SCA provides a booking system for transit vessels for due planning and implementation of the transit plan, and requires those transit vessels to contact the Authority at least four days in advance for booking followed by a firm notice given at least 48 hours before the scheduled transit.

Each Port Office in Port Said and Suez initiates its contact with the transit vessel when the vessel reaches 10 miles before the Approach Buoy of Port Said, or 5 miles before No. 1 buoy of the Suez Separation Zone either through VHF or radiotelegraphic means of communications for initiating its control operation.

Transit vessels are formed into a convoy for subsequent passages in the convoy where their manoeuvres are all guided by the instructions issued by the Port Office.

The Port Office at Ismailia communicates with each transit vessel and each signal station either by VHF, UHF or by radiotelegraphy, and movements of each transit vessel are recorded on traffic diagrams, thus the on-going situation in the Canal and associated waters can be generally monitored and controlled.

(ii) Traffic Control Facilities

i) Port Said Port Office

As a rule, about five persons in charge are engaged in the control watch service on a shift basis where a 6-hour 4-shift system is practiced.

Here, control operations are mainly carried out by giving anchoring instructions to arriving vessels, shifting instructions for passeges from anchorage to buoy berth, and heaving up anchor, unmooring, and instructions for entry to specific traffic routes or the Canal according to the predetermined order in the line-up of a convoy and the ship-to-ship distance for those vessels at anchor or being moored at the waiting buoy berth.

The radar images on the CRT of the SCVTMS are referred to for vessel traffic control to check on vessels' movements.

ii) Ismailia Port Office

The working system in the Ismailia Port Office is nearly the same as that of the Port Said Port Office.

Here, control operations are mainly carried out by preparing traffic diagrams for overall vessel traffic control, and by giving instructions for mooring operations in Ballah West Branch, anchoring and heaving up anchors for vessels in the Great Bitter Lake and Lake Timsah.

The radar images on the CRT of the SCVTMS are not generally referred to any appreciable degree.

iii) Suez Port Office

The features of the Suez Port Office are much the same as those of the Port Said Port Office, and the control operations here are more or less the same as in the port Said Port Office, too.

Note, however, that the radars of the SCVTMS are not placed in operation, and hence their information is not used for vessel traffic control operations here.

iv) Movement Office

The Movement Office is located at the Headquarters of the SCA in Ismailia, and overall traffic management is carried out here.

v) Signal Stations

The main duties of signal stations are to provide, transmit and to relay information on items relating to each Port Office and transit vessels, and to perform other auxiliary services for the Port Office.

vi) SCVTMS

As stated in II-5-1 Aids to Navigation, the SCVTMS is a centralized integral traffic management system of vessels transiting the Canal, and this is an extremely effective and superb system for the safe and efficient anagement and control of the Suez Canal.

However, the system is still in the testing stage and is not being used for the intended purpose at present.

(iii) Regulations

As mentioned above, traffic in the Suez Canal is governed by the Rules of Navigation prescribed by the SCA.

The Rules of Navigation comprise:

Part 1	Navigation
Part 2	Canal and Lakes (Characteristics)
Part 3	Communications – Signals
Part 4	Tonnage and Dues
Appendix	For Vessels Carrying Dangerous Cargo

Part 1 includes general transit rules, features of the Canal, approach, pilotage, entering port and preparation for transit, convoy transit system, maximum ship type, towage, escorting, emergency procedures and prohibited items; Part 2 considers the characteristics of the approaches, Canal and Lakes, drawings of buoys; Part 3 covers communications and liaisons, also signals; Part 4, the transit dues; and the Appendix lists regulatory requirements for vessels carrying dangerous cargo.

Below is an abstract of the principal requirements concerning traffic control prescribed in Part 1 and Part 3.

i) Part 1 Navigation

Art. 1 Obligations to observe the Rules of Navigation, the International Convention for the Safety of Life at Sea, International Convention for Preventing Collisions at Sea, and Orders of the Government of Egypt for Transit Vessels.

Art. 6 Compulsory pilotage for vessels of 300 SCGT or more

Art. 7 Prohibition of changing berths in road anchorages without permission from the Port Office

Art. 8 Requirements relating to Port Said

(a) Instructions for contacting the SCA 10 miles before reaching the approach buoy, anchoring and entry to traffic routes

(b) Use of the East Channel for northbound vessels

(c) Use of the West Channel for outgoing vessels from in-harbour area

(d) Courses for northbound vessels to be taken on arriving at port

(e) Courses for southbound vessels

Art. 9 Requirements relating to Suez

(a) Instructions for contacting the SCA 5 miles before reaching the No. 1 Buoy of the Separation Zone and anchoring instructions

(b) Separation zone

(c) Passage through traffic routes, and prohibition of overtaking, crossing and anchoring within traffic routes

(d) Courses to each anchorage and the Canal

(e) Courses for southbound vessels

(f) Priority order for in-harbour vessel operations

(g) Priority order for transiting through the Eastern Channel

(h) Regulations for port closing due to bad weather

Art. 11 Pilotage

(a) Compulsory pilotage

(b) Points of embarkation/disembarkation of pilots in Port Said

(c) Points of embarkation/disembarka. on of pilots in Suez

(d) Masters' duties for standing watch on the bridge and providing information to pilots

(e) Scope of pilotage service and the fact that the Master is fully responsible for all ship manoeuvres even under pilotage service

(f) Obligations of Master to accept pilots' advice

Art. 12 ooking

Booking system for transit, and obligation of giving a 4-day notice

Art. 13 Obligation of giving a 48-hour firm notice

Art. 14 Obligations of contacting the SCA 10 miles before reaching the Port Said Approach Buoy and at 5 miles before reaching the No. 1 Buoy of the Suez Separation Zone

Art. 49 Formation of convoys

Art. 50 Limit time of arrival to join convoys

Art. 51 Courses to keep on leaving for sea

Art. 59 Signals and communications at time of accidents

Art. 60 Notices and signals at time of leaks

Art. 62 Notices and signals at time of fires on board

Art. 64 Notice when oil pollution is found

ii) Part III Communications and Signals

Art. 87 Obligations to provide vessels with wireless and radiotelephony and VHF

Art. 89–91 SCVTMS

Art. 93 Sound signals to be used by vessels underway, at time of accidents and signals between transit vessels and tugs or escort boats.

Art 94 Visual signals to be used within Port Said, signals to be used by pilot boats, signals to be used by signal stations, special signals and signals to be used by dredgers.

(2) Disaster Treatment

1) General

(i) Rules

i) Responsibility for Accidents

Preliminary Regulation 12 in the Appendix for Vessels Carrying Dangerous Goods of the Rules of Navigation state that the responsibility for any accident involving transiting vessels are imposed on the transiting vessel(s) and that SCA shall be held responsible for ensuring the safety of the Canal.

ii) Communication

Chapter IX Radiocommunication of the Rules of Navigation, stipulates the rules for VHF and UHF communication, making it an obligation for all transit vessels to have VHF communication equipment installed on their bridges, and all the pilots aboard are to carry UHF communication equipment with themselves. Each pilot boat and signal station (a telephone set is available at each signal station) are equipped with VHF communication equipment. VHF and UHF communication equipment are installed aboard tug boats and main offices located at Port Said, Ismailia and Suez, respectively.

Use of the communication equipment is prescribed as follows:

UHF is for overall communication in the Canal zone, VHF Ch. 6 is for in the Port areas of Port Said and Suez, VHF Ch. 8 and Ch. 12 are for use in the Canal area, VHF Ch. 11 for use by dredgers, and VHF Ch. 10 for emergency use.

The effective range of VHF transmission is 15 miles, and that of UHF covers the entire Canal zone.

iii) Escort Boat

Articles 57 & 58 in Part I of the Rules of Navigation, provide for escorts by tug boats, or the like. Under the provision of the articles, use of tugs and escort tug are obligated for transit vessels. At the same time, these prescribed transit vessels are obligated to arrange on board ropes for towing purposes. However, the capabilities of the tugs are not prescribed in the regulations.

iv) Handling of Dangerous Goods

The appendix for Vessels Carrying Dangerous Goods of the Rules of Navigation stipulates that loading and unloading of crude oil, LNG, LPG, and other dangerous goods shall be totally prohibited, and that vessels are only permitted to pass through the waterway. As for the anchorage, at Port Said, the designated anchorage area is in the outer basin, away from the place of anchorage for ordinary vessels. However, at Port Tafick no specific place of anchorage is designated for vessels carrying dangerous cargoes because of the spaciousness of the port area.

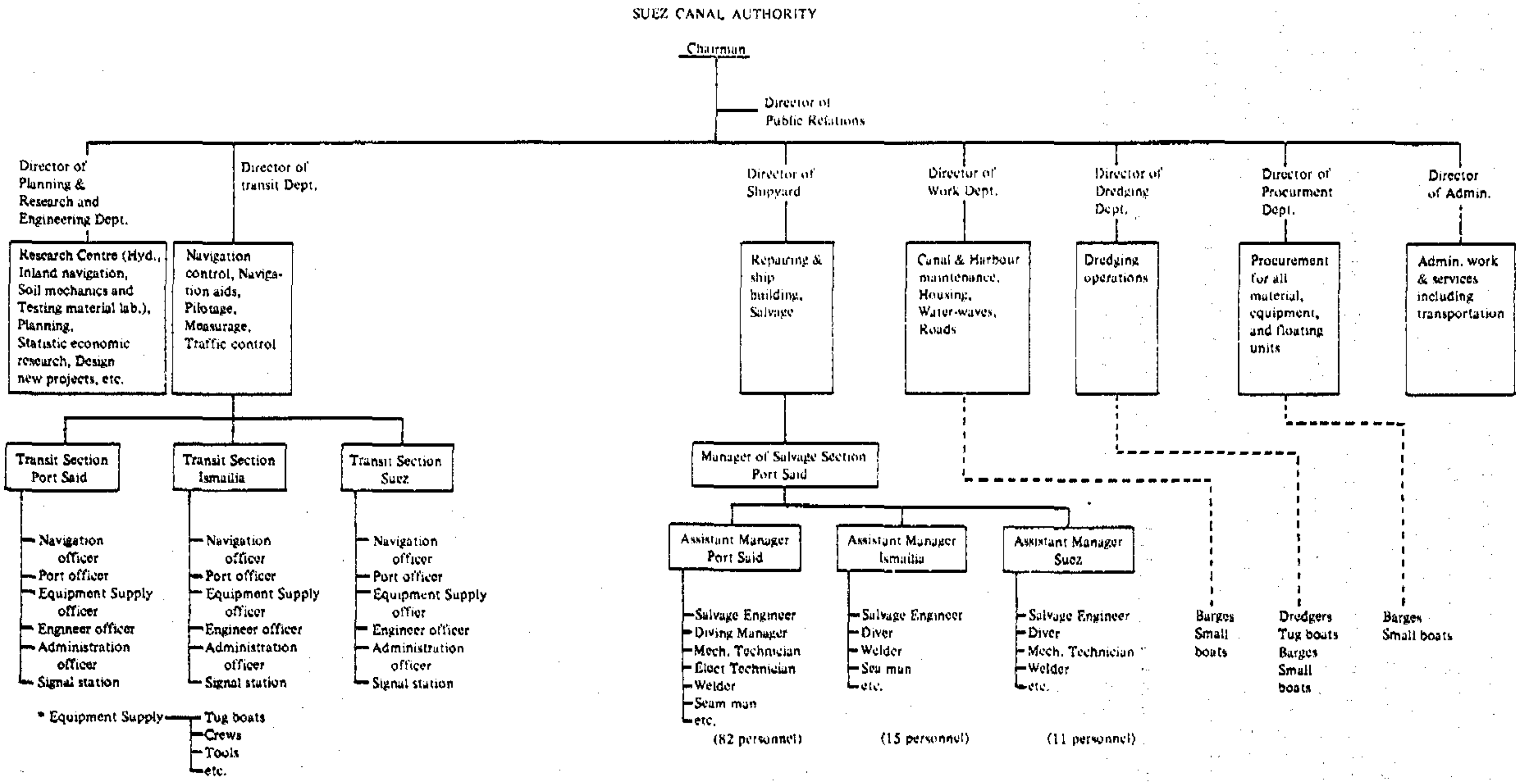
(ii) Organization

The organization is as indicated in Fig. II-5-(2)-1. If any accident occurs impeding voyage of vessels through the Canal, the pilot will notify the Equipment Supply Officer covering the area affected and offices concerned. Under the command and instructions of the Equipment Supply Officer, necessary manpower, materials and equipment such as the Salvage Section personnel, tug boats, etc. are mobilized from the entire canal areas for the control of the accident.

Division of jurisdictional areas are as follows: up to Km 51 from the end of the new east branch and the end of the west branch comes under Port Said. From Km 51 to Km 105 belongs to Ismailia, from Km 105 to the line between Ras El-Adabiya and Ras Misaita belongs to Suez. Any area beyond that is covered by the Ministry of Marine Transport.

Responsibility for spill and fire incident within each port rests with the Harbour Authorities.

Should any accident occur which hinder to safe navigation in waterways including the approach area, SCA will dispatch its personnel and put the accident under control.



(number of personnel is about 350 in each Transit Section)

Note: Total number of the personnel of SCA is about 15,000.

Fig. II-5-(2)-1 Organization of SCA

2) Resources

(i) Aircraft and Helicopter

SCA does not have any aircraft or helicopter.

(ii) Work vessels

i) Tug boats

Refer to Table II-5-(2)-1

ii) Floating cranes

Refer to Table II-5-(2)-2

iii) Dredgers

Refer to Table II-5-(3)-1

iv) Barges

(a) Lightering barges

A total of 11 fuel barges including one 400-ton barge and two 300-ton barges which were built in and after 1979 and assigned to the strategic locations on the Suez Canal.

(b) Barges for carrying rocks

Refer to Table II-5-(2)-3

(c) Floating barges

A total of 28 floating barges, each having various deck areas of 5m x 8m to 25m x 8m, are stationed at various places for loading and unloading cargoes and passengers.

v) Small Boats

Refer to Table II-5-(2)-4

(iii) Delivery Trucks

SCA has numerous delivery trucks and steel drums at many places.

(iv) Forklifts

A total of 20 forklifts of 2–5 ton capacity are used at various places.

(v) Tank Trucks

2 tank trucks, each having a capacity of 2,000 liters, are assigned at Port Said, Ismalia and Suez respectively.

(vi) Portable Generators

A total of 70 units of portable generators of 2–500 kw capacities assigned to various places.

(vii) Submersible Pump

Allocation of submersible pumps is indicated in Table II-5-(2)-5.

(viii) Skimmer

One skimmer mainly used for training purposes (Rheimerbt flotation adjustable weir type, approximately 2 meters across skimmer head, 4 meters to extremity of floats; 2 screw type oil pumps, one centrifugal water pump powered by 220/308 V supply) is assigned to Port Said.

(ix) Booms

600-meter long booms of Japanese make (36 inch booms – each 20 meters in length, PVC fabric, external flotation chain ballast) are assigned to Port Said.

(x) Fire Pumps

Allocation of Fire pumps is shown in Table II-5-(2)-6.

(xi) Nozzles and Hoses

Nozzles and hoses used for sea water, dispersant and foam fire-extinguishing concentrate are stockpiled at the main office, signal stations and on tug boats.

(xii) Eductor and Portable Spray Sets

Educators, with switching devices for variable concentrations of dispersant and foam concentrate, and portable spray sets for dispersant are assigned to each signal station.

(xiii) Dispersant

Allocation of dispersant is as indicated in Table II-5-(2)-7.

(xiv) Absorbent

No absorbent is stockpiled.

(xv) Foam Concentrate

Allocation of foam concentrate is shown in Table II-5-(2)-7.

(xvi) Dry Chemical Powder

Allocation of dry chemical powder is shown in Table II-5-(2)-7.

(xvii) Dippers and Shovels

At work shops located at Port Said, Ismailia and Suez, dippers and shovels can be procured in necessary quantities whenever required.

(xviii) Signal Stations

All along the Canal, there are 11 signal stations. They are furnished with telephone(s), VHF communication equipment, small boat(s), dispersant and foam concentrate, and the signal station person observe transiting vessels.

(xix) Disposal Facilities for Recovered Oil

There is no disposal facility for recovered oil.

(xx) Safety Equipment

There is no safety equipment such as self-contained breathing apparatus, gas detectors, gas masks, protective jackets, protective equipment, etc..

Table II-5-(2)-1 List of Tugs

PORT SAID

NAME OF TUG	DIMENSION LXBXD (M) NUMBER OF CREW	POWER (HP) SPEED (KT)	FIRE PUMP * (G/M) WATER CURTAIN	FOAM. (TONS) DRY CHEMICAL (TONS)	DISPERSANT (TONS)	MONITOR HEIGHT (M) DISCHARG RANGE (M)	MONITOR Nº DISCHARGE RATE (G/M)	COMMUNICATION FACILITY	SHIPPING CO. YEAR BUILT
A-Salvage tug									
Anter	45x12x5 17	4500 15	1x555 -	- -	-	7 50	2 200	UHF VHF	IBC INDUSTRIES HOLLAND 1956
B-Escort tugs									
Moawen 1	32.8x9.5x3.76 10	3200 13	1x888 FRONT	12 -	4	14.5 50	2 444	UHF VHF	IHI JAPAN 1976
Moawen 2	32.8x9.5x3.76 10	3200 13	1x888 FRONT	12 -	4	14.5 50	2 444	UHF VHF	DITTO
Besel 2	35x11x4 10	3700 12	2x740 1x1040	10 1	-	10.5 50	4 350	VHF UHF	HAYASBIKANE JAPAN 1978
Fahd	34.3x9.57x3.8 10	3400 12	- -	- -	-	-	-	VHF UHF	BODEWES HOLLAND 1976
Mounir	51.34x10x4.389 13	3200 15	2x370 -	5.4 -	-	10 50	2 200	VHF UHF	KURE SHIPBUILDING & ENGINEER-ING CO. JAPAN 1962
C-Harbor tugs									
Moawen 4	31.72x8.6x2.67 8	2600 13	1x888 FRONT	1.5 -	2	13 50	2 450	VHF UHF	IHI JAPAN 1976
Moawen 8	31.72x8.6x2.67 8	2600 13	1x888 FRONT	1.5 -	2	13 50	2 650	VHF UHF	IHI JAPAN 1980
Barea 2	35x11x4 10	3700 12	2x740 1x1040	10 1	-	11 50	4 350	VHF UHF	DITTO
Waker	27.2x7.25x3.55 6	1600 12	$60M^3/H$ -	2 -	-	6.5 30	1 200	VHF UHF	TIMSHA ISMAILIA 1963
Bouri	27.2x7.25x3.55 6	1600 12	DITTO	2 -	-	6.5 30	1 200	VHF UHF	DITTO
Shided	27.2x7.55x3.55 6	1600 12	DITTO	- -	-	6.5 30	1 200	VHF UHF	IBC INDUSTRIES HOLLAND 1956
Qirah	27.2x7.55x3.55 6	1600 12	DITTO	- -	-	6.5 30	1 200	VHF UHF	DITTO
Shabar	27.2x7.25x3.55 6	1600 12	DITTO	- -	-	6.5 30	1 200	VHF UHF	TIMSHA ISMAILIA 1963
Morgan	27.2x7.25x3.55 6	1600 12	$120M^3/H$ -	5.5 -	-	6.5 30	2 220	VHF UHF	IBC INDUSTRIES HOLLAND 1956
Ras El Ash	27.2x7.25x3.55 8	1600 12	$60M^3/H$ -	2 -	-	7.5 30	3 220	VHF UHF	TIMSHA ISMAILIA 1981

* G/M. gallon/minute

ISMAILIA

NAME OF TUG	DIMENSION LXBXD (M) NUMBER OF CREW	POWER (HP) SPEED (KT)	FIRE PUMP (G/M) WATER CURTAIN	FOAM. (TONS) DRY CHEMICAL (TONS)	DISPERSANT (TONS)	MONITOR		COMMUNICATION FACILITY	SHIPPING CO. YEAR BUILT
						HEIGHT (M) DISCHARGE RANGE (M)	N° DISCHARGE RATE (G/M)		
A-Salvage tug									
Mared	50x12x4.9 12	6400 15	1x740 2x370 -	2 -	-	10 50	2 370	VHF UHF	IHC HOLLAND 1960
B-Escort tugs									
Moaven 6	32.8x9.5x3.16 10	3200 13	1x1300 FRONT	8.3 2	5.8	21 50	1 660	VHF UHF	IHI HOLLAND 1980
Moaven 7	32.8x9.5x3.16 10	3200 13	1x1300 FRONT	8.3 2	5.8	21 50	1 660	VHF UHF	DITTO
Salam 1	35x11x5 10	3700 12	2x740 -	10 1	-	12 50	4 350	VHF UHF	BODEWES HOLLAND 1978
Salam 2	35x11x5 10	3700 12	2x740 -	10 1	-	12 50	4 350	VHF UHF	DITTO
Nimr	34.3x9.57x3.8 10	3400 12	- -	- -	-	-	-	VHF UHF	DITTO
Salam 3	35x11x5 10	3700 12	2x740 -	10 1	-	12 50	4 350	VHF UHF	BODEWES HOLLAND 1976
Salem 4	35x11x5 10	3700 12	2x740 -	10 1	-	12 50	4 350	VHF UHF	TIMSAH ISMAILIA 1976
C-Harbor tugs									
F. Bakr	35x11x4 10	3700 12	2x740 1x1040 -	10 1	-	11 50	4 350	VHF UHF	HAYASHIKANE JAPAN 1978
Balad	27.2x7.25x3.55 8	1600 12	$60M^3/H$ -	2 -	-	7.8 30	3 220	VHF UHF	TIMSAH ISMAILIA 1981
Shedwan	27.2x7.25x3.55 8	1600 12	DITTO	2 -	-	7.8 30	3 220	VHF UHF	DITTO
Batel	7.15x8.6x3.57 8	1600 11.5	1x220 -	2 -	-	5.3 30	1 220	VHF UHF	TIMSAH ISMAILIA 1975

SUEZ

NAME OF TUG	DIMENSION LXBXD (M) NUMBER OF CREW	POWER (HP) SPEED (KT)	FIRE PUMP (G/M) WATER CURTAIN	FOAM. (TONS) DRY CHEMICAL (TONS)	DISPERSANT (TONS)	MONITOR		COMMUNICATION FACILITY	SHIPPING CO. YEAR BUILT
						HEIGHT (M) DISCHARGE RANGE (M)	N° DISCHARGE RATE (G/M)		
A-Salvage tug									
Shahm	50x12x4.9 12	6400 15	1x740 2x370 -	2 -	-	10 50	370	VHF UHF	IHC HOLLAND 1960
B-Escort tugs									
Moawen 3	32.8x9.5x3.16 10	3200 13	1x888 FRONT	12	4	14.5 50	2 444	VHF UHF	IHI JAPAN 1976
Moawen 5	32.8x9.5x3.16 10	3200 13	1x888 FRONT	12 -	4	14.5 50	2 444	VHF UHF	DITTO
Abahgat	35x11x4 10	3700 13	2x740 1x1040 -	10 1	-	11 50	4 350	VHF UHF	HAYASHIKANE JAPAN 1978
Batal 2	35x11x4 10	3700 13	2x740 1x1040 -	10 1	-	11 50	4 350	VHF UHF	DITTO
Baher 2	35x11x4 10	3700 13	2x740 1x1040 -	10 1	-	11 50	4 350	VHF UHF	DITTO
C-Harbor tug									
Kader	27.15x8.6x3.87 8	1600 11.5	1x220 -	2 -	-	5.3 30	1 220	VHF UHF	TIMSAH ISMAILIA 1970

Table II-5-(2)-2 List of Floating Cranes

No.	Load (tons)	Year of Construction	Self Propelled or Towed	Length of Arm (m)	Belongs to Location
1	200	1960	Self	28.8	Shipyard, Port Said
1	100	1978	Self	40	ditto
1	40	1977	Self	12	ditto
2	500	1982	Self	35	Salvage, Port Said
1	100	1978	Self	40	Shipyard, Suez
1	40	1930	Self	38	Dredger, Working at many places in the Canal
1	25	1961	Self	6.6	ditto
2	25	1977	Self	20	ditto
1	9	1979	Self	10	ditto
3	8	1961	Self	95	ditto
1	3	1916	Towed	4.1	ditto
1	80	1954	Self	14	ditto
2	9	1979	Self	10	Workshop, Port Said
6	8	1950 ~ 1969	Self	9.5	Workshop, Port Said Ismailia Suez
2	9	1979	Self	10	Workshop, Suez
7	25	1960 ~ 1977	Self	6.6	Transit, Port Said Ismailia Suez
4	3	1916 ~ 1969	Self 2 Towed 1	4.6	Workshop, Suez

Table II-5-(2)-3 List of Barges for Carrying Rocks

No.	Self Propelled	Tonnage
9	Towed	40
77	Towed	50
124	Towed	100
53	Towed	200
10	Self	200
23	Self	450

Table II-5-(2)-4 List of Small Boats

Horse Power \ Location	Port Said	Ismailia	Suez
1300	2	2	3
740	1	2	4
650	6	1	5
300	12	10	4
140 or less	25	10	4

Table II-5-(2)-5 List of Submersible Pumps

Port Said			Ismailia			Suez			Belongs to
No.	Capacity	Electric Power	No.	Capacity	Electric Power	No.	Capacity	Electric Power	
33	800ℓ/m	AC	3	220 m^3/h	AC				Salvage section
7	80ℓ/m	AC	3	60 m^3/h	AC				Salvage section
5	1,800ℓ/m	AC							Salvage section
3	165m^3/h	AC							Salvage section
1	275m^3/h	AC				3	4.8 m^3/h	AC	Shipyard dept.
6	4.8m^3/h	AC							Shipyard dept.
2	2,500ℓ/m	AC							Shipyard dept.
1	275ℓ/m	AC				1	96 m^3/h	AC	Work dept.
1	650ℓ/m	AC							Work dept.
Total 59			Total 6			Total 4			

Table II-5-(2)-6 List of Fire Pumps

Port Said				Ismailia				Suez				Belongs to
No.	Capacity	Type of Generator	Manometer Height	No.	Capacity	Type of Generator	Manometer Height	No.	Capacity	Type of Generator	Manometer Height	
2	576 m^3/h	Diesel	18 m	3	150 m^3/h	Diesel	10 m	2	20 m^3/h	Diesel	45 m	Work dept.
2	150 m^3/h	Diesel	10 m					2	150 m^3/h	Diesel	10 m	Work dept.
								1	576 m^3/h	Diesel	18 m	Work dept.
1	45 m^3/h	Gasoline	80 m	3	48 m^3/h	Gasoline.	80 m					Transit dept.
				1		Gasoline						Transit dept.
				18	3,600ℓ/m	Gasoline						Transit dept. (For Signal Station)
2		Gasoline										Shipyard dept.
Total 7				Total 25				Total 5				

Table II-5-(2)-7 List of Chemical Agents

Location		Dispersant	Foam Concentrate	Dry Chemical Powder
East branch		139 barrels	–	–
Port Said	On shore	10 barrels	145 barrels	–
	On tugs	12 tons	63.9 tons	2 tons
Ras el Eah		53 barrels	63 barrels	–
EL Tineh		27 barrels	40 barrels	–
EL Cap		26 barrels	5 barrels	–
EL Kantara		55 barrels	5 barrels	–
EL Ballah		71 barrels	–	–
EL Ferdan		54 barrels	–	–
Ismailia	On shore	123 barrels	100 barrels	–
	On tugs	11.6 tons	74.6 tons	9 tons
Tousun		–	–	–
Deversoir		125 barrels	–	–
Kabrit		120 barrels	–	–
Geneffa		51 barrels	–	–
EL Shalloufa		52 barrels	–	–
Suez	On shore	100 barrels	37 barrels	–
	On tugs	8 tons	58 bons	3 tons

3) Training

Training sessions on spill accidents for crew members of tug boats and launches and signal station personnel are given 3 times a year (About 12 personnel each time). At each session, practical training on how to use skimmers, booms and dispersant are provided.

Also, staffmembers have been sent abroad to attend foreign training schools. Since 1981, one trainee was sent to the U.K. once, and three times (two men) to France (one of the trainees received training two times).

As for fire, the Civil Fire Department provides a 6-day training on a weekly basis to 30 to 40 personnel from all the fields on firefighting knowledge.

The training course lectures include the following:

- Causes of fire
- Types of firefighting equipment and materials and how to use them (water and portable firefighting equipment).
- How to get water supply
- How to handle hoses
- Destruction method
- How to make an access to the scene of a fire
- How to save lives

These lectures are not intended for fire fighting on vessels. They are designed for fighting fire at the shipyard, workshop or factory on ashore. In 1981, one trainee was sent to U.K. and received a 6-week training. This particular trainee is currently assigned to the Public Relation Dept. and should any accident occur, he will be called without delay.

4) Condition of Maintenance Works

(i) Maintenance of Equipment and Materials
Existing materials are well kept by the staff in charge.

(ii) Equipment Delivered in the Early Part of 1983

i) 150 m. Hoyle marine coastal boom with fabric tensile strength of 15,900 kg. The boom is on a reel and fits into a half container.

ii) 150 m. Hoyle marine permanent type boom.

iii) 5 flexible storage tanks

iv) 2 cyclonet (050) 30 m^3/h each

v) 1 weir type skimmer 20 m^3/h

(iii) Equipment Delivered by the End of 1983

i) Lightering barge, 3200 ton capacity

ii) Coastal and harbor antipollution craft, catamaran type with a weir system for oil collection, settling and storage tank with a maximum capacity of 300 m^3/h.

(iv) Equipment Delivered in 1984
Lightering barge, 3200 ton capacity

(v) Fire Boat Under Consideration

Multi-purpose craft with a firefighting system comprising;

i) One 5500 G/m monitor mounted on the wheel house

ii) Two 2500 G/m monitors mounted on the foredeck

iii) One 1500 G/m foam monitors mounted on the high level access tower (15 m. above water level).

iv) Water curtain

v) Firefighting foam concentrate or dispersant tank of 900 U.S. gallons.

vi) Dispersion Devices
Total pumping capacity about 6000 G/m

vii) Speed 28 knots

(vi) Transit Team Under Consideration
Setting up of the following team of specialists who have received education and training on spill control and firefighting as members of a transit team is being considered.

Head of the team (Ismailia)	Ismailia	Certificate checker	2
		Fire chief	1
		Pollution officer	1
		Crew members	4
		Salvage Section	
	Port Said	Certificate checker	2
		Fire chief	1
		Pollution officer	1
		Crew members	4
		Salvage Section	
	Suez	Certificate checker	2
		Fire chief	1
		Pollution officer	1
		Crew members	4
		Salvage Section	

(3) Construction and Maintenance Works

1) Dredging

(i) SCA currently owns 13 dredgers for the maintenance of the Canal. The main specifications of these dredgers, are shown in Table II-5-(3)-1. The main places for proper use of these dredgers are as follows:

The hopper suction dredgers : The approach channels
The cutter suction dredgers : The Canal
The bucket dredgers : The harbours

Table II-5-(3)-1 Dredgers Owned by SCA

No.	Name	Type	H.P.	Length (m)	Breadth (m)	Draught (m)	Max. Dredging Depth (m)	M^3/H
1	Tarek Ibn Zaid	Cutter Suction	10,000	119.3	19.5	3.8	30	1800
2	Al Seddiek	Cutter Suction	10,000	121.32	21.0	3.8	30	1800
3	Al Khattab	Cutter Suction	10,000	121.32	21.0	3.8	30	1800
4	Mahmoud Younes	Cutter Suction	5,500	97.3	15.0	3.5	25.3	800
5	Khofo	Cutter Suction	5,500	76.19	14.93	4.36	21	800
6	10th Ramadan	Cutter Suction	3,300	60.0	13.5	2.6	19	400
7	26th July	Cutter Suction	2,450	75.75	13.0	2.7	18	700
8	Zenobia	Cutter Suction	1,700	42.7	9.3	1.5	18	200
9	1st Septem.	Cutter Suction	1,700	42.7	9.3	1.5	18	200
10	Salah E-Din El Ayoubi	Hopper Suction	15,000	120.5	19.6	8.5	30	2200
11	Oboor Port Said	Hopper Suction	15,000	116.3	20.8	8.5	30	2200
12	Mina 1	Bucket	Bucket cap. 750 ℓ	61.3	12.06	3.65	24.65	300
13	Mina 2	Bucket	Bucket cap. 550 ℓ	58.0	11.8	3.65	22.3	200

(ii) Dredging work related to the Canal, after completion of the First Stage Development Project, is being executed by SCA's dredgers except for a part of the waiting area in the Great Bitter Lake which had been done by a Japanese contractor.

The dredging work which SCA's dredgers are carrying out in the Canal, in addition to widening the waiting area in the Great Bitter Lake, is not only maintenance dredging but simultaneously part of the Second Stage Development of the sections north of Lake Timsah and the Kabrit Bypass, i.e. dredging to deepen the Port Said approach channel (from minus

20.0 meters to minus 25.0) and the Port Said west channel (from minus 15.0 meters to minus 15.5), widening and deepening dredging between kilometers 19 and 45 (widening: 175 to 225 meters, and 160 to 210 meters; deepening: from minus 19.5 meters to minus 20), and widening dredging of the Kabrit east channel, etc. (Refer to Fig. II-5-(3)-1)

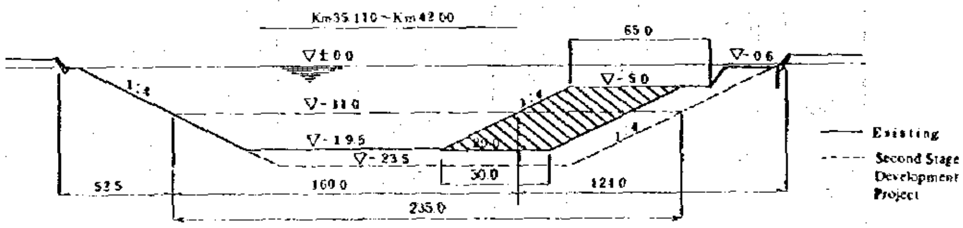


Fig. II-5-(3)-1 Typical Proposed Cross Section for the Second Stage Development Project

To avoid accidents between transit vessels and work vessels doing the dredging work in the Canal, the work vessels are executing the work according to the following regulations:

i) When transit vessels pass, in principle the dredgers and their accessories such as anchors are not left in the fairway of the Canal. SCA's dredgers ordinarily use the bollards located on both sides of the Canal as operation anchors.

ii) The dredgers are shifted to a position outside the navigation buoy line at least 30 minutes prior to the expected time of passing of the transit vessels and then they wait for the transit vessels to pass.

(a) One of the three main offices communicates the expected time of passing of the transit vessels to the dredgers 2 hours prior to their passenge by wireless. The names of the three main offices and their territories are as follows.

Port Said office	:	Port Said waiting area, Hectometer 195 to Kilometer 51
Ismailia office	:	Kilometers 51 to 105
Suez office	:	Kilometer 105 to Hectometer 85, Suez waiting area

(b) The dredgers receiving communication by wireless stop operations according to the captain's judgment and commence movements so as to complete the shift at least 30 minutes prior to the expected time of passing of the transit vessels.

Ordinarily they stop operations at least an hour prior to the expected time, because the shifting work takes them about 30 minutes. (Items and the required times for each are shown in Table II-5-(3)-2.)

Table II-5-(3)-2 The Time Required for Shifting Dredgers

Item	Time (minutes)	Note
Pipe Line Washing	5	In the case of a pipe line length of 1800 meters
Ladder Lowered	3	
Spud up	2	
Swing to the Right (Forepart)	6	
Spud Lowered	2	
Ladder up	3	
Swing to the Right (Afterpart)	7	
Ladder Lowered	2	
Total	30	

There is no obligation on the part of the captain to communicate with the offices concerning completion of the shift, but when the dreger can not move due to problems such as engine trouble with the winch, the situation is communicated to the transit department at one of the three main offices.

Following that there is communication by wireless between the transit department and the pilots who are on board the transit vessels. Pilots who receive such communication by wireless either reduce the speed of the transit vessels or stop, depending upon the situation, and wait for the further instructions.

(c) It is conceivable that there might be some cases where for some reason the dredgers could not shift to a position completely outside the navigation buoy line.

In these cases the pilot would discuss the situation with the dredger's captain and if there was not any means to reach a solution, the transit vessels would pass subject to the judgment of the pilot.

(d) In the case of widening dredging, operations continue outside the navigation buoy line, except when mammoth tankers pass by. In the case of deepening dredging, the dredger waits outside the line for the passing of the transit vessels.

(e) Of course, all pilots know the scheduled positions of the dredgers, and the numbers, drafts, etc. of the transit vessels.

(f) Proper use of the wireless (UHF and VHF) is shown in Table II-5-(3)-3.

Table II-5-(3)-3 Proper Use of the Wirelesses

Place	Type of Wireless	Note
Main Offices	UHF	Port Said, Ismailia, Suez (They have VHF too but they are not using it)
Signal Stations	VHF	Ras El Ish, El Tina, El Cap, El Kantara, El Bailah, El Firdan Tusun, Deversoir, El Kabrit, Geneffe, El Shallufa
Pilots	UHF	
Pilot Boats	VHF	
Tugboats	UHF, VHF	
Transit Vessels	VHF	
Dredgers	UHF, VHF	

2) Sounding Surveys

The schedule and the locations of maintenance dredging are decided according to the results of sounding surveys.

The basic schedule of SCA is once every three months for the Port Said approach channel, once every two years for the sections north of Lake Timsah, and once every three years for those south of it.

The survey methods are as follows:

(i) The Port Said approach channel area is being surveyed with a cross-sectional leveling carried out at 10 meter intervals using a survey boat equipped with the Sea Fix System.

Sea Fix System: It is composed of a radio range finder, a computer system and an echo sounder (ATLAS DESO 20).

It can automatically measure the positions of the survey boat and draw a sounding map.

(ii) The Canal and Suez entrance area are being surveyed with profile leveling on the center line only using an echo sounder (ATLAS DESO 20).

Concerning the places which should be resurveyed and the places suggested by the pilots, the Canal cross sections are being surveyed at 25 meter intervals with either portable echo sounders (RS-61S Type) or sounding leads.

At this time, echo sounders are not being used together with sounding leads.

By comparing the results of the profile leveling and the cross-sectional leveling, we can say that the depth of water at the Canal center is almost equal to the figures shown in Table II-5-(3)-4.

But even if the center depth is satisfactory in accordance with the planned depth, we can not say that other points also comply with the plans. Therefore, there is need for detailed surveys of the depth of the entire Canal once every year or two.

Table II-5-(3)-4 Comparison between the Depth by Profile Leveling and Cross-Sectional Leveling

Location	Design Depth	Depth by the Survey of the Cross Section				Depth by the Survey on the Center Line
		Survey Date	Depth of Center	Deepest Depth	Shallowest Depth	Survey Date 4.6.1983
Hm 190	-20.0 m	13. 7.1983	-21.0 m	-21.0 m	-20.8 m	-21.0 m
180	-20.0	13. 7.1983	-20.2	-20.7	-19.3	-20.7
170	-20.0	13. 7.1983	-20.2	-20.6	-19.2	-20.6
150	-20.0	1. 7.1983	-19.9	-20.2	-17.8	-20.2
120	-20.0	1. 7.1983	-20.4	-20.6	-17.6	-20.4
100	-20.0	1. 7.1983	-19.2	-19.5	-18.0	-19.4
90 (East)	-20.0	1. 7.1983	-22.4	-22.9	-18.9	-21.6
80 (East)	-20.0	1. 7.1983	-20.8	-22.3	-18.2	-21.1
70 (East)	-20.0	1. 7.1983	-20.0	-20.2	-17.0	-20.2
21.5 (West)	-15.5	1. 7.1983	-14.8	-14.8	-11.0	-14.8
Km 17.0 (East)	-19.5	15. 9.1983	-19.2	-20.0	-18.2	-19.5
17.0 (West)	-19.5	15. 9.1983	-19.3	-20.0	-18.5	-19.5
17.5	-19.5	17. 9.1983	-19.2	-21.3	-18.8	-19.7
42.45	-19.5	14. 9.1983	-21.8	-21.8	-18.8	-20.8
43.6	-19.5	14. 9.1983	-21.0	-21.5	-19.0	-20.4
47.5	-19.5	14. 9.1983	-19.8	-20.7	-19.2	-19.2
48.4	-19.5	11. 9.1983	-19.0	-19.7	-18.5	-19.3
51.0	-19.5	11. 9.1983	-21.1	-21.2	-19.4	-20.9
51.7 (West)	-15.5	11. 9.1983	-16.1	-16.4	-14.8	-16.0
59.8 (West)	-15.5	11. 9.1983	-16.4	-17.0	-12.6	-16.2
71.0	-19.5	10. 9.1983	-20.6	-21.2	-19.3	-20.3
81.0	-19.5	10.10.1983				-20.1
86.78	-19.5	2.10.1983	-20.4	-21.6	-19.1	-20.3
95.2 (East)	-19.5	12. 9.1983	-20.7	-20.8	-19.6	-21.0
95.2 (West)	-15.5	27. 9.1983	-17.6	-17.8	-15.8	-17.6
119.8 (East)	-19.5	29. 9.1983				-19.3
119.8 (West)	-15.5	29. 9.1983				-15.2

3) Activities of SCA's Dredgers (1981 ~ 1982)

In 1981 and 1982, the SCA was simultaneously carrying out maintenance dredging and part of the Second Stage Development Project using 15 dredgers (10 cutter suction dredgers, 2 hopper suction dredgers, and 3 bucket dredgers). The work began immediately after the completion of the First Stage Development Project.

The dredged volume was 45,153,699 m^3 in 1981, and 38,351,368 m^3 in 1982, for a total volume of 83,505,067 m^3. Tables II-5-(3)-5 ~ 9 and Fig. II-5-(3)-2 show the monthly operating conditions for each dredger and the areas dredged during these two years.

Table II-5-(3)-10, 11 show the operating efficiency for each dredger. The annual operating rate of the 5 dredgers of more than 5,000 HP, which seem to be the main dredgers for future work in the Canal, is 69 percent and the dredging time per operating day is 16 hours and 51 minutes.

The number of hours the dredging machines were operated per day was high because most of the work was widening dredging which involves continual operation of the dredging equipment. If the work shifts to primarily maintenance dredging, the number of hours the dredging machines are operated per day will decrease significantly.

The dredgers Nefertiti, Ramsis, and Khafrah are not currently being used.

Table II-5-(3)-5 Operating Conditions of SCA's Dredgers (1981 ~ 1982)

(Number of days operated per month)

No.	Name of Dredger	Type	H.P.	1981												1982											
				1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Tarek Ibn Ziad	Cutter Suction	10,000							24	30	24	28	30	30	31	27	31	27	31	21	26	25	24	23	16	
2	Al Seddiek	"	10,000	29		28	30	29	26	31	25	26	30	30	31	28	28	31	30	30	30	23	1	4	31	30	31
3	Al Kattab	"	10,000	15	28	31	30	31	30	31	29	26	30	30	26	30	27	31	30	31	30	30	29	29	19		
4	Mahmoud Younes	"	5,500	28	28	16	27	30	26	28	27	24	23	25	30	14	25	31	25	14							
5	Khofo	"	5,000	18	20	22			15	31	30	18	21	10	28	20		27	24	13	18	27	4	12	11	23	12
6	10th Ramadan	"	3,300									7	11	10													
7	26th July	"	2,450	27	18	31	30	31	21							17	27	31	27	31	30	31	11	7	31	28	30
8	Zenobia	"	1,700	27	14	7	24	2							5												
9	1st September	"	1,700																	20	23	27	31	7	22	3	
10	Nefertiti	"	400	9	22	27	8		17	15		8	18	11	26	28	14		1	31	25	19	24	28	31	30	28
11	Salah E-Din El Ayoubi	Hopper Suction	2x1600	30	27	31	29	31	30	5	25	30	30	30	31	31	10		30	31	30	30	31	29	31	29	31
12	Ramsis	"	2x750	29	26	31	29	12			5	30	30	30	31	21											
13	Mina 1	Bucket	Bucket Cap.750ℓ	24	27	31	29	27	29	22																20	31
14	Mina 2	"	Bucket Cap.550ℓ	7			19	28	25	29	29	28	28	30	31	8	24	17		24	26	30	19	7	30	30	29
15	Khafrah	"	Bucket Cap.850ℓ	3	26	20	29	30	30	31	27	21	29	19	4												

Table II-5-(3)-6 Operating Conditions of each Dredger owned by SCA (1)

Name of Dredger: Tarek Ibn Ziad (Cutter Suction, 10,000 H.P.)

Items \ Month (1981)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area							Km.3,600 ~ 6,850	—	—	Km.2,800 ~ 7,000 Km.7,000 ~ 15,700	Km.7,000 ~ 15,700	—	
Dredging Volume (m³)							618,230	884,615	662,145	651,205	866,070	819,900	4,302,165
Operation Dates (D)							24	30	24	28	30	30	116
Operation Hours (H)							390:00	484:30	379:45	374:30	556:30	538:00	2,731:15
Dumping Area							East	—	—	—	—	—	

Items \ Month (1982)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Km.7,000 ~ 15,700	—	—	Km.4,000 ~ 17,000	—	—	—	—	—	—	—			
Dredging Volume (m³)	849,015	804,070	1,005,015	1,064,650	977,870	605,990	938,185	819,795	590,180	489,395	368,290		8,532,455	12,834,620
Operation Dates (D)	31	27	31	27	31	31	26	25	24	23	16		292	448
Operation Hours (H)	561:30	488:30	570:00	498:00	520:30	537:30	448:30	421:30	382:30	351:30	255:00		4,833:00	7,564:15
Dumping Area	East	—	—	—	—	—	—	—	—	—	—			

Name of Dredger: Al Seddiek (Cutter Suction, 10,000 H.P.)

Items \ Month (1981)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.1,500		Km.1,580 ~ 2,850	Km.2,160 ~ 2,500	Km.2,500 ~ 2,900 Timsah	Timsah	Timsah	Timsah Km.114,000	Km.114,000	—	—	—	
Dredging Volume (m³)	366,265		470,380	990,400	1,056,025	1,171,720	1,266,025	865,900	628,230	999,500	1,107,050	1,150,445	10,499,460
Operation Dates (D)	29		28	30	29	26	31	23	26	30	30	31	313
Operation Hours (H)	404:00		493:15	453:30	491:30	530:00	586:00	457:30	471:00	580:00	570:00	606:00	5,392:45
Dumping Area	East		East	East	East	Onshore West		East in Bitter Lake	—	—	—		

Items \ Month (1982)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Km.114,000	—	—	—	—	—	Km.114,000 Km.36,000 ~ 43,000	Km.38,245 ~ 38,275	Km.38,280 ~ 38,400	Km.38,450 ~ 38,550	Km.38,550 ~ 40,150	Km.40,150 ~ 41,345		
Dredging Volume (m³)	977,065	812,800	703,075	712,950	775,315	719,865	324,685	19,300	77,000	661,175	724,055	606,985	7,114,400	17,814,060
Operation Dates (D)	28	28	31	30	30	30	23	1	4	31	30	31	297	612
Operation Hours (H)	550:30	478:00	504:00	471:00	510:30	531:00	359:30	14:00	86:00	556:30	512:00	413:00	4,986:00	10,378:45
Dumping Area	East in Bitter Lake	—	—	—	—	—	—	In a dike North of Kantara	—	—	—	—		

Name of Dredger: Al Kattab (Cutter Suction, 10,000 H.P.)

Items \ Month (1981)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.99.00 Km.5.39	Km.7.16	Km.7.595 ~ 8.90	Km.5.63 ~ 6.175	Km.9.863 ~ 11.87	Km.11.87 ~ 13.265 Km.6.195	Km.3.35 ~ 5.885 Km.13.265 ~ 14.305	Km.17.40 ~ 17.53	Km.17.53 ~ 18.43	Km.18.44 ~ 19.08 Km.14.50	Km.7.00 ~ 15.00	Km.7.00 ~ 15.00 Km.114.00	
Dredging Volume (m³)	304,950	1,178,980	1,343,490	1,240,550	1,397,590	1,302,780	1,081,400	1,303,200	1,009,060	497,395	421,465	1,113,025	12,793,885
Operation Dates (D)	13	28	31	30	31	30	31	29	26	30	30	26	337
Operation Hours (H)	198:15	531:30	629:30	590:30	607:50	596:00	584:30	564:30	435:30	405:00	475:30	471:30	4,088:05
Dumping Area		East	—	—	—	—	—	—	—	—	Port Fuad	Bitter Lake	

Items \ Month (1982)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Km.114.00	—	—	—	—	—	—	—	—					
Dredging Volume (m³)	1,162,310	996,210	802,700	1,071,775	931,775	727,725	909,655	655,550	468,000	267,815			7,928,715	20,724,600
Operation Dates (D)	30	27	31	30	31	30	30	29	29	19			286	623
Operation Hours (H)	559:00	476:00	542:30	579:30	579:30	542:30	576:00	550:00	508:00	356:30			5,197:30	11,285:35
Dumping Area	East in Bitter Lake	—	—	—	—	—	—	—	—	—				

Name of Dredger: Mahmoud Younes (Cutter Suction, 5,500 H.P.)

Items \ Month (1981)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.56.00 ~ 60.333	Km.56.00 ~ 60.335	Km.56.00 ~ 60.00	Km.56.00 ~ 60.00 Km.139.30 ~ 157.00	Km.139.00 ~ 157.00	—	—	—	Km.139.00 ~ 157.00 Km.53.60 ~ 54.40	Km.53.60 ~ 54.40	Km.53.60 ~ 54.40 Km.139.30 ~ 157.00	Km.139.30 ~ 157.00	
Dredging Volume (m³)	149,448	225,530	121,085	155,380	97,420	142,400	69,860	20,450	76,610	56,649	76,701	153,210	1,345,379
Operation Dates (D)	28	26	16	27	30	26	28	27	24	23	25	30	312
Operation Hours (H)	418:00	425:45	202:30	439:00	388:00	480:00	438:00	388:00	334:30	307:00	327:00	454:30	4,602:15
Dumping Area	West	—		In East dikes No. 3, 4, 5, 6	—	—	—	—	—	—	—	—	

Items \ Month (1982)	1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Km.139.30 ~ 157.00 Km.61.00 ~ 76.20	Km.61.00 ~ 76.20	—	—	—							Km.1.50		
Dredging Volume (m³)	71,830	139,275	176,270	128,610	59,590							34,300	609,875	1,975,254
Operation Dates (D)	14	25	31	25	24							5	114	426
Operation Hours (H)	206:00	366:30	510:30	359:30	160:00							51:30	1,654:00	6,256:15
Dumping Area	6	In East dikes		16, 14	—									

Table II-5-(3)-7 Operating Conditions of each Dredger owned by SCA (2)

Name of Dredger: Khofo (Cutter Suction, 5,000 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.139.30 ~ 143.30	←	←			Km.79.95 ~ 81.20 Km.139.30 ~ 147.30	Km.139.30 ~ 147.30	←	←	Port Taufiq	←	←	
Dredging Volume (m³)	94,150	119,225	104,770			90,775	87,900	99,200	30,270	134,460	62,600	267,300	1,106,570
Operation Dates (D)	18	20	22			15	31	30	18	21	10	28	213
Operation Hours (H)	318:00	351:00	399:00			232:30	332:00	323:45	269:15	281:30	124:40	327:10	3,361:10
Dumping Area	Dike No. 3, 4	←	←			No. 3, 4	←	←	←	West Dike	←	←	

1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Port Taufiq		Port Taufiq	←	←	←	←	←	←	←	←	←		
105,300		208,700	250,315	116,770	191,615	51,578	6,000	10,800	250	168,840	70,375	1,160,063	2,266,633
20		27	24	13	18	27	4	12	11	23	12	191	404
280:55		512:30	411:50	329:00	326:15	367:15	62:00	203:30	204:00	361:00	145:45	3,101:00	6,462:10
West Dike		West Dike	←	←	←	←	←	←	←	←	←		

Name of Dredger: 10th Ramadah (Cutter Suction, 3,300 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area									Timsah	←	←		
Dredging Volume (m³)									47,450	91,930	70,160		209,540
Operation Dates (D)									7	11	10		28
Operation Hours (H)									101:40	194:00	159:00		454:40
Dumping Area									West Km. 81	←	←		

1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
												0	209,540
												0	28
												0	454:40

Name of Dredger: 26th July (Cutter Suction, 2,450 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.4.72 ~ 4.925	Km.5.125 ~ 5.755	Km.5.55 ~ 6.10	Km.6.10 ~ 6.70	Km.6.57 ~ 7.195	Km.7.195 ~ 7.79							
Dredging Volume (m³)	151,615	103,420	172,900	180,775	174,310	104,950							888,970
Operation Dates (D)	27	16	31	30	31	21							156
Operation Hours (H)	356:30	299:00	320:00	456:30	422:00	273:30							2,327:30
Dumping Area	East	←	←	←	←	←							

1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Timsah ~Km80.45 Km.81.365	Km.81.00 ~ 76.20	←	←	←	Km.81.00 ~ 76.20 Km.36.00 ~ 45.00	Km.36.00 ~ 45.00	←	←	←	Km.36.00 ~ 45.00 Km.19.00 ~ 31.185	Km.19.00 ~ 36.00 Km.6.00 ~ 17.00		
130,900	165,120	177,390	108,860	101,750	113,615	196,013	79,430	30,850	365,490	211,035	288,880	1,867,575	2,756,545
17	27	31	27	31	30	31	11	7	31	28	30	301	457
408:00	483:00	551:00	453:00	528:00	504:00	496:30	178:30	138:00	571:30	474:00	486:30	5,252:00	7,579:30
East	Dikes No. 17, 13, 13'	←	←	←	North of Qantrah	←	←	←	←	←	←		

Name of Dredger: Zenobia (Cutter Suction, 1,700 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.5.615 ~ 6.085	Km.6.085 ~ 6.215	Km.54.55	Km.54.55 Timsah	Timsah							Timsah	
Dredging Volume (m³)	31,873	22,300	17,673	49,605	3,600							8,225	173,560
Operation Dates (D)	27	14	7	24	2							5	79
Operation Hours (H)	261:00	116:35	117:00	456:30	28:20							53:00	1,028:45
Dumping Area	East	←	West	←	←							West	

1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
												0	173,560
												0	79
												0	1,028:45

Table II-5-(3)-8 Operating Conditions of each Dredger owned by SCA (3)

Name of Dredger: 1st September (Cutter Suction, 1,700 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area													
Dredging Volume (m^3)													*
Operation Dates (D)													*
Operation Hours (H)													*
Dumping Area													

Items	1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area					Serabyum ——		Timsah ——							
Dredging Volume (m^3)					6,215	61,190	38,475	42,360	12,810	27,085	3,750		174,085	174,085
Operation Dates (D)					20	23	27	31	7	22	3		133	133
Operation Hours (H)					232:00	297:00	336:00	397:00	84:00	219:40	36:00		1,599:40	1,599:40
Dumping Area					——	East ——								

Name of Dredger: Nefertiti (Cutter Suction, 400 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Kantara	Port Said	Timsah	Timsah Kantara							Ballah ——		
Dredging Volume (m^3)	6,400	13,825	22,750	4,330		10,880	6,005		3,490	11,060	8,130	22,170	111,010
Operation Dates (D)	9	22	27	4		17	15		8	18	11	26	161
Operation Hours (H)	118:10	323:30	343:50	97:50		188:00	154:00		96:00	240:10	132:40	362:10	2,057:20
Dumping Area													

Items	1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Ballah ——			Ballah ——			Ballah Port Said	Port Said	Ballah ——			Ballah Timsah		
Dredging Volume (m^3)	22,320	5,200		330	17,940	15,700	8,620	14,600	19,250	21,650	18,400	14,780	156,980	267,990
Operation Dates (D)	28	14		1	31	25	19	26	28	31	30	29	259	420
Operation Hours (H)	370:00	61:30		6:00	351:30	317:50	174:00	371:30	344:40	388:20	360:50	334:50	2,985:00	5,042:20
Dumping Area														

Name of Dredger: Salah E-Din El Ayoubi (Hopper Suction, 2x1600 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.70~90	Km.70~120	Km.70~120 Km.65~90	Km.70~130 Km.65~85		Km.67~100	Km.67~100	Km.67~100	Km.67~120	Km.70~130	Km.79~90		
Dredging Volume (m^3)	771,740	629,950	865,000	661,000	876,000	915,500	96,000	604,000	734,500	765,000	762,000	790,500	8,566,190
Operation Dates (D)	30	27	31	29	31	30	5	25	30	30	30	31	329
Operation Hours (H)	461:00	425:05	518:10	461:35	523:30	531:19	63:30	422:10	517:40	525:56	484:03	503:44	5,443:40
Dumping Area	——			Off Shore Dumping Area ——									

Items	1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Km.70~90			Km.70~90		Km.70~90 Km.60~80	Km.70~120 Km.60~80 ——			Km.60~120 Km.60~90	Km.70~120 Km.60~80	Km.70~120 Km.50~90		
Dredging Volume (m^3)	771,000	271,500		925,500	1,002,000	948,000	930,000	1,023,000	931,500	999,000	926,000	930,000	9,635,500	18,201,690
Operation Dates (D)	31	10		30	31	30	30	31	29	31	29	31	313	642
Operation Hours (H)	486:36	142:04		488:10	521:35	493:20	485:15	531:49	485:40	516:30	479:09	507:10	5,137:18	10,578:58
Dumping Area	Off Shore Dumping Area			——		Off Shore Dumping Area ——								

Name of Dredger: Ramsis (Hopper Suction, 2x750 H.P.)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.30~40 Km.30~40	Km.25~55 Km.70~85	Km.35~65 Km.70~85	Km.35~65 Km.30~65	Km.30~40 Km.50~65			Km.25~55 Km.50~65	Km.35~65 Km.30~40 Km.80~110	Km.25~55 Km.30~80 Km.80~110	Km.35~65 Km.50~80 Km.80~100	Km.25~65 Km.40~70	
Dredging Volume (m^3)	246,200	231,000	289,400	242,500	106,500			50,700	470,700	461,500	443,700	442,400	3,002,300
Operation Dates (D)	29	26	31	29	12			5	30	30	30	31	253
Operation Hours (H)	341:35	309:37	399:33	374:34	162:55			46:25	415:40	395:49	373:20	374:44	3,196:32
Dumping Area	—— Off Shore Dumping Area ——							—— Off Shore Dumping Area ——					

Items	1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Km.25~55 Km.30~55													
Dredging Volume (m^3)	285,300												285,300	3,287,600
Operation Dates (D)	21												21	274
Operation Hours (H)	226:36												226:36	3,423:08
Dumping Area	Off shore Dumping Area													

Table II-5-(3)-9 Operating Conditions of each Dredger owned by SCA (4)

Name of Dredger: Mina 1 (Bucket)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.3.60 ~ 4.85	———	———	———	———	———	———						
Dredging Volume (m³)	43,600	44,940	78,730	77,260	77,440	100,200	73,420						495,590
Operation Dates (D)	24	27	31	29	27	29	22						189
Operation Hours (H)	233:40	253:55	360:55	330:40	328:55	401:30	317:00						2,274:35
Dumping Area													

Items \ Year / Month	1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area											Km.4.89 ~ 4.375	Km.4.375 ~ 4.85		
Dredging Volume (m³)											75,650	144,220	219,870	713,460
Operation Dates (D)											20	31	51	240
Operation Hours (H)											249:50	432:20	682:10	2,956:45
Dumping Area														

Name of Dredger: Mina 2 (Bucket)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Km.7			Km.7	Km5.75 Port Tawfiq	Port Tawfiq	———	———	Port Tawfiq Port Said	Km.7~15.7	Km.7.00 ~ 15.70 Km.6.70 ~ 6.40	Km.6.70 ~ 6.40 Km.3.40 ~ 3.525	
Dredging Volume (m³)	18,230			54,570	89,410	28,270	86,680	119,700	126,040	95,530	104,650	123,310	846,780
Operation Dates (D)	7			19	26	25	29	29	28	28	30	31	254
Operation Hours (H)	67:25			201:00	334:40	322:10	388:55	414:50	398:05	358:45	368:55	399:05	3,253:50
Dumping Area													

Items \ Year / Month	1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area	Km.3.40 ~ 3.425	Km.4.37 ~ 4.80	———		Km.4.275 ~ 4.80	Port Said	———	———	Km.3.95	———	———	Km.3.75		
Dredging Volume (m³)	35,840	93,030	64,660		61,190	63,300	63,400	37,000	16,200	81,600	71,400	72,950	666,570	1,513,350
Operation Dates (D)	8	24	17		26	26	30	19	7	30	30	29	244	498
Operation Hours (H)	106:05	320:30	233:45		329:15	361:55	389:15	239:05	90:50	415:20	422:20	406:15	3,314:45	6,568:35
Dumping Area														

Name of Dredger: Khafra (Bucket)

Items \ Year / Month	1981: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total
Location of Dredging Area	Port Said	———	———	Km.3.30	Km.2.392	Km.2.707	Km.2.373 ~ 2.724	Km.2.724 ~ 2.975	Port Said Km.7.00 ~ 15.00	Km.3.033 ~ 3.119	Km.3.091 ~ 3.009	Km.3.009 ~ 2.995	
Dredging Volume (m³)	5,560	63,070	35,010	73,920	90,060	89,000	64,390	57,600	47,710	34,770	26,410	4,380	612,080
Operation Dates (D)	3	26	20	29	30	30	31	27	21	29	19	4	269
Operation Hours (H)	20:40	226:10	144:00	270:55	319:35	323:55	275:05	282:40	207:40	236:50	142:25	26:50	2,494:45
Dumping Area													

Items \ Year / Month	1982: 1	2	3	4	5	6	7	8	9	10	11	12	Sub-Total	Total
Location of Dredging Area														
Dredging Volume (m³)													0	612,080
Operation Dates (D)													0	269
Operation Hours (H)													0	2,494:45
Dumping Area														

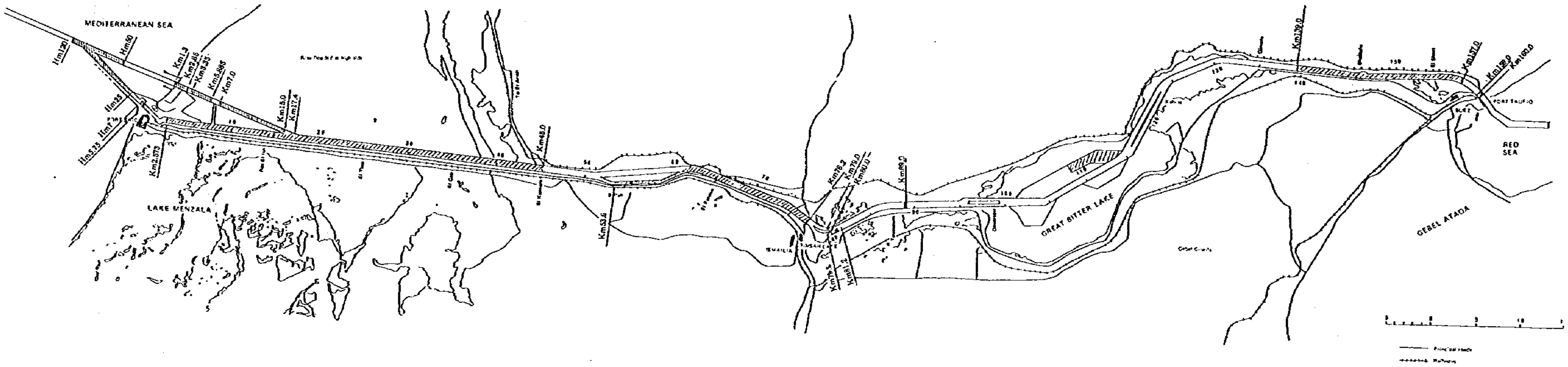


Fig. II-5-(3)-2 Areas Dredged by SCA's Dredgers (1981 ~ 1982)

Table II-5-(3)-10 Operating Efficiency of SCA's Dredgers (1981)

Name	Type	H.P.	Operating Months	Operating Day	Operating Hours	Operating hours per Day	Dredging Volume (m^3)	Dredging Volume per Operating Hour (m^3)
Tarek Ibn Ziad	Cutter Suction	10,000	(7∿12) 6	166	2,731:35	16.27	4,302,165	1,575
Al Seddiek	"	10,000	(1,3∿12) 11	315	5,592:45	17:45	10,699,660	1,913
Al Kattab	"	10,000	(1∿12) 12	337	6,088:05	18:04	12,795,885	2,102
Mahmoud Younes	"	5,500	(1∿12) 12	312	4,602:15	14:45	1,365,379	297
Khofo	"	5,000	(1∿3,6∿12) 10	213	3,561:10	16:43	1,106,570	311
10th Ramadan	"	3,300	(9∿11) 3	28	454:40	16:14	209,540	461
26th July	"	2,450	(1∿6) 6	158	2,327:30	14:44	888,970	382
Zenobia	"	1,700	(1∿5) 5	79	1,028:45	13:01	173,580	169
1st September	"	1,700	-	-	-	-	-	-
Nefertiti	"	400	(2∿4, 6∿7) (9∿12) 10	161	2,057:20	12:47	111,010	54
Salah E-Din El Ayoubi	Hopper Suction	2x1,600	(1∿12) 12	329	5,441:40	16:32	8,546,190	1,571
Ramsis	"	2x750	(1∿5,8∿12) 10	253	3,196:32	12:38	3,002,300	939
Mina 1	Bucket	Bucket Cap. 750ℓ	(1∿7) 7	189	2,224:35	11:46	493,590	222
Mina 2	"	Bucket Cap. 550ℓ	(1, 4∿12) 10	254	3,253:50	12:49	846,780	260
Khafrah	"	Bucket Cap. 850ℓ	(1∿12) 12	269	2,494:45	9:16	612,080	245
Total			126	3,063			45,153,699	

Table II-5-(3)-11 Operating Efficiency of SCA's Dredgers (1982)

Name	Type	H.P.	Operating Months	Operating Day	Operating Hours	Operating hours per Day	Dredging Volume (m^3)	Dredging Volume per Operating Hour (m^3)
Tarek Ibn Ziad	Cutter Suction	10,000	(1 ∿ 11) 11	282	4,835:00	17:09	8,532,455	1,765
Al Seddiek	"	10,000	(1 ∿ 12) 12	297	4,986:00	16:47	7,114,400	1,427
Al Kattab	"	10,000	(1 ∿ 10) 10	286	5,197:30	18:10	7,928,715	1,525
Mahmoud Younes	"	5,500	(1∿5, 12) 6	114	1,654:00	14:30	609,875	369
Khofo	"	5,000	(1, 3∿12) 11	191	3,101:00	16:14	1,160,043	374
10th Ramadan	"	3,300	-	-	-	-	-	-
26th July	"	2,450	(1 ∿ 12) 12	301	5,252:00	17:27	1,847,575	352
Zenobia	"	1,700	-	-	-	-	-	-
1st Stember	"	1,700	(5 ∿ 11) 7	133	1,599:40	12:02	174,085	109
Nefertiti	"	400	(1∿2, 4∿12) 11	259	2,985:00	11:32	156,980	53
Salah E-Din El Ayoubi	Hopper Suction	2x1600	(1∿2, 4∿12) 11	313	5,137:18	16:25	9,655,500	1,879
Ramsis	"	2x750	(1) 1	21	226:36	10:47	285,300	1,259
Mina 1	Bucket	Bucket Cap. 750ℓ	(11 ∿ 12) 2	51	682:10	13:23	219,870	322
Mina 2	"	Bucket Cap. 550ℓ	(1∿3, 4∿12) 11	244	3,314:45	13:35	666,570	201
Khafrah	"	Bucket Cap. 850ℓ	-	-	-	-	-	-
Total			105	2,492			38,351,368	

II-6 Survey of Canal Users

A questionnaire survey was conducted with respondents including the Canal pilots, masters of vessels transiting the Canal and Japanese captains who have transited the Suez Canal. As a result, 26 replies were received from the Canal pilots, 304 replies from masters of vessels transiting the Canal, and 98 replies from Japanese captains.

Shown below are a summary of the results of the questionnaire survey.

(1) Answers from Masters of Transiting Vessels

Table II-6-(1)-1 Respondents' Vessels by Type

Size (G/T) / Type	~10,000	10,000 ~50,000	50,000 ~100,000	100,000~	Unknown	Total
General Cargo	65	42		1	2	110
Container	32	32	7		1	72
Tanker	6	42	8	5		61
Others	5	53	1		2	61
Total	108	169	16	6	5	304

Table II-6-(1)-2 Number and Kind of Feared Danger, by Causes and Positions

Kind / Causes / Position	Collision			Grounding			Total
	Improper Aids to Navigation	Narrow Area	Others	Improper Aids to Navigation	Narrow Area	Other	
Port Said Waiting Area	1	2		5		2	10
Port Said	5	2	7	36	3	7	60
In the Canal	1		2	4	2	6	15
Suez	4	2	4	13	1	4	28
Suez Inner Anchorage		1					1
Suez Waiting Area	3	2		2			7
Total	14	9	13	60	6	19	121

Table II-6-(1)-3 Number and Kind of Feared Danger, by Type of Vessel and Direction

Kind	Direction	General Cargo ~10,000	General Cargo 10,000~50,000	General Cargo 50,000~100,000	General Cargo 100,000~	General Cargo Unknown	General Cargo Sub Total	Container ~10,000	Container 10,000~50,000	Container 50,000~100,000	Container 100,000~	Container Unknown	Container Sub Total	Tanker ~10,000	Tanker 10,000~50,000	Tanker 50,000~100,000	Tanker 100,000~	Tanker Unknown	Tanker Sub Total	Others ~10,000	Others 10,000~50,000	Others 50,000~100,000	Others 100,000~	Others Unknown	Others Sub Total	Total ~10,000	Total 10,000~50,000	Total 50,000~100,000	Total 100,000~	Total Unknown	Total
Collision	Northbound	1	3				4	1	1	2			4		1	1			2		1				1	2	6	3			20
	Southbound													1	2		1		4		5				5	1	7		1		
Grounding	Northbound	8	3			1	12	3	3	3			9		8	2			10	4	5				9	15	19	5		1	64
	Southbound	3					3	3	2	3			8		5	2	1		8		5				5	6	12	5	1		
Total		12	6			1	19	7	6	8			21	1	16	5	2		24	4	16				20	24	44	13	2	1	84

Table II-6-(1)-4 Summary of Comments by Type of Vessel

Comment	General Cargo ~10,000	General Cargo 10,000~50,000	General Cargo 50,000~100,000	General Cargo 100,000~	General Cargo Unknown	General Cargo Sub Total	Container ~10,000	Container 10,000~50,000	Container 50,000~100,000	Container 100,000~	Container Unknown	Container Sub Total	Tanker ~10,000	Tanker 10,000~50,000	Tanker 50,000~100,000	Tanker 100,000~	Tanker Unknown	Tanker Sub Total	Others ~10,000	Others 10,000~50,000	Others 50,000~100,000	Others 100,000~	Others Unknown	Others Sub Total	Total ~10,000	Total 10,000~50,000	Total 50,000~100,000	Total 100,000~	Total Unknown	Total
Racons are Needed	5	2				7	3	4	1			8		7		1		8	2	2				4	10	14	3			27
Lack of Information and Communication	2	1				3	1	4	3			8		2				2		1		1		2	3	8	3	1		15
Pilot must Board from the Anchorage	1				1	2								1	2			3		2				2	1	3	2		1	7
Better Maintenance of Buoys							1		1			2		1				1	1	1				2	2	2	1			5
Others	3					3		1	1		1	3		1				1		2				2	3	6				9
Total	11	3			1	15	5	9	6		1	21		12	2	1		15	3	8		1		12	19	33	9	1	1	63

(2) Answers from Canal Pilots

Table II-6-(2)-1 Summary of Answers from Canal Pilots

Grounding			
	Causes	Bank irregular	3
		Improper aids to navigation	5
		Narrow area	2
		Strong wind or current	2
Comments			
	Buoys should be well maintained		5
	More proper navigation aids		4
	Increase speed		3
	Better communication with center concerned		1
	Better cooperation with tug boats		1
	Others		2

(3) Answers from Japanese Captains

Table II-6-(3)-1 Canal Transit Experience of Respondents

Experience \ Responsibility	As Master	As Navigator
1 ~ 2 years	21	7
3 ~ 5	26	15
6 ~ 10	25	17
11 ~ 20	9	19
21 ~	1	11
Total	82	69

Table II-6-(3)-2 Respondents' Vessels by Type

Type \ Size (G/T)	~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	100,000 ~	Total
Container Vessel	6	38	17		61
Tanker		23	5	2	30
G/C Vessel & Others	11	31	2		44
Total	17	92	24	2	135

Table II-6-(3)-3 Number and Kind of Feared Dangers, by Causes and Size of Vessels for Containers

Kind / Size (G/T) / Cause	Collision between Vessels					Collision with Others					Grounding					Others					Total
	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	
Narrow Water		2	19	3	24			6		6		1	7	3	11			3		3	44
Small Curvature		1	1		2			2		.2			3		3			1		1	8
Complexity of Meeting		2	19	2	23			3		3			3	2	5			1		1	32
Shallow Effect				1	1			1	1	2		1	4	4	9						12
Improper Aids to Navigation			11	4	15			4	2	6			3	5	8			4	1	5	34
Strong Current			5	1	6			4	2	6			16	7	28			2		2	37
Others		4	18	3	25			8		8		1	14	3	18		1	8	3	12	63
Sub Total		9	73	14	96			28	5	33		3	50	24	77		1	19	4	24	230
Total	96					33					77					24					

Table II-6-(3)-4 Number and Kind of Feared Dangers, by Causes and Size of Vessels for Tankers

Kind / Size (G/T) / Cause	Collision between Vessels					Collision with Others					Grounding					Others					Total
	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	
Narrow Water			2		2			3		3			3		3		1			1	9
Small Curvature													1		1						1
Complexity of Meeting			5		5								1		1						6
Shallow Effect								1		1			3	1	4						5
Improper Aids to Navigation			3		3																3
Strong Current				1	1								1	4	5						6
Others			6	1	7								2	1	3						10
Sub Total			16	2	18			4		4			11	6	17		1			1	41
Total	18					4					17					1					

Table II-6-(3)-5 Number and Kind of Feared Dangers, by Causes and Size of Vessels for General Cargo Vessels and Others

Cause \ Kind / Size (G/T)	Collision between Vessels					Collision with Others					Grounding					Others					Total
	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	~ 5,000	5,000 ~ 10,000	10,000 ~ 50,000	50,000 ~ 100,000	Total	
Narrow Water			8	1	9			3		3			13		13						25
Small Curvature				1	1			1	1	2			1		1						4
Complexity of Meeting		1	9		10			1		1			1		1						12
Shallow Effect								2		2		1	3		4						6
Improper Aids to Navigation		1	4		5		2			2		1	8		7			1		1	17
Strong Current		1	4	1	6		2	4		6			7		7			2		2	21
Others		2	12		14			4		4			13		13		1	1	1	3	34
Sub Total		5	37	3	45		4	15	1	20		2	46		48		1	3	1	6	119
Total	45					20					48					6					

Table II-6-(3)-6 Number and Kind of Feared Dangers, by Causes and Positions for All Kinds of Vessels

Kind / Cause / Position	Collision between Vessels								Collision with Others								Grounding								Total
	Narrow Water	Small Curvature	Complexity of Meeting	Shallow Effect	Improper Aids to Navigation	Strong Current	Others	Sub Total	Narrow Water	Small Curvature	Complexity of Meeting	Shallow Effect	Improper Aids to Navigation	Strong Current	Others	Sub Total	Narrow Water	Small Curvature	Complexity of Meeting	Shallow Effect	Improper Aids to Navigation	Strong Current	Others	Sub Total	
Suez Approach and Waiting Area	4		7		2		6	19	1							1	1		1		2	1	1	6	26
Suez Inner Anchorage	10		10	1	2	2	17	42			2		1		2	5	2	1	1	2	7	1	4	18	65
Port Tewfiq									1							1	3	1		2	1	3	1	11	12
Little Bitter Lake and El Kabrit (km 116 ~ 134)						1		1				2				2	9	3	1	1	5	6		25	28
Great Bitter Lake (km 94 ~ 116)	4	1	1	1	1	1	4	13				1			1	2	1			2			3	6	21
Lake Timsah (km 73 ~ 82)																	2	1		4	1	1	2	11	11
El Ballah 6 (km 50 ~ 62)	1				1			2									1			2			4	7	9
Port Said Bypass (km 2 ~ 20)					1			1	1			1				2	2			2	4	8	1	17	20
Port Said	15	2	12		13	13	13	68	13	2	4		10	10	8	47	14	1	3		8	20	16	62	177
Port Said Approach and Waiting Area	1		9	1	6	2	4	23			1			4	2	7							1	1	31
Total	35	3	39	3	26	19	44	169	16	2	7	4	11	14	13	67	35	7	6	15	28	40	33	164	400

Table II-6-(3)-7 Summary of Comments

Simplification of booking notice	41
Improvement of communications at waiting areas	61
Sure anchorage instructions	37
Widening of anchorages	54
Canal pilots should board at waiting areas	55
Increased and improved maintenance of aids to navigation	22
Widening of the Canal	19
Doubling of the Canal	35
Improvement of the Canal transit system	15
Improvement of the communication system	24
Improvement of the operation of tugs and escort tugs	18
Give information not only to pilots but also to masters	28
Others	29
Total	438

II-7 Environment

The current Canal environment was reviewed based on "Environment along the Canal (1976)", information from interviews and discussions, and the results of a sampling survey of Canal water quality.

(1) Population and Assets

Fig. II-7-(1)-1 shows the distribution of population and of major public facilities along the Canal.

Even though the review was supposed to be done in areas within 1 Km of the Canal in the three large cities and within 500 m of the Canal in other regions, the population study was obliged to use data including whole administrative divisions. Also as to assets, those which are publicly important and were confirmed during the field survey are also illustrated in Fig. II-7-(1)-1.

In 1976, Port Said, Ismailia and Suez had populations of 78,363, 17,000 and 29,219 respectively, and totaled this represents 75% of the population along the Canal. From Port Said to Ismailia, except for such towns as Kantara and Firdan, noticeable urban areas are seldom recognizable from the road, and only agricultural land lies scattered in the southern part of this section. From Ismailia to Suez, there are many small towns continuously along the shores of Lake Timsah and Great Bitter Lake, and the land is mostly used for agriculture throughout this section except for its middle part.

Of public facilities, 11 signal stations, many mooring quays including jetties for ferry boats, roads and railways are pointed out as the important ones. If such accidents as fires and explosions should occur near these facilities, they may lose their ability to function and substitute means may consequently be required to maintain the life of the inhabitants as before. In this sense, it is preferable that sand hills be laid between the Canal road and the Canal to protect the road and the railway from disasters, because they are the principal routes connecting the major cities. These sand hills would also serve as barriers against side winds protecting the transit vessels as well.

Except for the assets mentioned above, nothing more than private houses can be found in some places and all other areas along the Canal are desert.

References :

1. Population Rank (unit : thousand)

100	80	60	40	20	10	5	1

2. Signal Stations

3. Mooring Facilities

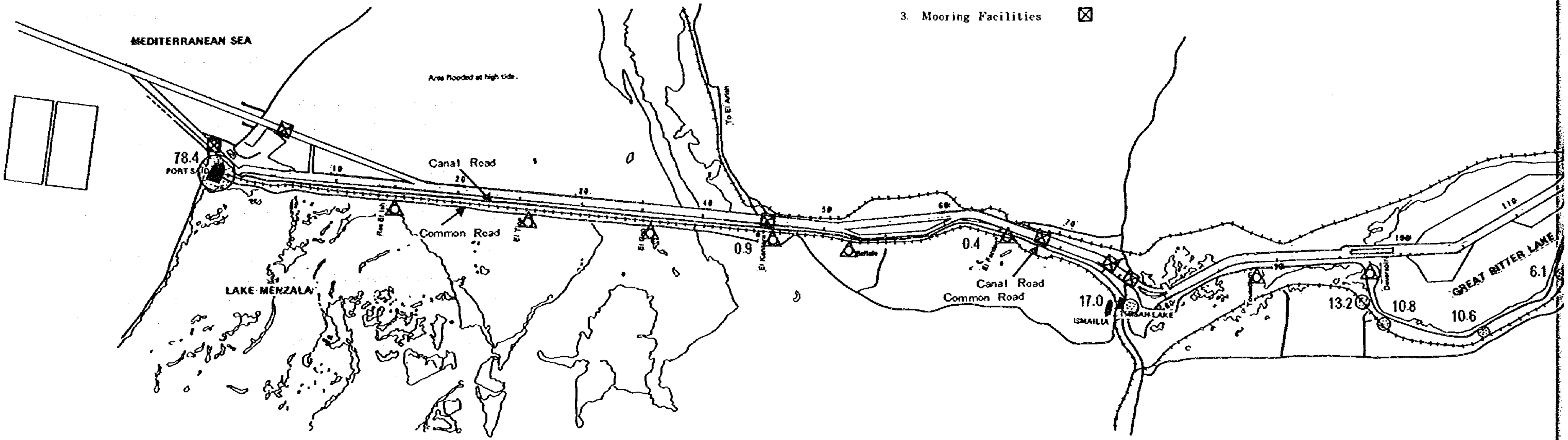


Fig. II-7-(1)-1 Environment along the Canal

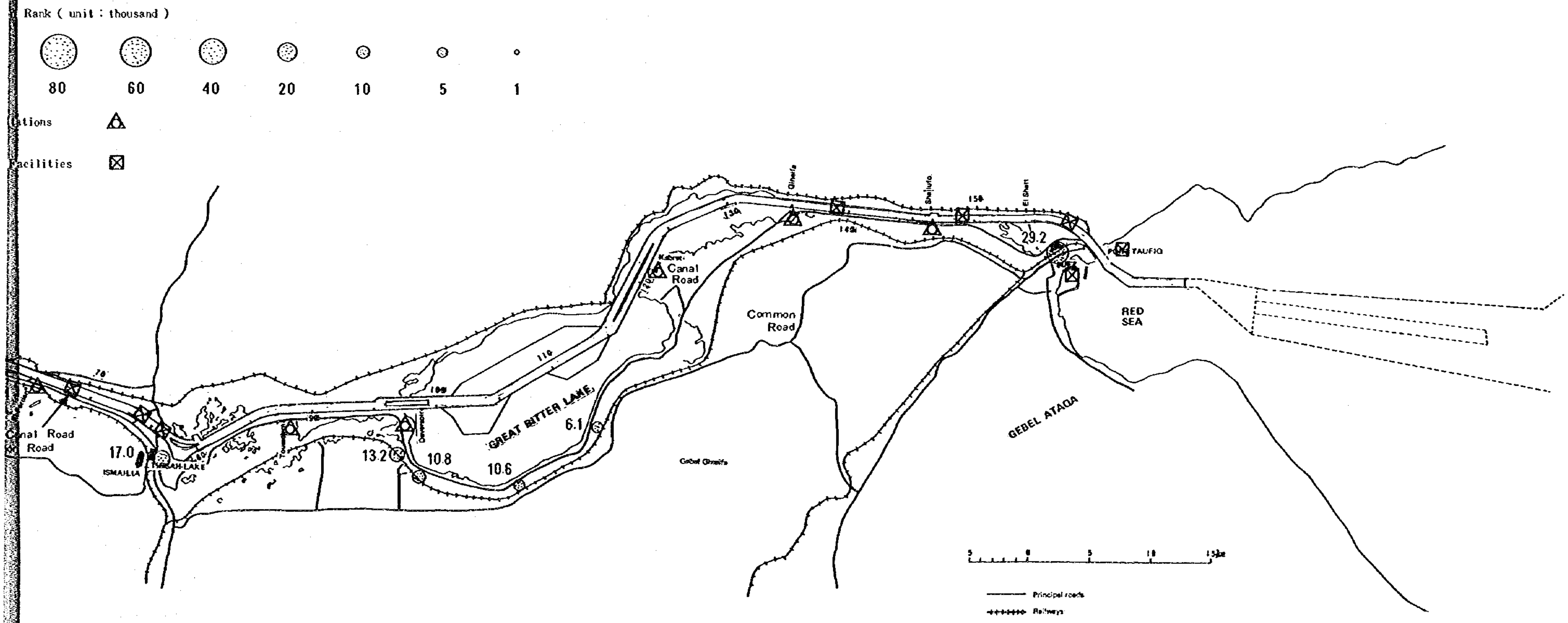


Fig. II-7-(1)-1 Environment along the Canal

(2) Water Wuality

21 samples were gathered to analyze the water quality of the Canal at the end of the period of the field survey so as to have as little delay before the analysis as possible, reducing possibility of qualitative changes in the samples. These samplings were carried out by means of sinking bottles to a 15 cm depth at some distance from the Canal bank so as not to take in floating refuse. The Japanese Industrial Standards (JIS) were, in general, applied to the survey, because this is a clear system, authorized by the Japanese Government taking into consideration the latest world trends in the environmental field.

This time, the items of analysis were selected with the view of clarifying the general water quality of the Canal and obtaining the boundary conditions for a computer simulation. Tests were run for seven items, Chemical Oxygen Demand (COD), Chloride Ion (Cl^-), Potential of Hydrogen (PH), Particulate and Dissolved Matter (SS), Dissolved Oxygen (DO), Temperature, and Oily Matter*1 (OCB).

*1 Oily matter: Mixture of Iso-Octane, Cetane and Benzen

Table II-7-(2)-1 shows the results of analysis together with the locations of the samples and Fig. II-7-(2)-1 shows the graphs of these results illustrated on the map of the Canal.

With regard to COD, the maximum value is the 7.4 mg/ℓ at St. 21 near the oil berth in Suez Bay and the minimum one is the 2.8 mg/ℓ at the west side of Little Bitter Lake. The range of COD values is roughly between 3 PPM and 7 PPM which generally speaking can not be considered a suitable value for fishery or swimming, and is takne as the limiting value representing a generally safe environment.

The highest values of Cl^- were recorded at St. 17 and the lowest at St. 11 which was located on the west side of Lake Timsah. The value of St. 11 is extremely low compared with the others' and it can be judged that the sample might have some special conditions taking into consideration the height of the COD value.

The values of PH are very constant and indicate a low level of alkalinity.

As to SS, the values can be separated into three groups, the first of about 10 PPM or less, the second of between 10 PPM and 20 PPM and the last one of 20 PPM or more. The high values were recorded in the harbour of Port Said and in the area from the juncture of Bitter Lakes to the center of Little Bitter Lake.

The results of testing for DO are on the whole acceptable throughout the Canal, because the minimum value is 4.1 PPM and the average value is 5.8 PPM.

The temperature of the Canal water was about 25°C and the maximum difference is only 2.1°C.

Oily matter could not be extracted at this time, and until now, at least, the oil pollution is not considered serious.

Fig. II-7-(2)-1 indicates the changes of the values, contrasting items to each other along the Canal.

The values of COD are generally worse in those water areas having a large city nearby. This is considered to be deeply connected with the fact that city sewage is freely passing untreated into the Canal.

The change of Cl^- is very interesting. Except for the value at St. 11, it is clear that the southern part indicates higher values than the northern part. The reason for this seems to be that the lakes in the southern part have a salty layer on their bottoms and provide chloride ions which dissolve into the sea water.

The value of PH does not seem to vary with the sampling location along the Canal.

The result of testing for SS shows that St. 16 and St. 17 have extremely high values. Taking into consideration the tidal current during the survey, it can be said that this area is judged to be the point where the water is not moved by the current and that in consequence of this, particulates and dissolved matters collect in this area.

The DO tests show that the values in the southern part are higher than those of the northern part, which means that the water quality of the former is preferable to that of the latter. This fact is connected with the temperature of the water. As Fig. II-7-(2)-2 indicates, the temperature of the southern part was also lower than that of the northern part and this is considered to have worked conservatively against bio-activity by animal and/or plant planktons.

In conclusion, the water quality of the Canal can be said to have already reached the limit of comfortable circumstances, as regards contamination.

Table II-7-(2)-1 Results of Analysis of Water Quality

	Name	Location		COD (mg/ℓ)	Cl⁻ (0/00)	PH	SS (mg/ℓ)	DO (mg/ℓ)	Temperature (°C)	OCB (mg/ℓ)
1	Port Said (1)	Hm 50	West Entrance	5.2	20.4	8.1	22.9	5.5	24.6	ND
2	Port Said (2)	Hm 30	Near Tip of East Breakwater	4.8	20.4	8.2	–	5.3	24.8	–
3	Port Said (3)	Km 2	in Harbour	5.0	20.6	8.1	18.4	4.2	25.1	ND
4	Ras El Ish	Km 14	West Channel	5.4	20.6	8.0	19.6	4.1	25.0	–
5	El Tina	Km 25		4.6	21.5	8.1	12.2	5.2	25.5	–
6	El Cap	Km 35		3.4	22.7	8.2	9.5	5.5	25.6	ND
7	El Kantara	Km 45		4.2	22.7	8.2	–	5.2	25.5	–
8	El Ballah	Km 55	West Branch	4.2	23.4	8.1	6.8	5.9	25.5	–
9	El Firdan	Km 62.5	Near Jancture	4.0	23.3	8.2	4.8	5.9	25.9	–
10	Ismailia	Km 77	Near Sailing Club	5.2	22.9	8.1	6.7	5.8	25.8	–
11	Lake Timah	Km 78	West Side	7.2	14.8	8.0	6.3	5.9	25.1	ND
12	Toussoum	Km 87		5.4	23.0	8.2	6.7	5.9	25.7	–
13	Deversoir	Km 97.5	West Branch	4.2	24.6	8.2	6.5	6.1	25.8	ND
14	Fayed	Km 104	West Side of Great Bitter Lake	4.9	23.8	8.3	11.1	7.6	25.8	–
15	Fanara Quay	Km 111	– ditto –	3.8	23.8	8.2	–	7.1	26.0	ND
16	El Kabrit	Km 121	West Branch	3.2	24.4	8.3	65.6	6.5	25.2	–
17	Geziret El Hiraba	Km 128	West Side of Little Bitter Lake	2.8	24.7	8.2	25.4	5.9	24.8	ND
18	Gtineifa	Km 134.5	Entrance to Little Bitter Lake	3.3	24.4	8.2	8.6	5.9	24.3	ND
19	El Shallufa	Km 146		4.2	24.5	8.2	6.5	5.7	24.2	ND
20	Port Taufiq	Km 160	in Harbour	4.2	24.5	8.2	7.5	5.8	24.0	–
21	Suez	Hm 47.5	Near Oil Berth	7.4	24.6	8.2	5.0	5.9	24.0	ND

Note: 1. Samplings were conducted on Oct. 10, 1983 at St. 1 to 10 and Oct. 11, 1983 at St. 11 to 21.

2. The columns marked with a bar (–) means that the sample of the location was not analyzed for the item.

3. The "ND" means that the oily matter could not be extracted.

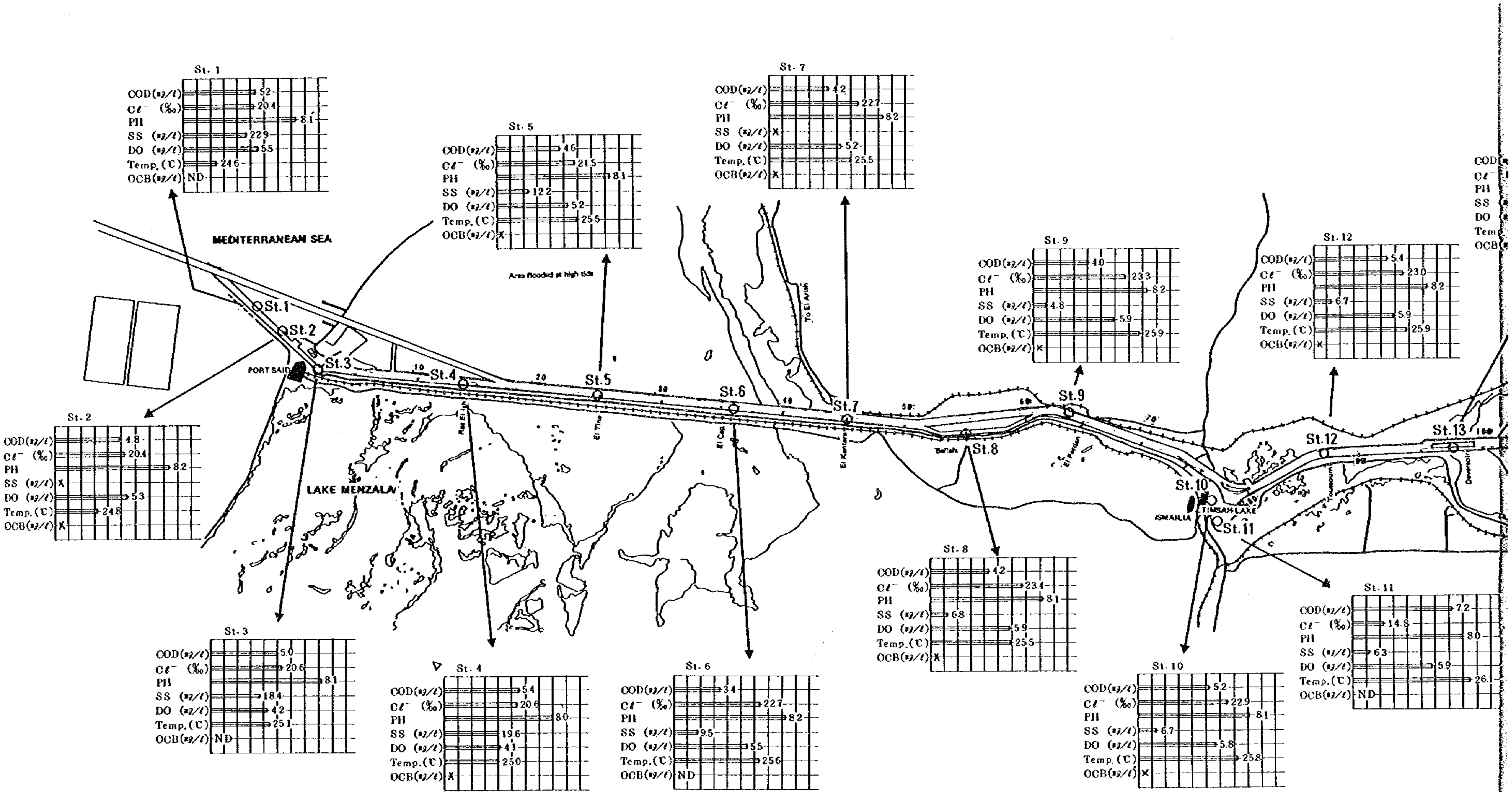
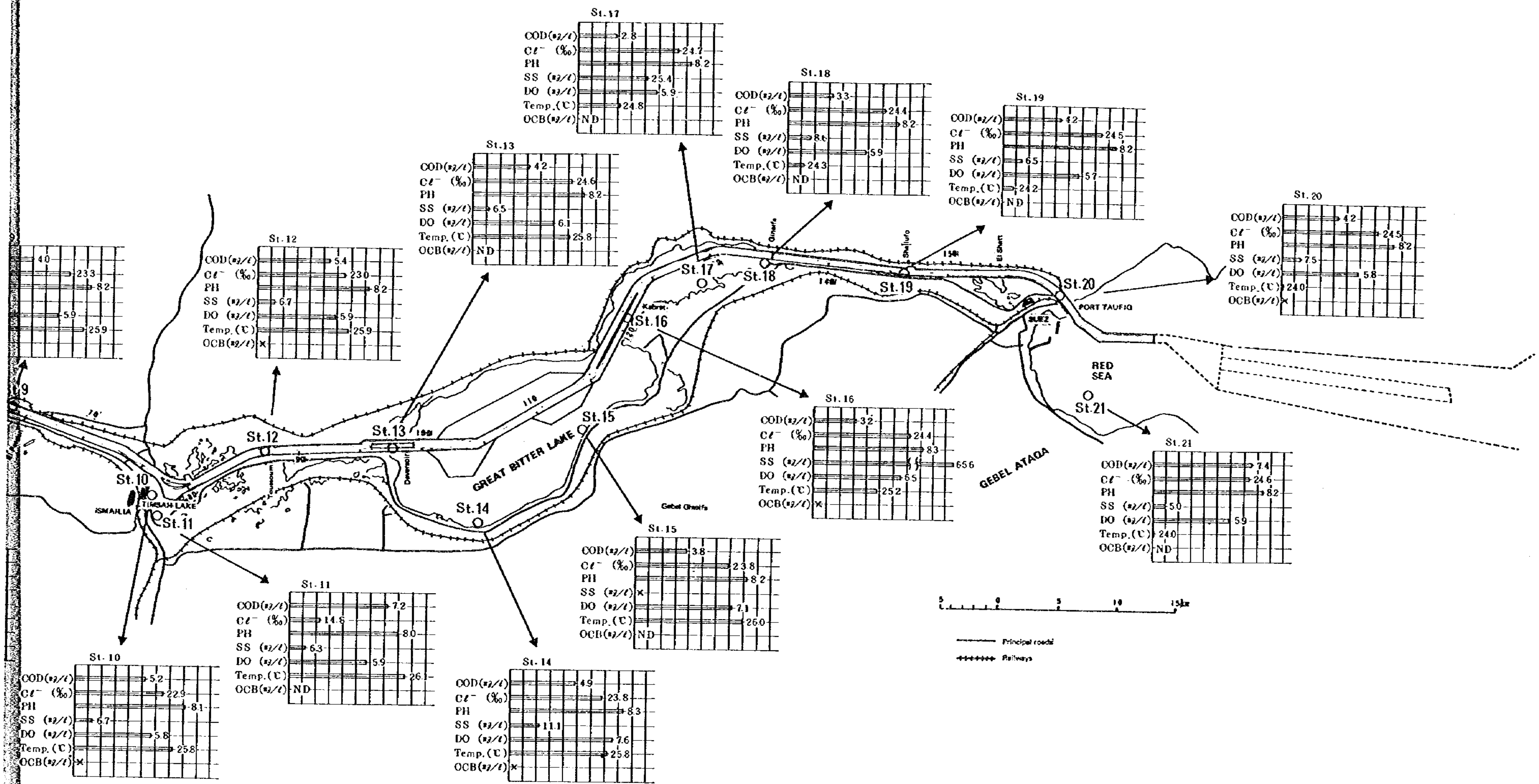
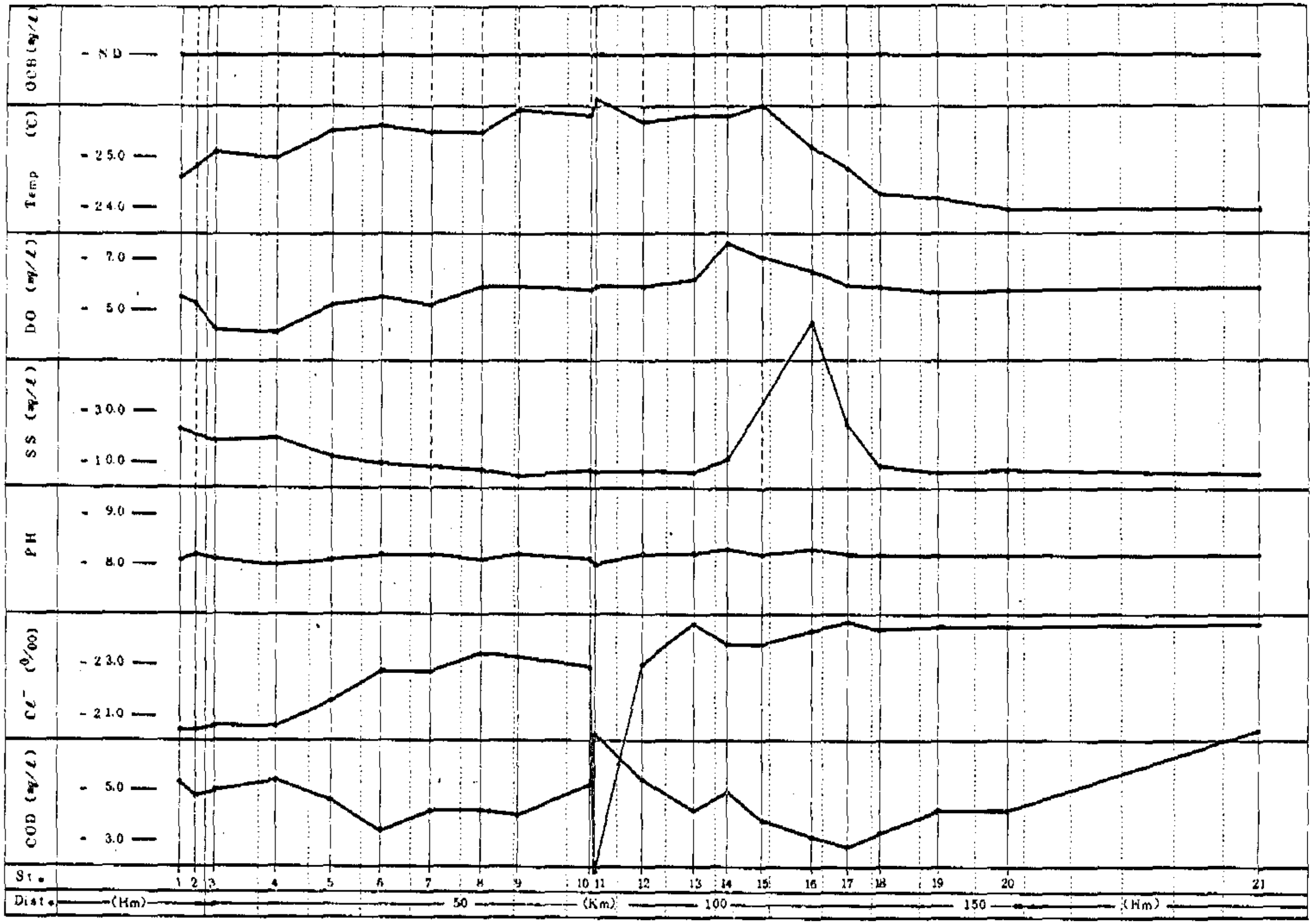


Fig. II-7-(2)-1 Water Quality of the Canal



Note: Items marked x were not analyzed.

Fig. II-7-(2)-1 Water Quality of the Canal



Note: Vertical dotted lines show that the sample was not analyzed for the item.

Fig. II-7-(2)-2 Quality of the Canal Water by Location