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Contract Report to

U. S. Navy, Atlantic Division,
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INTRODUCTION

Entrainment of the hydroid (Sertularia argentea) and the fleshly bryozoan (Alcyonidium verrilli) in the sea suction of deep draft naval vessels (carriers) in the area of the Norfolk Naval station has been a recurring problem since the early 60's. These fouling organisms (the term fouling is used in this report to indicate clogging of hull bottom intake grates and cooling system condenser tube sheets and not the growth of organisms on any part of the vessel) are winter species, growing only in the fall and winter and not the summer. Unfortunately they are also the most abundant and widely distributed species of hydroid and bryozoan in the entire Chesapeake Bay.

The problems caused by the fouling organisms in the Pier 12 area are not a result of organisms that have grown up within Pier 12, but result from adult organisms that have been transported to the pier area by water currents. The transport of organisms into Pier 12, which acts as a settling basin, combined with deep vessel draft and vessel pre-departure procedures are the three main elements that form the fouling problem.

In this report we are dealing with the element of transport of organisms into Pier 12, which breaks down into the following areas of investigation:

- Origin of fouling organisms (major growing areas)
- Movement of fouling organisms in Hampton Roads

- Flux of fouling organisms into Pier 12 area
- Evaluation of slip raking operations
- Current studies around Pier 12

In addition we also examined methods of deploying the anti-fouling net beneath a carrier's hull, identified areas where improvements in existing methods could be made, and explored techniques that could be implemented with the least assistance of the carrier's personnel through a separate contract with EG&G Washington Analytical Services Center. This effort is provided as a separate report.

BACKGROUND ON THE ORGANISMS

The hydroid, Sertularia argentea, is the most common winter hydroid in the Chesapeake Bay region. Each colony of animals is generally attached to a hard substrate, rocks, shells, piling, etc., by a stolon. Colonies can obtain lengths over 10" and be quite plumose encompassing a volume equivalent to a 10 to 12" sphere. The integrity of the colony is maintained by a very tough chitinous polymucosaccharide sheath that is resistant to decay and breakage.

This hydroid has an annual life cycle in the Bay area. In the early and late winter adult colonies reproduce sexually producing a swimming larval phase that eventually sets on a suitable substrate. The newly set colonies grow until spring. When the Bay waters start to warm they become dormant and remain over summer in a dormant state. In the fall, when Bay waters cool, growth ensues, and by early winter colonies mature and reproduce sexually completing the life cycle.

Sertularia is widely distributed in the Bay and can be found growing in every major tributary from the Potomac south. It is an estuarine species and tends to be found attached and growing at salinities of 20 to 25 $^{o}/oo$. It does not develop at salinities below 10 or above 30 $^{o}/oo$. However we really do not know if there are specific areas around the Bay that are major production points. In the winter when storms generate a lot of wave action the hydroid is broken free of its attachment and drifts with the currents, in a manner very similar to tumbleweed. The hydroid is definitely denser than sea water and does not float. A summary of its hydrodynamic properties is presented in Table 1.

The bryozoan, Alcyonidium verrilli, is the most common winter bryozoan in the Chesapeake Bay region. Colonies of animals can be attached to a variety of hard substrates including the sheath of Sertularia. Colonies can obtain sizes larger than spheres 18" in diameter. The colonies are very fleshly and are given structural support by a fibrous connective tissue. Unlike the hydroid the bryozoan is prone to decay once it dies and does not tend to accumulate in the sediments.

We do not know what the life history of Alcyonidium is in the Bay area but it is most likely an annual one and follows a similar pattern to Sertularia. The bryozoan differs from the hydroid in that it is more a marine species and seems to be found growing at salinities of 25 $^{o}/oo$ or higher.

Waves and currents are also responsible for the disattachment of the bryozoan. Once free to move it tends to concentrate in areas of reduced currents or in areas protected from wave action. The bryozoan is also denser than water. Its hydrodynamic properties are summarized in Table 1.

More detailed accounts of the fouling organisms' hydrodynamic properties can be found in reports by Ho, Diaz, and Neilson (1979), Diaz (1980), and Hydro Research Science (1981).

Table 1. Summary of the Hydrodynamic properties of Hydroids and Bryozoans (from Hydro Research Science Report).

Density

Hydroids	(live)	1.026 g/cc
"	(dead & buried)	1.087 g/cc
Bryozoans	(live)	1.128 g/cc
	(dead & buried)	1.187 g/cc

Critical Flow Velocity

Individual Colony Hydroids	live	1.45 cm/sec
Individual Colony Hydroids	dead	6.70 cm/sec
Individual Colony Bryozoans	live	6.21 cm/sec
Individual Colony Bryozoans	dead	6.70 cm/sec
Mixed Colonies Hydroids	live & dead	2.13 to 2.43 cm/sec
Mixed Colonies Bryozoans	live & dead	6.09 to 7.01 cm/sec

Initiation of Motion Velocity

Hydroids		Bryozoans	
Individual Live Colonies			
wet weight (g)	velocity (cm/sec)	wet weight (g)	velocity (cm/sec)
0.6	1.66	16.8	10.41
1.7	2.23	27.1	11.41
4.1	2.84	73.0	12.05
7.8	3.39	89.1	12.56

Mix of live and dead colonies

Hydroids	4.26 - 5.18 cm/sec
Bryozoans	8.53 - 9.75 cm/sec

Drag Coefficient

Hydroids	live	0.000541
Bryozoans	live	0.000738

Table 1 (concluded).

Fall Velocity of Organisms

Hydroids

Live Colonies Winter 1980 Growth wet weight (g)	fall vel. (cm/sec)	Dead Colonies Winter 1979 Growth wet weight (g)	fall vel. (cm/sec)
158	3.42	23.3	2.8
50	2.71	12.4	3.2
29	3.71	6.6	2.6
7.0	1.27	3.1	5.0
2.4	0.97	0.5	5.5
0.7	0.69	0.4	8.3
0.4	0.67	0.2	11.9

Bryozoans

Live Colonies Winter 1980 Growth wet weight (g)	fall vel. (cm/sec)	Dead Colonies Winter 1979 Growth wet weight (g)	fall vel. (cm/sec)
278	6.90	77.2	2.7
130	6.50	42.4	3.4
94	8.96	20.5	3.9
45	8.10	18.2	5.0
28	7.74	9.1	4.0
22	8.05	8.2	3.7
17	6.62	3.7	4.9
		3.3	6.5

PART I: ORGANISM SOURCE AND TRANSPORT ROUTE INVESTIGATION

Methods and Materials

Sites for Collection of Fouling Organisms

In Hampton Roads a total of 31 sites were chosen to track hydroid movement and find where the fouling organisms originate. Additional sites were located outside Hampton Roads on Willoughby Banks, Thimble Shoals, and near the Chesapeake Bay bridge-tunnel. Most sites in Hampton Roads were sampled weekly. On Willoughby Banks and the other areas samples were taken at irregular intervals depending upon the weather.

Collecting sites (Figure 1) were established adjacent to Pier 12 (C, CE, and PH) to see if the organisms were accumulating outside the berthing area. Three transects running north and south across Hampton Roads were set up (labeled A, B and C on Figure 1) to follow movement of organisms. A transect was established going up the James River (JR) and Elizabeth River (ER) to see if the areas were a source of fouling organisms. Sites were also set on Middle Ground (MGW and MGE), off Sewells Point (SP), off Newport News Point (NP), and in a dredged pit on Hampton Bar (PIT) to look for sources within Hampton Roads and other areas of fouling organism accumulation. Anchorage Whiskey (W), where deep draft naval vessels often moor, was also sampled.

Fouling Organism Collection

The basic gear for collection of fouling organisms was a 5'

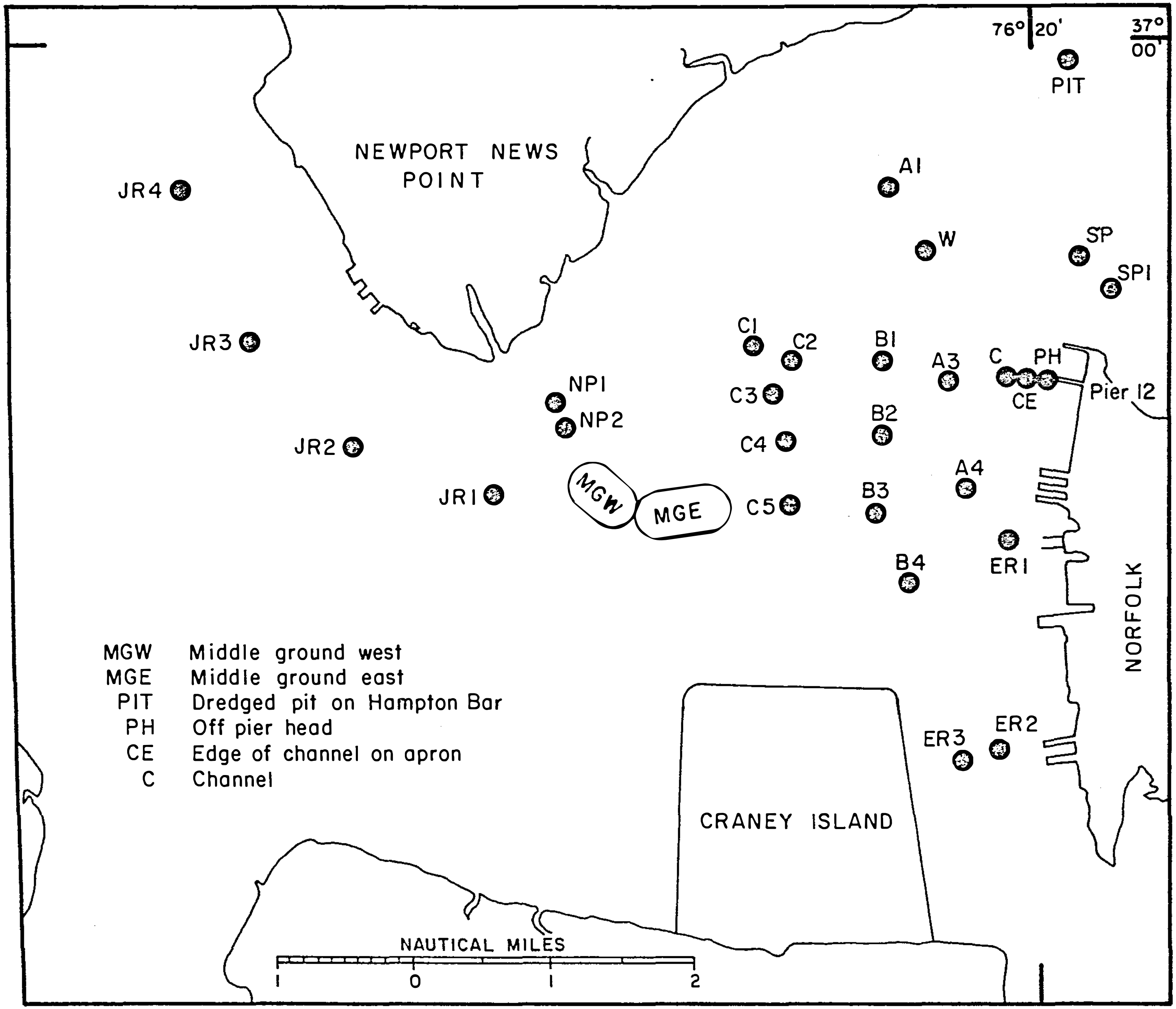

Figure 1. Location of fouling organism sampling sites in Hampton Roads.

crab rake. The rake was pulled at a scope of 2:1 with 3/8" chain (i.e., in water 50' deep, 100' of chain would be let out). Within Pier 12 tows for fouling organisms were taken perpendicular to the pier. The rake was set 50' from the pier and towed to the edge of the dredged berth. The total distance towed in the north berth was 315' and 365' in the south berth. Away from the pier out in Hampton Roads tows were done at a constant engine speed (700 RPM) and time (2 minutes). Even with speed and time constant the lengths of the tows were probably variable being influenced by tides and wind conditions. This makes the direct comparison of areal concentrations between the slip area and Hampton Roads impossible.

Data collected in the pier could then be converted to a unit area measure by multiplying the width of the rake by distance towed. However, data collected in Hampton Roads are not convertible to unit area and are treated as semiquantitative indicating relative abundances of fouling organisms in the sampling area.

After collection the fouling organisms were washed to remove sediment; sorted into hydroids, bryozoans, and other categories; drained of excess water; and weighed to the nearest 0.1 kilogram. The other category consisted mainly of sponges and algae.

Surveys for fouling organisms were conducted weekly or semiweekly from November 13, 1980 through to March 9, 1981. A total of 31 cruises were conducted and 805 rake tows made.

Pier Sampling

For quantitatively estimating the concentration of fouling organisms in the Pier berths we divided the berths into 11 segments.

Along both sides of Pier 12 are bollards, for vessel mooring lines, that are conveniently spaced at about 100' intervals from the bulkhead to the end of the pier. Bollard 1 was designated as the one on the bulkhead and bollard 12 the one on the end of the pier. The samples were collected of the bollards and numbered accordingly (Figure 2). The area in each pier segment was then berth width times 100', the distance between bollards. Each segment of the north berth was 36,500 sq.ft., the south berth 41,500 sq.ft. During each tow the 5' crab dredge covered 1,575 sq.ft. in the north berth (315' times 5') and 1,825 sq.ft. in the south berth (365' times 5').

Fouling Organisms in Hampton Roads

The general conditions for hydroid growth in the 1980-1981 growing season seemed more favorable than in the previous two seasons. The overall density of hydroids in Hampton Roads was higher in 80-81. While this comparison is based on scanty sampling in 1978 and 1979 it is also supported by observations made by the winter crab dredge fleet, which works in the lower Bay.

The pattern of hydroid abundance followed a seasonal cycle. In November the colonies were growing rapidly. At all sites sampled in November we found "healthy" colonies many of which were mature and reproducing sexually. The majority of all the hydroids caught in Hampton Roads were alive. The overall abundance of hydroids continued to increase through December and January. The proportion of sexually reproducing colonies was highest in December, with an apparent decrease in January of sexual forms. Through to the end of February the average abundance of hydroids continued to increase. By mid-March

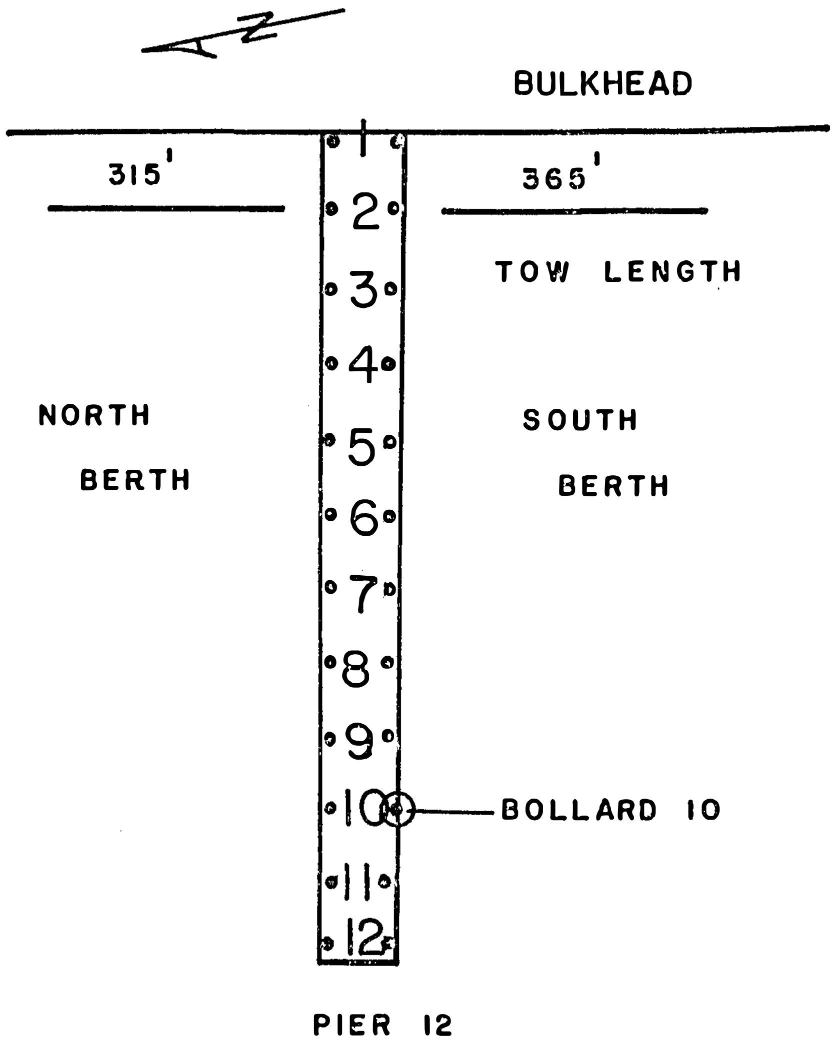

Figure 2. Sampling locations along Pier 12 for fouling organisms (not to scale).

abundances were down to approximately those found in December (Figure 3 and Table 2). Original data are in Appendix C.

Sampling ended in March but we expect the abundance to continue a decline reaching a low in the summer, during which time the hydroids encyst. With the onset of cooling in the fall the cysts commence growing. Summarying the data we collected by month and dividing by the total number of tows in the month, to get catch per unit effort, we get an approximate picture of hydroid abundance in Hampton Roads as follows:

November	3.5 Kg/tow*
December	6.7 Kg/tow
January	9.0 Kg/tow
February	13.3 Kg/tow
March	6.8 Kg/tow

The bryozoan was not abundant relative to the hydroid. Its occurrence was patchy around Hampton Roads. There were no consistent patterns in its distribution that would indicate seasonal growth even though the bryozoan is also a winter growing species. The patchy pattern of bryozoan distribution would indicate a source outside of Hampton Roads. If the bryozoans were originating in Hampton Roads we should have detected increases in concentrations through the season. Also we should have found bryozoans attached and growing, but all the bryozoans collected were always broken freely rolling colonies.

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* A tow is 2 minutes long at constant chain scope and engine speed. Depending on tide and winds the actual area covered by the 5' dredge was variable so no quantitative areal comparisons can be made. The data are semiquantitative indicating trends and relative abundances.

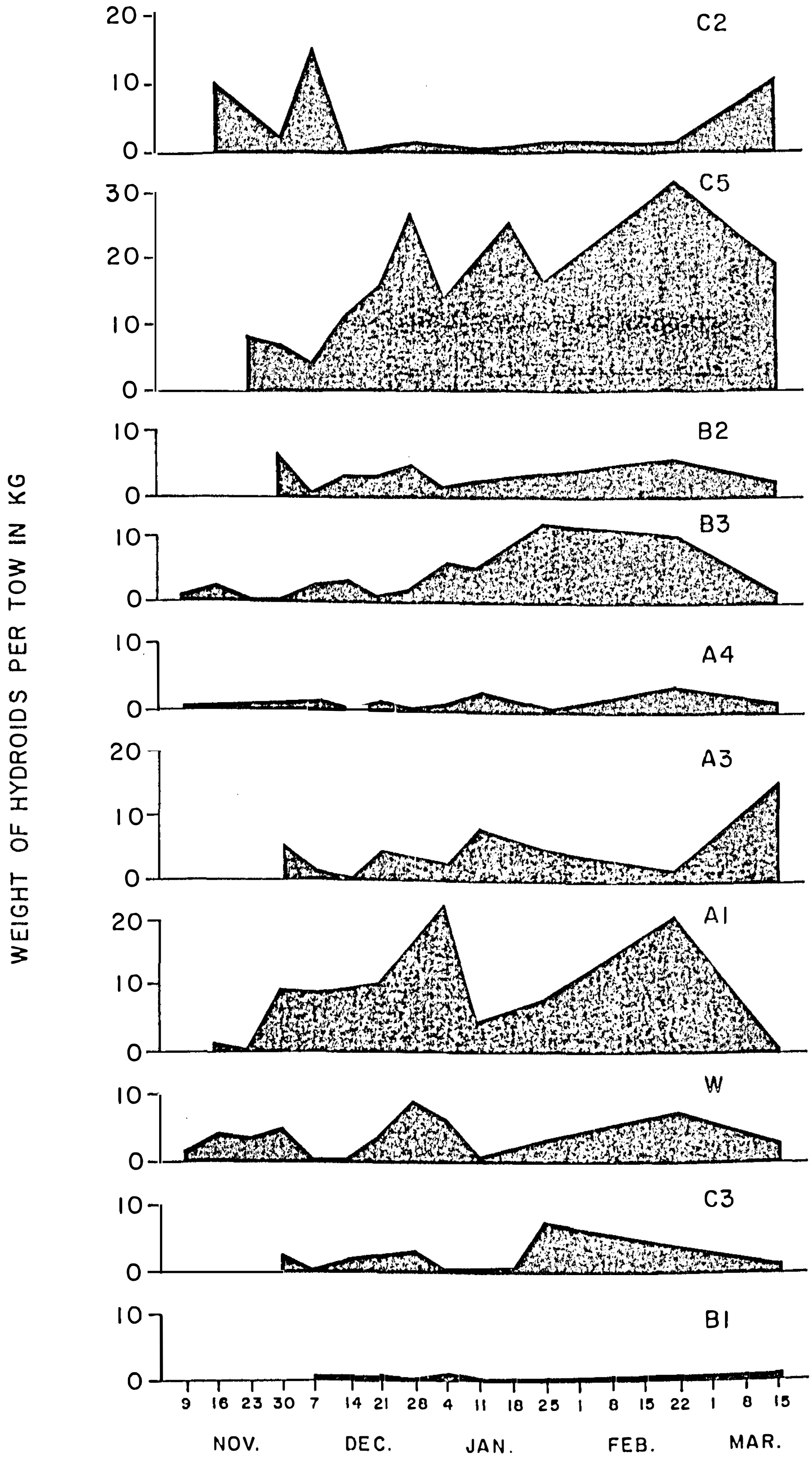


Figure 3. Amounts of hydroids collected at sites in Hampton Roads through the course of the growing season.

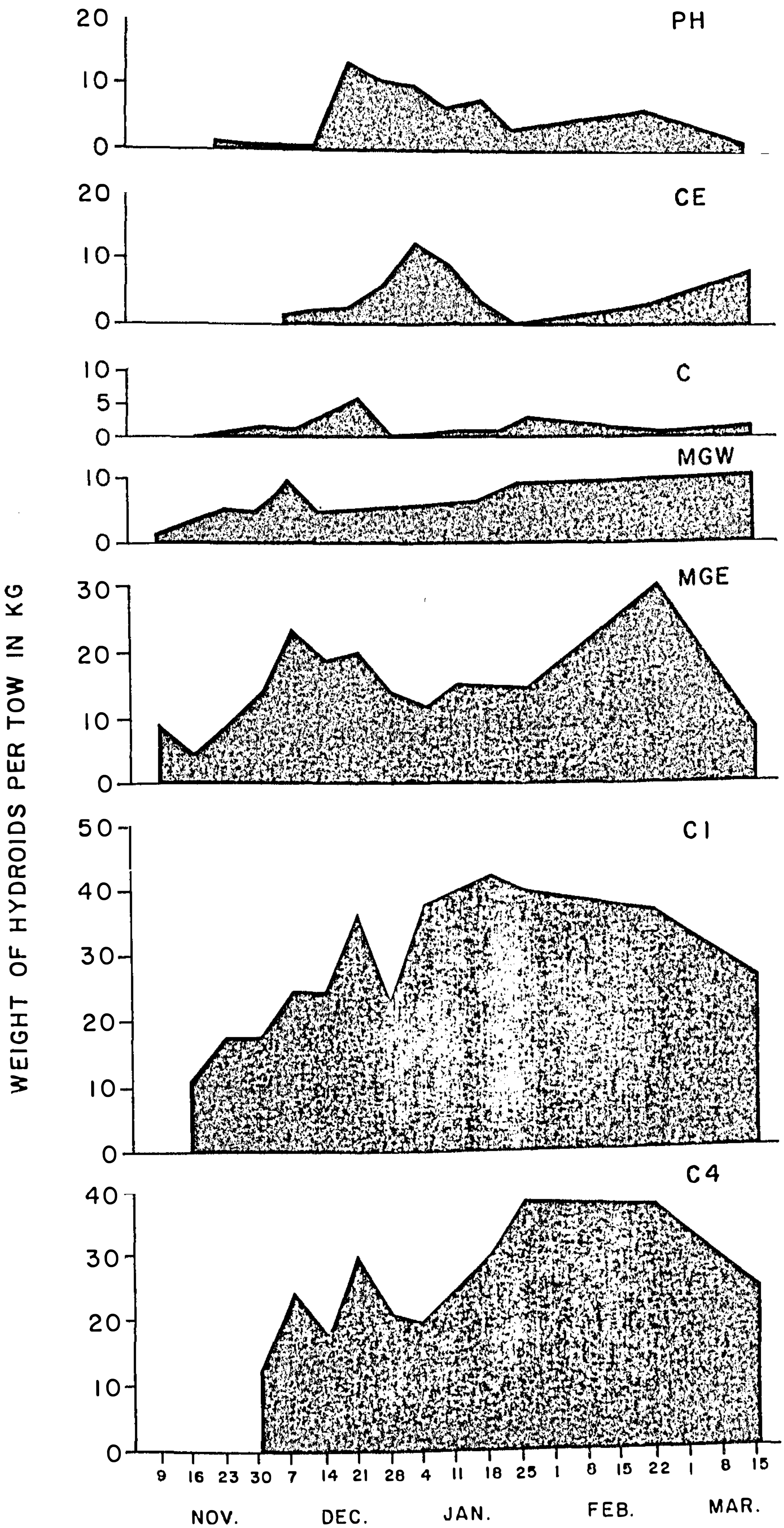


Figure 3 (continued)

Table 2. Weekly averages for hydroids in Kilograms per tow.

SITE	NOV 9	NOV 16	NOV 23	NOV 30	DEC 7	DEC 14	DEC 21	DEC 28	JAN 4	JAN 11	JAN 18	JAN 25	FEB 22	MAR 15
A1		1.8	0.9	9.1	9.1		10.2		23.0	5.0		8.5	21.0	2.0
W	1.4	4.0	3.9	5.0	0.1	0.5	4.0	9.5	6.8	1.0		3.5	8.0	3.0
A3				5.0	1.7	0.1	4.5	3.4	3.0	8.0		5.0	2.8	15.5
A4	0.1			0.9	1.4	0.1	1.2	0.8	1.2	3.0		0.5	4.0	1.2
B1					0.8	0.8	0.8	0.7	1.0	0.5		Tr*	Tr	1.0
B2				6.2	0.5	3.0	3.0	4.4	1.5	2.5		3.5	5.8	2.5
B3	1.0	2.1	0.2	0.1	2.7	3.2	1.0	2.1	6.0	5.5		12.0	11.0	2.0
B4							Tr							
C1		10.7	17.2	17.2	24.7	24.5	36.5	23.0	38.0		42.5	40.0	36.8	26.5
C2		10.6	6.7	2.3	15.4	0.1	0.8	1.1	1.0	Tr		1.5	1.3	11.0
C3				2.9	0.7	2.0	2.5	3.2	0.5		1.0	7.5	4.0	1.5
C4				12.8	24.6	18.0	30.0	21.5	20.0		30.0	38.0	37.5	25.0
C5			8.2	7.8	4.6	11.4	15.5	27.0	14.0		26.0	17.0	32.0	20.0
MGW	1.3		5.0	4.3	9.9	5.0					7.0	9.5		10.5
MGE	8.8	4.5	13.3	23.3	18.9	20.0	14.0	12.0	15.0		14.5	17.0	30.0	7.5
PH			0.9	0.2	0.4	0.4	13.0	10.4	9.8	6.5	7.5	3.0	6.0	1.3
CE					1.8	2.2	3.0	6.0	12.5	9.5	3.8	Tr	3.5	8.5
C		0	0.9	1.8	1.6	3.5	6.0	0.7	0.6	1.0	1.0	3.0	1.0	2.0
PIT	0.2	1.4												
ER1			0.8				3.0							
ER2			0.1											
ER3			0											
JR1		2.8		2.8										2.0
JR2		0		0.5										10.0
JR3				Tr										1.0
JR4				Tr										1.5
SP		0.4			1.9									0
SP1		0			9.5									
NP1		2.3		0.7										13.5
NP2		0.3		0.2										1.5

*Trace

Origin of Hydroids

There were several areas around Hampton Roads which had consistently high concentrations of hydroids. These were the eastern half of Middle Ground (MGE) and sites C1, C4, and C5 (Figures 1 and 3). Our conclusion is that these sites are the primary growing areas for hydroids in Hampton Roads and are the source for most of Hampton Roads and the Pier 12 area. While an attempt to use a deep sea camera to photograph hydroids growing in these areas was unsuccessful, because of near bottom turbidity, an analysis of the epifauna (animal communities attached to the hydroid colony) did substantiate that Pier 12 hydroids come from Hampton Roads.

Jaccard's similarity coefficient was calculated between epifaunal communities on Pier 12 hydroids and those on hydroids collected by raking in Hampton Roads, Thimble Shoals, Willoughby Banks, and near the Chesapeake Bay Bridge-Tunnel. The hydroids were likely not attached at these sites, but drifting. Similarities were as follows:

Similarity of Pier 12 hydroids to

PIT	0.38*
Anchorage Whiskey (W)	0.33
Middle Ground East (MGE)	0.29
C1	0.28
NP1	0.26
North Side Chesapeake Bay Bridge-Tunnel	0.24
B2	0.21
Willoughby Banks	0.17
South Side Chesapeake Bay Bridge-Tunnel	0.14
Thimble Shoals	0.13

* Jaccard's similarity coefficient ranges from 1.0, perfectly similar, to 0.0 no similarity. Significant differences cannot be placed on these similarities. They represent qualitative differences between sites and indicate trends. Differences of 0.1 or greater are substantial change in similarity. Values of 0.3 to 0.6 are moderately high similarity.

The highest similarity was between Pier 12 and the subaqueous borrow pit on Hampton Bar. Both of these areas have high deposition rates and are similar in geometry. The pit was dug in 1975 when the Newport News Shipyard removed over 1,000,000 yd^3 of sand for fill. Depth in the pit is about 30', it has very steeply sloping sides, and restricted circulation. The highest similarity between Pier 12 and the pit results from the similarity of their physical environments. In both areas the most sensitive epifaunal species would tend to die first, leaving the more resistant and tolerant species.

The generally low similarity values between the pier and other areas reflects the cropping of sensitive epifaunal species once the hydroids become trapped in the depositional basin. If it is assumed and reasonably so, that the general epifaunal communities on hydroids growing in Hampton Roads and in other areas of the lower Bay have the same proportion of sensitive to tolerant species. Then the value of the similarity coefficient would indicate the most likely origin for the hydroids in the Pier 12 area. From examining five areas in Hampton Roads and four outside Hampton Roads the highest similarities were between the Pier 12 area and Hampton Roads hydroids. The similarity between the north side of Chesapeake Bay Bridge-Tunnel and Pier 12 was due to the absence of bivalves (*Mytilus* and *Anadara*) from the north side sample. The main differences in epifaunal communities on hydroids in and out of Hampton Roads were in the bivalves and amphipods. Fewer species occurred in Hampton Roads.

Movement of Hydroids

Several approaches were tried to document the movement of hydroids around Hampton Roads and the Pier 12 area. Unfortunately none were successful. Tagging hydroids for recapture did not work. Traps to catch hydroids as they moved did not work. Seabed drifters were marginally successful. The following sections give details on each approach.

Hydroid Tagging and Trapping

One approach that was considered for determination of hydroid transport route was use of marked hydroids. Such a task would require large quantities of marked hydroids. Thus, a quick and easy method of marking was needed, as well as a marker that will be obvious in a large mass of non-marked hydroids. The approach chosen was to use a dye that would strongly color the hydroids.

Several dyes were tested for their hydroid staining abilities; Rhodamine, Rose Bengal, Fast Green, and Fluorescien. The dyes were tested by mixing a strongly colored solution of the dye and placing a small quantity of hydroids into the container. The hydroids remained in the solutions for 24-48 hours and then were rinsed and placed into containers with sea water (to simulate natural conditions). The water was changed and the hydroids rinsed every 1-2 hours. After 4-5 water changes the stained hydroids were compared to unstained hydroids. Those hydroids that were stained with a fluorescent dye were also examined under a black light in a dark room.

It was felt that none of the above dyes stained hydroids with sufficient intensity after 2 or 3 rinses to provide an adequate marker for differentiation from unstained hydroids. The chemical makeup of the hydroid skeletal material, a chitinous polymucosaccharide, was imperiable to all the dyes tested. In most cases, after the initial staining the color intensity was good, but this was found to quickly leach in seawater. The dyes did not tend to bind to the chitinized exoskeletons, but instead stained internal tissue. Much of the leaching could probably be attributed to the breakdown of the dead tissue within the exoskeleton. Thus this tagging approach was never pursued in the field. Consultation with dye experts at Dupont indicated that a process known as covalent bonding may work, but it was too complicated to apply.

Hydroid traps, which were similar to typical commercial crab pots except with smaller mesh and larger openings, were deployed in the pier area and in Hampton Roads. For several reasons they turn out to be unsuccessful. The trap placed in the slip area lasted two weeks. After one week we found our trap on Pier 12. We redeployed it against the bulkhead on the north side, so it would be out of everyone's way, and never found it again. The traps placed in Hampton Roads lasted about as long. They were checked for hydroids after one week and then lost. Apparently hydroids rolling around the bottom will catch on the trap's float line. Wave action or currents will then push the hydroid up the float line weighting it down and eventually sinking the float. This is the presumed fate of all our traps. Crab potter experience the same problem but their gear loss is leased by fishing the pots daily and removing accumulated hydroids.

Seabed Drifters

Since the tagging and trapping of hydroids was not successful we attempted to use sea bed drifters as a means of following the movement of hydroids into the Pier 12 area. The drifters are designed to float just above the bottom and be transported by bottom currents, which would presumably also be capable of transporting hydroids. We deployed 165 drifters in the pier area and eventually retrieved 13. On December 15, five drifters were placed on the bottom in the center of the north berth off each of bollards, 2 to 11. On December 20, five drifters were placed on the bottom in the center of south berth off each of bollards 2, 3, 4, 5, and 6. On February 9, ten drifters were placed at each of nine locations in a line from the stone breakwater at Sewells Point to Pier 12, covering the shoal area and North berth entrance and fan in front of Pier 12.

The drifters we retrieved in the course of raking the pier area were lower than we predicted, being only 7 of 165. This assumed the drifters stayed in the pier area. Obviously they did not, 6 returns were from areas away from the pier (Table 3). It appears that both transport into and out of the berthing areas is possible. Of the seven drifters caught in the berths only one was retrieved in the same area it was deployed. All other pier catches were always closer to the bulkhead than the original deployment sites. This indicates an net bottom influx pathway for hydroids does exist along the logitudinal axis of the berths. Hydroids that get to the entrance of Pier 12 can be transported toward the bulkhead. Conversely a net outward transport route exists, as demonstrated by the returns from

Table 3. Seabed drifter retrieval data.

Release Date	Retrieval Date	Release Site	Retrieval Site
Dec. 15	Jan. 26	North berth bollard 10	North berth bollard 2
Dec. 15	Dec. 23	" " " 6	" " " 2
Dec. 15	Dec. 20	" " " 5	" " " 2
Dec. 15	Mar. 9	" " " 4	" " " 4
Dec. 20	Dec. 20	South " " 2	South " " 2
Feb. 9	Feb. 9	100' off Pier head N. side	North " " 10
Feb. 9	Feb. 24	300' " " " " "	" " " 3
Dec. 15	Feb. 12	North berth bollard 7	Lafayette R.
Dec. 15	Jan. 8	" " " 11	Fort Story Lighthouse
Dec. 15	Jan. 1	" " " 9	Duck, NC
Dec. 20	Feb. 5	South berth bollard 3	Ocean View
Dec. 20	Jan. 8	" " " 4	Virginia Beach
?*	July 5	???	Duck, NC

* Serial number of drifter does not match our records, but this is probably a Pier 12 drifter. No one at VIMS has recently used bed drifters.

rather great distances away from Pier 12. A drifter placed as close as 200' from the bulkhead (Bollard 3) ended up at Ocean View. While these drifter returns may seem strange they confirm the complicated nature of the circulation patterns around and in Pier 12.

Generalizations on Hydroid Movement

While our attempts to document the movement of hydroids into and out of Pier 12 was less than successful generalizations can be drawn from the bed drifter returns and measured currents (see Part II for details on currents). The basic facts we have to work with are:

1) Bed drifters placed at the head of the pier can be moved to the bulkhead.

2) Bed drifters placed near the bulkhead can be moved out of the pier area.

3) The general circulation pattern in Hampton Roads cause the water in front of Pier 12 to flow in a northerly direction most of the time. On ebb tide currents are fastest. On flood tide currents slow down but are still predominantly northerly.

4) There are at times east and west components to the bottom currents that would be capable of transporting hydroids into (east) or out of (west component) the pier area.

5) Hydroids in Pier 12 are most likely from stocks grown in Hampton Roads.

6) Major hydroid growing areas in Hampton Roads are the eastern portion of Middle Ground (MGE), the 20-25' shoal area north of the Newport News channel (C1), and the shoal area south of the Newport News channel and east of Middle Ground (C4, C5) (see Figure 1 for location of sites).

From these facts we can postulate a combination of events needed to bring hydroids to Pier 12. The general circulation in Hampton Roads produces a large counterclockwise eddy that sweeps across the major hydroid growing areas. The water is then deflected to the north by the

Craney Island Flats and the Navy base waterfront. It then passes Pier 12 on its way out of Hampton Roads or back around the eddy. This eddy is a persistent feature of the circulation in Hampton Roads and would tend to transport any loose hydroids along its path. During periods of storms dislodged hydroids could get from the prime growing areas to Pier 12 in a tidal cycle. Once in the pier area a slight change in the northerly currents toward the east would be all that was needed to bring the hydroids into the berthing area. Transport into the berth could be either direct from the head of the berth or over the shoal areas to the north and south of Pier 12.

Circulation within the Pier 12 berths would then move hydroids around the berths once they arrived in the pier area. At times it even appears that hydroids leave the slip. Movement of hydroids within Pier 12 are discussed in the next section.

Flux of fouling organisms at Pier 12

Attempts were made to get weekly estimates of fouling organism concentrations in the Pier 12 area. However, vessel movements and mooring prevented us from getting continuous weekly data on the entire berthing area. The data we collected did document an almost monotonic increase in total fouling organisms from November through to February. Early in the season the south berth had lower concentrations than the north berth. This continued until December when the concentrations in both berths were about even for the rest of the study (Table 4).

In the north berth there was a decrease of algae and sponge material (Other) through the season. The south berth had fairly uniform amounts until late February when concentrations dropped. Bryozoan concentrations did not show much of a pattern with time, indicating

Table 4. Concentrations of fouling organisms in Pier 12. Amounts are for 100' sections of Pier off Pier Bollards. Bollard 2 is first 100' from bulkhead, Bollard 3 is 200' to 300' from bulkhead, etc.

Date Week of	Organism	South Side Pier 12 Bollards 2	3	4	5	6	7	8	9	10
Nov 9		Kennedy in berth								
Nov 16	Hyd	1.2	2.5	3.1		1.2		0		2.5
	Bry	21.1	5.0	5.0		2.5		3.7		0
	Other	18.6	2.5	1.2		3.1		0		1.2
	Total	40.9	10.0	9.3		6.8		3.7		3.7
Nov 23	Hyd	5.0	3.1	8.7		1.9		1.9		
	Bry	9.9	2.5	13.6		5.0		32.2		
	Other	13.6	1.8	23.6		1.2		1.9		
	Total	28.5	7.4	45.9		8.1		36.0		
Nov 30	Hyd	18.6	17.4	2.5	9.9	24.8	2.5		0	
	Bry	50.9	12.4	0	5.0	19.8	26.0		0	
	Other	29.8	3.1	0.6	1.9	2.5	1.2		0	
	Total	99.3	32.9	3.1	16.8	47.1	29.7		0	
Dec 7	Hyd	21.1	8.7	32.2	40.9	54.6	1.2	4.3		
	Bry	42.2	16.1	0.6	0	18.6	0	0		
	Other	17.4	9.9	1.9	3.1	5.6	1.2	1.2		
	Total	80.8	34.7	34.7	44.0	78.8	2.4	5.5		
Dec 14	Hyd	44.7	24.8	42.8	6.2	54.6	9.9	41.6	7.4	16.1
	Bry	40.9	12.4	0	2.5	62.0	0	88.1	0	12.4
	Other	19.8	0.6	14.3	1.2	50.2	1.9	11.8	3.1	4.3
	Total	105.4	37.8	57.1	10.2	166.8	11.8	141.5	10.5	32.8
Feb 22	Hyd	843.0	186.0	80.6	80.6	25.4	12.4	111.6	5.0	
	Bry	37.2	0	0	0	55.8	12.4	0	0	
	Other	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
	Total	881.4	187.2	81.8	81.8	82.4	26.0	112.8	6.2	

Table 4 (continued)

Date Week of	Organism	North Side Pier 12 Bollards 2	3	4	5	6	7	8	9	10	11	12
Nov 9	Hyd	4.6		1.2		6.9		1.2		1.2	0	1.2
	Bry	0		0		9.3		0		0	0	0
	Other	23.2		25.5		20.8		0		0	0	0
	Total	26.8		26.7		37.0		1.2		1.2	0	1.2
Nov 16	Independence in berth											
Nov 23	Hyd	22.0	13.9	3.5	9.3	8.1	11.6	4.6	1.2			
	Bry	99.6	13.9	16.2	1.2	3.5	0	0	0			
	Other	192.2	63.7	13.9	2.3	15.0	4.6	0	1.2			
	Total	313.8	91.5	33.6	12.8	26.6	16.2	4.6	2.4			
Nov 30	Hyd	76.4	16.2	13.9	10.4	11.6		3.5		2.3		
	Bry	10.9	77.6	0	0	0		0		0		
	Other	63.7	15.0	17.4	2.3	16.2		0.6		0		
	Total	151.0	108.8	31.3	12.7	27.8		4.1		2.3		
Dec 7	Hyd	27.8	49.8	6.9	1.2	11.6	6.9		1.2			
	Bry	1.2	24.3	0	0	1.2	0		0			
	Other	69.5	45.2	6.9	1.2	1.2	4.6		1.2			
	Total	98.5	119.3	13.8	2.4	14.0	11.5		2.4			
Dec 14	Hyd	275.6	9.8	20.8	11.6	12.7	4.6	12.7	4.6	5.8		
	Bry	59.0	23.2	0	0	0.6	0	6.9	0	1.2		
	Other	54.4	0.6	5.2	1.2	1.7	1.2	2.9	1.2	1.2		
	Total	389.0	33.6	8.0	13.4	14.4	5.8	22.5	5.8	8.2		
Jan 11	Hyd	304.0	92.6	625.3	139.0	115.8	23.2	23.2	11.6			
	Bry	3.5	115.8	0	0	0	57.9	0	0			
	Other	15.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2			
	Total	322.5	209.6	626.5	140.2	117.0	82.3	24.4	12.8			

Table 4 (concluded)

Date Week of	Organism	North Side Pier 12 Bollards 2	3	4	5	6	7	8	9	10	11	12
Feb 22	Hyd	335.8	347.4	133.2	29.0	63.7	237.4	11.6	29.0	29.0		
	Bry	57.9	23.2	41.1	0	0.6	34.7	1.2	0	86.8		
	Other	1.2	11.6	1.2	1.2	1.2	1.2	1.2	1.2	1.2		
	Total	394.9	382.2	175.5	30.2	65.5	273.3	14.0	30.2	117.0		

that Hampton Roads is not a likely source area. Both north and south berths had about the same amounts of bryozoans (Table 5).

Concentrations of hydroids increased two orders of magnitude from November to February. In January there was a sharp increase in hydroid concentrations in both slips. The south berth has slightly lower concentrations than the north berth. For most of season the majority of the hydroids in the berths were alive and not buried in the sediments. Even in February the percentages of dead and buried hydroids was less than 20%.

We found that there was a concentration gradient of fouling organisms along the length of Pier 12. Highest concentrations were consistently found near the bulkhead (Bollard 2 and 3). We were able to sample this area even when ships were moored at Pier 12, most of the time, and obtained a more detailed look at the flux of fouling organisms (Table 6).

The concentrations found in the pier berths were in time with the general abundance of hydroids in Hampton Roads (Figure 4). When our catch per unit effort went up to a peak of about 14.8 Kg/tow in mid-January the concentrations of hydroids in the berths also peaked. The pier concentrations however did not follow the gradual increase seen in Hampton Roads from November to January. Pier concentrations remained low from November through mid-December. At this time a sharp influx of hydroids was noted. In February and March when hydroid populations were declining in Hampton Roads concentrations in Pier 12 remained high, except for the south berth of bollard 2 on January 25 when we found little hydroid material. This low catch represents a significant decline of hydroids in the bollard 2 area. Unfortunately

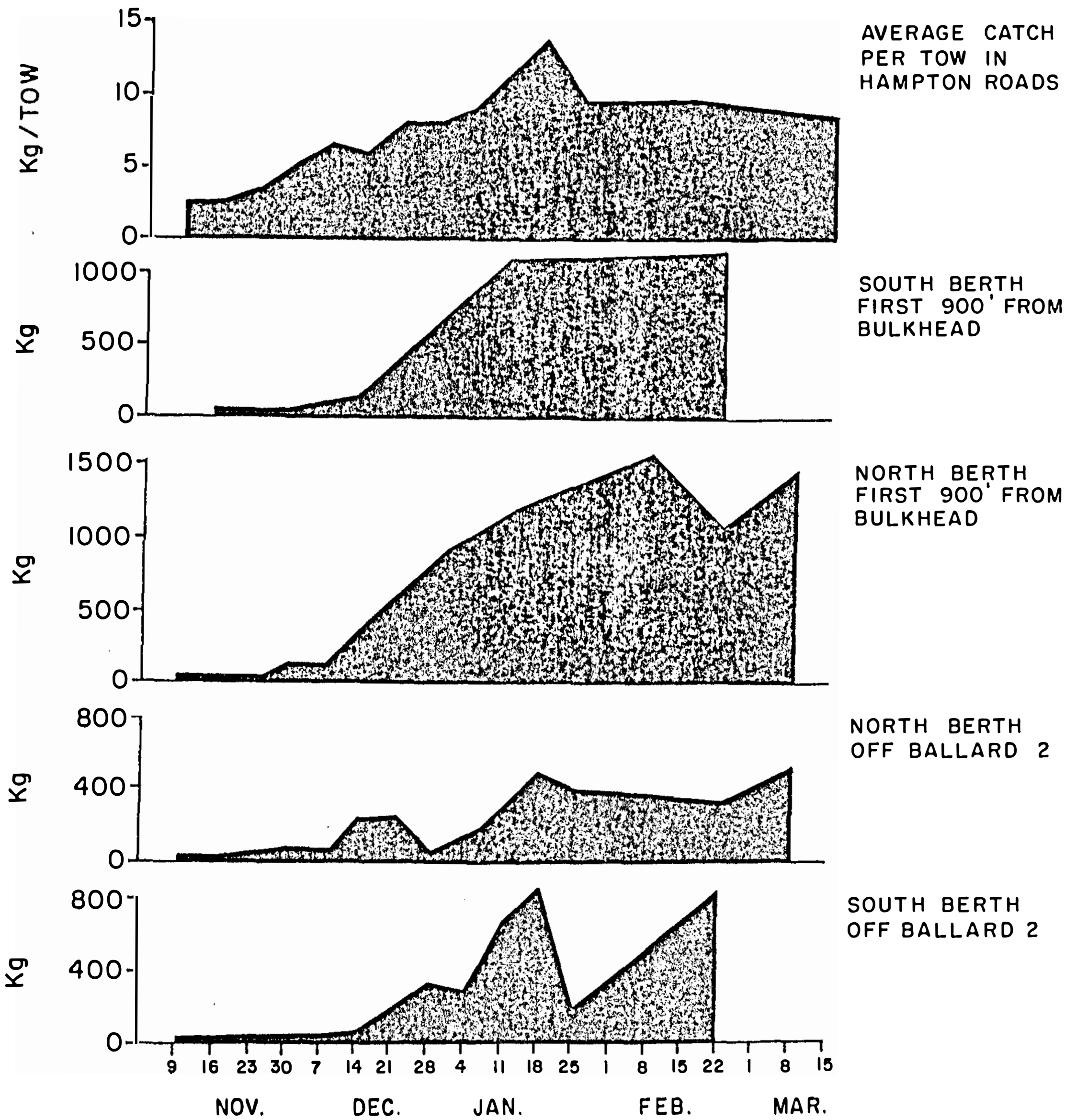


Figure 4. Comparison of hydroid abundance in Hampton Roads with the concentrations found in Pier 12.

Table 5. Total fouling organisms in Pier 12 from bulkhead out to bollard 10 or a total of 900'. All data are in Kilograms.

Date	North Berth				South Berth			
	Hydroid	Bryozoan	Other	Total	Hydroid	Bryozoan	Other	Total
Nov. 9	27	19	127	173				
Nov. 16					12	46	31	89
Nov. 23	74	134	293	501	30	123	58	211
Nov. 30	145	88	124	357	78	127	40	245
Dec. 7	109	27	133	269	167	78	42	287
Dec. 14	358	91	70	519	248	218	107	573
Jan. 11	1335	177	23	1535				
Feb. 8	2066	197	10	2273				
Feb. 22	1216	246	21	1483	1350	105	12	1467
Mar. 8				1907				

Table 6. Concentrations of fouling organisms off of Bollard 2. The inboard end of Pier 12.

Date Week of	North Berth Hyd	Bry	Other	Total	South Berth Hyd	Bry	Other	Total
Nov 9	4.6	0	23.2	26.8				
Nov 16					1.2	21.1	18.6	40.9
Nov 23	22.0	99.6	192.2	313.8	5.0	9.9	13.6	28.5
Nov 30	76.4	10.9	63.7	151.0	18.6	50.9	29.8	99.3
Dec 7	27.8	1.0	69.5	98.5	21.1	42.2	17.4	80.8
Dec 14	275.6	59.0	54.4	389.0	44.7	40.9	19.8	105.4
Dec 21	268.6	9.7	1.2	279.5	191.0	8.7	1.2	200.9
Dec 28	68.9	4.6	27.8	101.3	349.7	138.9	5.0	493.6
Jan 4	148.0	27.8	12.2	188.0	290.2	100.4	6.2	396.8
Jan 11	304.0	3.5	15.0	322.5	649.8	32.2	2.5	684.5
Jan 18	490.2	32.7	7.2	530.1	830.8	27.3	1.2	859.3
Jan 25	390.2	8.8	2.0	401.0	195.9	2.5	0	198.4
Feb 1								
Feb 8	382.1	0	0.6	382.7				
Feb 15								
Feb 22	335.8	57.9	1.2	394.9	843.0	37.2	1.2	881.4
Mar 1								
Mar 8				515.5				

we were unable to sample the south berth during January because of vessels moored in the berth.

This pattern is consistent with the life history of the hydroid and weather. In January hydroid growth peaked, winter storms dislodge the colonies, and they drift around Hampton Roads. Even though the growth rate may be slowing and total abundance declining in Hampton Roads in February and March there is a higher proportion of dislodged and drifting colonies to foul the pier area. Average semimonthly flux rates for Pier 12 calculated from the data collected off bollard 2 are (2 weeks of data are averaged at a time):

From	To	North berth	South berth
Nov. 16	Nov. 30	+ 45 Kg/2 weeks	+ 11 Kg/2 weeks
Dec. 1	Dec. 15	+102 " "	+ 21 " "
Dec. 16	Dec. 31	+ 17 " "	+237 " "
Jan. 1	Jan. 15	+ 57 " "	+200 " "
Jan. 16	Jan. 31	+214 " "	+ 43 " "
Feb. 1	Feb. 15	-249 " "	-- -- --
Feb. 16	Feb. 28	+ 23 " "	+330 Kg/4 weeks
Mar. 1	Mar. 15	+348 " "	-- -- --

+ Flux into pier - Flux out of pier

The rate of entry of hydroids into the bollard 2 area of the north and south berths of Pier 12 were different. Peak influx times for the north berth were the first half of December, second half of January, and the first half of March. The south berth had peak influx during the last half of December and first half of January, and February. In February there was a net flux of hydroids out of the bollard 2 area of the north berth (Figure 4). If the total fouling organism data for the first 900' of pier from the bulkhead are averaged by month (data in Table 5) we find the general pier conditions to be

(Keep in mind these fluxes are based on less data than the fluxes for bollard 2):

	North	Flux	South	Flux
Nov.	344 Kg	+ 50 Kg/month	182 Kg	+ 248 Kg/month
Dec.	394 "	+1141 " "	430	
Jan.	1535 "	+ 343 " "	--	+ 1037 Kg/2 mon.
Feb.	1878 "	+ 29 "	1467	
Mar.	1907 "		--	

All fluxes are positive indicating the net increase of fouling organism material throughout the study.

Gear Efficiency Comparisons

While a standard 5' crab rake or dredge was used for routine collection of fouling organisms, trials were run on six types of gear for comparative purposes. The gear tested included various rakes, tongs, a grab and a beam trawl (Table 7). A measured 550' course was set up in Hampton Roads at site C4 for testing. C4 had consistently high densities of hydroids throughout the study and it was felt spacial variation of hydroid colonies would be minimal so we would get a less biased estimate of gear efficiency. On a gross catch bases the 5' crab dredge caught the most, an average of 32.5 Kg/tow. This translates to 11.8 g of Hydroids/sq.ft. However, the highest per sq.ft. catch was in patent tongs, which resemble large oyster tongs, at 13.4 g/sq.ft. Patent tongs are likely the most efficient of all the gear because they thoroughly rake a small area, relative to dredges, with teeth spaced about 1" apart. If we then consider the patent tongs as 100% efficient the efficiencies for the other gear are:

Table 7. Comparison of various gear for catching hydroids.

Tests at Site C4, Jan. 20-22, 1981

Type of Gear	Area Covered Over Measured 550' Course	Average Catch	Number of Tows	Hydroids Caught per sq.ft.
2' oyster dredge	1100 sq.ft.	9.4 Kg	7	8.5 g
5' crab dredge	2750 " "	32.5 "	9	11.8 "
6' crab dredge	3300 " "	31.7 "	5	9.6 "
16' beam trawl	8800 " "	21.7 "	9	2.5 "
Patent tongs	13.4 " "	0.18 "	20	13.4 "
Van Veen Grab	2.7 " "	0.0 "	5	0 "

Tests at Pier 12 North berth off Bollard 2, Jan. 26, 1981

Type of Gear	Area Covered	Average Catch	Number of Tows	Hydroids/ sq.ft.
2' oyster dredge	630 sq.ft.	6.1 Kg	5	9.7 g
5' crab dredge	1575 " "	16.0 "	5	10.2 "
6' crab dredge	1890 " "	26.3 "	5	13.9 "
Patent tongs	13.4 " "	0.45 "	5	33.6 "
Beam trawl	snagged and broke beam			

Efficiency relative to patent tongs at C4

2'	oyster dredge	63%
5'	crab dredge	88%
6'	crab dredge	72%
16'	beam trawl	19%
	Van Veen grab	0%

The 2' dredge is probably just too small and quickly fills to capacity. The 5' and 6' dredges have different efficiencies, the 6' being lower. Logic says the 6' dredge should have caught more. The 6' dredge was longer than the 5' but its mouth* was shorter than the 5' dredge. Both dredges had approximately the same cross-sectional area (mouth x width), which may play a critical role in hydroid capture. Both the 5' and 6' dredges caught almost the same gross amount of hydroids.

The beam trawl caught fair amounts of hydroids but it did not do well when you consider the area covered by the net. Much of the hydroids caught were on the beam itself and not in the net. The beam was a 2' pipe that stretched across the mouth of the net holding it open to 16'. The grab, while large for a grab, was completely ineffective in catching hydroids because of its small area. Grabs also catch a lot of sediment, requiring washing of the sample to remove the hydroids.

The gear was also evaluated at Pier 12 to see if efficiencies changed. The patent tongs caught an average of 33.6 g of hydroid/sq.ft., almost three times the C4 area test. This indicates that the hydroid densities are at least three times higher in the berths than in the highest density area of Hampton Roads. Again considering the patent tongs at 100% efficient the efficiencies of the other gear are:

* mouth of a dredge is the distance from the tooth bar, that digs into the sediment to the top bar, that holds the dredge bag.

Efficiency relative to Patent tongs at Pier 12

2' oyster dredge	29%
5' crab dredge	30%
6' crab dredge	41%

Efficiencies of dredges in the berth area are lower than at C4. This may be due to differences in the efficiency of the patent tongs in sand (C4) and mud (berth area). In mud they would bite deeper probably catching buried hydroids. But, we believe the biggest differences in efficiency relate more to the catching characteristics of the dredges. At C4 the dredges were towed 550' and in the pier area 315'. This is a difference of about 75%, which if applied to the gross catch in the pier to make the total area covered mathematically equal increase efficiencies to 50, 53, and 72% respectively for the 2', 5', and 6' dredges.

The larger gross catch for the 6' dredge over the 5' dredge may be more an artifact of the 6' dredge being tested first and reducing the amount of material for the 5' dredge to catch. All tests were done off of bollard 2.

For future work we would recommend the use of either a 5' or 6' dredge for slip cleaning and patent tongs for surveying the berth areas to determine if cleaning is necessary.

Comparison of PWC and VIMS methods

The Public Works Center (PWC) is usually called upon to test rake the berth areas for hydroids to determine if cleaning is necessary. To evaluate their effectiveness we both sampled the berth areas at the same time. Results indicate that PWC consistently underestimated the concentration of total fouling organisms present (Table 8). This takes into account the correction for PWC's rake being 2.5 times smaller than VIMS's.

Slip Raking Operations

On three occasions we worked to clear Pier 12 of accumulated hydroid material. This is the standard operating procedure when it is thought that the concentration of hydroids is sufficiently high to cause fouling. December 20 was the first slip cleaning. We worked the south berth and removed a total of 612 Kg of fouling organisms in 42 rake tows using a 5' crab rake. This represents approximately half of the material we estimated to be in the berth when we started. A running average of the amount of material taken on successive tows starts at about 20 Kg and drops to only 18 Kg after 28 tows. If the two tows that came up empty are discounted due to presumed equipment malfunction (dredge possibly flipped upside down), then the running average drops from 41 at the start of raking to 20 at the end. This corresponds closely to the drop in hydroids recorded between our pre- and post-rake surveys (Table 9).

On February 9th and 10th we raked the north berth (Table 10). At this time the concentration of hydroids was at its peak, an estimated 2,270 Kg or 5,000 lbs., for the study period. After one day's work a total of 525 Kg, which was about 1/4 of the total in the slip was removed. The next day we resurveyed and found the concentration of hydroids to be about half of the previous day, or 1,120 Kg. Raking on the 10th, with the same effort as on the 9th, produced a

Table 8. Comparison of PWC and VIMS methods for rake sampling of Pier 12. Weights of fouling organisms are actual amounts caught off each bollard in Kg. PWC used a 2' homemade rake; VIMS used a 5' crab rake.

North Berth Pier 12

Bollard	Hydroids		Broyozoans		Other		Total	
No.	PWC	VIMS	PWC	VIMS	PWC	VIMS	PWC	VIMS
2	0.7	5.0	0.2	3.0	0.3	2.5	1.2	10.5
3	Trace	0.8	0	2.0	0.7	Trace	0.7	2.8
4	0.1	1.0	0	0	Trace	0.4	0.1	1.4
5	0	0.8	0	0	0	Trace	0	0.8
6	Trace	0.8	1.8	0	0	Trace	1.8	0.8
7	0	0.2	0	0	0	Trace	0	0.2
8	Trace	0.8	0	0	Trace	Trace	Trace	0.8
9	0	0.2	0	0	0	0.1	0	0.3
10	0	0.1	0	Trace	0	Trace	0	0.1
Total	0.8	9.7	2.0	5.0	1.0	3.0	3.8	17.7

South Berth Pier 12

Bollard	Hydroids		Broyozoans		Other		Total	
No.	PWC	VIMS	PWC	VIMS	PWC	VIMS	PWC	VIMS
2	Trace	1.7	0	2.0	0.1	0.5	0.1	4.2
3	0.1	1.0	0	1.0	Trace	Trace	0.1	2.0
4	0.4	Trace	Trace	0	0.1	Trace	0.5	Trace
5	0.1	0.2	0	0.2	0	Trace	0.1	0.4
6	0.4	3.0	0	5.0	0	4.0	0.4	12.0
7	Trace	0.5	0	0	0	Trace	Trace	0.5
8	0.1	Trace	0	0	0	Trace	0.1	Trace
9	0.2	0.2	0	0	Trace	Trace	0.2	0.2
10	0.1	0.2	0.9	0.5	Trace	Trace	1.0	0.7
Total	1.4	6.8	0.9	8.7	0.2	4.5	2.5	20.0

Table 9. Concentrations of fouling organisms found during slip raking operations in the South Berth.

South berth Pier 12 - Raked Dec 20

Bollard	Pre Rake	Post Rake	Change
2	1,042	327	-720
3	174	99	- 75
4	0	0	0
5	5	162	+157
6	10	25	+ 15
7	25	7	- 18
8	15	5	- 10
Total	1,271	620	-651

Amounts removed from berth in Kg during raking

		Running Average
Start	41	
	0	20.5
	42	27.7
	19	25.5
	9	22.2
	16	21.2
	8	19.3
	0	16.9
	17	16.9
	33	18.5
	14	18.1
	27	18.8
	26	19.4
	10	18.7
	16	18.5
	15	18.3
	29	18.9
	13	18.6
	9	18.1
	18	18.1
	17	18.0
	38	19.0
	11	18.6
	23	18.8
	13	18.6
	7	18.1
	28	18.5
End	13	18.5
Total	512	

Actual amounts of fouling organisms removed	
Prerake survey	51 Kg
Raking	512 Kg
Postrake survey	49 Kg
	612 Kg

Table 10. Concentrations of fouling organisms found during slip raking operations in the North Berth.

North berth Pier 12 - Raked Feb 9 and 10

Estimated total fouling organisms

Bollard	Pre Rake Feb 9	Post Rake Feb 10	Change*
2	440	324	-116
3	278	93	-185
4	625	324	-301
5	116	81	- 35
6	174	93	- 81
7	162	46	-116
8	81	69	- 12
9	185	1	-184
10	208	93	-115
Total	2,269	1,124	-1,145

*Before raking on Feb 10

Actual amounts of fouling organisms removed

Prerake survey Feb 9	90Kg
Raking Feb 9	435
Postrake survey Feb 10	48
Raking Feb 10	236

Amount removed on each tow Feb 9

		Running Average
Start	21	
	28	24.5
	16	21.7
	16	20.2
	12	18.6
	18	18.5
	12	17.6
	19	17.8
	23	18.3
	22	18.7
	12	18.1
	22	18.4
	11	17.8
	8	17.1
	15	17.0
	22	17.3
	5	16.6
	15	16.5
	15	16.4
	1	15.6
	3	15.0
	10	14.8
	24	15.2
	15	15.2
	1	14.6
	2	14.1
	2	13.7
	13	13.7
	11	13.6
	3	13.2
	19	13.4
End	19	13.6
Total	435	

Amount removed on each tow Feb 10

		Running Average
Start	8	
	12	10.0
	12	10.7
	4	9.0
	3	7.8
	6	7.5
	12	8.1
	4	7.6
	18	8.8
	2	8.1
	8	8.1
	4	7.8
	6	7.6
	15	8.1
	10	8.3
	7	8.2
	14	8.5
	4	8.3
	11	8.4
	4	8.2
	10	8.3
	16	8.6
	7	8.6
	8	8.5
	6	8.4
	3	8.2
	1	8.0
	12	8.1
	2	7.9
	3	7.7
End	4	7.6
Total	236	

total of 284 Kg of hydroids. This is only 54% of what was raked on the 9th. Summing both days we removed 809 Kg of hydroids or about 1/3 of the amount estimated to be in the slip. The running average on the 9th dropped from 24 to 14 Kg/tow from the start to the end of raking. On the 10th it dropped from 10 to 8. From the 9th to the 10th there was a 4 Kg/tow drop in average. This difference results from starting the average anew on the 10th.

The north berth was raked a third time on March 9 (Table 11). The pre-rake survey indicated a concentration of about 1,500 Kg, a fairly high amount. However the raking failed to produce the amount of hydroids expected. A total of 266 Kg was collected. Pier operations caused some delays in the raking and prevented us from working to the same level of effort on the previous raking dates. This caused a lower total hydroid catch but does not explain why the average catch per tow did not change appreciably during the raking. The running average started at about 6 Kg/tow, dropped to a low of 4, and by the end of the raking was up again to 6. The pre- and post-rake survey indicated a drop of 47% in the hydroid concentration. The raking accounts for only 22% of this decline. The remainder of the decline is unaccounted for and is attributed to sampling error in the pre-rake survey. The amounts of hydroids taken in the pre-rake survey, a total of 64 Kg or 10.7 Kg/tow, was higher than the average raking catch. It seems likely that the consistently low catch per tow does verify that the pre-rake survey was too high, an estimate of hydroid concentrations.

Our general assessment of slip raking is that it does reduce the amount of hydroids in the slip, but its efficiency is low. If the

Table 11. Concentration of fouling organisms found during slip raking operations in the North Berth, March 9, 1981

North berth Pier 12 - Raked Mar 9

Estimated total fouling organisms ppt

Bollard	Pre Rake	Post Rake	Change
2	417	197	-220
3	799	58	-741
4			
5	69	93	+ 24
6	174	255	+ 81
7	23	93	+ 70
8	1		
Total	1,483	696	-786

Actual amount of fouling organisms removed

Prerake survey	64 Kg
Raking	172
Postrake survey	30

Amounts removed from berth in Kg during raking

		Running Average
Start	10	
	3	6.5
	4	5.7
	2	4.8
	3	4.4
	5	4.5
	3	4.3
	2	4.0
	4	4.0
	15	5.1
	8	5.4
	9	5.7
	12	6.2
	6	6.1
	10	6.4
	6	6.4
	9	6.5
	1	6.2
	5	6.2
	12	6.4
	4	6.3
	12	6.6
	11	6.8
	4	6.7
End	5	6.6
Total	172	

amounts removed are compared to the estimated hydroid concentrations before raking we get:

Date	Pre-Rake Survey	Amount Removed	Efficiency
Dec. 20	1270 Kg	610 Kg	48%
Feb. 9 & 10	2270 Kg	810 Kg	36%
Mar. 9	1488 Kg	270 Kg	18%

The lower efficiency on March 9 is possibly a result of the over-estimate of hydroids in the pre-rake survey. A large amount of hydroids were taken off bollard 3 in the pre-rake survey. We are not sure why, but it may have been a concentrated wave of hydroids moving around the slip. The highest efficiency on December 20 was highest because of the distribution of hydroids within the slip. A very strong gradient existed that day with 96% of the hydroids being within 200' of the bulkhead. The other 4% were spread over the berthing area from 200' to 700' from the bulkhead. We were able to concentrate our efforts near the bulkhead giving us a high efficiency. In February the distribution of hydroids was more uniform with only 32% of the hydroids within 200' of the bulkhead. This caused us to move around the slip more raking over larger areas that had less hydroids per square foot when compared to the December raking. This lowered our efficiency despite the fact that in February there was almost twice the concentration of hydroids in the berth.

PART II: CURRENTS, WINDS AND TIDES INVESTIGATION

Methods and Materials

Wind Data

Hourly wind speeds and directions were recorded in tabular form on Meteorological Form 1-10 (Surface Weather Observations) at NAS, Norfolk. Information from these forms pertaining to location, data, time, speed and direction of the wind was entered into the VIMS Prime computer disk file. Wind directions were reversed (π radians were added) to conform with oceanographic notation giving the magnitude of the wind (in knots) and the direction towards which the wind was blowing. Wind data thus modified was used to generate stick plots of hourly wind vectors for successive seven day periods from 9 November 1980 to 9 March 1981.

Tidal Height Data

Copies of original data tapes from the Hampton Roads tide gauge for November-December 1980, January 1981 and March 1981 were obtained from NOAA and processed at VIMS to obtain hourly water levels for the study period. These values were plotted as seven day marigram segments to coincide with wind data.

Current Velocities

1. Moorings, November 1980 to January 1981

Four current meter moorings were established on 20-21 November 1980 at locations shown in Figure 5. Moorings were designated as A

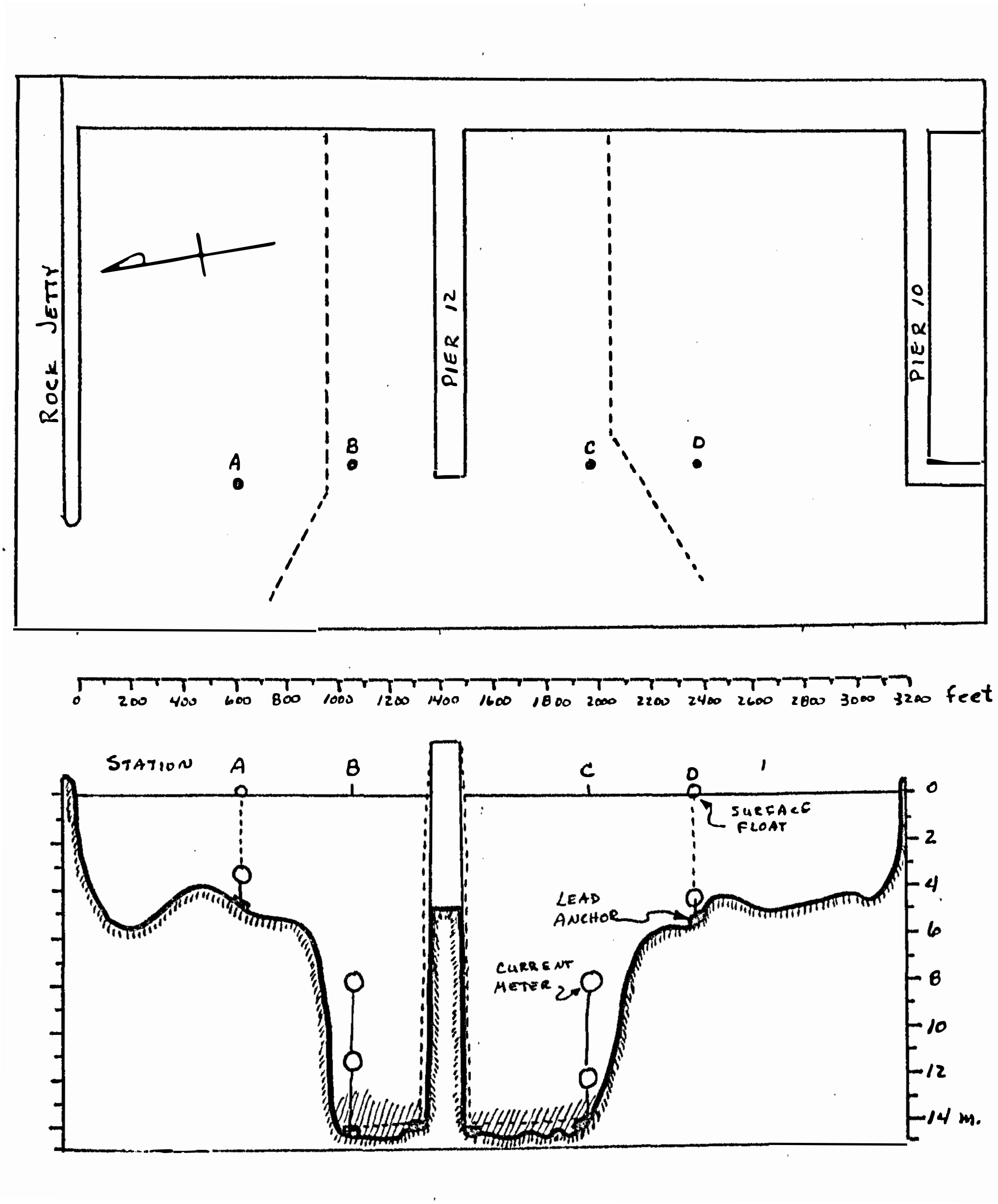


Figure 5. Current meter mooring locations (upper figure) and instrument depths (lower figure) in the vicinity of Pier 12, Norfolk Naval Station during the period 20 November 1980 - 23 January 1981.

through D (from North to South) and each contained a G.O. (General Oceanics Winged) current meter approximately one meter above the bottom. Additional G.O. current meters were placed 8 meters below the water surface at moorings B and C. Four G.O. current meters on loan from the Naval Surface Weapons Facility, Ft. Lauderdale, Fla. were used for moorings B and C. VIMS current meters were used at moorings A and D.

Mooring locations were selected to measure water movement in and out of the slip areas adjacent to Pier 12 and neighboring shoal areas but were restricted by frequent movement of deep draft aircraft carriers (hence the locations of moorings B and C). Depth of the uppermost current meters at moorings B and C was additionally restricted by frequent tugboat traffic in these areas which precluded placement of any portion of the moorings (current meters or floats) within the upper 12 feet of the water column.

Current meters were serviced on a fortnightly basis to insure against loss of large data sets resulting from accidental removal of a mooring. Servicing of meters at moorings A and D was accomplished by diver. Moorings B and C were designed to be serviced by small boat. Their configuration is shown in Figure 6. Lead disks and railroad wheels (600 lb. each) were used as anchors. Anchors were set on 19 November, and allowed to settle one day before current meters and floats were attached. Each lead disk was fitted with six one foot long loops of 1/4 inch stainless steel wire rope linked to form a flexible chain. During the settling period, a length of 1/2 inch polypropylene rope with a surface marker (1 foot diameter from sphere) was attached to the uppermost wire rope link. On 20 and 21 November

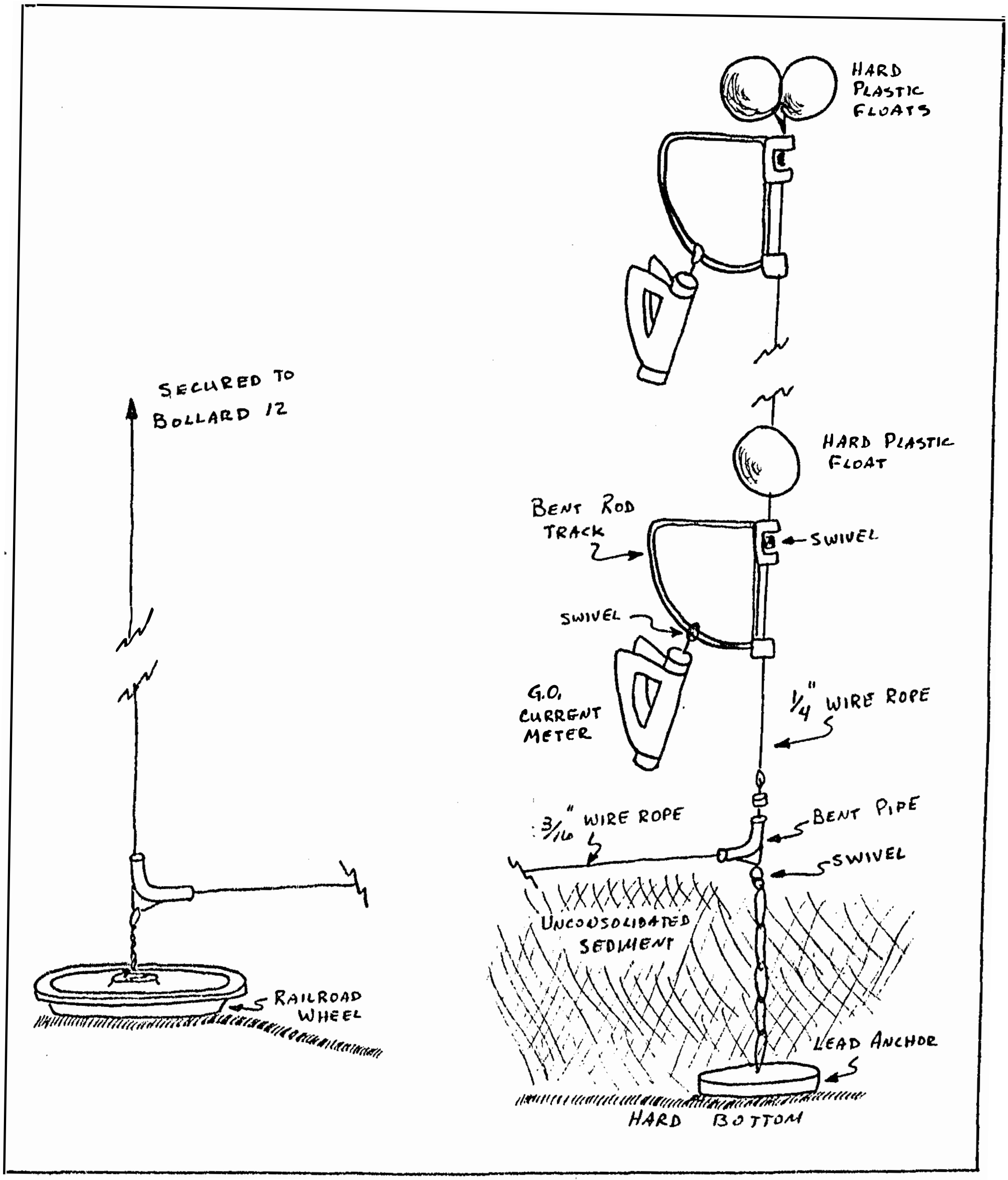


Figure 6. Configuration of moorings B and C at Norfolk Naval Base, Pier 12 region, 20 November 1980 - 23 January 1981.

current meter and hard plastic float assemblies were prepared and put in place by divers. Single current meter moorings at locations A and D were set first and the diver noted that the lead anchors were resting on a hard sand bottom. Moorings at stations B and C were established by attaching "L" shaped sections of 2 inch pipe with a swivel at the apex, to the wire rope loop at the water-silt interface. At location B, this was the uppermost loop (thus there was approximately) six feet of unconsolidated sediment above the lead anchor) while at station C, the third loop down was accessible (indicating approximately four feet of unconsolidated sediment). Similar swiveled bent pipes were attached to railroad wheel anchors placed below the final bollards on the north and south sides of Pier 12. Lengths of 3/16 inch wire rope were threaded through each pair of bent pipes before attachment to the anchors. The ends of the wire rope at mooring B and C locations were fitted with floats and the pier-side ends were secured to the bollards. Pre-assembled current meter moorings replaced the floats on the 3/16 inch wire ropes and the moorings were set by hauling in on the pier-side end of the wire ropes until the uppermost floats were just below the water surface. An additional 12 feet of wire rope was hauled in and secured to the bollard. Final station configurations are shown in Figure 6. Moorings B and C were serviced by releasing the wire ropes on the bollards which allowed the moorings to float to the surface.

Current meters were serviced according to the following schedule.

20-21 November 1980 -	Moorings set
4 December 1980 -	Moorings serviced - meters replaced at moorings A & D. Tapes changed in meters at moorings B & C.
18 December 1980 -	Moorings serviced - meters replaced at moorings A & D. Tapes changed in meters at moorings B & C. New batteries installed in all meters.
20 December 1980 -	Secured current meters from mooring C. Cable severed in vicinity of bollard.
21 December 1980 -	Reset mooring C in a configuration which would require servicing by diver.
31 December 1980 -	Replaced current meters at moorings A & D. Changed tapes in current meters at moorings B and C.
21 January 1981 -	Removed moorings A, C and D.
23 January 1981 -	Removed mooring B. Difficulty recovering this mooring due to damage of upper floats.

2. Moorings and Stations, March 1981

Preliminary results of current meter data obtained during November - January suggested currents had not been measured at optimum locations to show hydrodynamic continuity in the Sewells Point - Pier 12 - Pier 11 region. At no additional cost to the contract, an attempt was made in March 1981 to obtain surface to bottom currents at 8 closely spaced stations between Sewells Point and Pier 10 for a period of one tidal cycle. Unfortunately, equipment failure, poor weather and other conditions precluded securing usable data from this portion of the study.

3. Current meter calibration

All current meters used in this study were subjected to calibration checks in February of 1981. Lack of time prior to the start of the study precluded earlier calibrations. Results of calibration checks were used to correct field data.

G.O. current meters used in this study were mounted on a tiltable rack and aligned to a common direction. The rack was rotated through 360° by 30° steps. At each step of rotation the rack was tilted at angles of 0,5,10,20,30,40,50 and 60° from the vertical and allowed to remain in each tilted position for 5 minutes. Before calibration, new batteries and tape cassettes were placed in all meters and the meters were turned on. Each meter sampled the following parameters in a "burst" sampling mode:

- time
- tilt of meter from the vertical
- x,y and z components of the earth's magnetic field.

"Burst" sampling consisted of recording parameter values eight times at 1.32 second intervals and repeating the procedure at 1.5 minute intervals. Each tilt-direction combination was thus measured 24 times by each meter.

Tapes were processed and results compared with independent measures of tilt and direction. All meters operated within manufacturers specifications with the exception of one Navy meter (serial number 59) which produced an unusually distorted or "noisey" record. Results obtained from this instrument during the November - January deployments are therefore questionable. This instrument was located at a depth of 8 meters at mooring C during the study.

4. Data Processing

Data Files:

Raw data was read from current meter cassettes to disk file in the VIMS Prime computer. Files were identified by current meter serial number and date of deployment. Thus data taken from current meter #59 starting on 20 November 1980 was in file number 59.201180. Raw data, in hexidecimal form was given a file prefix RAW. Each step in processing resulted in the creation of a new file with a new prefix and the original file number.

Comparison with Field Logs:

RAW data files were checked to insure they contain the proper meter number and burst sampling arrangements as specified in field logs. Two hours of raw data (with time determined from recorded values of time) were scanned. If current meter number or sampling scheme did not agree with similar data from field logs, the RAW (data file) was flagged and the machine operator informed that a discrepancy must be rectified.

Editing:

Two editing steps were followed:

a. Raw data was plotted as values of recorded time, tilt and x,y,z components of the earth's magnetic field as functions of sample number. These plots were used to determine the quality of the raw data and indicate malfunctions in sensors.

b. Raw data was read in burst size increments and non-valid readings were eliminated. (Non-valid readings are those which lie beyond the sensor range). Recorded times of remaining data were preserved and remaining data was used to calculate vector averages of current velocities for each burst of samples. Velocities were stored as speed, direction, north component and east component. Number of samples used to calculate these averages was also stored. Average velocities of bursts were then vector averaged and weighted, according to number of readings used, to yield hourly averages of current speed and direction. Averaged data was placed in a new file (ARC file number) and both the RAW and ARC files were recorded on magnetic tape for archiving.

Creation of Final Data File:

ARC (data file) was used to create the final print file (PRT data file) which presents the following information.

Current meter type and number

Location (river, latitude, longitude)

Depth

Record starting and ending time

Number of samples used in averaging

Listing, by date and time, of:

Average speed and direction per burst

Average north and east components per burst

Average components in-out and across Pier 12
slip area per burst

Weighted vector averaged speed and direction
for each 1 hour period of record

Number of samples used in calculating each
of the averaged values.

The assembled PRT (data file) was then printed for a permanent hard copy record.

Plots of Data:

The ARC (data file) was used to generate a plotting file which listed hourly speed and direction at each sampling location (as opposed) to a similar listing for each current meter tape cassette). Missing values were replaced by zeros to yield a time sequence starting on 22 November 1980 and ending on 21 January 1981. The plot file was then used to generate seven day sequences of stick plots to coincide with marigram segments and wind stick plots.

Currents, Wind, and Tides

Results from the November 1980 to January 1981 portion of the study are presented as tables and figures in the appendices. Hourly tidal heights, wind speed and direction and current speed and direction are given in Appendix A as Tables A-I through A-III respectively. Table A-III is segmented into six portions (a, b_1, b_2 c_1, c_2 and d) to correspond with current meter moorings and depths. The tables are blocked as seven days segments for convenience.

Tabular data was plotted as stick plots representing hourly wind and current vectors and as marigrams. These figures constitute Appendix B. Each figure in Appendix B gives, wind, tides and currents for weekly periods found in the table.

Wind data was taken from copies of original data logs at NAS-Norfolk. Tidal information represents average water level for each hour based on ten values per hour. Current data represents the vector average of up to 32 current readings taken over each hour. These readings were originally made as bursts of eight instantaneous measurements of speed and direction separated by 1.32 second intervals. A burst of 8 measurements was made once every 15 minutes and averages were calculated when 50% or more of the desired number of measurements taken in a given hour were acceptable. Times listed represent the time of the last burst. Thus, the values listed for 0600 hrs represent the average of readings taken between 0500 and 0600 hrs.

Current and Wind Data Analysis

Physical data (current, wind and tide) obtained during this study were subjected to the following analyses:

- Classification of winds and currents according to 12 tidal stages based on the periods from low to high water and high to low water
- Analysis of current data to determine average currents over a tidal cycle for various wind conditions
- Analysis of current data to determine components parallel to Pier 12 over a tidal cycle under low wind conditions (wind speeds less than 5 knots) in order to determine if the data show hydraulic continuity in the study area
- Analysis of current data under low wind speeds during times when no ships were moored at Pier 12 to provide information suitable for hydraulic model verification checks

General Circulation in the Hampton Roads Area

Currents in the area of Pier 12 are unusual in that they are unidirectional and show no flood component upstream towards the Elizabeth River. The lack of an upstream flood current near Pier 12 is most evident when results of tests in the James River Hydraulic Model are considered. Figure 7 shows a sequence of surface current patterns at alternate hours of the tidal cycle. The sequence starts with the tide ebbing at the surface (hour 1) and shows an abrupt change from ebb to flood between hours 3 and 5. During the flooding portion of the tidal cycle (hours 7 and 9) an eddy is formed off the Sewells Point - Pier 12 region resulting in continuous northerly directed flow off Pier 12 except during a slack period between the

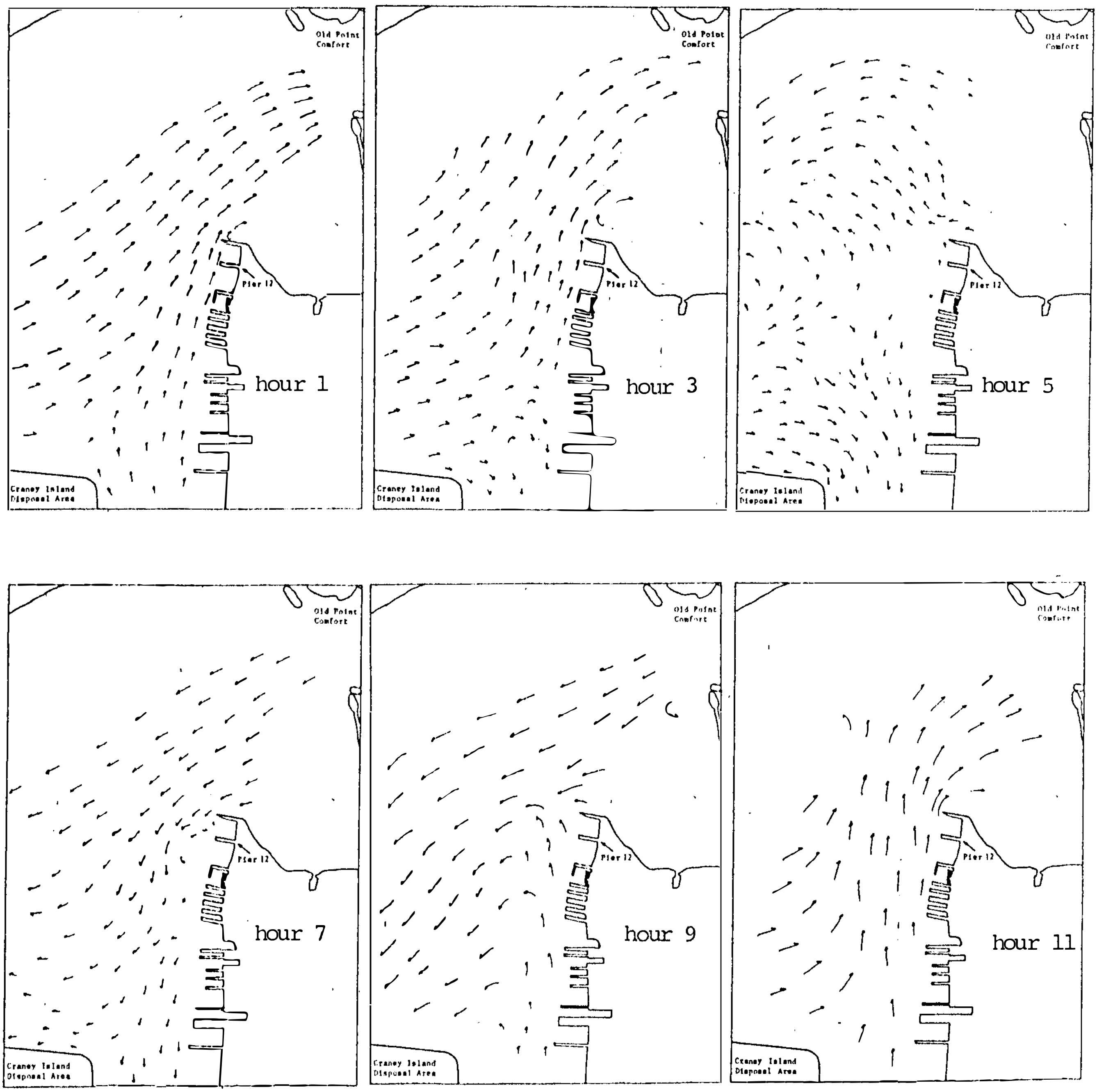


Figure 7. Surface currents in Hampton Roads over a tidal cycle as measured in the James River Hydraulic Model. Tidal hours are indicated in the lower right corner of each panel.

flood and ebb portions of the tidal cycle. These hydraulic model data were substantiated by current measurements made during the present study (see Appendix A) and indicate that the normal flood and ebb shifts in currents are not applicable to the study area.

Wind-Tide-Current Comparisons

To facilitate handling the large volume of current data obtained during this study, a Wind-Tide Condition index was established for the period 20 November 1980 - 23 January 1981. The index establishes the dates and times when each of 300 combinations of wind speed-direction and tidal stage occurred. Wind was classified by 25 speed and direction indices: 0 to 5 knots, 6 to 15 knots and 16 to 35 knots with the latter two groups each divided into twelve 30° direction indices. Tidal data was classified according to heights between low and high water and between high and low water. The Wind-Tide Condition index is shown as Table 12 and indicates that 30% of the time winds were in the 0 to 5 knot class while winds blew from 6 to 15 knots 61% of the time and were greater than 15 knots only 9% of the time. The index also shows that for winds greater than 5 knots, the predominant direction was from the north (315° to 45°) with an occurrence of 36% of the time. The second predominant wind direction was from the southwest (195° to 255°) which occurred 18% of the time. Occurrences were evenly distributed throughout the tidal cycle with an average of 151.75 hours of data for each tide class (with a standard deviation of ±5.2). It should be noted that tide classes used here are not synonomous to tidal hours shown in Figure 7. Tide classes are ordered as follows: class 1 is the hour

Table 12. Tide-wind condition index. Number of occasions when hourly winds of a given speed and direction occurred during each of 12 tidal stages.

Wind Class	Speed kt	Direction (30° centered) on	Tidal Stage: Hour following low water 1	2	3	4	5	High Water 6	High Water 7	8	9	10	11	Hour preceding low water 12	Total
1	0-5	all direction	41	42	44	48	41	46	45	48	50	47	47	46	545
2	6-15	0°	18	15	18	12	16	12	12	14	16	16	10	23	182
3		30°	15	17	12	14	16	12	11	7	11	11	12	11	149
4		60°	5	3	4	2	1	3	6	7	5	5	5	5	51
5		90°	2	3	1	4	1	2	1	1	1	2	0	2	20
6		120°	1	1	0	0	2	0	6	2	3	2	1	1	19
7		150°	0	0	2	0	1	0	0	0	0	1	1	0	5
8		180°	4	3	0	1	2	6	4	5	3	1	2	2	33
9		210°	13	13	15	16	16	15	16	14	17	14	19	19	187
10		240°	13	13	10	14	6	19	10	9	10	13	8	9	134
11		270°	8	5	6	3	6	10	5	8	6	5	3	2	67
12		300°	7	9	4	6	9	5	7	5	9	6	7	5	79
13		330°	14	12	13	17	19	14	15	12	12	16	26	16	186
14	16-25	0°	4	6	6	6	8	10	9	6	4	2	2	1	64
15		30°	2	1	4	6	2	3	2	3	4	3	4	3	37
16		60°	0	0	0	0	0	0	0	0	0	1	0	0	1
17		90°	0	0	0	0	0	0	0	0	0	0	0	0	0
18		120°	0	0	0	0	0	0	0	0	0	0	0	0	0
19		150°	0	0	0	0	0	0	0	0	0	0	0	0	0
20		180°	1	0	0	0	0	0	0	0	1	0	0	0	2
21		210°	0	1	0	0	0	0	0	0	0	0	0	0	1
22		240°	1	0	0	3	1	0	1	0	0	0	1	1	8
23		270°	0	0	0	0	0	0	1	1	1	0	0	1	4
24		300°	1	1	1	1	1	2	0	0	0	1	2	1	11
25		330°	3	5	3	4	4	4	2	4	2	2	2	1	36
		Total	153	150	143	157	152	163	153	146	155	148	152	149	1821

following low water, class 6 is the hour prior to high water, class 7 is the hour following high water and class 12 is the hour prior to low water.

Currents capable of transporting hydroids and bryozoans into the Pier 12 region were of primary interest in this study. Because of this, the average of current components parallel to the axis of the pier were plotted as functions of tide class for each station and predominant wind class. These plots are shown in Figures 8 through 13 for the locations and depths where currents were measured. In each of these figures wind classes from upper panel to lower panel are: 0-5 knots - all directions, 6-15 knots from the north, 6-15 knots from the southwest and 16-25 knots from the north.

Figure 13 shows that the largest change in in-out transport in the shoal area north of Pier 12 (Station A, depth 4.0 m) occurs with strong winds from the north. Strong northerly winds reverse and strengthen this current component resulting in a net outward transport of water. A similar condition, although not as well defined, prevails over the shoal area to the south of the pier. Stations at the offshore ends of the Pier 12 berthing areas (stations B and C) shows no similar strong response to shifts in wind speed or direction. This may be due to the high frequency of ships entering and leaving the Pier 12 berths during the study.

Continuity Determinations

It was not an original intent of this study to measure currents between the Sewells Point jetty and Pier 10 in order to establish hydraulic continuity over any particular tidal cycle or

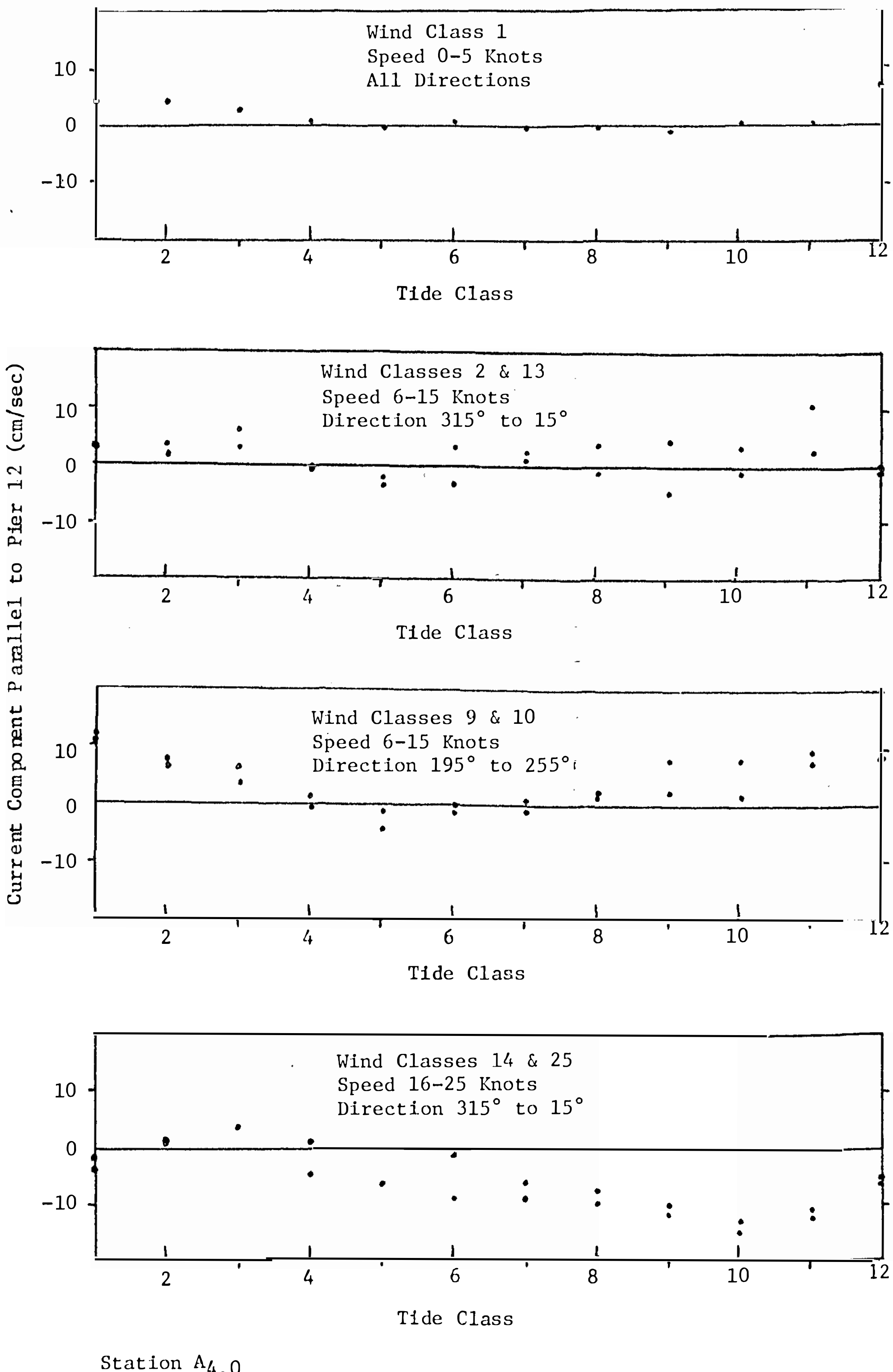
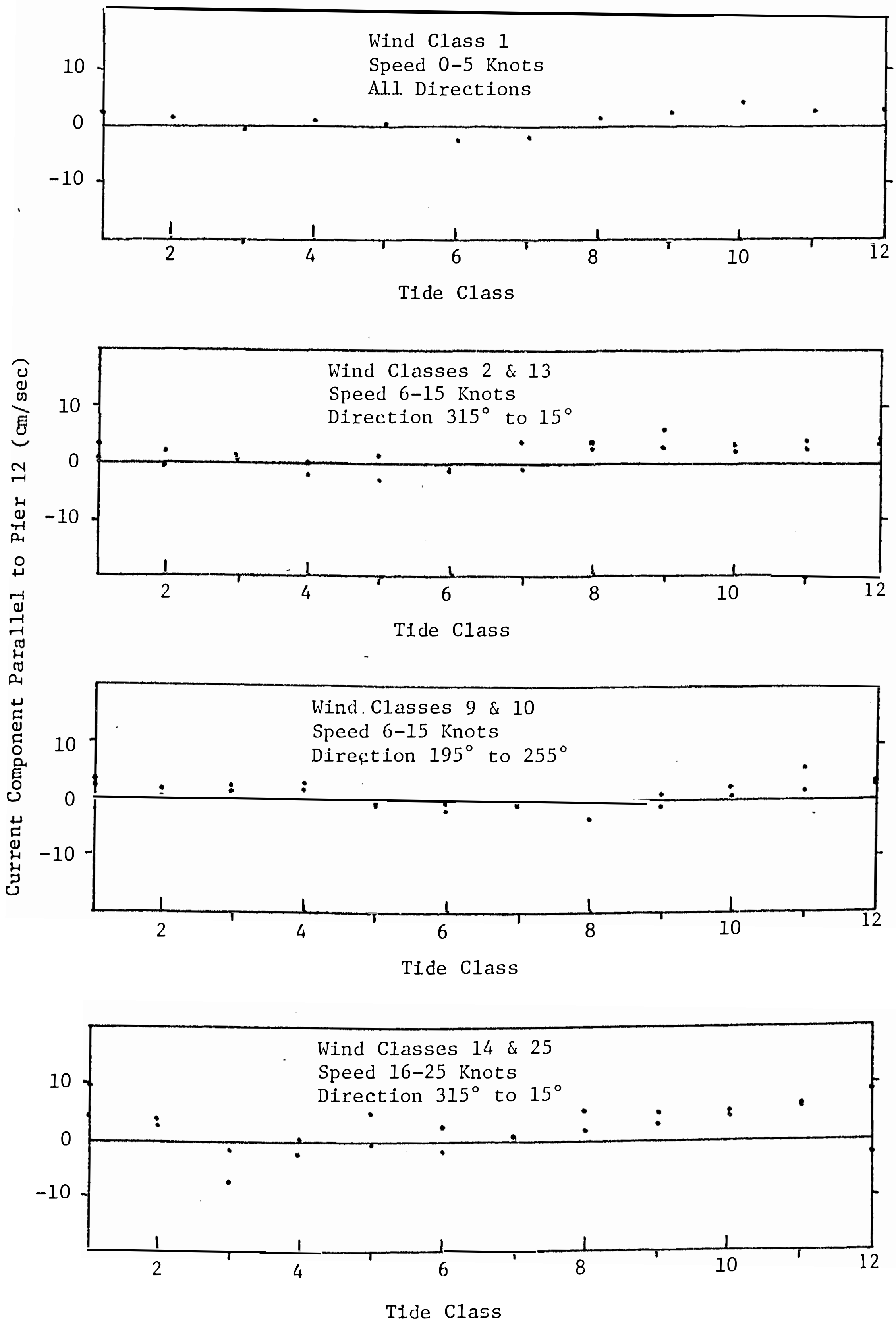
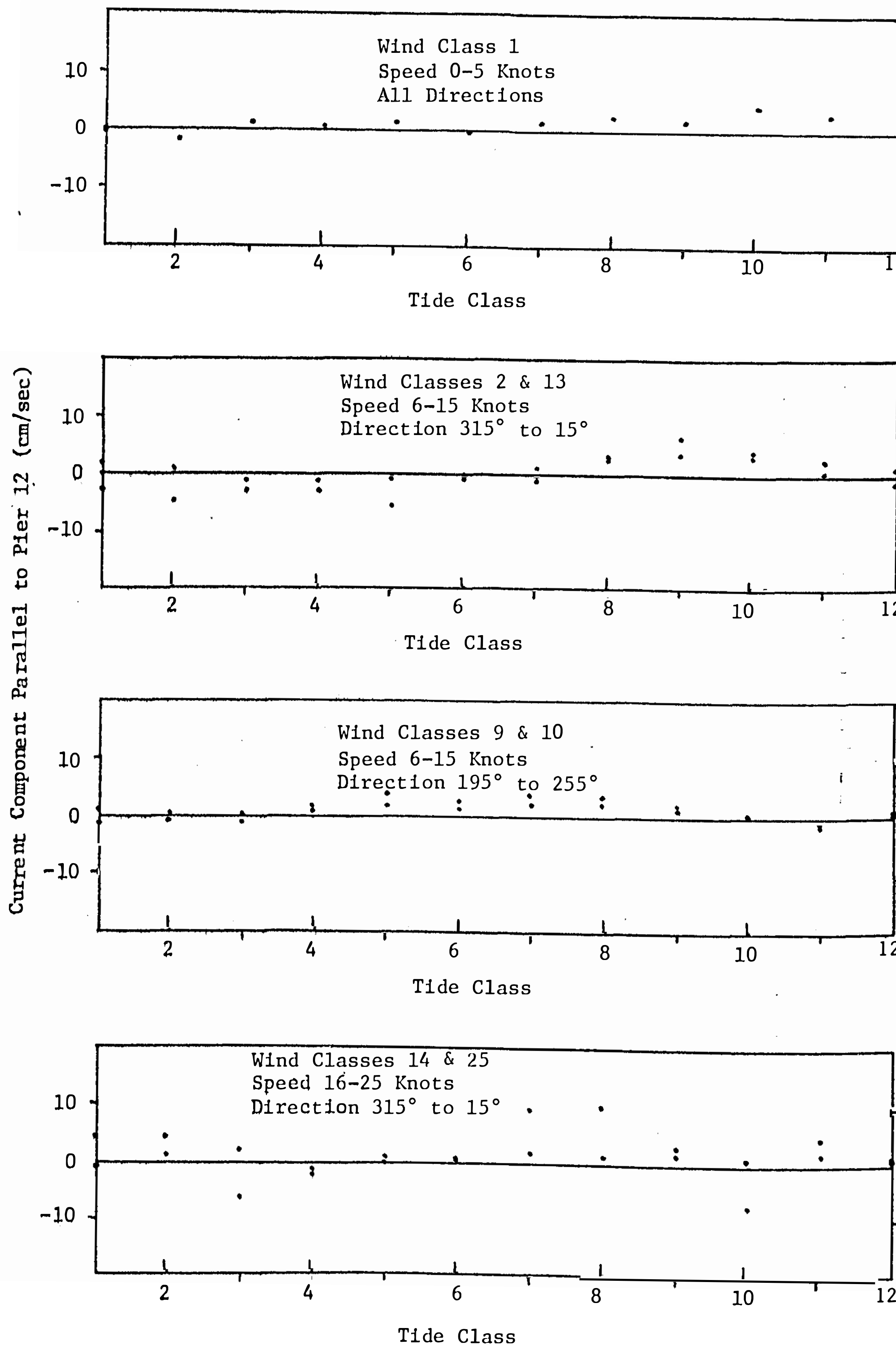


Figure 8. Current components over one tidal cycle parallel to Pier 12 at station A (depth 4.0m) for wind classes specified.



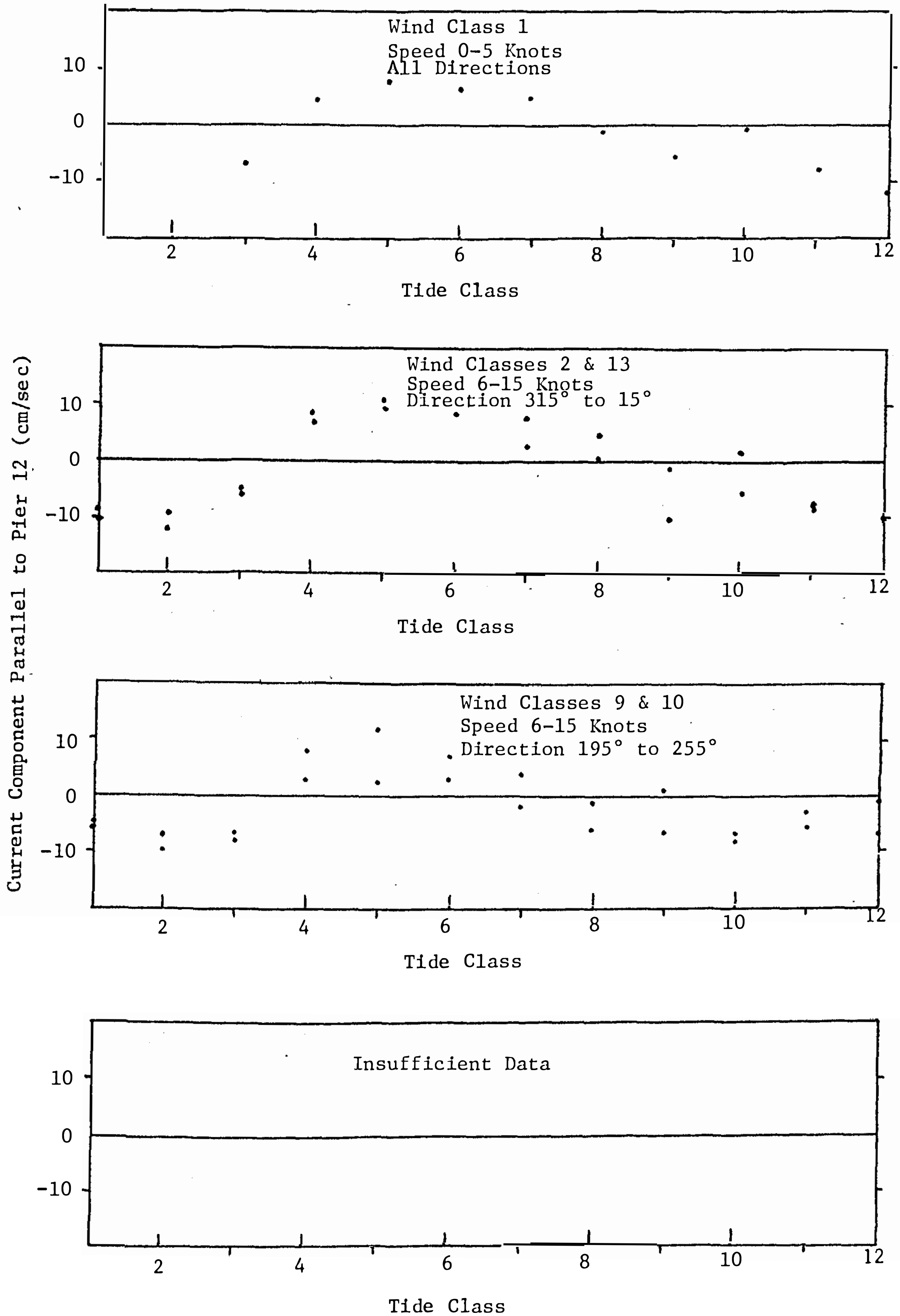
Station $B_{8.0}$

Figure 9. Current components over one tidal cycle parallel to Pier 12 at station B (depth 8.0m) for wind classes specified.



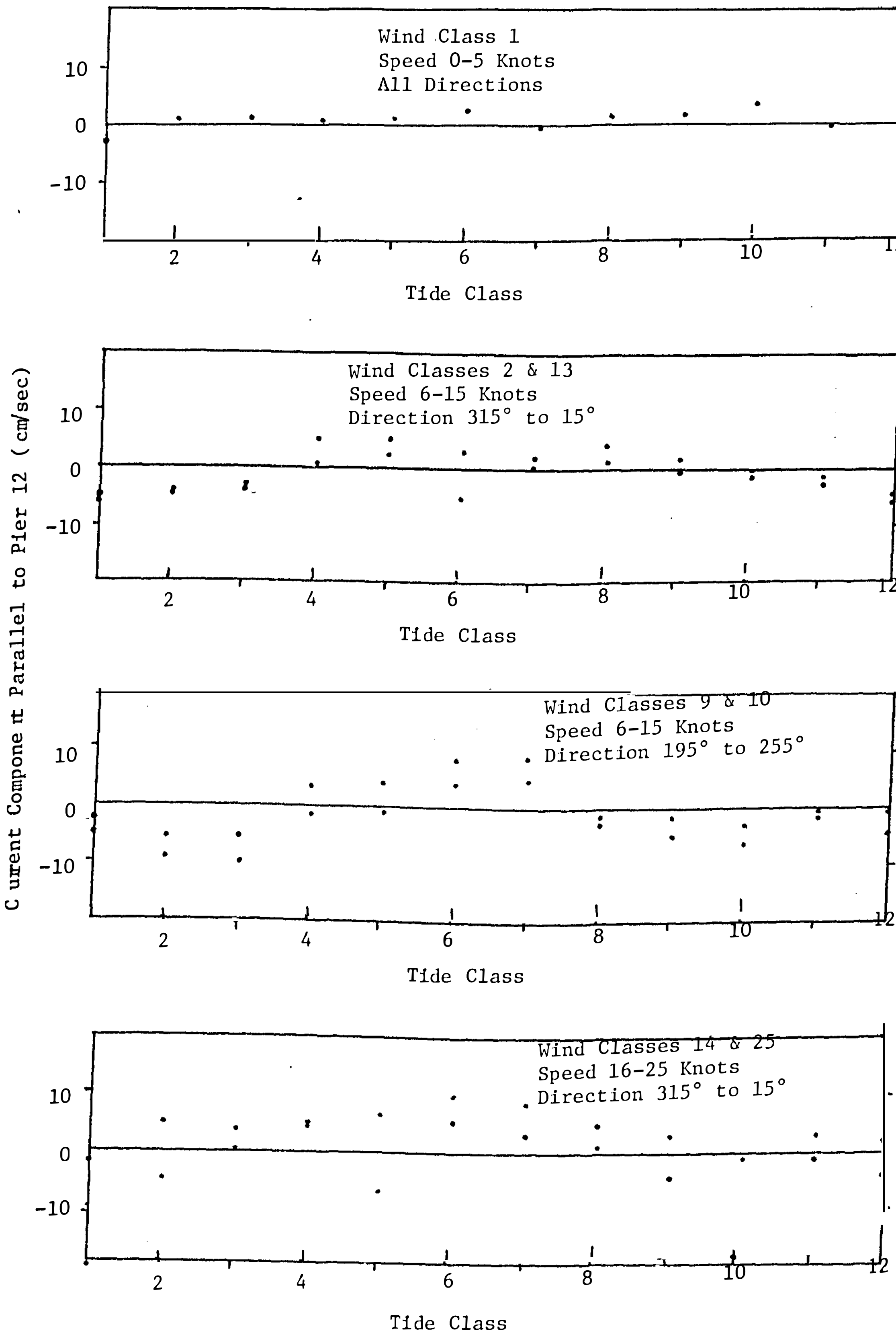
Station $B_{11.2}$

Figure 10. Current components over one tidal cycle parallel to Pier 12 at station B (depth 11.2m) for wind classes specified.



Station $C_{8.0}$

Figure 11. Current components over one tidal cycle parallel to Pier 12 at station C (depth 8.0m) for wind classes specified.



Station $C_{13.0}$

Figure 12. Current components over one tidal cycle parallel to Pier 12 at station C (depth 13.0m) for wind classes specified.

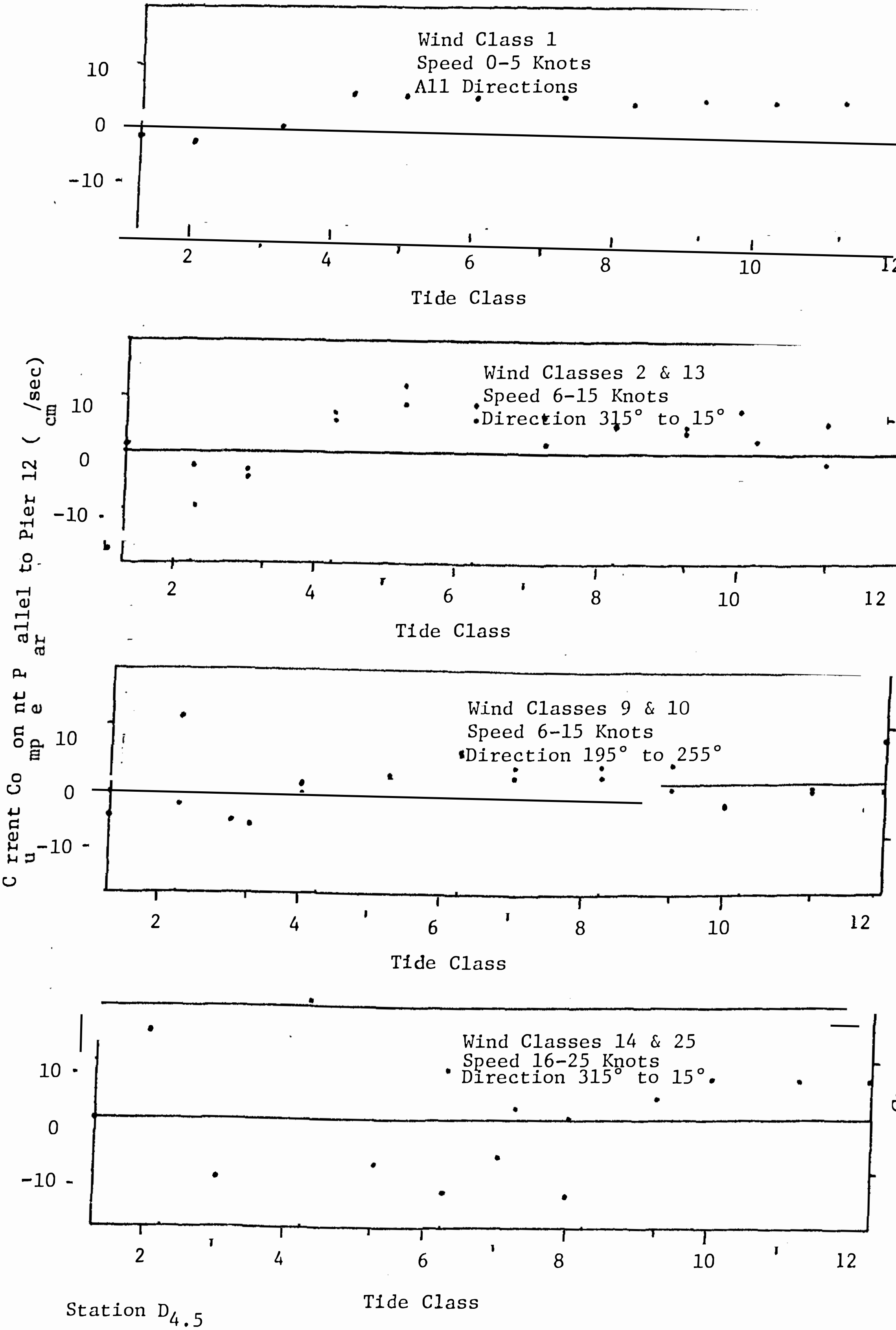


Figure 13. Current components over one tidal cycle parallel to Pier 12 at station D (depth 4.5m) for wind classes specified.

for "average" conditions. Questions have recently been raised regarding the accuracy and validity of the current data resulting from this study. The questions are concerned with the failure of the data to show hydraulic continuity in the study area. In addressing these questions, we wish to point out that the constraints regarding where currents could be measured and the small number of current meters available to the study precluded making continuous current measurements in a manner that would illustrate hydraulic continuity. Measurements were made at locations and depths shown in Figure 5. If we can assume each current meter measurement represented water movement within the 4 meter vertical and the 6 meter horizontal distances centered on the instrument, then all six meters used measured flow through a cross-sectional area of 144 square meters which is less than 2% of the total cross-sectional area between Sewells Point jetty and Pier 10. In an extreme case, we may assume each instrument represented an 8 x 12 meter area and thus imply currents were measured over 7.5% of the area in question. Using either assumption, it would be highly unusual if hydraulic continuity could be satisfied with the November - January current data.

We have, however, conducted an analysis of the November - January data for low wind conditions augmented with short current records obtained at eight additional locations in March 1981. The analysis consisted of plotting the current components parallel to the axis of Pier 12 for each of the twelve tide classes at all locations where measurements were available. Linear interpolations where applied between adjacent measurements with a positive value assigned to inward motion and a negative value assigned to outward motion. Additionally, volume increases and decreases in the study area resulting from tidal fluctuations were accounted for. The results of this analysis are shown in Figure 14 with November - January current meter locations shown as squares and March current meter locations shown as triangles. Regions where no current measurements are available are cross hatched. These results should be treated with caution as they represent two distinct data sets taken at widely spaced locations. They do, however, give an indication of what appear to be distinct current features. In particular they show a persistent inward flow over the shoal region south of Pier 12 (at Station I) during all portions of the tidal cycle and an outward flow during tidal classes 1 through 3 and 7 through 12 centered around the 8 meter depth at station C.

None of the tidal class flows shown in Figure 14 shows hydraulic continuity. Continuity can be "forced" in each instance by one of two assumptions (or a combination of both). These assumptions are:

- All current measurements were biased and indicate an inward flow approximately 2 cm/sec greater than it should be, or
- Flows in the unmeasured regions averaged 8.9 cm/sec outward.

Neither assumption is felt to be valid and we therefore conclude that hydraulic continuity was not achieved because of improperly positioned and widely spaced instruments. Unfortunately, these conditions could not be overcome with the constraints and limitations placed on the study.

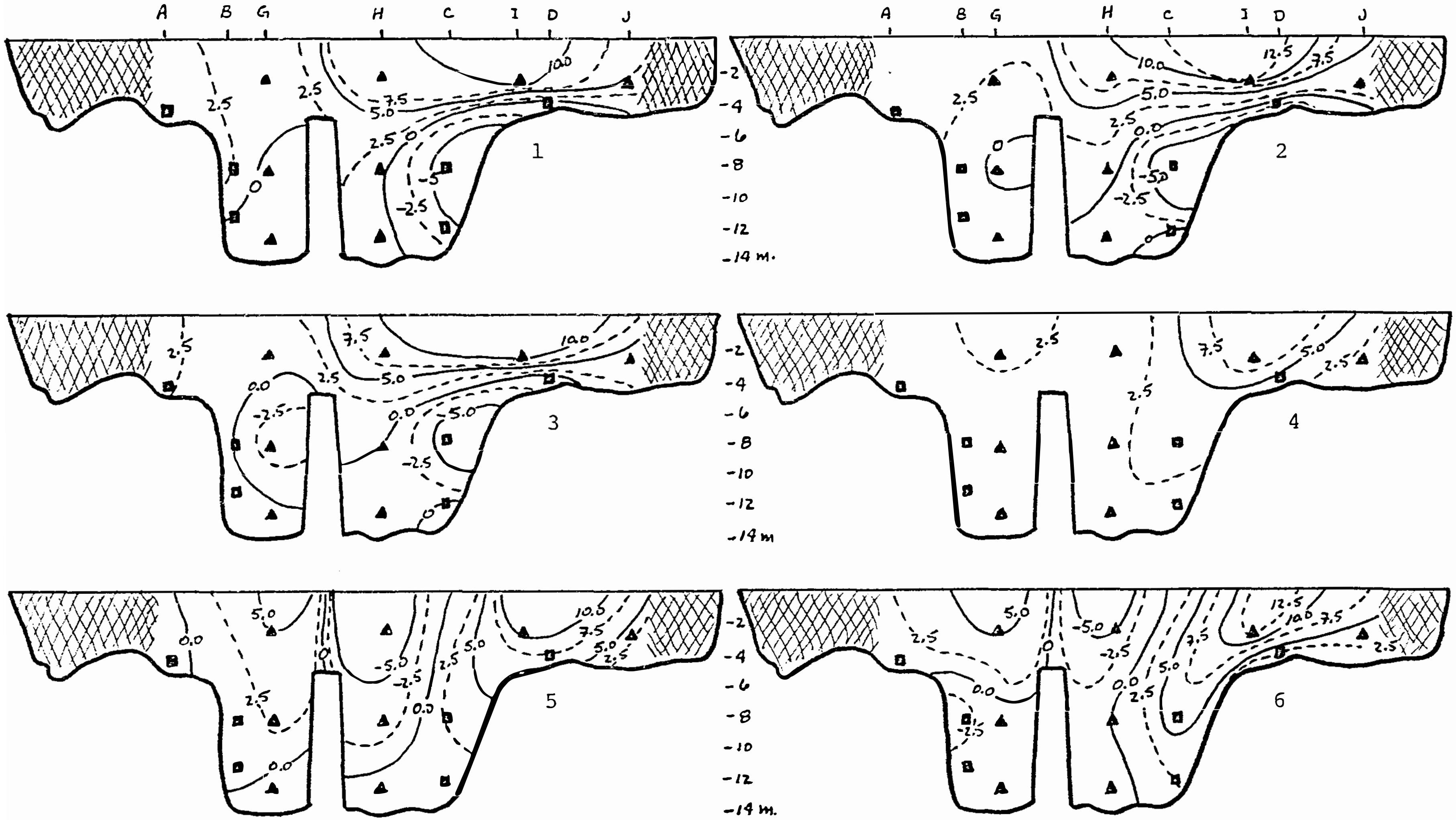


Figure 14. Current components parallel to the axis of Pier 12 along the cross section between Sewell's Point Jetty and Pier 10 for each of twelve tide stages as indicated. Isotacks are in cm/sec with positive values directed shoreward. Current meter positives are marked with squares (Nov. - Jan.) and triangles (Mar.). Station designations are shown at top.

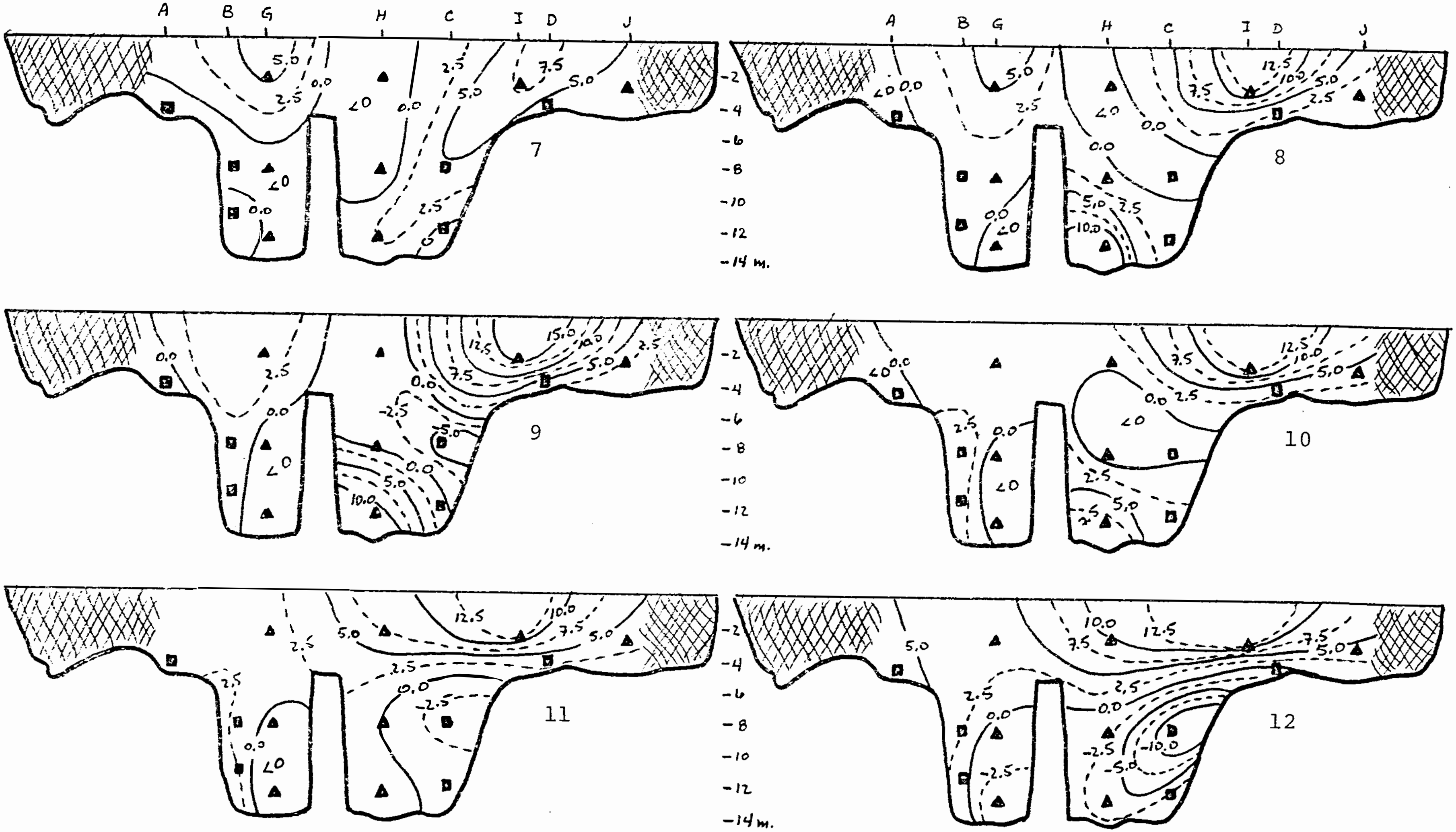


Figure 14. Continued.

Model Verification

To satisfy a request that current data be presented in a format which would allow for verification checks of an hydraulic model, we took the low wind (0-5 knot) periods and arranged hourly averaged data in fourteen hourly segments starting one hour prior to low water. Initially, data used was from the period 20 November - 31 December 1981. Vector averages were calculated for all data available at each measurement location for each of the fourteen hour classes. Resulting current speeds and directions (with associated standard deviations) are presented as Table 13. Subscripts to station designations indicate sampling depths.

To facilitate model operation, we felt it would be advisable to resegregate the data with respect to two constraints:

- periods of minimal wind conditions and
- periods when no ships were berthed at Pier 12

To achieve this, a berthing history at Pier 12 was requested and is presented as Table 14. This history gives arrival and departure time as well as berthing location and length, breadth and draft of the ship. From the information in Table 14 and the Tide-Wind Condition index we determined that a period of four tides was available which best satisfied the constraining conditions. These occurred on 24, 25 and 27 November 1980. Although two ships were berthed at Pier 12 during these times, these were the only dates when adequate current data were available at all locations. Table 15 was prepared from these data. We feel it meets the physical conditions which can best be duplicated in an hydraulic model:

- minimal winds and
- minimal obstruction of flow from ships' hulls.

Table 13. Average hourly speeds and directions of currents near Pier 12 for the period 20 November 1980 - 31 December 1980. Values are in cm/sec and degrees true and are based on data taken when wind speed was less than 5 kt.

Hour	Station $A_{4.5}$ Speed	Station $A_{4.5}$ Direction	Station $B_{8.0}$ Speed	Station $B_{8.0}$ Direction	Station $B_{11.2}$ Speed	Station $B_{11.2}$ Direction	Hour
1	29.6±4.9	23.3±4.1	5.8±3.8	57.8±31.2	1.5±1.0	338.4±97.3	1
2	29.1±5.0	28.0±7.8	4.0±4.0	61.1±65.5	1.3±2.5	23.0±67.5	2
3	19.7±5.0	30.8±11.9	2.6±3.1	42.5±64.9	1.3±0.2	293.0±166.4	3
4	5.6±5.4	67.4±36.5	1.3±1.7	126.6±43.8	0.3±2.4	28.4±82.9	4
5	3.3±4.3	57.5±48.5	0.4±1.1	126.6±49.8	0.6±1.8	81.6±33.7	5
6	5.4±3.1	4.7±10.3	0.6±1.1	90.5±36.1	1.9±2.7	57.1±53.2	6
7	3.5±2.9	16.5±4.3	0.5±0.8	10.0±116.6	2.1±2.9	74.7±26.5	7
8	7.0±4.6	25.8±42.2	0.9±1.7	30.6±97.8	2.4±3.4	58.4±52.4	8
9	10.6±3.9	12.7±20.5	1.5±1.7	52.3±53.1	8.1±6.0	55.0±33.7	9
10	14.8±3.6	22.9±15.8	1.8±2.3	13.2±106.8	7.1±2.3	61.8±16.1	10
11	19.3±5.3	26.3±17.9	1.9±2.9	13.0±94.1	6.7±5.0	52.6±21.3	11
12	25.7±5.1	21.0±10.3	3.1±2.3	47.2±38.4	1.5±1.1	57.3±50.4	12
13	28.3±5.6	24.3±11.3	3.4±3.0	68.1±39.1	0.6±1.9	331.3±152.7	13
14	30.3±5.6	26.3±9.3	4.7±3.6	57.6±34.9	1.3±2.6	32.6±84.3	14

Hour	Station $C_{8.0}$ Speed	Station $C_{8.0}$ Direction	Station $C_{13.0}$ Speed	Station $C_{13.0}$ Direction	Station $D_{4.5}$ Speed	Station $D_{4.5}$ Direction	Hour
1	5.3±4.0	297.4±80.6	2.3±2.6	267.5±51.6	14.4±3.1	4.4±14.3	1
2	7.5±3.2	292.4±96.1	6.3±2.5	274.6±14.3	13.6±3.1	355.5±16.4	2
3	6.8±3.7	279.5±92.7	6.6±4.0	278.3±27.4	11.7±3.9	347.8±7.5	3
4	8.4±3.2	286.9±162.6	3.2±2.7	276.4±57.8	10.2±3.8	345.2±2.2	4
5	4.9±8.4	294.3±145.4	4.5±3.1	134.0±34.2	2.0±3.9	214.0±180.0	5
6	7.2±6.3	300.2±50.5	5.8±4.8	77.8±25.9	10.3±6.0	58.9±39.9	6
7	6.4±6.1	52.5±52.9	2.5±5.2	36.6±69.2	12.2±6.7	41.6±32.3	7
8	9.8±4.6	57.5±27.5	11.3±4.2	62.9±19.5	11.1±3.1	29.4±15.0	8
9	6.9±4.8	40.3±34.2	14.3±3.6	69.7±11.6	14.1±3.6	22.0±20.1	9
10	5.6±2.5	311.1±35.2	6.2±3.8	58.3±26.8	17.1±2.1	20.5±8.2	10
11	4.8±5.1	315.7±125.9	1.2±2.5	24.0±84.5	17.3±4.6	16.6±10.6	11
12	4.7±4.2	272.7±63.0	1.9±3.0	291.9±154.0	19.9±1.5	14.0±4.9	12
13	5.5±4.5	128.0±12.7	3.4±3.0	378.4±147.8	16.2±3.2	13.5±10.8	13
14	6.6±4.4	277.4±13.5	4.3±3.5	284.0±64.3	14.5±4.1	352.7±5.7	14

Table 14. Berthing history at Pier 12 during current study. Dates of occupation, berth and dimensions (waterline and below) of ships berthed at Pier 12 during the period November 1980 - January 1981. Odd numbered berths are 00 the north side of Pier 12 and even numbers to the south. Berth numbers increase with distance from shore.

		Date/Time					
North		From	To	Berth	Length	Breadth	Draft
	1	1530, 26 Nov.	0800, 1 Dec.	3	420	46	16
	2	1400, 4 Dec.	0645, 10 Dec.	1-3-5	990	130	38
	3	0800, 13 Dec.	1200, 13 Dec.	3	118	25	8
	4	1600, 16 Dec.	0930, 13 Jan.	1-3-5	990	130	38
	5	0730, 16 Jan.	1000, 16 Jan.	3	580	82	29
	6	0845, 18 Jan.	1300, 27 Jan.	1-3-5	990	130	38
South	7	1400, 17 Nov.	0800, 27 Nov.	6	200	40	20
	8	1000, 1 Dec.	0800, 8 Dec.	6	510	54	20
	9	0700, 11 Dec.	1100, 19 Dec.	2	415	47	17
	10	0730, 12 Dec.	1200, 12 Dec.	6	415	47	17
	11	0900, 13 Dec.	0830, 15 Dec.	6	557	84	23
	12	0930, 22 Dec.	0900, 23 Jan.	2-4-6	1056	134	38
	13	0915, 23 Jan.	1500, 26 Jan.	6	524	54	20
	14	0900, 26 Jan.	-- -- --	6	560	61	33

Table 15. Current speed and direction in the vicinity of Pier 12 under conditions of light winds (less than 5 kt) with no ships moored at pier. Speeds are in cm/sec, directions ° true. ± 1 standard deviation.

	Station A		Station $B_{8.0}$		Station $B_{11.2}$		
Hour	Speed	Direction	Speed	Direction	Speed	Direction	Hour
1	31.56±5.32	45.3±10.3	8.49±2.72	52.6±17.0	1.46±4.68	41.0±106.6	1
2	27.06±6.91	48.2±14.7	4.26±5.21	59.8±45.4	1.46±3.92	159.0±41.1	2
3	19.98±10.19	56.5±30.4	4.78±5.27	10.0±90.1	0.00±4.76	-- ±90.1	3
4	11.86±5.63	81.6±33.6	3.02±3.56	75.6±52.9	2.25±4.82	100.0±107.0	4
5	7.04±4.23	93.9±27.1	1.25±2.74	136.9±15.9	1.03±2.92	114.0±1.5	5
6	4.74±2.97	28.4±40.6	0.35±1.47	55.0±113.2	2.25±0.38	100.0±0.0	6
7	7.52±2.08	13.8±7.3	0.79±1.08	351.6±148.4	1.27±2.73	111.3±3.5	7
8	9.28±4.03	24.0±23.7	0.35±1.06	55.0±63.4	1.25±0.64	100.0±0.00	8
9	9.28±7.47	24.0±51.9	3.02±3.93	75.6±36.5	6.36±5.25	55.0±43.9	9
10	16.65±6.45	45.8±22.5	11.31±6.03	64.9±27.2	8.46±2.99	65.8±55.8	10
11	20.26±3.78	45.5±10.5	11.31±2.67	64.9±10.9	5.66±3.98	55.0±43.3	11
12	26.00±6.86	43.2±15.5	10.40±6.40	64.8±24.5	3.40±5.83	64.0±42.0	12
13	29.68±4.84	44.4±9.8	7.30±6.12	62.0±30.3	2.06±5.08	14.0±86.3	13
14	30.41±9.02	46.7±19.2	7.25±4.20	56.4±29.6	1.25±4.42	316.9±157.1	14

	Station $C_{8.0}$		Station $C_{13.0}$		Station $D_{4.5}$		
Hour	Speed	Direction	Speed	Direction	Speed	Direction	Hour
1	7.07±1.15	199.9±23.2	6.01±3.15	277.6±3.6	14.98±3.30	349.2±12.2	1
2	8.05±9.64	304.4±42.5	5.88±4.52	292.3±47.1	14.46±1.87	344.0±6.5	2
3	6.28±3.88	312.0±104.0	5.06±7.56	288.5±147.5	14.24±7.95	337.4±70.4	3
4	6.54±4.68	273.4±50.1	5.59±5.86	306.6±84.4	8.48±10.44	325.0±173.0	4
5	3.50±6.31	190.0±41.3	0.71±1.91	55.0±48.3	2.54±5.93	256.8±83.8	5
6	9.06±2.45	106.3±25.1	8.00±5.39	48.7±43.8	3.15±6.57	132.0±28.7	6
7	13.00±3.65	32.6±17.0	12.82±3.87	30.6±14.1	22.16±6.17	53.8±48.6	7
8	12.67±3.76	45.4±16.9	13.27±3.66	52.7±16.1	17.78±6.32	40.4±21.2	8
9	14.68±2.43	49.5±9.6	11.31±6.60	55.0±28.2	16.58±8.07	25.1±20.9	9
10	7.22±7.39	356.0±102.5	10.12±7.18	30.2±44.8	20.74±2.81	14.6±4.30	10
11	7.33±4.15	10.0±51.2	4.53±6.53	16.3±112.2	20.43±2.96	15.6±10.1	11
12	2.13±6.63	318.5±24.6	1.46±4.61	311.0±115.9	20.01±5.67	11.9±15.0	12
13	8.25±3.22	294.0±29.0	5.15±4.57	294.0±60.5	14.10±6.99	3.2±32.0	13
14	8.31±7.39	301.2±70.8	9.25±4.31	298.9±35.7	16.47±5.75	338.2±3.1	14

SUMMARY AND CONCLUSIONS

The general circulation of surface waters in the Hampton Roads area suggests that material approaches the Pier 12 area from the south and west. Winter storms are usually accompanied by winds of sufficient strength to thoroughly mix the water column in relatively shoal areas where fouling organisms are found. It appears that the general circulation pattern would then move these organisms towards the north end of Craney Island disposal area, into the approach channel to the Elizabeth River and thence towards Sewells Point. Faunal communities associated with hydroid colonies found at Pier 12 indicate these organisms are primarily from Hampton Roads populations thus supporting the suggestion of transport by the general circulation. Current data available from the vicinity of Pier 12 indicates a predominant inward flowing current over the southern shoal area adjacent to the pier with outward motion along the far side of the south berthing area.

We suggest the fouling problem may be reduced by placement of a barrier screen extending northward from the northeast corner of Craney Island disposal area. Such a barrier would trap hydroids before they reached the Elizabeth River approach channel from which they may enter the Pier 12 area. We further suggest, however, that consideration be given to preliminary investigations using the Chesapeake Bay Hydraulic model at Kent Island, Md. or the James River Hydraulic model at Vicksburg, MS.

We were unable to identify the precise areas of entry of the hydroids into Pier 12. The most likely entry areas are along the bottom, probably the bottom 5' to 10' of the water column. Hydroids could enter across the entire cross-section from Sewells Point to Pier 10, but it seems most likely that entry is from the mouth of Pier 12 berths. Our data find a slightly higher amount of fouling material in the north berth over the south berth. If the shoal areas were the main entry areas then we would expect higher amounts in the south berth because of the greater area of shallow water on the south side of Pier 12.

Entry of the hydroids into Pier 12 tends to be episodic. There was no build up of fouling material on the Pier 12 apron and channel adjacent to Pier 12. We believe that during a certain combination of tide, currents, and weather the hydroids are transported to the Pier 12 area in pulses.

The raking of the berths to remove fouling organism to prevent fouling of carriers is moderately effective for temporarily reducing the amount of organisms in the berth. From the measurements of flux of hydroids through time it was impossible to see the effects of the raking operation between sampling periods.

The best gear for raking seems to be a 5' or 6' crab dredge towed with chain. The vessel needed for pulling this rake would be at least 24-26' and be equipped with a dredge platform for hoisting the dredge on deck. A mechanical or hydraulic winch is necessary with at least a 1 ton capacity. A properly rigged vessel could then work in 2' to 3' seas.

APPENDIX A

This appendix contains tables of tidal heights (in feet above mean low water), wind speed and direction (in knots and degrees true), and current speed and direction (in cm/sec and degrees true) measured in the vicinity of the Norfolk Naval Base and Pier 12 between 16 November 1980 and 24 January 1981. Each page represents hourly measurements taken over a one week period. Dates and times of measurements are indicated in the first row and first column. Type of measurement, and, in the case of currents, station designation and depth, are listed at the top of each page.

CURRENTS FOR STATION A DEPTH IS 4.0 M

HOUR	16 NOV 80 SPD	16 NOV 80 DIR	17 NOV 80 SPD	17 NOV 80 DIR	18 NOV 80 SPD	18 NOV 80 DIR	19 NOV 80 SPD	19 NOV 80 DIR	20 NOV 80 SPD	20 NOV 80 DIR	21 NOV 80 SPD	21 NOV 80 DIR	22 NOV 80 SPD	22 NOV 80 DIR
1														
2														
3														
4														
5														
6														
7														
8													10	23
9													14	47
10													21	49
11													26	47
12													33	46
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														

CURRENTS FOR STATION A DEPTH IS 4.0 M

HOUR	23 NOV 80 SPD	23 NOV 80 DIR	24 NOV 80 SPD	24 NOV 80 DIR	25 NOV 80 SPD	25 NOV 80 DIR	26 NOV 80 SPD	26 NOV 80 DIR	27 NOV 80 SPD	27 NOV 80 DIR	28 NOV 80 SPD	28 NOV 80 DIR	29 NOV 80 SPD	29 NOV 80 DIR
1					26	43	19	45	10	31	8	9	5	265
2	37	48			27	42	20	50	14	47	7	21	1	82
3	39	50			35	44	26	42	16	48	10	50	7	5
4	27	54			36	46	38	43	21	49	14	50	15	25
5	8	82			32	51	38	47	20	45	20	48	15	38
6	6	78	10	121	19	59	33	49	21	48	20	38	20	32
7			4	37	12	129	22	52	25	50	26	42	21	39
8			5	339	7	21	6	78	15	66	24	55	16	42
9			5	354	5	358	7	77	8	109	15	67	18	56
10			6	41	11	23	5	34	6	61	9	94	16	72
11			14	48	12	36	9	17	7	15	8	46	2	344
12			18	46	16	42	10	44	5	25	4	2	2	70
13	29	50	23	46	19	46	15	49	4	50	11	346	8	80
14	32	43	30	44	26	41	17	50	11	46	14	34	6	55
15	32	48	32	43	32	41	25	48	16	50	22	34	6	11
16	36	51	41	45	42	46	26	44	24	50	26	43	12	24
17	18	68	29	49	37	50	38	48	26	48	27	43	16	32
18	12	118	12	65	30	51	38	47	24	44	25	43	26	43
19	6	35	10	120	10	63	32	50	30	48	31	47	32	44
20	5	287	7	83	8	115	13	53	22	52	39	51	38	49
21			5	349	11	42	9	75	12	74	26	53	37	51
22			10	13	7	32	4	102	11	122	22	52	29	54
23			14	31	11	5	7	27	7	33	6	66	4	18
24			18	48	14	30	9	14	2	49	2	325	8	59

CURRENTS FOR STATION A DEPTH IS 4.0 M

HOUR	30 NOV 80 SPD	30 NOV 80 DIR	1 DEC 80 SPD	1 DEC 80 DIR	2 DEC 80 SPD	2 DEC 80 DIR	3 DEC 80 SPD	3 DEC 80 DIR	4 DEC 80 SPD	4 DEC 80 DIR	5 DEC 80 SPD	5 DEC 80 DIR	6 DEC 80 SPD	6 DEC 80 DIR
1	8	273	6	76	10	65	3	58	25	52	30	25	23	21
2	3	51	5	113	5	90	5	303	11	62			32	30
3	15	31	10	105	4	50	15	105	7	96			15	35
4	14	26	6	36	6	227	5	332	15	71	2	346		
5	14	33	1	25	4	289	7	47	6	343	7	2	5	5
6	16	31	13	35	3	263	6	215	5	10	4	18	5	32
7	19	39	13	25	10	36	8	359	13	17	2	192	7	10
8	26	40	20	28	18	32	17	32	14	47	8	23	3	343
9	26	47	28	41	26	34	25	46			23	25	16	12
10	18	47	26	46	30	40	22	48			22	30	18	23
11	14	59	19	60	33	44	13	54	31	20	16	25	17	17
12	10	60	14	62	33	49	23	51	40	25	23	20	24	18
13	5	86	11	114	26	56	14	57	39	35	34	21	25	17
14	14	90	4	114	2	280	3	276	30	27	26	26	30	19
15	13	10	5	11	1	224	3	51	18	45	27	32	31	31
16	9	359	4	226	2	80	6	352	15	37	2	43	14	30
17	11	25	9	17	8	44	6	28	8	61	4	61	4	43
18	13	21	11	2	8	21	11	9	2	279	11	345	0	306
19	18	33	8	3	14	27	13	14	0	253	8	112	7	339
20	22	37	20	33	11	24	14	31	11	51	6	18	2	356
21	29	43	28	37	21	37	16	31	8	56	14	11	11	4
22	30	52	22	44	34	42	24	36	15	6	14	15	14	359
23	32	52	23	43	35	45	25	44	21	9	12	9	16	360
24	13	51	22	53	29	53	32	49	27	22	18	9	25	20

CURRENTS FOR STATION A DEPTH IS 4.0 M

HOUR	21 DEC 80 SPD	21 DEC 80 DIR	22 DEC 80 SPD	22 DEC 80 DIR	23 DEC 80 SPD	23 DEC 80 DIR	24 DEC 80 SPD	24 DEC 80 DIR	25 DEC 80 SPD	25 DEC 80 DIR	26 DEC 80 SPD	26 DEC 80 DIR	27 DEC 80 SPD	27 DEC 80 DIR
1	44	355	26	346	26	352	13	357	19	354	13	319	16	342
2	41	1	36	354	29	343	26	349	24	352	22	351	20	348
3	27	1	39	0	33	350	26	337	28	345	20	352	22	349
4	12	41	22	7	38	356	40	355	33	343	21	347	29	344
5	7	31	8	90	14	6	31	357	42	353	24	339	33	340
6	3	306	4	339	8	105	8	22	25	355	30	359	28	352
7	12	300	9	353	3	322	7	99	26	341	23	13	19	352
8	10	319	2	323	2	294	7	313	10	349	7	35	11	16
9	16	354	8	343	8	314	0	262	8	112	1	143	5	98
10	15	345	16	359	14	338	2	313	1	144	0	352	6	358
11	19	356	16	2	14	3	12	328	6	296	4	340	8	329
12	28	350	20	357	18	4	16	342	15	313	4	21	8	312
13	39	354	30	350	26	352	21	356	19	343	14	343	9	321
14	42	352	33	349	26	336	23	350	19	336	17	346	2	331
15	40	1	45	351	36	354	28	334	26	328	18	335	25	355
16	26	8	31	359	43	352	44	354	40	349	23	333	27	353
17	7	55	20	358	31	3	46	357	40	354	25	342	27	335
18	5	74	8	37	7	64	27	356	42	359	24	341	26	337
19	8	302	4	16	4	108	11	51	33	0	19	336	20	356
20	5	307	4	3	4	310	3	106	18	5	9	358	19	19
21	6	328	4	283	3	8	4	40	4	132	5	68	1	233
22	12	355	6	335	0	4	8	314	5	311	3	103	3	127
23	17	348	14	350	13	333	10	323	5	324	7	341	3	26
24	23	351	17	343	15	333	17	352	11	347	2	80	11	323

CURRENTS FOR STATION A   DEPTH IS 4.0 M

HOUR	28 DEC 80 SPD	28 DEC 80 DIR	29 DEC 80 SPD	29 DEC 80 DIR	30 DEC 80 SPD	30 DEC 80 DIR	31 DEC 80 SPD	31 DEC 80 DIR	1 JAN 81 SPD	1 JAN 81 DIR	2 JAN 81 SPD	2 JAN 81 DIR	3 JAN 81 SPD	3 JAN 81 DIR
1	8	306	10	311	3	169	2	159						
2	9	328	11	344	3	335	3	69						
3	17	346	23	350	4	13	5	335						
4	17	345	23	358	6	16	12	348						
5	25	335	22	343	10	1	15	326						
6	25	344	22	351	19	353	23	358						
7	26	344	30	346	21	341	26	352						
8	19	344	25	344	19	319	32	355						
9	12	348	18	330	22	321	25	337						
10	7	60	14	302	17	317	32	337						
11	9	340	3	168	10	312	23	344						
12	2	327	4	115	7	321	16	337						
13	3	292	13	347	3	103								
14	11	316	1	288	4	27								
15	17	344	10	323	5	73								
16	20	342	26	358	7	26								
17	23	340	21	329	13	342								
18	25	347	27	341	22	346								
19	24	341	20	339	24	346								
20	26	352	24	327	24	331								
21	20	355	24	337	30	347								
22	17	9	20	352	23	338								
23	13	28	17	357	11	342								
24	8	19	1	9	9	333								

CURRENTS FOR STATION B   DEPTH IS 8.0 M

	16 NOV 80		17 NOV 80		18 NOV 80		19 NOV 80		20 NOV 80		21 NOV 80		22 NOV 80	
HOUR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR
1													5	192
2													7	61
3													2	347
4													5	84
5													0	216
6													5	215
7													7	312
8													6	110
9													8	75
10													20	48
11													23	61
12													27	29
13													10	50
14													20	64
15											24	302	8	79
16											46	258	11	61
17											12	228	2	338
18											17	275	3	151
19											6	109	4	27
20											9	299	0	297
21											14	56	0	152
22											8	6	12	55
23											17	63	14	58
24											3	241	18	62

CURRENTS FOR STATION B DEPTH IS 8.0 M

HOUR	23 NOV 80 SPD	23 NOV 80 DIR	24 NOV 80 SPD	24 NOV 80 DIR	25 NOV 80 SPD	25 NOV 80 DIR	26 NOV 80 SPD	26 NOV 80 DIR	27 NOV 80 SPD	27 NOV 80 DIR	28 NOV 80 SPD	28 NOV 80 DIR	29 NOV 80 SPD	29 NOV 80 DIR
1	9	64	17	66	18	63	9	69	1	160	1	3	1	9
2	14	63	13	66	8	61	8	70	8	65	1	322	5	309
3	11	79	4	50	6	47	3	64	14	74	3	100	3	343
4	9	59	7	69	9	47	8	44	15	68	5	97	1	341
5	1	225	4	49	11	68	12	43	11	61	11	64	3	19
6	0	44	4	151	2	63	10	57	1	167	4	77	3	72
7	2	284	1	88	0	157	6	32	7	25	1	333	1	295
8	1	310	0	38	1	31	0	191	3	94	6	51	4	306
9	1	113	0	144	1	289	1	148	5	148	1	100	1	312
10	10	68	3	45	1	84	1	106	3	173	0	258	1	189
11	11	71	10	60	1	87	0	27	1	224	1	28	2	242
12	14	72	15	73	14	65	2	6	1	204	0	137	3	148
13	15	71	16	71	14	65	11	71	1	247	1	288	1	40
14	5	68	13	62	15	60	14	69	10	58	0	303	9	37
15	10	50	6	66	6	67	15	66	13	65	5	20	3	355
16	9	80	10	46	10	45	10	61	17	74	5	11	3	343
17	3	40	9	73	17	50	2	70	15	71	5	53	3	250
18	0	124	1	5	10	47	6	71	2	71	5	61	1	346
19	1	72	4	151	4	93	7	46	6	47	7	58	5	55
20	6	307	1	219	2	355	3	42	0	271	8	63	12	66
21	1	306	1	25	1	4	0	128	2	129	10	55	6	63
22	2	76	3	315	1	24	2	137	6	156	9	45	8	68
23	11	72	0	115	3	307	1	169	1	152	6	46	3	59
24	14	70	8	65	1	192	2	118	1	313	0	294	6	56

CURRENTS FOR STATION 8 DEPTH IS 8.0 M

HOUR	30 NOV 80 SPD	DIR	1 DEC 80 SPD	DIR	2 DEC 80 SPD	DIR	3 DEC 80 SPD	DIR	4 DEC 80 SPD	DIR	5 DEC 80 SPD	DIR	6 DEC 80 SPD	DIR
1	4	342	1	292	0	269	0	273	5	69				
2	1	115	0	68	3	302	4	170	4	81				
3	9	21	0	332	1	90	5	147	0	303				
4	6	12	2	322	2	113	2	131	0	29				
5	1	48	3	305	0	10	0	250	6	17				
6	1	334	7	315	1	122	1	158	0	8				
7	6	48	7	302	2	63	5	305	10	96				
8	11	63	2	291	0	303	6	27	2	115				
9	6	70	1	70	4	55	6	25	2	92				
10	2	323	2	170	3	12	5	13	1	127				
11	1	206	6	96	4	64	4	57						
12	1	227	4	135	2	90	6	64						
13	0	138	1	144	0	237	4	18						
14	5	151	1	119	3	238	9	326						
15	1	79	0	121	2	95	1	7						
16	3	57	2	91	0	130	1	83						
17	2	294	2	96	0	135	1	34						
18	3	291	0	299	3	17	5	8						
19	4	70	1	171	4	312	3	351						
20	10	69	2	296	3	305	0	303						
21	8	49	1	95	4	300	3	310						
22	11	54	2	77	1	358	7	61						
23	7	27	1	92	2	42	1	93						
24	1	247	0	204	4	81	6	59						

CURRENTS FOR STATION B DEPTH IS 8.0 M

HOUR	14 DEC 80 SPD	14 DEC 80 DIR	15 DEC 80 SPD	15 DEC 80 DIR	16 DEC 80 SPD	16 DEC 80 DIR	17 DEC 80 SPD	17 DEC 80 DIR	18 DEC 80 SPD	18 DEC 80 DIR	19 DEC 80 SPD	19 DEC 80 DIR	20 DEC 80 SPD	20 DEC 80 DIR
1											21	33	29	25
2											5	28	12	27
3											3	91	9	17
4											4	72	2	315
5											7	287	3	352
6											2	276	4	286
7											7	41	2	282
8											7	27	9	40
9											9	26	12	30
10											14	32	14	25
11											15	22	15	41
12											24	25	24	29
13											20	36	30	29
14											7	37	23	35
15									10	67	4	118	24	32
16									7	343	8	109	16	42
17									13	279	8	296	6	89
18									17	312	4	313	5	57
19									6	48	0	285	7	294
20									17	45	5	30	0	30
21									18	37	19	47	1	23
22									8	32	15	38	9	41
23									21	22	12	42	9	38
24									23	13	23	24	12	29

CURRENTS FOR STATION B DEPTH IS 8.0 M

HOUR	21 DEC 80 SPD	21 DEC 80 DIR	22 DEC 80 SPD	22 DEC 80 DIR	23 DEC 80 SPD	23 DEC 80 DIR	24 DEC 80 SPD	24 DEC 80 DIR	25 DEC 80 SPD	25 DEC 80 DIR	26 DEC 80 SPD	26 DEC 80 DIR	27 DEC 80 SPD	27 DEC 80 DIR
1	27	32	8	37	15	33	13	38	11	42	4	63	4	2
2	24	32	18	33	13	32	9	39	12	28	11	43	4	21
3	23	35	25	20	29	25	8	42	22	17	13	36	19	31
4	4	68	17	31	24	29	23	24	28	20	9	41	18	31
5	3	54	1	193	8	29	19	34	22	26	8	33	18	23
6	10	291	1	136	2	120	1	53	17	43	24	25	13	26
7	5	303	2	39	4	323	2	339	14	25	13	36	7	46
8	1	14	1	191	4	299	6	246	9	56	1	66	10	53
9	9	24	0	140	1	277	1	302	4	243	2	329	2	110
10	11	33	9	39	1	23	1	355	3	240	0	44	5	70
11	13	36	13	53	7	38	0	278	3	242	0	139	4	18
12	11	50	17	45	15	38	8	33	3	189	1	83	1	12
13	21	23	15	39	17	35	14	36	11	36	2	88	6	294
14	25	19	20	33	13	42	14	35	13	20	9	37	5	27
15	26	27	28	30	23	33	12	26	18	23	2	343	19	44
16	10	34	19	28	30	29	23	23	22	15	17	26	21	30
17	1	2	5	22	19	25	19	21	29	23	11	26	3	14
18	3	354	1	35	0	347	14	29	28	30	7	20	3	21
19	1	316	3	49	0	152	1	336	11	25	6	320	5	345
20	0	203	1	184	1	23	2	14	16	35	2	0	5	90
21	0	246	1	265	1	338	5	28	4	78	0	139	4	77
22	4	35	1	58	0	89	3	3	1	232	0	54	2	277
23	11	46	9	42	5	31	0	140	3	67	5	42	1	33
24	15	39	13	35	9	34	6	30	2	249	0	262	2	297

CURRENTS FOR STATION B DEPTH IS 8.0 M

HOUR	28 DEC 80 SPD	28 DEC 80 DIR	29 DEC 80 SPD	29 DEC 80 DIR	30 DEC 80 SPD	30 DEC 80 DIR	31 DEC 80 SPD	31 DEC 80 DIR	1 JAN 81 SPD	1 JAN 81 DIR	2 JAN 81 SPD	2 JAN 81 DIR	3 JAN 81 SPD	3 JAN 81 DIR
1	4	236	1	41	0	214	0	4						
2	10	11	5	74	1	106	4	41						
3	9	15	12	17	4	67	1	285						
4	13	24	8	11	3	294	1	331						
5	14	26	18	31	4	350	12	285						
6	2	37	12	27	13	30	10	18						
7	13	25	14	23	17	32	20	35						
8	4	10	12	21	9	29	30	30						
9	6	1	2	20	5	327	21	26						
10	2	66	2	252	11	305	10	23						
11	3	37	1	330	10	309								
12	1	24	1	82	0	165								
13	0	101	9	54	1	354								
14	10	21	2	183	1	248								
15	9	7	1	358	3	274								
16	14	25	5	31	3	74								
17	16	27	11	21	2	10								
18	16	26	21	32	14	24								
19	15	29	11	27	13	23								
20	20	30	2	191	12	22								
21	8	33	7	8	12	19								
22	14	24	9	356	9	20								
23	10	35	4	16	1	254								
24	3	59	0	116	2	329								

CURRENTS FOR STATION B DEPTH IS 8.0 M

HOUR	4 JAN 81 SPD	DIR	5 JAN 81 SPD	DIR	6 JAN 81 SPD	DIR	7 JAN 81 SPD	DIR	8 JAN 81 SPD	DIR	9 JAN 81 SPD	DIR	10 JAN 81 SPD	DIR
									1	66	19	2	14	342
1									2	143	19	36	11	22
2									8	272	8	52	12	7
3									8	18	17	295	7	56
4									10	104	27	296	16	291
5									6	138	1	283	10	303
6									9	131	5	103	12	291
7									5	85	9	305	5	91
8									9	66	9	5	7	344
9									15	50	18	264	6	231
10									13	55	5	69	17	23
11									3	91	15	8	3	107
12									5	242	15	36	7	93
13									10	295	7	89	1	29
14													3	2
15							14	351	10	349	11	286	6	38
16							1	354	5	294			10	84
17							19	85	11	264	10	285	4	88
18							11	52	5	196	2	262	6	150
19							4	203	14	327	4	357	6	280
20							15	76	3	140	12	294	1	134
21							10	61	4	37			2	80
22							1	18	11	342	5	294	16	29
23							8	13	11	42	17	47	7	174
24														

CURRENTS FOR STATION B DEPTH IS 8.0 M

HOUR	11 JAN 81 SPD	11 JAN 81 DIR	12 JAN 81 SPD	12 JAN 81 DIR	13 JAN 81 SPD	13 JAN 81 DIR	14 JAN 81 SPD	14 JAN 81 DIR	15 JAN 81 SPD	15 JAN 81 DIR	16 JAN 81 SPD	16 JAN 81 DIR	17 JAN 81 SPD	17 JAN 81 DIR
1	22	15	0	151	5	100	3	49	0	114	2	122	4	111
2	11	79	9	49	7	46	4	123	5	85	7	89	0	128
3	3	45	10	58	11	54	13	72	8	94	7	95	1	141
4	10	255	5	73	9	71	1	37	8	68	13	62	0	0
5	2	44	3	13	2	52	0	335	5	58	6	68	3	111
6	11	315	2	312	7	45	1	77	1	50	2	117	7	97
7	11	314	2	32	1	279	5	73	3	101	1	254	5	57
8	0	0	1	264	2	282	7	133	7	43	1	46	5	75
9	3	89	2	262	7	284	5	101	8	62	4	85	0	0
10	3	14	7	104	4	262	1	302	0	340	1	117	7	274
11	2	357	9	50	1	42	0	29	0	154	6	87	4	279
12	0	98	1	121	0	0	1	112	4	108	6	296	5	116
13	6	60	2	123	2	79	5	107	0	103	1	279	6	274
14	4	80	12	40	3	117	4	54	2	105	1	70	11	271
15	9	94	7	67	10	51	2	183	1	33	1	347	11	267
16	11	59	7	37	7	70	6	82	0	289	0	312	10	279
17	4	51	0	350	3	69	1	36	2	84	6	114	2	29
18	7	289	2	282	1	295	3	292	6	69	5	83	8	55
19	8	300	6	24	0	26	2	114	5	302	9	100	2	48
20	4	270	3	353	0	197	6	99	5	53	4	92	9	67
21	1	259	2	339	2	115	5	90	2	49	1	310	3	69
22	1	186	0	350	0	252	3	60	0	257	3	288	3	52
23	5	68	0	7	0	0	0	155	2	285	16	284	6	258
24	4	74	5	74	0	0	0	259	0	120	5	19	12	265

CURRENTS FOR STATION B   DEPTH IS 8.0 M

	18 JAN 81		19 JAN 81		20 JAN 81		21 JAN 81		22 JAN 81		23 JAN 81		24 JAN 81	
HOUR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR
1	10	269	4	278	1	268	12	42	0	278	6	104		
2	8	266	4	264	6	249	2	69	2	92	3	92		
3	11	274	0	342	5	255	8	261	6	258	0	278		
4	4	289	2	147	0	9	3	262	13	255	11	262		
5	6	67	2	355	0	15	0	291	5	245	11	252		
6	10	93	1	359	1	15	0	0	1	276	2	266		
7	9	98	2	124	5	70	1	121	0	225	8	123		
8	8	107	0	0	5	72	1	127	1	219	3	28		
9	9	110	0	356	2	59	0	204	1	110	33	238		
10	20	114	1	234	6	109	6	19	2	109				
11	7	81	0	268	0	239	2	102	3	32				
12	2	13	1	284	1	303	8	89	2	48				
13	3	263	2	273	1	126	4	55	7	83				
14	9	253	1	350	2	269	4	96	6	72				
15	0	274	6	262	5	284	9	259	4	252				
16	1	53	0	243	5	273	12	254	13	254				
17	2	187	0	124	1	83	8	251	5	250				
18	4	9	2	353	1	79	2	131	7	153				
19	1	79	1	55	1	227	1	10	9	266				
20	1	120	2	88	0	111	6	102	1	298				
21	8	103	7	49	3	103	0	118	4	60				
22	9	83	2	85	4	30	6	29	1	96				
23	7	55	2	259	6	80	4	59	1	268				
24	7	48	1	32	2	122	8	40	5	81				

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	16 NOV 80 SPD	16 NOV 80 DIR	17 NOV 80 SPD	17 NOV 80 DIR	18 NOV 80 SPD	18 NOV 80 DIR	19 NOV 80 SPD	19 NOV 80 DIR	20 NOV 80 SPD	20 NOV 80 DIR	21 NOV 80 SPD	21 NOV 80 DIR	22 NOV 80 SPD	22 NOV 80 DIR
1													14	199
2													14	149
3													5	140
4													10	74
5													16	51
6													3	148
7													19	300
8													7	236
9													22	342
10													19	62
11													20	337
12													13	13
13													9	105
14											105	242	10	69
15											23	289	11	128
16											43	256	6	282
17											17	165	4	321
18											24	282	0	109
19											18	256	8	66
20											15	295	5	70
21											4	38	2	70
22											11	308	6	61
23											17	191	1	354
24											37	276	13	34

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	23 NOV 80 SPD	DIR	24 NOV 80 SPD	DIR	25 NOV 80 SPD	DIR	26 NOV 80 SPD	DIR	27 NOV 80 SPD	DIR	28 NOV 80 SPD	DIR	29 NOV 80 SPD	DIR
1	6	61	14	56	9	67	12	46	3	16	0	121	1	329
2	7	272	13	62	6	50	13	58	6	51	0	345	2	33
3	9	101	1	90	3	272	6	51	9	65	4	71	9	85
4	3	184	2	99	2	311	3	329	13	51	6	72	5	75
5	0	229	1	226	2	314	1	308	8	61	11	42	2	65
6	11	341	9	130	2	300	4	37	2	302	1	77	4	280
7	3	78	2	109	1	306	1	49	7	273	5	255	3	265
8	1	257	3	302	0	107	2	322	2	96	6	259	2	288
9	0	37	7	295	2	271	1	119	3	91	3	37	2	265
10	6	49	8	64	1	122	2	9	5	117	3	67	1	19
11	11	69	5	48	3	67	1	307	5	109	4	358	2	306
12	15	56	10	61	12	66	5	64	4	105	2	102	0	277
13	15	60	9	58	2	64	5	66	4	49	4	70	2	3
14	5	62	10	56	3	60	4	88	6	63	10	52	3	17
15	0	45	5	249	2	348	14	57	4	80	1	33	7	105
16	5	87	2	86	3	32	13	50	12	68	5	72	4	98
17	8	127	3	17	1	359	0	259	9	60	3	64	1	51
18	3	132	5	113	1	34	0	237	0	354	8	59	1	287
19	3	323	5	106	0	332	2	7	4	259	6	273	3	69
20	8	264	2	228	3	132	2	58	2	276	6	110	10	62
21	3	280	1	284	0	18	1	99	3	155	2	40	6	53
22	4	40	1	299	1	360	0	126	3	132	2	303	7	72
23	6	56	1	254	2	293	1	77	1	97	1	103	4	78
24	11	72	14	50	1	70	2	5	4	95	5	289	4	332

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	30 NOV 80 SPD	30 NOV 80 DIR	1 DEC 80 SPD	1 DEC 80 DIR	2 DEC 80 SPD	2 DEC 80 DIR	3 DEC 80 SPD	3 DEC 80 DIR	4 DEC 80 SPD	4 DEC 80 DIR	5 DEC 80 SPD	5 DEC 80 DIR	6 DEC 80 SPD	6 DEC 80 DIR
1	3	316	6	276	4	277	11	98					2	226
2	2	18	2	93	3	270	8	125			6	266	6	298
3	4	23	1	57	9	92	1	269			5	256	8	277
4	2	87	3	90	6	93	2	284					4	261
5	0	122	2	81	4	56	2	56					0	310
6	1	229	5	68	11	59	4	98			6	98	1	236
7	2	302	0	54	3	84	2	259			8	55	10	82
8	3	84	1	327	1	282	4	269			4	73	12	66
9	6	90	0	288	0	288	3	301			11	63	10	49
10	4	272	2	111	0	233	4	288					7	65
11	0	80	11	104	5	117	1	46			12	51	3	90
12	0	264	5	114	6	116	4	263			10	33	6	69
13	3	278	3	290	1	128	10	283			5	270	1	289
14	1	37	1	359	3	142	6	276			6	304	1	116
15	4	62	7	77	0	344	6	302			7	275	10	272
16	10	61	8	101	1	92	2	265			2	351	2	182
17	7	53	8	78	1	164	1	331			1	24	11	122
18	1	212	2	72	9	109	3	23			2	37	5	100
19	2	303	2	51	5	91	7	84			4	92	1	56
20	0	57	0	113	6	74	4	52			6	60	3	69
21	0	299	1	49	1	219	1	307			7	50	11	83
22	1	95	3	119	1	339	0	159			8	66	9	86
23	1	5	0	102	4	293					9	62	2	28
24	4	301	1	277	6	97					1	318	8	41

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	7 DEC 80 SPD	7 DEC 80 DIR	8 DEC 80 SPD	8 DEC 80 DIR	9 DEC 80 SPD	9 DEC 80 DIR	10 DEC 80 SPD	10 DEC 80 DIR	11 DEC 80 SPD	11 DEC 80 DIR	12 DEC 80 SPD	12 DEC 80 DIR	13 DEC 80 SPD	13 DEC 80 DIR
1	6	59	4	42	5	260	4	63	7	61	1	333	3	317
2	1	247	3	96	3	255	4	256	12	36	15	55	11	58
3	2	275	4	80	3	80	3	279	10	52	14	51	6	51
4	8	266	3	231	1	263	3	163	6	279	1	50	12	44
5	3	239	5	301	3	279	3	291	0	84	3	356	1	309
6	6	25	1	41	6	107	0	101	3	24	5	67	1	335
7	6	98	6	66	3	23	6	105	2	120	1	218	4	7
8	10	96	13	96	12	53	2	99	1	100	4	277	2	16
9	12	61	14	53	8	64	4	71	6	10	3	100	5	138
10	6	37	14	51	9	65	0	333	2	277	3	267	3	347
11	1	265	4	54	6	62	5	54	2	357	4	321	1	139
12	2	116	0	220	1	265	11	51	4	38	6	58	1	220
13	8	106	3	71	4	64	8	66	15	51	10	47	5	51
14	12	76	8	80	2	221	13	42	14	54	14	49	6	52
15	1	339	8	101	2	15	9	40	14	48	13	51	14	61
16	3	276	1	305	1	125	2	266	1	65	11	47	16	59
17	3	271	2	261	3	88	2	326	2	19	5	260	10	31
18	3	110	0	240	1	109	2	167	0	345	4	359	7	295
19	1	57	3	272	3	264	2	121	2	297	6	34	1	218
20	6	93	2	52	1	84	7	109	0	247	2	23	3	108
21	12	59			11	73	1	324	0	293	1	142	3	85
22	10	75	10	67	5	119	0	299	2	57	2	19	2	154
23	1	316	9	58	10	89	0	49	2	86	5	34	2	341
24	6	10	2	187	9	59	2	247	1	102	3	73	5	257

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	14 DEC 80 SPD	14 DEC 80 DIR	15 DEC 80 SPD	15 DEC 80 DIR	16 DEC 80 SPD	16 DEC 80 DIR	17 DEC 80 SPD	17 DEC 80 DIR	18 DEC 80 SPD	18 DEC 80 DIR	19 DEC 80 SPD	19 DEC 80 DIR	20 DEC 80 SPD	20 DEC 80 DIR
1	6	103	1	279	1	119	0	357	1	32	19	289	16	335
2	8	35	5	71	3	94	9	58	4	320	6	27	3	18
3	8	64	9	48	8	52	4	95	1	104	6	247	1	63
4	11	60	9	66	6	29	10	59	4	78	16	243	6	246
5	11	67	8	80	3	50	10	45	9	94	19	45	0	354
6	8	46	7	58	6	43	8	79	7	47			6	98
7	5	307	15	43	5	45	2	77	7	65	9	313	7	101
8	5	253	2	289	2	70	1	118	10	74	2	29	6	30
9	1	251	4	239	4	120	3	65	8	54	17	8	9	34
10	1	112	3	60	2	168	2	313	1	282	29	346	12	37
11	2	101	2	106	2	214	10	271	5	344	24	306	12	25
12	5	72	1	40	1	283	7	273	4	7	19	298	7	354
13	6	89	4	44	6	96	5	276			7	308	13	41
14	7	65	3	88	10	42	4	221			7	49	10	24
15	9	52	4	66	1	86	1	31	6	263	11	267	12	30
16	4	44	15	43	6	288	1	219	10	126	3	93	8	32
17	0	192	6	60	15	66	5	100	14	337	2	359	4	349
18	6	276	10	35	9	74	10	72			6	253	2	342
19	0	169	1	312	2	89	7	79	28	266	8	297	5	270
20	3	34	3	135	1	86	1	47			5	90	3	346
21	11	66	3	20	2	227	1	211	10	308	13	33	25	332
22	1	52	2	171	11	269	3	297	7	332	17	16	23	27
23	1	94	0	88	6	261	8	354	8	230	5	33	7	52
24	7	287	1	147	5	270	1	64	25	292	8	263	16	22

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	21 DEC 80 SPD	21 DEC 80 DIR	22 DEC 80 SPD	22 DEC 80 DIR	23 DEC 80 SPD	23 DEC 80 DIR	24 DEC 80 SPD	24 DEC 80 DIR	25 DEC 80 SPD	25 DEC 80 DIR	26 DEC 80 SPD	26 DEC 80 DIR	27 DEC 80 SPD	27 DEC 80 DIR
1	11	18	7	28	16	44	12	54	14	49	10	59	10	75
2	11	27	1	332	7	32	13	43	5	59	13	46	4	273
3	3	11	3	219	9	356	3	35	11	20	8	50	1	81
4	3	62	4	22	14	9	10	316	11	331	12	45	6	77
5	3	109	1	85	1	83	3	17	9	20	2	22	1	82
6	12	281	2	67	3	109	1	196	9	18	10	321	7	56
7	5	204	3	63	4	3	1	166	4	13	1	321	1	238
8	6	358	3	151	0	130	4	50	3	147	1	169	1	212
9	5	83	2	65	2	233	0	285	3	117	2	89	4	109
10	12	2	12	46	3	35	0	50	3	209	1	336	1	182
11	15	47	10	76	8	49	4	22	6	309	1	27	2	323
12	22	16	9	63	11	71	13	48	5	31	3	104	3	76
13	13	16	12	47	18	40	16	45	14	59	10	44	10	50
14	15	20	1	34	12	40	17	47	7	55	8	69	4	278
15	8	13	12	20	1	203	9	37	0	199	7	32	3	109
16	9	314	4	40	10	12	4	320	1	224	4	47	0	104
17	7	101	0	187	8	20	6	350	15	357	1	31	0	188
18	7	356	3	169	1	202	1	104	15	18	5	275	7	123
19	5	345	2	21	0	111	4	326	5	10	4	287	4	28
20	1	171	2	106	1	232	2	250	2	35	3	273	12	60
21	8	278	0	16	1	78	2	32	1	44	1	192	5	66
22	4	64	2	61	2	115	4	37	0	227	0	190	3	108
23	12	50	9	43	3	53	0	148	8	70	6	28	2	63
24	13	40	9	50	13	42	9	38	5	74	3	97	1	6

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	28 DEC 80 SPD	28 DEC 80 DIR	29 DEC 80 SPD	29 DEC 80 DIR	30 DEC 80 SPD	30 DEC 80 DIR	31 DEC 80 SPD	31 DEC 80 DIR	1 JAN 81 SPD	1 JAN 81 DIR	2 JAN 81 SPD	2 JAN 81 DIR	3 JAN 81 SPD	3 JAN 81 DIR
1	1	320	6	57	0	16	2	117						
2	6	52	6	51	0	54	2	231						
3	17	42	14	31	2	69	1	293						
4	2	4	4	60	2	244	0	112						
5	9	32	3	61	4	274	4	57						
6	0	60	5	59	1	295	1	273						
7	1	310	1	123	7	55	2	111						
8	1	81	3	121	10	43	2	103						
9	2	130	0	197	1	241	1	30						
10	3	332	0	295	12	278	6	32						
11	1	148	0	51	6	287	5	36						
12	4	234	8	118	4	122								
13	1	296	2	28	4	117								
14	7	40	0	316	1	333								
15	11	33	2	61	2	102								
16	14	40	17	44	2	76								
17	13	20	2	63	1	360								
18	2	197	15	25	2	230								
19	1	101	10	31	3	58								
20	1	139	0	209	3	31								
21	2	310	8	280	1	55								
22	1	291	12	291	7	287								
23	1	276	8	293	1	288								
24	1	259	3	280	3	281								

CURRENTS FOR STATION B DEPTH IS 11.2 M

HOUR	4 JAN 81 SPD	4 JAN 81 DIR	5 JAN 81 SPD	5 JAN 81 DIR	6 JAN 81 SPD	6 JAN 81 DIR	7 JAN 81 SPD	7 JAN 81 DIR	8 JAN 81 SPD	8 JAN 81 DIR	9 JAN 81 SPD	9 JAN 81 DIR	10 JAN 81 SPD	10 JAN 81 DIR
1									8	24	18	72	22	34
2									1	110	8	50	20	23
3									7	257	13	11	21	70
4									11	35	22	305	11	16
5									14	44	23	288	40	285
6									4	352	23	286	17	279
7									18	324	22	240	9	275
8									16	351	13	29	13	36
9									7	332	16	344	12	4
10									9	325	13	212	10	60
11									14	41	15	17	22	14
12									7	158	15	306	5	47
13									4	246	20	74	21	12
14									13	72	26	34	7	306
15									10	88	20	25	20	20
16							9	359	14	316	25	11	25	345
17							4	104	13	77	29	268	17	8
18							8	245	8	227	15	277	28	285
19							9	130	10	353	9	208	19	282
20							11	256			18	223	24	277
21							10	207	3	72	25	1	13	260
22							2	48	20	246	10	114	15	114
23							7	303	14	37	4	111	7	61
24							3	325	25	45	6	18	17	80

CURRENTS FOR STATION 8 DEPTH IS 11.2 M

HOUR	11 JAN 81 SPD	11 JAN 81 DIR	12 JAN 81 SPD	12 JAN 81 DIR	13 JAN 81 SPD	13 JAN 81 DIR	14 JAN 81 SPD	14 JAN 81 DIR	15 JAN 81 SPD	15 JAN 81 DIR	16 JAN 81 SPD	16 JAN 81 DIR	17 JAN 81 SPD	17 JAN 81 DIR
1	26	50	31	47	11	38	19	45	10	301	9	99	2	102
2	21	71	24	27	23	39	14	51	18	352	23	69	0	234
3	7	337	19	45	27	58	8	63	21	88	12	85	6	99
4	27	317	11	64	14	60	8	277	18	60	14	50	0	225
5	9	55	17	19	15	65	13	17	12	57	7	72	2	114
6	21	290	19	281	15	35	18	331	0	177	5	65	8	108
7	12	317	16	315	11	346	7	94	4	108	6	267	1	58
8	23	291	2	269	10	272	12	89	8	53	0	178	5	63
9	11	32	7	28	19	272	7	49	7	101	10	74	0	299
10	27	318	31	50	5	135	7	111	3	116	8	119	6	277
11	13	90	6	97	15	307	5	246	5	220	1	115	8	268
12	11	95	35	43	34	318	25	87	8	180	5	351	0	320
13	23	35	45	36	1	53	5	105	13	109	3	239	6	279
14	21	53	18	35	26	90	13	20	5	113	2	111	13	278
15	11	59	21	68	33	44	4	224	7	43	1	24	10	277
16	11	39	6	47	8	60	15	51	14	67	2	183	7	280
17	18	350	2	21	13	53	1	42	8	99	7	134	0	242
18	15	238	20	271	6	254	1	349	8	84	1	35	4	30
19	17	294	21	297	8	251	0	14	7	297	11	81	7	60
20	30	277	15	347	7	243	14	112	7	62	2	69	5	65
21	6	336	19	310	19	38	17	76	10	60	0	0	0	316
22	12	39	9	339	10	255	7	168	0	249	2	284	1	346
23	24	37	6	19	16	62	18	208	5	263	21	278	3	295
24	10	37	8	64	22	284	16	279	5	230	1	264	19	276

CURRENTS FOR STATION 8 DEPTH IS 11.2 M

HOUR	18 JAN 81 SPD	18 JAN 81 DIR	19 JAN 81 SPD	19 JAN 81 DIR	20 JAN 81 SPD	20 JAN 81 DIR	21 JAN 81 SPD	21 JAN 81 DIR	22 JAN 81 SPD	22 JAN 81 DIR	23 JAN 81 SPD	23 JAN 81 DIR	24 JAN 81 SPD	24 JAN 81 DIR
1	9	276	3	293	6	282	11	62	2	309	6	113		
2	10	283	3	300	9	279	4	53	1	301	1	115		
3	11	281	0	301	5	263	7	284	4	296	1	97		
4	5	294	2	308	1	20	8	278	14	278	13	275		
5	1	36	2	344	0	0	2	324	6	268	14	274		
6	5	108	6	8	2	262	2	308	3	26	1	271		
7	8	119	0	47	3	103	1	154	1	1	3	138		
8	13	109	3	278	2	102	0	0	2	267	0	224		
9	5	119	1	85	1	254	1	72	0	304	22	255		
10	17	118	1	269	3	111	3	14	0	178				
11	8	106	2	325	1	317	1	292	4	49				
12	2	5	3	321	1	358	4	74	0	67				
13	4	298	5	290	2	37	7	57	7	100				
14	11	272	0	36	9	279	2	57	6	77				
15	7	276	7	286	6	266	9	278	3	304				
16	1	62	1	42	6	281	12	275	14	278				
17	1	241	1	243	3	169	6	271	6	270				
18	3	28	3	6	3	116	2	279	4	157				
19	0	117	1	289	2	276	2	260	9	280				
20	2	122	1	313	1	308	0	161	1	292				
21	10	121	6	71	1	132	0	315	3	88				
22	8	101	1	109	2	14	4	28	0	122				
23	8	69	4	262	2	64	2	23	2	22				
24	10	58	2	325	2	106	3	44	9	97				

CURRENTS FOR STATION C DEPTH IS 8.0 M

	16 NOV 80		17 NOV 80		18 NOV 80		19 NOV 80		20 NOV 80		21 NOV 80		22 NOV 80	
HOUR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR
1													10	269
2											10	290	10	279
3											9	281	11	293
4													10	283
5											11	64	7	229
6											14	49	14	76
7											17	51	14	79
8											17	15	15	49
9											13	1	13	25
10											11	7	11	354
11											8	253	9	329
12											11	271	7	278
13											10	280	11	282
14											11	273	11	269
15											10	279	13	269
16									11	171	10	237	11	276
17									15	70	6	215	10	303
18									16	51	13	70	9	255
19									12	61	15	41	11	72
20									17	27	15	57	16	45
21									18	14	15	13	18	64
22									11	7	14	6	14	32
23									3	298	8	340	15	17
24									8	285	10	274	10	349

CURRENTS FOR STATION C DEPTH IS 8.0 M

HOUR	23 NOV 80 SPD	23 NOV 80 DIR	24 NOV 80 SPD	24 NOV 80 DIR	25 NOV 80 SPD	25 NOV 80 DIR	26 NOV 80 SPD	26 NOV 80 DIR	27 NOV 80 SPD	27 NOV 80 DIR	28 NOV 80 SPD	28 NOV 80 DIR	29 NOV 80 SPD	29 NOV 80 DIR
1	8	339	13	343	15	15	9	348	17	32	12	42		
2	7	264	6	316	6	30	9	354	17	29				
3	11	271	5	303	9	243	3	277	10	352	9	64	16	54
4	10	294	12	261	11	268	9	282	10	349	9	328	6	353
5	11	283	8	353	11	272	9	296			6	4	9	267
6	3	178	8	228	12	276	10	302	12	272	8	288	8	282
7	15	45	10	90	8	258	12	292	12	332			8	264
8	18	50	18	47	10	113	12	287	7	1			5	356
9	15	54	16	67	17	32	4	311	2	303	10	287		
10	15	29	10	67	16	52	13	25	12	106	4	272	12	324
11	12	348	15	26	14	56	15	52	13	52	9	117		
12	11	335	22	19	8	357	16	37	15	45	10	17		
13	6	301	24	9	11	40	14	45			9	28		
14	9	261			1	346	12	35	15	42				
15	10	260	7	295	9	288	9	359	16	21	4	239	9	61
16	11	275	9	283	12	269			9	332			8	272
17	10	293	9	326	10	266	7	296			7	18	9	261
18	6	267	6	288	10	263	10	281			9	321		
19	5	151	7	227	8	313	8	299			13	0		
20	14	35	10	195	4	234	10	331	10	313	9	322	12	291
21			10	66	11	147	8	314	10	357	8	307	6	250
22	15	55	14	42	14	50	10	154	4	288	11	332	9	264
23			13	47	18	29	12	45	10	124	11	312		
24	11	343	22	40	15	48					11	265	11	288

CURRENTS FOR STATION C DEPTH IS 8.0 M

HOUR	30 NOV 80 SPD	30 NOV 80 DIR	1 DEC 80 SPD	1 DEC 80 DIR	2 DEC 80 SPD	2 DEC 80 DIR	3 DEC 80 SPD	3 DEC 80 DIR	4 DEC 80 SPD	4 DEC 80 DIR	5 DEC 80 SPD	5 DEC 80 DIR	6 DEC 80 SPD	6 DEC 80 DIR
1			12	295			8	290						
2	6	274	9	71			5	227	12	299				
3	5	157	7	346	7	64	12	200	13	283				
4			10	69	15	61	3	130	6	253				
5			7	300					11	118				
6	10	256	4	8	13	56	6	326						
7	9	271			5	291	9	296	20	63				
8	6	26	10	291					11	67				
9			7	348	4	345	9	290						
10			6	282	8	253	5	344						
11	13	281	3	346										
12	11	293					7	265						
13														
14	7	118	8	33										
15	11	68	4	3										
16	9	43	12	60	12	105	12	271						
17	9	281	7	26			2	158						
18	8	237	5	357	7	315	7	97						
19	2	232	2	337	9	317	11	43						
20	3	17			9	291	6	300						
21	8	277					10	272						
22	11	280			5	341	4	288						
23	15	330	3	277			7	331						
24					11	279								

CURRENTS FOR STATION C DEPTH IS 8.0 M

	14 DEC 80		15 DEC 80		16 DEC 80		17 DEC 80		18 DEC 80		19 DEC 80		20 DEC 80	
HOUR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR	SPD	DIR
1											13	345		
2														
3											8	300		
4														
5														
6														
7											10	44		
8														
9														
10														
11														
12														
13														
14											18	44		
15											18	58		
16														
17														
18									13	60			14	54
19														
20														
21									5	318	4	351		
22														
23														
24														

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	16 NOV 80 SPD	DIR	17 NOV 80 SPD	DIR	18 NOV 80 SPD	DIR	19 NOV 80 SPD	DIR	20 NOV 80 SPD	DIR	21 NOV 80 SPD	DIR	22 NOV 80 SPD	DIR
1											11	278	8	268
2											10	286	8	289
3											6	289	9	296
4											7	290	9	296
5											12	38	4	249
6											14	38	11	50
7											15	50	12	69
8											9	27	11	47
9											12	349	8	34
10											21	17	18	19
11											4	293	17	12
12											8	270	4	347
13											10	280	9	268
14											10	293	11	285
15											11	303	10	281
16									6	277	8	297	12	290
17									13	57	4	243	11	296
18									14	57	11	62	7	279
19									10	44	15	30	10	64
20									10	61	10	59	11	30
21									23	20	13	23	15	57
22									18	16	19	26	17	40
23									9	284	5	342	21	25
24									14	285	2	254	16	18

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	23 NOV 80 SPD	23 NOV 80 DIR	24 NOV 80 SPD	24 NOV 80 DIR	25 NOV 80 SPD	25 NOV 80 DIR	26 NOV 80 SPD	26 NOV 80 DIR	27 NOV 80 SPD	27 NOV 80 DIR	28 NOV 80 SPD	28 NOV 80 DIR	29 NOV 80 SPD	29 NOV 80 DIR
1	4	336	20	13	17	14	9	22	16	42	11	29	5	70
2	10	268	6	254	3	252	9	360	13	48	9	58	15	60
3	9	278	8	266	6	270	2	311	12	10	5	76	18	68
4	10	286	9	285	8	291	9	274	17	13	9	352	2	339
5	10	306	5	303	11	297	10	278	3	262	5	4	6	81
6	4	279	5	214	10	301	9	296	10	265	2	343	2	352
7	15	38	7	77	4	277	8	292	13	289	9	267	1	279
8	16	51	14	38	3	81	8	288	12	320	7	269	1	324
9	12	65	16	62	15	28	4	308	1	332	8	295	6	263
10	11	29	9	63	16	56	11	19	6	70	5	280	4	276
11	14	8	15	34	13	53	13	44	17	31	2	108	5	303
12	20	18	22	30	6	60	16	41	16	44	6	51	13	71
13	6	295	23	23	1	175	10	68	10	27	10	55	4	285
14	6	275	16	15	5	255	7	45	13	61	19	72	12	74
15	10	279	9	277	7	268	15	11	14	26	7	63	13	67
16	9	296	9	277	12	268	5	294	24	19	2	231	5	68
17	6	293	9	305	10	297	9	268	10	15	2	5	2	241
18	4	229	3	234	11	291	10	289	9	268	4	290	3	282
19	3	98	2	200	6	287	12	290	10	270	8	279	3	284
20	15	30	1	122	2	234	8	303	1	353	12	281	7	269
21	14	51	10	43	4	143	4	340	4	61	13	268	4	269
22	11	65	9	32	12	29	1	215	5	257	11	274	7	277
23	18	29	12	49	16	29	10	32	4	92	13	284	6	278
24	21	13	18	68	10	43	15	35	15	39	7	288	9	273

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	30 NOV 80 SPD	30 NOV 80 DIR	1 DEC 80 SPD	1 DEC 80 DIR	2 DEC 80 SPD	2 DEC 80 DIR	3 DEC 80 SPD	3 DEC 80 DIR	4 DEC 80 SPD	4 DEC 80 DIR	5 DEC 80 SPD	5 DEC 80 DIR	6 DEC 80 SPD	6 DEC 80 DIR
1	6	285	7	93	1	356	0	349	11	286				
2	9	66	9	76	11	84	5	233	14	281				
3	12	72	5	275	3	27	3	70	15	287				
4	11	74	11	78	6	43	3	217	2	35				
5	11	81	7	58	19	74	13	85	14	73				
6	2	335	7	66	14	74	13	71	21	66				
7	2	312	1	202	1	347	8	71	18	82				
8	2	296	4	265	6	256	3	72	8	82				
9	2	264	3	301	5	282	7	273	0	0				
10	2	267	4	262	7	259	3	31	5	285				
11	3	230	8	277	4	270	5	230						
12	8	285	5	253	7	288	11	275						
13	10	86	6	271	7	270	11	265						
14	0	49	16	71	5	248	0	267						
15	12	76	2	30	4	97	5	264						
16	12	70	15	72	11	76	2	216						
17	3	52	13	73	12	79	9	84						
18	5	280	10	71	23	69	10	70						
19	6	260	0	195	14	71	11	68						
20	6	263	4	272	6	51	3	42						
21	6	259	4	264	4	293	0	46						
22	6	254	6	274	1	27	2	302						
23	14	234	3	284	2	259	7	265						
24	12	306	6	270	12	275	9	258						

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	14 DEC 80 SPD DIR	15 DEC 80 SPD DIR	16 DEC 80 SPD DIR	17 DEC 80 SPD DIR	18 DEC 80 SPD DIR	19 DEC 80 SPD DIR	20 DEC 80 SPD DIR
1						6 73	
2						4 291	11 332
3						52 271	
4						15 267	
5						19 329	
6						12 251	
7						5 74	2 120
8						13 302	
9						16 326	
10						12 243	
11						22 4	
12						36 336	
13					19 134	34 17	
14					34 279	24 288	
15					8 90	0 256	
16					5 344		
17					8 59	29 282	
18					3 298		
19					9 287		
20					12 277	8 259	
21					16 276	12 276	
22					22 266		
23					18 313	40 306	
24					9 301	34 320	

CURRENTS FOR STATION C   DEPTH IS 13.0 M

HOUR	21 DEC 80 SPD	DIR	22 DEC 80 SPD	DIR	23 DEC 80 SPD	DIR	24 DEC 80 SPD	DIR	25 DEC 80 SPD	DIR	26 DEC 80 SPD	DIR	27 DEC 80 SPD	DIR
1			8	239	6	350	12	2	10	8	7	19	5	356
2			10	346	11	320	6	349	14	36	9	32	5	13
3			9	343	11	318	6	330	4	46	12	25	16	33
4			23	313	5	349	11	11	9	2	10	10	13	26
5			9	334	3	330	6	336	4	132	2	351	9	6
6			10	90	8	182	0	254	4	291	7	358	5	22
7			18	33	15	63	11	164	7	104	2	346	3	13
8			4	156	25	65	14	102	1	70	6	11	2	92
9			6	32	19	34	15	38	6	158	6	128	8	144
10			16	15	16	32	16	41	10	49	8	122	7	123
11			4	301	24	342	11	36	18	30	10	82	4	115
12	7	129	8	317	16	359	12	12	17	37	9	11	10	36
13	3	91	8	273	23	6	22	13	9	27	11	39	11	306
14	14	356	10	56	2	356	15	8	6	341	8	8	5	351
15	18	334	8	340	15	328	12	319	7	5	9	37	13	27
16	13	327	4	324	10	331	21	2	4	338	13	23	3	23
17	4	303	4	82	15	301	15	342	14	338	6	1	5	158
18	5	93	3	90	1	274	12	331	10	330	2	339	0	321
19	21	75	10	134	1	97	9	326	16	325	5	279	4	45
20	23	34	19	22	14	103	2	307	14	345	7	317	6	36
21	9	45	16	43	17	42	7	136	4	133	1	111	3	100
22	12	18	13	39	18	47	13	59	9	107	9	144	2	115
23	17	342	21	344	20	23	16	33	15	74	10	84	4	141
24	3	124	21	11	14	24	15	43	10	30	13	44	6	87

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	28 DEC 80 SPD	28 DEC 80 DIR	29 DEC 80 SPD	29 DEC 80 DIR	30 DEC 80 SPD	30 DEC 80 DIR	31 DEC 80 SPD	31 DEC 80 DIR	1 JAN 81 SPD	1 JAN 81 DIR	2 JAN 81 SPD	2 JAN 81 DIR	3 JAN 81 SPD	3 JAN 81 DIR
1	15	36	20	46	6	146	10	134						
2	19	28	17	51	11	114	7	109						
3	22	24	17	43	7	22	10	300						
4	11	25	16	25	11	323	15	309						
5	7	0	22	34	14	17	10	303						
6	3	142	8	12	10	34	3	4						
7	7	24	11	11	15	23	21	23						
8	3	212	1	243	3	38	17	30						
9	3	136	3	66	6	316	9	33						
10	4	149	1	331	10	303	3	304						
11	3	142	4	138	8	306	7	32						
12	6	51	3	135	0	145	2	22						
13	8	40	8	93	8	126								
14	19	27	11	37	4	276								
15	16	37	16	35	13	305								
16	21	26	19	18	16	307								
17	11	24	19	27	5	1								
18	1	296	7	27	6	33							7	328
19	6	298	7	357	14	16								
20	3	248	3	0	6	347								
21	3	238	4	268	5	310								
22	5	346	4	346	3	308								
23	8	20	2	319	5	317								
24	5	146	1	245	5	308								

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	4 JAN 81 SPD	DIR	5 JAN 81 SPD	DIR	6 JAN 81 SPD	DIR	7 JAN 81 SPD	DIR	8 JAN 81 SPD	DIR	9 JAN 81 SPD	DIR	10 JAN 81 SPD	DIR
1					5	12	11	13	16	28	12	9	16	7
2			1	291	12	299	5	14	10	3	6	355	10	359
3			21	303	11	302	8	17	6	315	5	319	5	355
4			17	298	17	301	10	337	7	312	4	21	4	324
5			24	259	14	190	9	315	2	307	0	21	2	101
6			9	240	11	118	6	325	2	285	4	309	4	320
7			25	334	13	28	8	148	11	150	6	156	3	345
8	26	314	21	331	3	56	9	94	9	89	15	138	2	35
9			1	197	30	357	13	326	7	26	20	53	12	112
10	11	34	29	328	11	358	10	22	9	37	15	53	19	56
11	10	295	13	324	6	14	10	318	10	323	14	28	12	49
12			22	343	6	8	4	359	11	24	11	8	14	18
13	17	80	5	148	3	324	7	308	11	17	15	29	5	68
14	27	321	18	323	9	301	17	8	5	348	16	360	3	329
15	34	293	16	321	10	347	12	340	7	319	9	359	2	8
16	11	300	6	339	10	319	9	302	11	320	4	331	3	316
17	4	64	18	288	4	322	11	296	10	325	5	358	14	336
18	5	311	3	287	6	120	1	195	9	315	7	326	11	328
19	10	93	9	96	10	120	4	182	11	331	4	318	12	321
20	13	338	12	23	11	47	10	68	4	114	2	83	10	340
21	15	342	24	355	18	340	3	312	16	82	9	125	2	50
22	4	337	3	10	11	352	7	8	17	51	17	41	9	120
23	12	265	8	332	20	28	13	292	4	13	15	30	15	78
24	27	317	2	336	20	29	10	22	4	357	10	30	13	32

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	11 JAN 81 SPD	DIR	12 JAN 81 SPD	DIR	13 JAN 81 SPD	DIR	14 JAN 81 SPD	DIR	15 JAN 81 SPD	DIR	16 JAN 81 SPD	DIR	17 JAN 81 SPD	DIR
1	18	23	17	42	10	28	13	103	7	121	5	166	4	137
2	11	3	11	8	12	38	12	36	8	96	13	102	5	284
3	10	6	9	21	8	357	11	319	4	347	14	21	12	148
4	10	23	14	38	12	11	6	312	13	292	9	41	9	72
5	6	351	3	96	7	16	9	3	10	305	7	356	6	65
6	2	336	6	20	4	21	18	37	7	2	6	343	13	10
7	6	332	4	86	3	303	15	18	16	26	6	3	3	344
8	9	305	4	281	5	1	8	7	27	16	11	20	10	312
9	0	128	6	329	5	287	6	328	5	14	14	19	8	5
10	9	97	2	143	2	52	4	317	3	324	7	322	3	9
11	16	59	17	74	5	146	1	5	3	323	7	305	7	285
12	9	29	15	35	10	121	0	21	9	305	7	309	9	315
13	8	19	13	32	13	76	12	123	2	308	2	298	3	216
14	11	22	17	25	7	22	8	82	5	143	0	27	1	295
15	8	21	13	7	10	13	13	296	12	108	4	141	1	258
16	9	1	6	348	7	360	4	327	6	77	14	96	2	216
17	2	347	9	358	11	323	9	301	7	331	8	48	9	135
18	5	4	5	335	6	11	4	35	13	9	5	8	14	55
19	8	314	12	329	6	14	21	32	9	27	9	45	13	24
20	7	294	12	325	9	7	16	16	6	14	16	30	9	20
21	9	302	15	332	3	20	5	318	12	2	12	28	9	326
22	1	168	12	333	2	266	7	303	3	297	9	3	3	11
23	12	123	3	197	0	218	6	340	9	332	3	347	5	356
24	21	56	14	57	9	129	9	332	5	323	5	313	9	319

CURRENTS FOR STATION C DEPTH IS 13.0 M

HOUR	18 JAN 81 SPD	18 JAN 81 DIR	19 JAN 81 SPD	19 JAN 81 DIR	20 JAN 81 SPD	20 JAN 81 DIR	21 JAN 81 SPD	21 JAN 81 DIR	22 JAN 81 SPD	22 JAN 81 DIR	23 JAN 81 SPD	23 JAN 81 DIR	24 JAN 81 SPD	24 JAN 81 DIR
1	13	312	7	285	7	323	6	325						
2	15	327	8	291	8	340	7	293						
3	5	310	3	284	10	317	7	328						
4	2	251	8	185	7	315	3	310						
5	13	58	13	106	3	130	8	200						
6	10	18	16	35	15	65	11	103						
7	19	14	10	45	14	41	17	43						
8	12	344	11	5	12	33	13	29						
9	3	20	8	0	5	334	14	35						
10	7	7	10	29	8	54	20	24						
11	3	254	12	11	7	31	22	11						
12	0	148	5	338	16	19								
13	8	289	2	275	8	349								
14	5	16	10	311	10	16								
15	7	301	8	333	10	322								
16	6	272	9	306	7	311								
17	12	127	3	207	5	308								
18	19	61	12	101	8	151								
19	10	7	17	28	13	69								
20	11	351	16	20	10	23								
21	14	11	16	12	12	35								
22	7	11	9	23	16	14								
23	4	342	13	23	24	13								
24	5	285	12	8	11	3								

CURRENTS FOR STATION D   DEPTH IS 4.5 M

HOUR	16 NOV 80 SPD	16 NOV 80 DIR	17 NOV 80 SPD	17 NOV 80 DIR	18 NOV 80 SPD	18 NOV 80 DIR	19 NOV 80 SPD	19 NOV 80 DIR	20 NOV 80 SPD	20 NOV 80 DIR	21 NOV 80 SPD	21 NOV 80 DIR	22 NOV 80 SPD	22 NOV 80 DIR
1											17	321	12	342
2											13	324	14	322
3											8	308	16	309
4											8	255	10	301
5											15	37	8	245
6											24	53	15	71
7											20	39	26	57
8											18	3	22	34
9											21	17	20	359
10											24	23	23	18
11											21	353	24	17
12									70	227	19	353	21	355
13									98	224	17	341	16	338
14									13	339	17	300	16	315
15									7	280	13	300	14	324
16									12	206	11	303	11	342
17									10	85	9	253	15	307
18									22	60	9	76	7	256
19									10	56	26	40	9	59
20									20	16	20	35	28	50
21									26	15	20	353	14	53
22									23	14	22	3	21	14
23									19	351	16	360	22	16
24									21	359	12	336	22	13

CURRENTS FOR STATION D DEPTH IS 4.5 M

HOUR	23 NOV 80 SPD	23 NOV 80 DIR	24 NOV 80 SPD	24 NOV 80 DIR	25 NOV 80 SPD	25 NOV 80 DIR	26 NOV 80 SPD	26 NOV 80 DIR	27 NOV 80 SPD	27 NOV 80 DIR	28 NOV 80 SPD	28 NOV 80 DIR	29 NOV 80 SPD	29 NOV 80 DIR
1	20	357	26	18	26	13	21	4	12	44	18	39	6	208
2	14	325	17	352	18	3	20	21	14	18	18	27	2	50
3	16	316	16	353	14	357	12	10	21	15	12	354	7	74
4	12	310	15	329	16	339	23	352	23	22	16	20	6	39
5	12	299	12	323	16	314	22	327	13	344	15	5	12	32
6	2	204	7	215	16	305	20	318	13	345	3	357	13	13
7	24	45	8	116	8	282	16	303	21	351	7	13	9	25
8	22	55	25	65	8	184	14	295	14	349	9	1	8	25
9	18	30	16	71	28	49	4	233	3	5	14	316	10	3
10	21	13	13	33	22	49	20	31	5	165	7	293	13	317
11	21	24	22	16	10	25	20	58	18	67	6	195	16	302
12	25	22	25	12	18	13	16	44	12	42	10	50	6	282
13	14	359	28	17	21	23	17	18	14	35	13	60	5	233
14	15	341	29	6	22	6	21	23	18	20	10	39	8	169
15	16	330	24	352	16	359	26	24	23	14	21	30	3	94
16	11	333	19	337	21	341	19	347	25	22	16	2	14	30
17	6	319	16	336	18	321	20	358	22	20	15	354	9	20
18	6	237	9	327	17	316	17	333	16	347	24	355	13	1
19	7	177	3	208	14	299	19	323	20	356	33	1	24	2
20	24	48	7	197	5	258	16	318	17	345	23	332	17	354
21	18	58	8	53	6	204	8	318	13	10	15	341	13	334
22	20	22	20	49	13	25	10	214	2	228	21	357	4	338
23	20	15	20	30	29	38	13	46	7	177	14	326	1	21
24	22	23	25	20	20	34	20	46	17	42	4	248	2	333

CURRENTS FOR STATION D DEPTH IS 4.5 M

HOUR	30 NOV 80 SPD	DIR	1 DEC 80 SPD	DIR	2 DEC 80 SPD	DIR	3 DEC 80 SPD	DIR	4 DEC 80 SPD	DIR	5 DEC 80 SPD	DIR	6 DEC 80 SPD	DIR
1	5	84	10	310							30	14	11	11
2	6	229	2	253							24	3	20	358
3	11	210	2	131							5	13	15	343
4	0	35	0	357							8	162	8	282
5	2	89	0	315							9	72	13	101
6	6	51	3	81							15	30	15	49
7	20	2	6	36							21	26	16	24
8	17	359	19	5									15	28
9	11	3	16	360							15	30	14	26
10	8	335	17	5							20	29	17	29
11	6	324	10	353							20	25	12	23
12	8	327	7	357					27	24	17	9	19	20
13	8	305	7	328					13	358	13	21	12	15
14	9	237	9	233					21	358	4	354	7	4
15	2	50	8	231					24	352	14	3	16	357
16	7	45							23	342	4	1	14	333
17	6	47							7	178	0	111	5	185
18	14	11							0	95	8	95	5	139
19	18	10							2	9	2	35	13	67
20	20	4							8	9	11	14	12	21
21	23	3							5	28	25	20	19	14
22	16	357							14	18	15	27	12	15
23	22	342							21	16	9	18	17	23
24	16	321							24	23	18	15	23	20

CURRENTS FOR STATION D DEPTH IS 4.5 M

HOUR	7 DEC 80 SPD	DIR	8 DEC 80 SPD	DIR	9 DEC 80 SPD	DIR	10 DEC 80 SPD	DIR	11 DEC 80 SPD	DIR	12 DEC 80 SPD	DIR	13 DEC 80 SPD	DIR
1	18	21	15	9	12	7	8	16	18	17	18	21	3	51
2	11	17	2	12	20	9	11	15	24	19	17	18	18	13
3	7	7	7	350	17	353	7	16	11	8	17	17	23	16
4	13	343	17	360	15	344	12	3	13	11	17	15	15	15
5	5	257	13	342	8	343	16	343	25	349	26	15	20	19
6	7	142	2	120	9	312	9	306	17	338	21	353	26	16
7	9	67	10	79	5	148	5	145	7	300	17	341	17	350
8	7	32	15	22	12	48	18	43	8	189	12	302	15	342
9	4	13	14	23	18	4	22	31	12	67	8	211	11	325
10	11	20	10	7	22	14	17	34	22	44	15	42	2	263
11	4	15	17	7	10	25	18	35	13	29	18	48	6	34
12	29	19	22	20	16	29	15	34	16	30	12	31	18	32
13	26	14	29	17	26	22	16	29	26	27	17	25	19	46
14	0	133	14	12	14	12	23	28	21	30	17	21	22	27
15	10	353	9	328	13	348	19	20	21	9	21	20	20	23
16	18	6	14	357	19	348	18	349	15	6	21	14	18	23
17	10	343	18	335	11	342	15	7	22	6	19	15	13	5
18	2	196	9	322	13	333	15	341	23	355	20	1	20	21
19	11	110	7	193	8	329	14	343	16	350	20	351	21	17
20	5	24	7	107	6	163	3	194	7	7	12	341	19	356
21	11	18	1	96	3	295	11	155	6	241	9	332	16	343
22	13	25	9	15	2	24	16	53	6	89	8	307	9	318
23	19	23	12	1	12	18	8	43	17	46	2	56	4	62
24	12	11	4	21	16	19	17	29	13	35	14	37	29	50

CURRENTS FOR STATION D DEPTH IS 4.5 M

HOUR	14 DEC 80 SPD	DIR	15 DEC 80 SPD	DIR	16 DEC 80 SPD	DIR	17 DEC 80 SPD	DIR	18 DEC 80 SPD	DIR	19 DEC 80 SPD	DIR	20 DEC 80 SPD	DIR
1	20	42	19	45	9	49	8	179	12	328			19	59
2	10	19	6	34	18	35	14	54	4	310			31	50
3	20	20	13	31	13	36	21	34	3	66				
4	19	24	18	24	13	45	18	35	18	19			3	62
5	14	24	15	34	11	30	12	35	19	24	7	283		
6	2	324	22	35	15	23	6	33	15	22	21	79		
7	6	43	19	16	17	23	15	28	15	17	30	102		
8	16	12	18	25	12	8	8	7			15	16		
9	11	350	5	59	12	11	7	4			15	67	26	69
10	9	5	7	22	24	21	29	14	74	198				
11	7	228	4	249	14	341	19	346	63	228				
12	1	64	12	179	4	346	23	351	64	154			47	82
13	5	83	10	22	2	158	8	333						
14	11	22	14	31	9	97	4	224	106	124				
15	11	23	19	28	19	29	14	101					48	69
16	14	2	19	31	18	27	14	46	20	73			2	297
17	1	120	17	29	9	25	12	10						
18	12	26	18	25	17	23	17	22			24	69	12	68
19	18	12	21	21	16	21	21	20	32	98			45	65
20	16	355	19	15	18	16	19	26			3	271	40	60
21	16	352	25	9	14	19	23	19			14	46	20	36
22	13	340	21	349	19	358	23	12					7	35
23	9	246	20	341	18	333	28	358	25	92			13	69
24	19	45	4	307	10	319	18	341	17	64			15	153

CURRENTS FOR STATION D DEPTH IS 4.5 M

HOUR	7 DEC 80 SPD	7 DEC 80 DIR	8 DEC 80 SPD	8 DEC 80 DIR	9 DEC 80 SPD	9 DEC 80 DIR	10 DEC 80 SPD	10 DEC 80 DIR	11 DEC 80 SPD	11 DEC 80 DIR	12 DEC 80 SPD	12 DEC 80 DIR	13 DEC 80 SPD	13 DEC 80 DIR
1	18	21	15	9	12	7	8	16	18	17	18	21	3	51
2	11	17	2	12	20	9	11	15	24	19	17	18	18	13
3	7	7	7	350	17	353	7	16	11	8	17	17	23	16
4	13	343	17	360	15	344	12	3	13	11	17	15	15	15
5	5	267	13	342	8	343	16	343	25	349	26	15	20	19
6	7	142	2	120	9	312	9	306	17	338	21	353	26	16
7	9	67	10	79	5	148	5	145	7	300	17	341	17	350
8	7	32	15	22	12	48	18	43	8	189	12	302	15	342
9	4	13	14	23	13	4	22	31	12	67	8	211	11	325
10	11	20	10	7	22	14	17	34	22	44	15	42	2	263
11	4	15	17	7	10	25	18	35	13	29	18	48	6	34
12	29	19	22	20	16	29	15	34	16	30	12	31	18	32
13	26	14	29	17	26	22	16	29	26	27	17	25	19	46
14	0	133	14	12	14	12	23	28	21	30	17	21	22	27
15	10	353	9	328	13	348	19	20	21	9	21	20	20	23
16	18	6	14	357	19	348	18	349	15	6	21	14	18	23
17	10	343	18	335	11	342	15	7	22	6	19	15	13	5
18	2	196	9	322	13	333	15	341	23	355	20	1	20	21
19	11	110	7	193	8	329	14	343	16	350	20	351	21	17
20	5	24	7	107	6	163	3	194	7	7	12	341	19	356
21	11	18	1	96	3	295	11	155	6	241	9	332	16	343
22	13	25	9	15	2	24	16	53	6	89	8	307	9	318
23	19	23	12	1	12	19	8	43	17	46	2	56	4	62
24	12	11	4	21	16	19	17	29	13	35	14	37	29	50

CURRENTS FOR STATION D   DEPTH IS 4.5 M

HOUR	14 DEC 80 SPD	14 DEC 80 DIR	15 DEC 80 SPD	15 DEC 80 DIR	16 DEC 80 SPD	16 DEC 80 DIR	17 DEC 80 SPD	17 DEC 80 DIR	18 DEC 80 SPD	18 DEC 80 DIR	19 DEC 80 SPD	19 DEC 80 DIR	20 DEC 80 SPD	20 DEC 80 DIR
1	20	42	18	45	9	49	8	179	12	328			19	59
2	10	19	6	34	18	35	14	54	4	310			31	50
3	20	20	13	31	13	36	21	34	3	66				
4	19	24	18	24	13	45	18	35	18	19			3	62
5	14	24	15	34	11	30	12	35	19	24	7	283		
6	2	324	22	35	15	23	6	33	15	22	21	79		
7	6	43	19	16	17	23	15	28	15	17	30	102		
8	16	12	18	25	12	8	8	7			15	16		
9	11	350	5	59	12	11	7	4			15	67	26	69
10	9	5	7	22	24	21	29	14	74	198				
11	7	228	4	249	14	341	19	346	63	228				
12	1	64	12	179	4	346	23	351	64	154			47	82
13	5	83	10	22	2	158	8	338						
14	11	22	14	31	9	97	4	224	106	124				
15	11	23	19	28	19	29	14	101					48	69
16	14	2	19	31	18	27	14	46	20	73			2	297
17	1	120	17	29	9	25	12	10						
18	12	26	18	25	17	23	17	22			24	69	12	58
19	18	12	21	21	16	21	21	20	32	98			45	65
20	16	355	19	15	13	16	19	26			3	271	40	60
21	16	352	25	9	14	19	23	19			14	46	20	36
22	13	340	21	349	19	358	23	12					7	35
23	9	246	20	341	13	333	28	358	25	92			13	69
24	19	45	4	307	10	319	18	341	17	64			15	153

CURRENTS FOR STATION D DEPTH IS 4.5 M

HOUR	21 DEC 80 SPD	21 DEC 80 DIR	22 DEC 80 SPD	22 DEC 80 DIR	23 DEC 80 SPD	23 DEC 80 DIR	24 DEC 80 SPD	24 DEC 80 DIR	25 DEC 80 SPD	25 DEC 80 DIR	26 DEC 80 SPD	26 DEC 80 DIR	27 DEC 80 SPD	27 DEC 80 DIR
1	24	58	11	112	13	140	8	28	12	18				
2	3	334	17	69	12	109	7	153	7	200				
3					15	72	11	115	6	150				
4	25	64	20	59	23	56	7	57	11	71				
5	5	51	16	58	18	62	17	57	10	55				
6	13	232	20	56	15	57	20	58	11	52				
7	8	9	16	46	16	53	23	53	16	50				
8	7	17	5	93	12	48	13	47	21	60				
9	19	31	22	48	8	41	13	45	28	61				
10	40	24	12	2	24	45	7	50	27	61				
11	8	153	7	16	17	33	13	36	17	57				
12	10	149			22	29	13	32	10	52				
13	21	64	11	125	15	167	8	16	5	308				
14	33	56	21	69	9	136	8	160	98	179				
15	14	48	17	70	11	68	5	131	108	189				
16	17	54			13	54	9	15						
17	39	49	5	50	11	55	12	44						
18	25	52	10	52	17	52	14	53						
19			19	49	14	52	11	42						
20	24	59	20	42	16	53	13	44						
21			12	44	18	40	12	43						
22	15	14	22	44	19	33	7	41						
23			15	38	22	26	12	39						
24			9	19	20	16	17	24						

WIND SPEED AND DIRECTION

HOUR	9 NOV 80 SPD	9 NOV 80 DIR	10 NOV 80 SPD	10 NOV 80 DIR	11 NOV 80 SPD	11 NOV 80 DIR	12 NOV 80 SPD	12 NOV 80 DIR	13 NOV 80 SPD	13 NOV 80 DIR	14 NOV 80 SPD	14 NOV 80 DIR	15 NOV 80 SPD	15 NOV 80 DIR
1	0	0	6	230	15	350	12	310	10	320	8	220	4	200
2	0	0	3	230	15	350	12	310	10	340	8	210	5	210
3	0	0	3	270	10	330	13	320	8	330	8	210	6	220
4	0	0	3	270	15	330	12	320	8	340	7	220	2	260
5	4	180	3	270	11	330	12	320	8	340	7	210	1	210
6	4	200	5	250	15	320	20	350	10	360	7	220	1	290
7	6	200	5	270	19	330	20	350	7	350	8	220	2	220
8	8	210	5	270	16	330	18	330	5	340	6	210	0	0
9	10	220	8	270	14	320	16	330	4	330	10	240	6	320
10	6	230	9	260	16	320	20	340	3	360	11	220	6	40
11	10	220	12	270	14	330	18	350	0	0	10	220	4	360
12	8	220	15	280	14	310	15	340	1	350	9	210	5	20
13	10	230	14	290	12	300	14	350	1	350	12	230	5	20
14	12	230	14	300	14	320	14	350	2	230	7	230	6	40
15	12	240	12	320	16	310	8	330	0	0	6	250	8	30
16	9	240	12	340	16	320	10	330	2	200	6	270	8	60
17	6	230	14	330	14	320	8	330	1	190	9	240	7	50
18	6	210	20	360	12	330	8	320	0	0	3	230	8	50
19	8	210	18	350	13	320	7	340	4	170	6	220	8	70
20	8	220	18	360	9	320	7	330	4	210	6	210	6	60
21	7	310	19	340	12	330	8	330	5	200	6	210	7	20
22	6	270	15	330	14	330	10	330	6	200	5	230	6	40
23	5	260	15	330	17	320	8	320	8	220	4	220	7	40
24	7	280	18	330	10	320	7	330	6	220	3	210	8	40

WIND SPEED AND DIRECTION

HOUR	16 NOV 80 SPD	16 NOV 80 DIR	17 NOV 80 SPD	17 NOV 80 DIR	18 NOV 80 SPD	18 NOV 80 DIR	19 NOV 80 SPD	19 NOV 80 DIR	20 NOV 80 SPD	20 NOV 80 DIR	21 NOV 80 SPD	21 NOV 80 DIR	22 NOV 80 SPD	22 NOV 80 DIR
1	6	20	9	50	4	310	12	320	2	220	0	0	8	340
2	11	20	12	40	4	270	15	340	0	0	0	0	9	340
3	14	20	7	40	6	290	13	340	9	350	0	0	10	340
4	15	20	8	50	6	300	13	340	10	350	4	320	5	320
5	18	20	10	50	5	270	10	340	10	350	5	340	6	330
6	20	20	10	50	7	280	8	330	8	350	3	300	5	300
7	19	20	6	40	8	300	7	330	8	350	4	350	6	330
8	16	20	9	50	5	310	7	340	8	50	3	340	4	330
9	16	20	8	70	7	300	9	330	8	20	6	340	7	340
10	16	10	7	80	8	300	12	360	5	10	4	340	8	340
11	16	10	6	80	12	320	12	350	4	30	6	290	8	340
12	12	20	9	100	14	340	10	350	8	50	6	340	7	280
13	12	20	7	80	12	320	6	360	5	70	8	320	8	280
14	13	30	5	110	12	340	9	30	7	30	6	340	10	300
15	14	20	7	120	13	340	6	30	4	60	6	350	8	280
16	16	20	5	110	15	330	4	70	3	80	6	310	8	310
17	12	20	9	120	14	330	0	0	2	70	4	310	2	300
18	14	20	8	130	15	320	0	0	0	0	5	310	5	300
19	16	50	8	130	15	340	0	0	4	100	5	300	2	340
20	12	20	6	130	11	330	0	0	4	100	3	270	6	10
21	10	40	10	160	17	330	0	0	2	120	6	290	0	0
22	11	50	11	170	16	330	0	0	0	0	7	330	0	0
23	10	50	17	190	12	320	2	200	0	0	7	330	0	0
24	12	50	17	290	12	320	2	210	0	0	12	340	0	0

WIND SPEED AND DIRECTION

HOUR	23 NOV 80 SPD	DIR	24 NOV 80 SPD	DIR	25 NOV 80 SPD	DIR	26 NOV 80 SPD	DIR	27 NOV 80 SPD	DIR	28 NOV 80 SPD	DIR	29 NOV 80 SPD	DIR
1	0	0	0	0	6	300	10	340	11	60	4	170	12	240
2	0	0	4	20	6	350	11	340	8	70	4	210	10	240
3	0	0	7	140	6	350	13	330	8	30	4	190	9	230
4	0	0	6	150	6	360	11	360	7	70	2	260	10	220
5	0	0	7	150	7	360	10	350	11	50	4	250	10	220
6	0	0	6	150	10	350	8	340	2	90	3	260	12	220
7	6	210	7	140	5	340	10	340	3	80	5	240	11	230
8	2	210	8	150	7	330	10	350	8	30	6	280	11	240
9	0	0	8	150	10	340	12	360	10	70	9	240	10	230
10	2	250	9	150	11	340	10	360	10	90	9	240	11	240
11	5	260	8	150	8	350	7	10	10	90	17	240	15	250
12	2	90	10	190	13	350	10	10	9	110	13	220	16	250
13	5	230	9	200	10	350	14	10	7	90	15	250	17	250
14	8	200	10	180	8	340	12	20	6	110	17	240	12	250
15	4	130	11	180	8	330	9	30	8	90	14	240	16	270
16	2	150	11	180	8	340	8	20	10	110	14	240	12	250
17	3	130	12	180	9	350	6	10	11	100	13	230	11	250
18	2	310	8	190	10	350	7	20	8	120	11	230	12	250
19	0	0	6	220	10	360	7	20	11	110	16	250	10	250
20	0	0	5	220	14	10	8	20	12	120	16	240	12	260
21	2	10	5	270	14	350	3	60	11	130	13	250	15	260
22	0	0	4	300	15	350	6	20	7	140	9	220	13	260
23	2	340	7	300	16	340	8	50	5	160	10	240	13	260
24	0	0	8	320	10	330	9	60	4	140	17	240	14	270

WIND SPEED AND DIRECTION

HOUR	30 NOV 80 SPD	DIR	1 DEC 80 SPD	DIR	2 DEC 80 SPD	DIR	3 DEC 80 SPD	DIR	4 DEC 80 SPD	DIR	5 DEC 80 SPD	DIR	6 DEC 80 SPD	DIR
1	13	270	9	200	5	220	15	300	8	330	6	10	8	310
2	12	260	10	210	4	230	17	300	11	350	5	350	6	310
3	8	260	12	210	4	220	16	300	10	340	4	340	7	310
4	7	250	12	210	6	230	18	300	11	340	4	10	8	320
5	5	240	12	210	4	230	16	300	10	330	3	340	9	320
6	4	230	12	220	8	230	15	290	11	340	4	330	7	330
7	7	250	11	220	9	190	16	270	17	340	5	360	6	320
8	8	250	10	220	9	200	16	270	12	340	8	20	6	330
9	7	250	10	220	10	210	14	280	12	330	7	360	5	310
10	7	260	10	230	9	210	14	290	9	350	7	10	6	340
11	7	270	10	240	11	210	18	310	8	350	6	360	8	310
12	11	270	9	220	11	210	16	280	8	340	5	360	7	330
13	8	240	10	240	16	220	14	290	4	350	3	270	6	300
14	10	270	10	230	14	220	14	290	8	330	5	270	8	290
15	8	270	10	210	15	210	14	290	6	310	6	300	8	290
16	5	240	6	210	13	210	10	290	5	320	7	280	6	290
17	4	240	6	210	14	210	13	300	4	290	6	300	5	300
18	2	190	6	200	14	200	9	310	4	330	6	300	2	270
19	5	200	6	210	13	190	7	320	4	330	5	300	2	250
20	3	190	8	210	13	190	10	340	4	320	7	320	0	0
21	6	200	8	210	15	200	11	350	4	320	7	310	0	0
22	7	200	8	210	15	210	15	340	5	340	6	310	0	0
23	8	200	6	210	15	230	13	320	4	350	7	310	0	0
24	9	200	7	210	17	300	13	330	5	10	8	310	0	0

WIND SPEED AND DIRECTION

HOUR	7 DEC 80 SPD	7 DEC 80 DIR	8 DEC 80 SPD	8 DEC 80 DIR	9 DEC 80 SPD	9 DEC 80 DIR	10 DEC 80 SPD	10 DEC 80 DIR	11 DEC 80 SPD	11 DEC 80 DIR	12 DEC 80 SPD	12 DEC 80 DIR	13 DEC 80 SPD	13 DEC 80 DIR
1	0	0	4	200	11	210	10	220	3	290	5	220	12	220
2	0	0	5	200	10	230	8	240	4	270	5	220	11	220
3	0	0	5	210	9	230	8	230	6	300	6	220	12	220
4	0	0	0	0	10	230	4	240	14	360	4	230	10	230
5	0	0	6	210	12	230	3	240	10	10	4	250	8	230
6	0	0	4	200	9	230	13	20	8	360	1	220	8	220
7	0	0	4	200	8	230	14	20	9	350	0	0	8	220
8	0	0	4	200	9	220	12	30	8	10	0	0	8	230
9	0	0	3	210	10	230	14	10	8	10	4	270	8	240
10	2	180	4	220	8	240	9	40	10	360	6	250	12	240
11	4	180	4	210	8	230	12	30	9	10	4	240	11	240
12	2	240	5	300	7	250	10	50	10	30	8	190	12	240
13	0	0	3	240	5	210	12	50	6	40	9	220	12	240
14	0	0	7	210	9	230	10	60	8	40	10	210	10	240
15	0	0	8	220	10	240	8	50	5	40	9	210	10	240
16	6	190	7	220	8	210	7	70	4	50	8	220	8	220
17	5	200	7	220	8	200	6	30	4	90	6	200	6	230
18	3	180	1	210	10	210	7	20	2	110	6	200	4	240
19	5	180	8	210	10	210	1	60	0	0	8	200	3	260
20	6	190	10	210	12	210	4	10	0	0	8	210	6	300
21	6	180	10	220	12	220	4	330	2	170	8	200	4	270
22	7	180	10	220	12	210	4	300	2	170	8	210	9	350
23	4	180	9	220	13	220	3	300	3	170	7	200	14	350
24	6	200	12	230	14	230	2	260	4	220	9	210	8	30

WIND SPEED AND DIRECTION

HOUR	14 DEC 80 SPD	14 DEC 80 DIR	15 DEC 80 SPD	15 DEC 80 DIR	16 DEC 80 SPD	16 DEC 80 DIR	17 DEC 80 SPD	17 DEC 80 DIR	18 DEC 80 SPD	18 DEC 80 DIR	19 DEC 80 SPD	19 DEC 80 DIR	20 DEC 80 SPD	20 DEC 80 DIR
1	1	10	10	30	5	340	12	330	3	200	8	200	15	10
2	12	350	6	60	3	10	12	340	4	190	8	200	18	10
3	5	340	8	60	6	360	14	350	2	190	6	200	16	10
4	6	340	8	50	4	360	12	360	6	210	10	210	17	10
5	6	340	8	50	5	10	14	340	6	190	12	210	15	360
6	6	340	8	60	4	10	14	340	10	200	12	210	16	350
7	2	300	6	90	4	310	11	340	10	200	14	210	20	350
8	0	0	3	120	7	350	14	340	13	200	9	230	19	360
9	3	240	9	90	6	30	13	330	15	210	7	220	19	350
10	7	220	8	90	6	360	13	350	12	220	6	260	20	340
11	10	240	6	90	8	20	15	350	8	200	7	260	20	350
12	10	270	4	110	6	20	12	360	14	250	6	310	14	360
13	10	260	6	100	6	20	11	10	10	240	7	40	18	350
14	10	240	4	120	5	10	10	10	13	240	12	50	15	10
15	10	270	9	120	6	10	9	20	12	230	12	20	14	350
16	12	240	7	120	3	20	7	20	10	240	18	20	12	350
17	8	230	3	90	5	20	5	60	5	230	18	30	15	350
18	5	220	4	110	4	20	8	20	6	180	20	30	12	350
19	6	190	6	120	5	10	10	360	7	190	20	20	10	330
20	6	210	2	120	4	360	9	10	7	190	18	20	12	330
21	4	240	2	100	6	350	7	10	10	200	17	20	14	330
22	7	340	2	120	6	360	4	20	8	200	16	20	16	340
23	17	30	0	0	8	360	2	120	10	200	13	10	14	340
24	11	30	0	0	11	340	2	180	12	200	18	20	14	340

WIND SPEED AND DIRECTION

HOUR	21 DEC 80 SPD	21 DEC 80 DIR	22 DEC 80 SPD	22 DEC 80 DIR	23 DEC 80 SPD	23 DEC 80 DIR	24 DEC 80 SPD	24 DEC 80 DIR	25 DEC 80 SPD	25 DEC 80 DIR	26 DEC 80 SPD	26 DEC 80 DIR	27 DEC 80 SPD	27 DEC 80 DIR
1	14	330	10	350	5	20	2	240	31	340	4	30	12	30
2	14	340	9	40	7	340	4	270	22	350	3	60	13	30
3	16	340	7	60	9	10	4	260	22	330	5	50	14	20
4	16	340	7	60	6	350	8	230	22	330	5	50	14	20
5	14	340	9	50	7	350	6	240	22	330	5	60	15	20
6	14	340	6	50	9	360	8	210	20	320	3	90	16	20
7	12	340	7	50	6	10	6	150	28	350	0	0	16	30
8	14	340	8	40	6	330	6	170	22	330	0	0	14	20
9	13	340	8	40	7	340	8	180	25	350	0	0	12	30
10	13	340	10	40	0	0	7	170	20	340	0	0	16	20
11	13	350	10	50	0	0	9	190	20	360	4	330	18	10
12	10	20	8	40	5	340	10	100	20	360	3	50	20	10
13	10	30	7	40	3	340	10	190	18	340	4	10	20	20
14	10	20	10	30	4	360	19	190	16	360	3	30	18	10
15	8	20	8	40	4	20	14	200	14	350	2	120	20	20
16	7	30	6	50	6	10	12	210	12	340	2	120	20	20
17	3	30	3	40	5	10	8	220	11	340	5	90	19	20
18	5	360	3	40	7	350	16	240	11	340	5	210	18	20
19	5	360	6	40	6	10	12	250	12	340	2	70	20	10
20	6	330	3	60	7	10	6	260	12	340	6	30	20	10
21	8	340	3	40	8	360	6	290	10	330	8	30	19	10
22	9	350	3	40	5	350	9	310	10	340	7	40	20	10
23	10	350	4	30	3	340	12	360	12	350	9	20	18	10
24	10	350	4	10	0	0	23	340	8	30	8	20	15	10

WIND SPEED AND DIRECTION

HOUR	28 DEC 80 SPD	DIR	29 DEC 80 SPD	DIR	30 DEC 80 SPD	DIR	31 DEC 80 SPD	DIR	1 JAN 81 SPD	DIR	2 JAN 81 SPD	DIR	3 JAN 81 SPD	DIR
1	13	10	16	10	7	330	11	20	2	10	3	250	10	60
2	17	20	16	10	6	340	11	30	6	10	6	220	8	50
3	16	10	17	360	5	330	14	20	5	10	7	250	6	60
4	15	10	16	10	3	330	13	30	4	360	8	270	3	90
5	16	20	18	10	6	340	12	20	4	50	10	270	2	150
6	17	20	16	10	5	320	11	10	0	0	12	270	0	0
7	16	20	16	10	5	320	10	30	0	0	12	270	2	210
8	16	20	19	10	8	340	10	30	0	0	10	270	4	170
9	14	20	13	10	10	340	8	20	2	120	12	270	5	170
10	16	30	14	10	12	360	9	20	0	0	12	270	8	180
11	16	40	14	360	8	350	8	40	0	0	14	270	10	230
12	13	40	16	360	12	350	9	30	0	0	11	290	10	210
13	16	10	15	350	6	340	9	20	4	40	13	280	8	210
14	13	10	16	360	8	360	8	20	5	20	11	270	9	190
15	13	10	16	360	9	350	8	20	4	20	12	230	8	190
16	10	20	18	360	8	30	6	20	2	10	10	280	8	200
17	14	20	15	350	5	30	3	40	0	0	8	270	7	200
18	12	20	14	350	5	20	3	70	5	290	7	270	6	200
19	11	30	12	350	4	20	6	50	4	330	2	240	4	240
20	12	20	8	350	5	10	7	40	5	340	3	250	2	240
21	13	20	8	350	8	10	5	20	4	20	0	0	5	250
22	14	20	9	340	6	360	6	20	3	360	3	250	5	250
23	13	20	8	330	9	20	4	10	4	350	5	260	8	300
24	16	20	9	350	8	10	2	10	0	0	8	40	5	310

WIND SPEED AND DIRECTION

HOUR	4 JAN 81 SPD	4 JAN 81 DIR	5 JAN 81 SPD	5 JAN 81 DIR	6 JAN 81 SPD	6 JAN 81 DIR	7 JAN 81 SPD	7 JAN 81 DIR	8 JAN 81 SPD	8 JAN 81 DIR	9 JAN 81 SPD	9 JAN 81 DIR	10 JAN 81 SPD	10 JAN 81 DIR
1	17	20	11	320	2	170	7	200	7	340	8	50	7	350
2	16	20	14	320	2	150	8	220	11	350	8	40	8	360
3	13	20	10	320	2	160	9	240	11	350	4	70	8	360
4	16	20	12	320	0	0	12	250	13	350	6	40	6	310
5	18	30	12	340	4	200	13	240	11	350	4	50	8	350
6	16	20	12	320	4	210	11	230	12	350	4	40	12	350
7	20	360	14	340	7	230	12	250	12	350	2	60	12	360
8	15	360	9	330	7	220	10	250	12	350	4	40	12	340
9	18	350	14	350	9	210	10	260	13	360	6	10	19	350
10	16	330	16	350	9	210	10	260	10	360	6	20	19	340
11	14	350	10	340	11	220	10	270	10	360	6	10	16	350
12	20	330	8	340	9	220	10	270	6	360	4	10	17	350
13	12	340	9	270	12	210	13	280	8	10	4	350	14	340
14	10	350	10	270	13	220	11	280	9	10	5	10	14	330
15	18	340	10	300	14	200	11	290	7	20	6	10	14	330
16	16	340	9	310	12	210	10	290	4	50	6	10	12	330
17	16	330	7	290	11	210	9	330	5	30	4	20	16	330
18	14	340	7	300	8	200	2	350	4	50	6	10	12	350
19	16	330	8	310	9	190	10	360	6	40	6	30	13	350
20	14	320	4	300	9	180	9	310	4	50	8	20	10	330
21	15	340	4	300	10	190	6	300	7	50	8	360	14	340
22	12	320	2	230	10	190	9	300	6	40	7	360	9	340
23	10	320	0	0	10	190	8	350	6	10	7	360	10	340
24	11	330	2	150	9	200	8	340	6	20	8	340	9	360

WIND SPEED AND DIRECTION

HOUR	11 JAN 81 SPD	11 JAN 81 DIR	12 JAN 81 SPD	12 JAN 81 DIR	13 JAN 81 SPD	13 JAN 81 DIR	14 JAN 81 SPD	14 JAN 81 DIR	15 JAN 81 SPD	15 JAN 81 DIR	16 JAN 81 SPD	16 JAN 81 DIR	17 JAN 81 SPD	17 JAN 81 DIR
1	10	330	16	350	6	320	4	160	2	150	4	50	14	320
2	10	350	18	360	6	340	3	150	2	150	0	0	12	320
3	12	340	15	350	5	300	5	170	0	0	0	0	14	310
4	10	350	16	350	9	340	4	170	3	120	3	360	10	310
5	10	350	16	350	8	330	4	160	0	0	4	330	10	290
6	8	360	16	350	7	320	4	200	0	0	3	350	12	320
7	5	340	14	360	6	310	6	200	0	0	4	340	13	310
8	6	330	13	350	7	290	6	200	2	250	0	0	14	320
9	6	350	14	350	8	260	7	210	3	290	4	260	15	320
10	7	350	18	340	5	240	7	220	2	210	3	220	19	330
11	5	10	15	10	4	240	7	250	4	270	3	200	11	320
12	3	20	8	340	2	270	5	260	6	280	6	260	18	320
13	5	360	12	360	7	270	2	210	10	290	5	240	17	310
14	4	340	12	340	4	230	2	270	8	300	6	280	15	340
15	2	270	12	330	6	210	5	40	8	290	4	260	15	310
16	3	280	12	320	4	200	5	80	7	300	2	190	15	290
17	2	240	8	320	6	170	2	30	5	290	4	350	13	300
18	6	300	10	340	4	150	3	140	7	300	0	0	13	310
19	7	310	10	340	4	150	5	140	4	350	3	190	12	320
20	9	330	10	320	5	170	4	140	5	340	0	0	11	340
21	7	350	9	350	6	150	5	140	4	340	2	230	16	330
22	5	360	7	340	5	170	5	140	5	10	4	240	12	340
23	6	350	8	330	3	150	4	160	7	20	14	330	10	330
24	14	340	8	330	5	170	4	160	6	30	14	340	14	330

WIND SPEED AND DIRECTION

HOUR	18 JAN 81 SPD	18 JAN 81 DIR	19 JAN 81 SPD	19 JAN 81 DIR	20 JAN 81 SPD	20 JAN 81 DIR	21 JAN 81 SPD	21 JAN 81 DIR	22 JAN 81 SPD	22 JAN 81 DIR	23 JAN 81 SPD	23 JAN 81 DIR	24 JAN 81 SPD	24 JAN 81 DIR
1	12	330	0	0	3	240	7	80	4	310	4	20	0	0
2	8	310	0	0	3	240	6	80	6	300	4	30	0	0
3	8	310	2	250	1	230	5	90	4	280	0	0	0	0
4	6	300	5	270	0	0	8	50	5	290	0	0	0	0
5	4	290	3	270	1	250	6	70	4	260	0	0	0	0
6	6	240	0	0	2	230	9	40	4	240	0	0	3	20
7	6	240	5	230	2	230	10	40	4	200	0	0	0	0
8	8	270	5	250	2	220	10	60	5	190	2	210	0	0
9	8	270	6	250	2	260	12	50	4	200	2	210	3	340
10	8	270	7	250	0	0	10	50	7	200	0	0	5	10
11	10	270	7	240	3	260	12	20	9	240	2	300	5	10
12	8	290	4	230	0	0	12	360	10	250	0	0	6	30
13	9	310	6	220	0	0	18	10	10	250	3	60	5	40
14	4	250	10	200	0	0	16	10	10	250	4	80	2	360
15	2	250	8	210	4	60	18	360	10	250	3	80	5	250
16	2	360	7	220	0	0	16	360	12	220	2	90	4	20
17	2	360	4	210	3	30	20	360	7	220	2	120	2	90
18	2	170	6	220	0	0	14	350	5	210	0	0	2	120
19	2	180	4	210	0	0	13	350	6	220	0	0	0	0
20	2	180	5	210	2	110	13	340	7	240	4	160	0	0
21	3	120	5	210	2	70	13	350	7	240	3	170	0	0
22	2	190	7	210	3	60	12	330	9	250	4	180	0	0
23	0	0	4	240	5	50	8	310	8	20	5	200	0	0
24	0	0	4	240	3	70	7	310	9	20	3	190	0	0

WIND SPEED AND DIRECTION

HOUR	25 JAN 81 SPD	25 JAN 81 DIR	26 JAN 81 SPD	26 JAN 81 DIR	27 JAN 81 SPD	27 JAN 81 DIR	28 JAN 81 SPD	28 JAN 81 DIR	29 JAN 81 SPD	29 JAN 81 DIR	30 JAN 81 SPD	30 JAN 81 DIR	31 JAN 81 SPD	31 JAN 81 DIR
1	0	0	7	190	2	230	5	320	5	220	14	360	14	350
2	2	40	6	210	8	230	8	40	6	210	13	360	12	360
3	0	0	8	200	9	230	7	30	9	280	14	360	11	360
4	0	0	7	210	6	230	13	30	8	230	12	10	11	360
5	0	0	6	210	6	230	10	30	4	250	13	10	8	350
6	0	0	8	200	4	220	10	40	6	250	11	10	10	350
7	0	0	9	200	4	220	8	30	4	260	9	360	12	360
8	0	0	9	200	5	210	8	30	9	270	11	360	6	360
9	0	0	11	220	6	210	9	40	9	270	10	360	10	360
10	5	160	12	220	6	230	12	30	8	280	10	10	10	20
11	4	200	14	220	9	230	11	40	8	270	8	30	8	10
12	5	140	14	220	4	240	12	20	11	270	8	40	6	30
13	3	20	12	220	5	210	12	30	16	290	8	40	5	50
14	7	40	12	230	4	240	14	20	16	290	3	60	4	20
15	8	40	13	220	0	0	10	30	14	290	6	350	3	290
16	5	30	10	210	3	250	8	40	12	300	8	360	6	320
17	6	100	8	220	4	220	6	60	6	340	8	340	4	80
18	6	110	7	220	4	220	2	30	18	40	8	330	2	100
19	8	120	7	230	3	240	0	0	13	20	7	330	2	100
20	7	120	10	230	3	220	0	0	18	360	11	350	0	0
21	6	130	9	230	2	260	0	0	17	350	12	10	2	150
22	6	140	7	250	4	290	1	170	12	360	12	360	3	200
23	7	180	10	250	3	280	2	180	9	350	12	360	0	0
24	7	190	8	240	3	290	3	200	11	360	13	360	0	0

TIDES MEASURED AT SEWELLS POINT

HOUR	9 NOV 80 HT (F)	10 NOV 80 HT (F)	11 NOV 80 HT (F)	12 NOV 80 HT (F)	13 NOV 80 HT (F)	14 NOV 80 HT (F)	15 NOV 80 HT (F)
1	0.74	1.19	1.66	1.60	2.09	1.94	1.77
2	0.20	0.65	1.11	1.26	1.86	1.79	1.89
3	-0.09	0.23	0.74	0.79	1.48	1.44	1.81
4	-0.14	0.14	0.42	0.42	1.02	0.98	1.53
5	0.20	0.33	0.27	0.19	0.68	0.57	1.18
6	0.76	0.64	0.26	0.12	0.57	0.28	0.74
7	1.39	1.22	0.52	0.31	0.64	0.15	0.40
8	2.03	1.88	0.99	0.76	0.93	0.18	0.23
9	2.46	2.37	1.62	1.40	1.41	0.40	0.38
10	2.62	2.63	2.15	2.04	1.94	0.72	0.71
11	2.49	2.63	2.34	2.53	2.44	1.20	1.26
12	2.06	2.28	2.32	2.71	2.72	1.70	1.80
13	1.43	1.80	1.93	2.63	2.76	2.06	2.26
14	0.76	1.17	1.30	2.24	2.55	2.20	2.56
15	0.25	0.64	0.64	1.71	2.15	2.04	2.65
16	-0.01	0.47	0.07	1.13	1.71	1.64	2.53
17	0.06	0.53	-0.23	0.64	1.20	1.12	2.21
18	0.44	0.93	-0.38	0.32	0.80	0.65	1.82
19	0.90	1.50	-0.21	0.23	0.60	0.24	1.35
20	1.46	1.92	0.13	0.39	0.62	0.09	0.96
21	2.04	2.26	0.59	0.83	0.82	0.12	0.79
22	2.42	2.57	1.21	1.33	1.18	0.46	0.87
23	2.26	2.53	1.58	1.79	1.53	0.93	1.33
24	1.77	2.25	1.75	2.09	1.90	1.41	1.83

TIDES MEASURED AT SEWELLS POINT

HOUR	16 NOV 80 HT (F)	17 NOV 80 HT (F)	18 NOV 80 HT (F)	19 NOV 80 HT (F)	20 NOV 80 HT (F)	21 NOV 80 HT (F)	22 NOV 80 HT (F)
1	2.42	1.81	1.12	0.47			
2	2.31	2.32	1.95	0.02			
3	3.01	2.71	2.62				
4	3.00	2.90	3.02				
5	2.86	2.80	3.08				
6	2.57	2.49	2.83				
7	2.24	1.98	2.46				
8	1.83	1.38	1.93				
9	1.47	0.92	1.46				
10	1.44	0.61	0.94				
11	1.53	0.61	2.10				
12	2.03	0.83	1.13				
13	2.55	1.36	0.58				
14	2.98	1.97	0.26				
15	3.20	2.51	0.27				
16	3.21	2.83	0.59				
17	3.02	2.87	1.19				
18	2.61	2.68	1.81				
19	2.06	2.34	2.37				
20	1.47	1.78	2.65				
21	1.05	1.08	2.60				
22	0.89	0.60	2.21				
23	0.99	0.32	1.51				
24	1.30	0.56	1.09				

TIDES MEASURED AT SEWELLS POINT

HOUR	23 NOV 80 HT (F)	24 NOV 80 HT (F)	25 NOV 80 HT (F)	26 NOV 80 HT (F)	27 NOV 80 HT (F)	28 NOV 80 HT (F)	29 NOV 80 HT (F)
1			2.49	2.45	2.04	2.42	1.72
2			1.79	1.95	1.91	2.47	1.98
3			1.07	1.33	1.47	2.27	2.05
4			0.60	0.31	0.94	1.90	1.82
5			0.46	0.46	0.43	1.43	1.50
6			0.81	0.31	0.25	1.05	1.04
7			1.31	0.45	0.07	0.72	0.66
8			2.15	0.90	0.38	0.74	0.40
9			2.96	1.59	0.68	0.96	0.33
10			3.54	2.28	1.39	1.40	0.50
11			3.75	2.77	2.04	1.95	0.76
12		3.40	3.61	2.93	2.50	2.40	1.21
13		2.77	3.20	2.88	2.69	2.72	1.72
14		1.88	2.49	2.42	2.63	2.59	2.08
15		1.10	1.71	1.72	2.28	2.32	2.16
16		0.55	1.04	0.97	1.70	1.93	2.02
17		0.42	0.69	0.36	1.11	1.40	1.64
18		0.73	0.61	0.05	0.64	0.92	1.12
19		1.25	0.90	-0.04	0.36	0.56	0.54
20		1.92	1.36	0.08	0.36	0.33	0.07
21		2.69	1.97	0.50	0.59	0.28	-0.15
22		3.18	2.59	1.07	1.17	0.35	-0.15
23		3.30	2.87	1.65	1.68	0.72	0.05
24		3.05	2.86	2.01	2.17	1.15	0.30

TIDES MEASURED AT SEWELLS POINT

HOUR	30 NOV 80 HT (F)	1 DEC 80 HT (F)	2 DEC 80 HT (F)	3 DEC 80 HT (F)	4 DEC 80 HT (F)	5 DEC 80 HT (F)	6 DEC 80 HT (F)
1	0.72	0.27	0.22	0.21	-0.66	-0.88	-0.11
2	1.24	0.65	0.80	0.65	-0.51	-0.74	-0.20
3	1.44	0.99	1.34	1.08	-0.13	-0.37	0.07
4	1.52	1.20	1.77	1.54	0.40	0.18	0.61
5	1.35	1.18	2.04	1.72	1.01	0.85	1.26
6	1.01	1.00	2.07	1.73	1.48	1.41	1.89
7	0.65	0.61	1.85	1.59	1.65	1.77	2.34
8	0.23	0.16	1.44	1.14	1.57	1.89	2.61
9	0.00	-0.23	0.92	0.79	1.32	1.75	2.61
10	-0.09	-0.55	0.43	0.38	0.83	1.33	2.34
11	0.00	-0.52	0.10	0.14	0.17	0.71	1.87
12	0.27	-0.32	0.03	-0.04	-0.39	0.12	1.25
13	0.70	0.09	0.21	0.00	-0.64	-0.31	0.68
14	1.15	0.53	0.54	0.09	-0.69	-0.47	0.35
15	1.47	0.96	0.95	0.28	-0.47	-0.36	0.29
16	1.52	1.29	1.39	0.59	-0.05	0.00	0.52
17	1.37	1.44	1.69	1.05	0.47	0.52	0.95
18	1.09	1.36	1.79	1.27	0.88	1.06	1.51
19	0.64	1.10	1.67	1.23	1.06	1.44	2.01
20	0.09	0.67	1.27	1.03	0.98	1.59	2.32
21	-0.30	0.19	0.78	0.61	0.72	1.51	2.31
22	-0.47	-0.15	0.26	0.08	0.19	1.17	2.06
23	-0.43	-0.29	0.02	-0.31	-0.35	0.65	1.60
24	-0.18	-0.12	0.00	-0.57	-0.73	0.21	1.06

TIDES MEASURED AT SEWELLS POINT

HOUR	7 DEC 80 HT (F)	8 DEC 80 HT (F)	9 DEC 80 HT (F)	10 DEC 80 HT (F)	11 DEC 80 HT (F)	12 DEC 80 HT (F)	13 DEC 80 HT (F)
1	0.58	0.82	0.89	1.32	2.00	1.99	1.68
2	0.30	0.41	0.34	0.77	1.43	1.58	1.46
3	0.33	0.20	-0.01	0.28	0.38	0.97	0.94
4	0.66	0.32	-0.13	-0.01	0.57	0.36	0.41
5	1.19	0.74	0.10	0.12	0.58	0.01	-0.06
6	1.84	1.40	0.62	0.59	0.65	-0.14	-0.37
7	2.41	2.03	1.25	1.13	0.95	-0.03	-0.49
8	2.84	2.56	1.90	1.88	1.47	0.43	-0.36
9	2.94	2.84	2.45	2.51	2.14	1.04	0.07
10	2.76	2.84	2.67	3.01	2.70	1.69	0.63
11	2.32	2.57	2.57	3.24	3.00	2.18	1.23
12	1.67	2.01	2.17	2.99	2.98	2.44	1.69
13	1.06	1.36	1.51	2.62	2.61	2.39	1.96
14	0.58	0.73	0.85	2.00	2.07	2.01	1.88
15	0.36	0.30	0.30	1.23	1.34	1.43	1.50
16	0.45	0.14	0.01	0.67	0.76	0.73	0.95
17	0.78	0.35	0.02	0.46	0.33	0.22	0.38
18	1.36	0.75	0.36	0.61	0.17	-0.11	-0.11
19	1.92	1.34	0.87	0.82	0.32	-0.20	-0.34
20	2.33	1.82	1.40	1.29	0.68	-0.08	-0.37
21	2.50	2.13	1.81	1.86	1.18	0.28	-0.17
22	2.31	2.20	2.07	2.22	1.68	0.81	0.30
23	1.93	1.96	2.05	2.46	2.06	1.32	1.14
24	1.38	1.51	1.76	2.34	2.19	1.64	1.86

TIDES MEASURED AT SEWELLS POINT

HOUR	14 DEC 80 HT (F)	15 DEC 80 HT (F)	16 DEC 80 HT (F)	17 DEC 80 HT (F)	18 DEC 80 HT (F)	19 DEC 80 HT (F)	20 DEC 80 HT (F)
1	2.24	1.81	1.39	1.67	0.62	-0.53	-0.07
2	2.24	2.15	1.87	2.31	1.20	-0.24	-0.06
3	2.02	2.25	2.21	2.88	1.85	0.42	0.28
4	1.54	2.06	2.35	3.30	2.39	1.17	0.93
5	1.02	1.71	2.29	3.46	2.78	1.83	1.75
6	0.64	1.23	1.91	3.31	2.85	2.22	2.35
7	0.28	0.66	1.45	2.94	2.54	2.27	2.80
8	0.04	0.23	0.93	2.43	2.02	2.03	2.91
9	0.14	0.04	0.58	1.91	1.28	1.53	2.77
10	0.58	0.15	0.41	1.49	0.58	0.84	2.30
11	1.05	0.47	0.52	1.26	0.02	0.15	1.47
12	1.56	1.06	0.90	1.28	-0.27	-0.30	0.69
13	1.88	1.57	1.46	1.56	-0.15	-0.56	-0.02
14	1.94	1.94	2.00	1.98	0.21	-0.52	-0.43
15	1.71	1.99	2.44	2.54	0.79	-0.09	-0.51
16	1.28	1.92	2.66	2.97	1.50	0.66	-0.18
17	0.70	1.56	2.61	3.12	2.11	1.59	0.53
18	0.20	1.02	2.33	2.96	2.40	2.32	1.31
19	-0.21	0.46	1.79	2.58	2.25	2.73	1.81
20	-0.49	-0.04	1.19	1.99	1.79	2.59	2.05
21	-0.59	-0.27	0.66	1.29	1.11	2.11	1.91
22	-0.28	-0.28	0.44	0.62	0.43	1.41	1.49
23	0.53	0.08	0.53	0.25	-0.14	0.77	0.82
24	1.33	0.69	0.95	0.24	-0.46	0.24	0.16

TIDES MEASURED AT SEWELLS POINT

HOUR	28 DEC 80 HT (F)	29 DEC 80 HT (F)	30 DEC 80 HT (F)	31 DEC 80 HT (F)	1 JAN 81 HT (F)	2 JAN 81 HT (F)	3 JAN 81 HT (F)
1	2.97	2.86	2.41	2.15	1.48	0.90	0.24
2	3.12	3.21	2.85	2.62	1.94	1.33	0.54
3	2.99	3.31	3.02	3.09	2.48	1.78	0.97
4	2.73	3.24	3.04	3.37	2.84	2.28	1.46
5	2.36	3.07	2.95	3.39	3.09	2.57	1.91
6	2.02	2.74	2.68	3.21	3.04	2.61	2.17
7	1.63	2.24	2.25	2.85	2.83	2.35	2.18
8	1.54	1.91	1.81	2.34	2.42	1.93	1.98
9	1.64	1.68	1.55	1.86	1.89	1.44	1.66
10	1.95	1.74	1.52	1.55	1.38	0.84	1.09
11	2.37	1.99	1.70	1.46	1.10	0.48	0.43
12	2.73	2.41	2.05	1.55	1.07	0.26	-0.14
13	3.01	2.91	2.45	1.78	1.27	0.34	-0.39
14	3.15	3.23	2.79	2.15	1.56	0.54	-0.36
15	2.98	3.38	3.02	2.46	1.90	0.92	-0.12
16	2.66	3.23	3.06	2.73	2.24	1.37	0.37
17	2.23	2.95	2.91	2.76	2.43	1.78	0.91
18	1.84	2.55	2.63	2.70	2.43	1.98	1.35
19	1.49	2.12	2.13	2.34	2.19	1.95	1.50
20	1.22	1.68	1.69	1.93	1.76	1.62	1.37
21	1.20	1.41	1.38	1.44	1.26	1.12	1.03
22	1.41	1.35	1.21	1.14	0.83	0.61	0.52
23	1.81	1.50	1.37	1.00	0.60	0.29	-0.05
24	2.34	1.39	1.70	1.16	0.65	0.13	-0.46

TIDES MEASURED AT SEWELLS POINT

HOUR	21 DEC 80 HT (F)	22 DEC 80 HT (F)	23 DEC 80 HT (F)	24 DEC 80 HT (F)	25 DEC 80 HT (F)	26 DEC 80 HT (F)	27 DEC 80 HT (F)
1	-0.33	-0.24	0.42	1.44	2.22	1.59	2.21
2	-0.63	-0.70	-0.20	0.76	1.92	1.29	2.14
3	-0.53	-0.85	-0.64	0.10	1.49	0.77	1.82
4	-0.04	-0.66	-0.80	-0.32	1.11	0.18	1.41
5	0.80	-0.09	-0.54	-0.40	0.64	-0.28	1.03
6	1.59	0.70	0.23	-0.05	0.54	-0.51	0.74
7	2.26	1.48	1.03	0.51	0.43	-0.36	0.67
8	2.67	2.10	1.75	1.28	0.78	-0.06	0.82
9	2.73	2.48	2.37	2.00	1.48	0.42	1.21
10	2.49	2.48	2.63	2.51	2.17	1.00	1.71
11	1.88	2.16	2.51	2.64	2.72	1.48	2.33
12	1.00	1.49	2.15	2.46	2.97	1.86	2.77
13	0.19	0.63	1.52	2.04	2.74	1.90	3.02
14	-0.44	-0.13	0.70	1.31	2.16	1.66	2.97
15	-0.78	-0.65	-0.07	0.53	1.40	1.18	2.69
16	-0.70	-0.87	-0.46	-0.06	0.62	0.63	2.37
17	-0.26	-0.74	-0.48	-0.42	0.00	0.12	1.88
18	0.45	-0.14	-0.02	-0.41	-0.39	-0.14	1.56
19	1.13	0.62	0.48	-0.06	-0.42	-0.22	1.38
20	1.57	1.29	1.18	0.46	-0.13	-0.08	1.37
21	1.72	1.70	1.81	1.14	0.32	0.28	1.53
22	1.56	1.80	2.20	1.76	0.85	0.87	1.80
23	1.13	1.57	2.22	2.21	1.31	1.50	2.21
24	0.43	1.10	1.93	2.29	1.61	1.99	2.64

TIDES MEASURED AT SEWELLS POINT

HOUR	4 JAN 81 HT (F)	5 JAN 81 HT (F)	6 JAN 81 HT (F)	7 JAN 81 HT (F)	8 JAN 81 HT (F)	9 JAN 81 HT (F)	10 JAN 81 HT (F)
1	-0.29	-0.83	-0.92	-0.70	0.08	-0.33	0.62
2	0.08	-0.87	-0.77	-0.76	-0.09	-0.73	0.16
3	0.49	-0.48	-0.21	-0.51	-0.10	-0.73	-0.04
4	1.08	0.24	0.47	-0.13	0.23	-0.42	0.08
5	1.83	0.88	1.13	0.53	0.79	0.14	0.39
6	2.49	1.42	1.63	1.19	1.55	0.87	0.99
7	2.86	1.65	1.86	1.76	2.29	1.52	1.79
8	2.81	1.66	1.87	2.01	2.62	2.03	2.48
9	2.55	1.43	1.53	2.00	2.59	2.24	2.95
10	2.00	0.87	0.96	1.58	2.16	2.09	2.95
11	1.41	0.10	0.31	0.96	1.43	1.63	2.64
12	0.80	-0.54	-0.27	0.27	0.59	0.86	2.00
13	0.30	-1.02	-0.72	-0.31	-0.11	0.15	1.26
14	0.05	-1.00	-0.83	-0.67	-0.57	-0.39	0.64
15	0.12	-0.65	-0.56	-0.50	-0.70	-0.60	0.28
16	0.39	-0.02	0.01	0.03	-0.43	-0.53	0.17
17	0.84	0.59	0.65	0.55	0.13	-0.14	0.24
18	1.21	1.03	1.20	1.03	0.73	0.45	0.55
19	1.45	1.27	1.55	1.76	1.22	1.18	1.10
20	1.41	1.19	1.54	2.00	1.54	1.75	1.70
21	1.10	0.83	1.29	2.05	1.61	1.99	2.12
22	0.66	0.32	0.81	1.60	1.36	1.98	2.26
23	0.13	-0.28	0.21	1.07	0.90	1.73	2.08
24	-0.49	-0.74	-0.35	0.46	0.21	1.22	1.65

TIDES MEASURED AT SEWELLS POINT

HOUR	11 JAN 81 HT (F)	12 JAN 81 HT (F)	13 JAN 81 HT (F)	14 JAN 81 HT (F)	15 JAN 81 HT (F)	16 JAN 81 HT (F)	17 JAN 81 HT (F)
1	1.03	0.54	0.60	1.59	2.22	2.68	2.36
2	0.42	0.14	0.04	0.99	1.60	2.34	2.33
3	-0.06	0.01	-0.29	0.50	0.93	1.78	2.43
4	-0.16	0.18	-0.32	0.28	0.43	1.11	1.78
5	0.11	0.62	-0.03	0.36	0.16	0.53	1.12
6	0.72	1.12	0.50	0.63	0.14	0.17	0.62
7	1.49	1.65	1.11	1.13	0.37	0.11	0.32
8	1.95	1.98	1.60	1.67	0.76	0.33	0.29
9	2.19	1.97	1.85	2.16	1.29	0.77	0.49
10	2.05	1.65	1.87	2.39	1.71	1.31	0.80
11	1.61	1.21	1.69	2.41	1.97	1.81	1.39
12	0.97	0.63	1.30	2.13	1.96	2.17	1.86
13	0.23	0.11	0.73	1.71	1.71	2.25	2.18
14	-0.23	-0.36	0.16	1.12	1.15	1.97	2.13
15	-0.47	-0.64	-0.20	0.60	0.59	1.41	1.71
16	-0.46	-0.55	-0.23	0.23	0.12	0.73	1.20
17	-0.28	-0.13	0.01	0.22	-0.18	0.17	0.59
18	0.31	0.47	0.51	0.50	-0.15	-0.07	0.05
19	1.03	1.06	1.20	1.01	0.19	0.12	-0.25
20	1.66	1.58	1.88	1.67	0.84	0.54	-0.19
21	2.08	1.82	2.27	2.20	1.53	0.99	0.23
22	2.14	1.75	2.40	2.58	2.10	1.45	0.89
23	3.29	1.46	2.33	2.70	2.51	2.08	1.58
24	1.03	1.10	2.07	2.61	2.70	2.56	2.17

TIDES MEASURED AT SEWELLS POINT

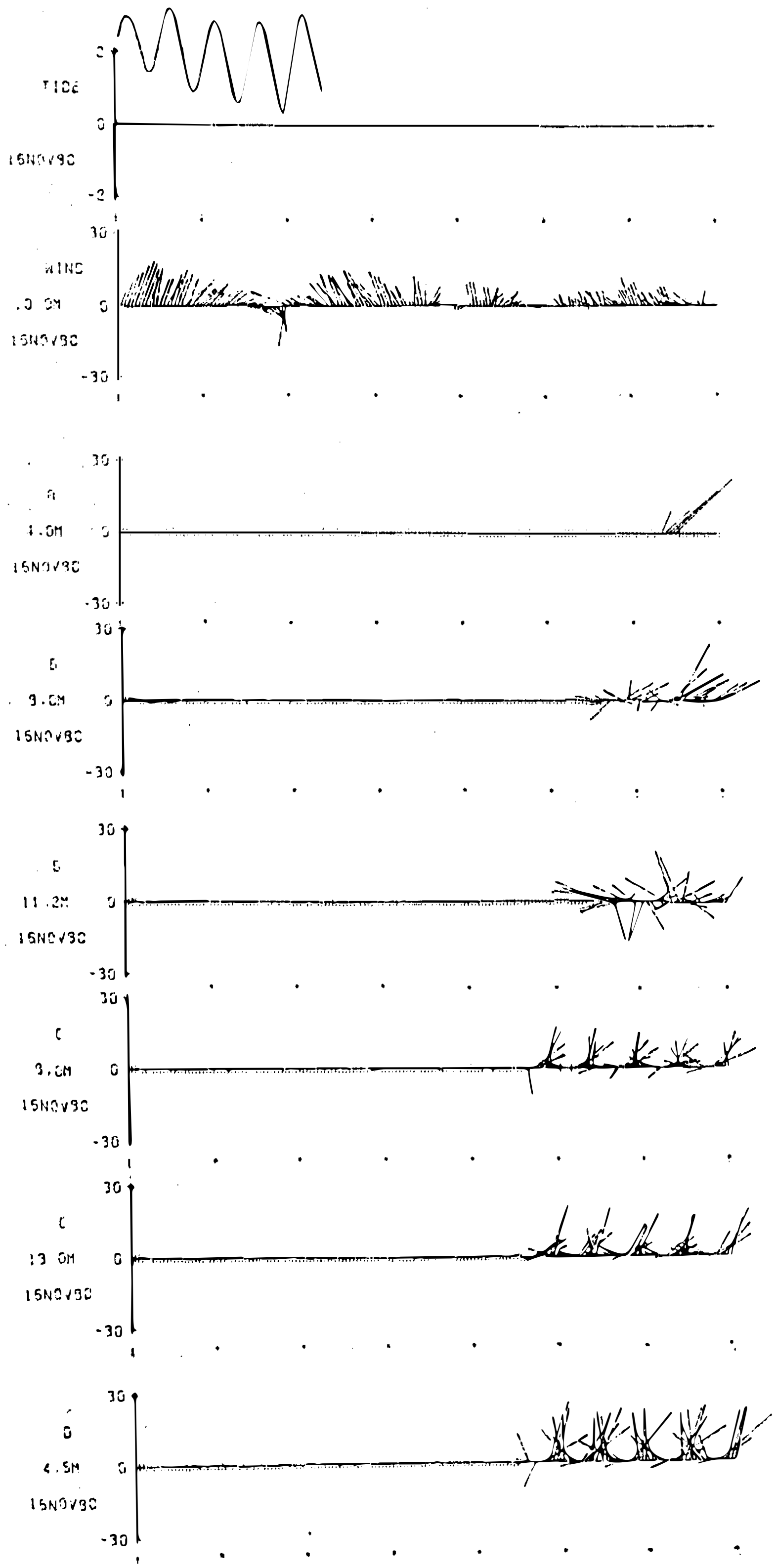
HOUR	18 JAN 81 HT (F)	19 JAN 81 HT (F)	20 JAN 81 HT (F)	21 JAN 81 HT (F)	22 JAN 81 HT (F)	23 JAN 81 HT (F)	24 JAN 81 HT (F)
1	2.38	2.66	2.08	2.28	1.89	1.31	0.71
2	2.28	2.70	2.41	2.75	2.53	1.93	1.30
3	1.89	2.43	2.40	3.04	2.98	2.47	1.93
4	1.28	1.90	2.16	2.90	2.97	2.75	2.37
5	0.60	1.14	1.34	2.53	2.66	2.67	2.55
6	-0.03	0.43	0.53	1.85	2.06	2.28	2.39
7	-0.33	-0.10	-0.14	1.18	1.26	1.70	2.00
8	-0.40	-0.34	-0.57	0.70	0.48	0.94	1.20
9	-0.15	-0.16	-0.64	0.46	-0.04	0.36	0.58
10	0.52	0.25	-0.32	0.74	-0.20	0.03	0.15
11	1.33	0.98	0.34	1.09	0.11	0.09	0.04
12	1.90	1.67	1.05	1.62	0.58	0.34	0.18
13	2.14	2.08	1.67	2.18	1.17	0.81	0.51
14	2.01	2.16	2.04	2.65	1.79	1.34	0.95
15	1.61	1.87	2.07	2.89	2.27	1.93	1.55
16	0.95	1.35	1.77	2.82	2.56	2.27	2.03
17	0.29	0.68	1.28	2.58	2.40	2.33	2.33
18	-0.16	0.05	0.60	1.99	1.99	2.19	2.26
19	-0.39	-0.42	-0.02	1.22	1.31	1.73	1.88
20	-0.30	-0.63	-0.38	0.54	0.65	1.08	1.37
21	0.11	-0.53	-0.43	0.13	0.21	0.47	0.71
22	0.85	0.00	0.01	0.09	0.15	0.16	0.30
23	1.69	0.75	0.75	0.56	0.30	0.07	0.04
24	2.28	1.50	1.55	1.16	0.76	0.26	0.11

TIDES MEASURED AT SEWELLS POINT

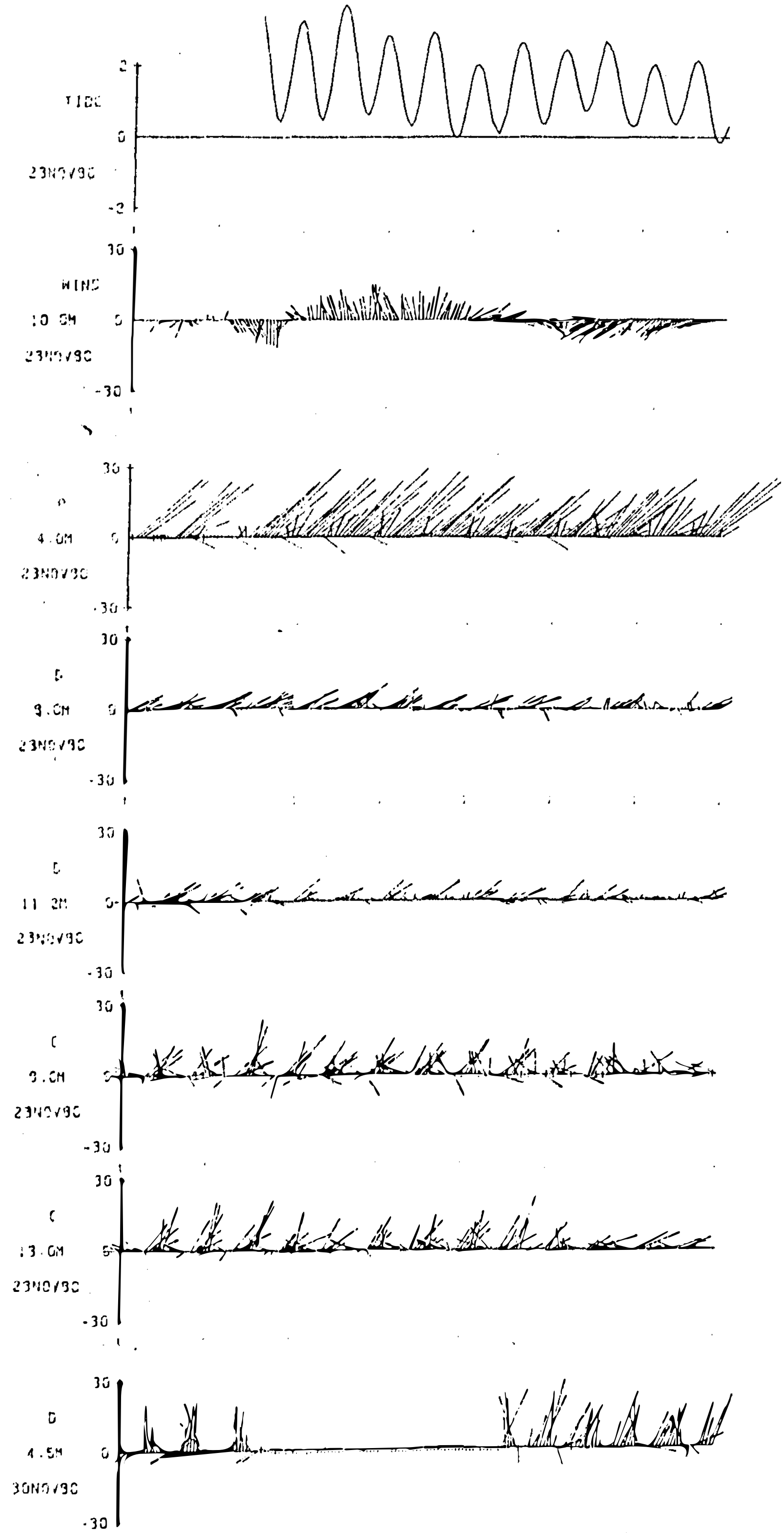
HOUR	25 JAN 81 HT (F)	26 JAN 81 HT (F)	27 JAN 81 HT (F)	28 JAN 81 HT (F)	29 JAN 81 HT (F)	30 JAN 81 HT (F)	31 JAN 81 HT (F)
1	0.31	0.16	-0.03	0.60	0.57	0.80	0.65
2	0.79	0.44	0.04	0.54	0.42	0.43	
3	1.37	0.85	0.39	0.73	0.43	0.24	
4	1.93	1.33	0.83	1.06	0.60	0.34	
5	2.26	1.71	1.26	1.46	0.97	0.59	
6	2.28	1.85	1.64	1.94	1.38	0.93	
7	1.97	1.76	1.75	2.12	1.60	1.26	
8	1.43	1.40	1.62	2.10	1.73	1.45	
9	0.85	0.95	1.33	1.75	1.60	1.47	
10	0.37	0.45	0.93	1.42	1.46	1.36	
11	0.14	0.13	0.54	1.00	1.50	1.01	
12	0.12	-0.04	0.24	0.69	1.27	0.59	
13	0.28	-0.02	0.07	0.43	0.90	0.27	
14	0.60	0.10	0.14	0.36	0.55	0.02	
15	1.09	0.41	0.33	0.54	0.42	0.03	
16	1.61	0.86	0.86	0.89	0.54	0.34	
17	2.03	1.42	1.36	1.41	1.04	0.81	
18	2.15	1.80	1.84	1.84	1.58	1.39	
19	1.96	1.88	2.11	2.11	1.93	1.84	
20	1.62	1.69	2.14	2.15	2.11	2.16	
21	1.12	1.29	1.99	2.04	2.23	2.22	
22	0.62	0.88	1.71	1.76	2.04	2.05	
23	0.26	0.41	1.32	1.37	1.69	1.66	
24	0.14	0.07	0.87	0.90	1.25	1.18	

APPENDIX B

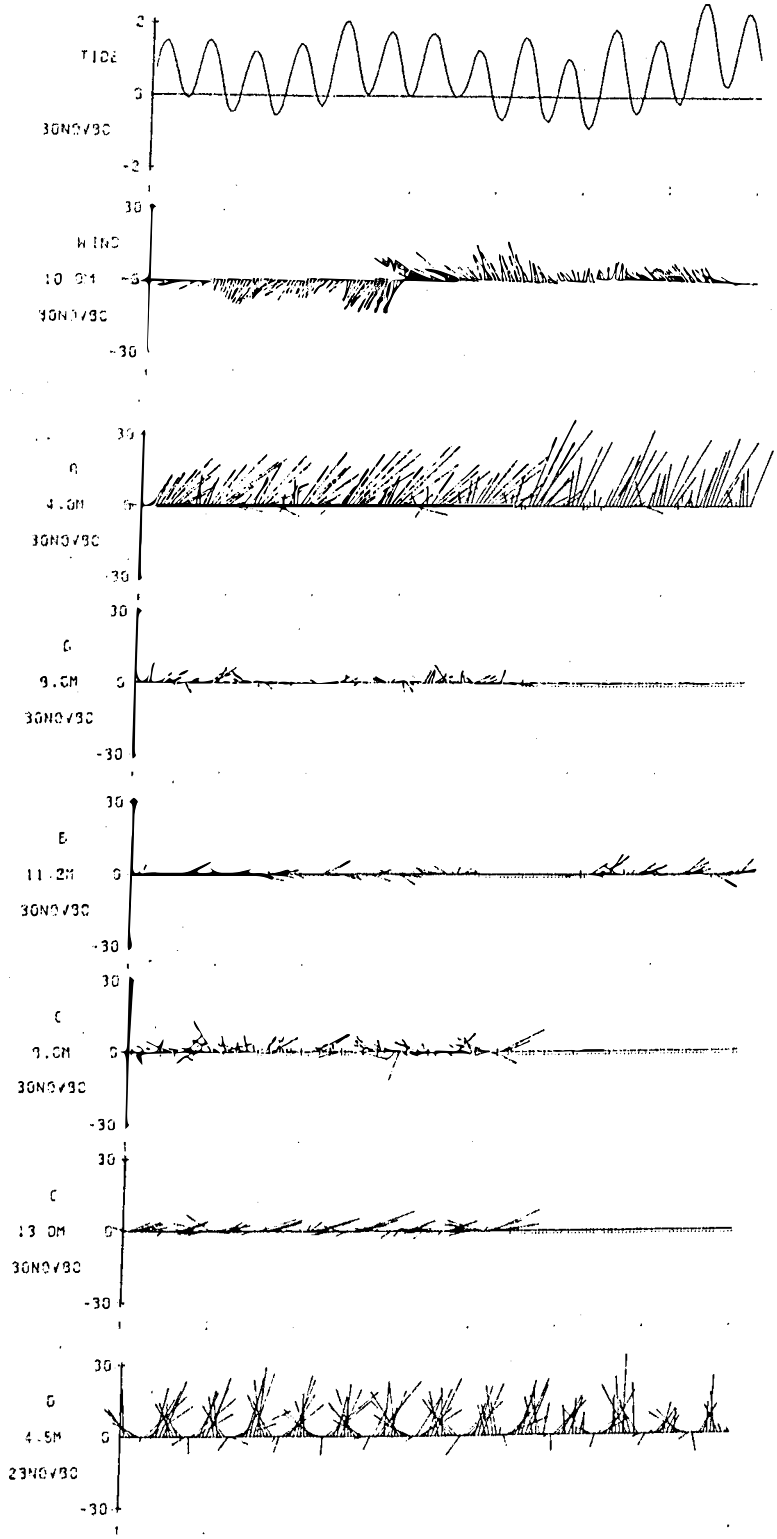
This appendix contains plots of hourly tidal heights, wind vectors and current vectors measured in the vicinity of the Norfolk Naval Base and Pier 12. Wind and current vectors are presented as stick plots indicating hourly magnitude and direction towards which the wind or current was moving. To the left of each plot is information indicating the height (or depth) at which measurements were made, as well as the station designation and the date of the first day of each seven day series. Missing data is indicated by a small vertical line. Each page contains plots of data taken over a seven day period.

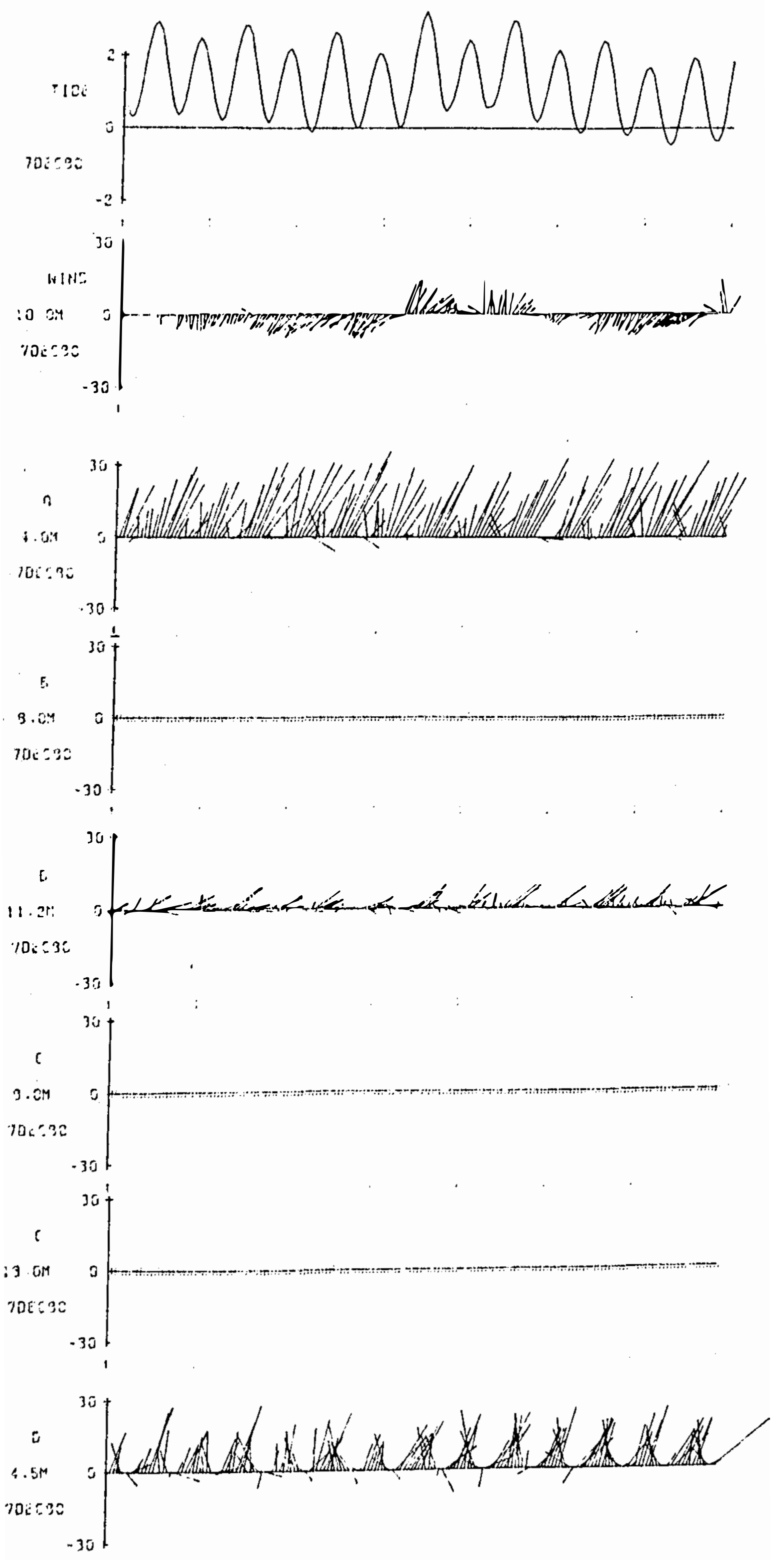


TIDE
2
0
-2
15NOV80
WIND
30
0
-30
4.0M
9.0M
11.2M
3.0M
13.0M
4.5M

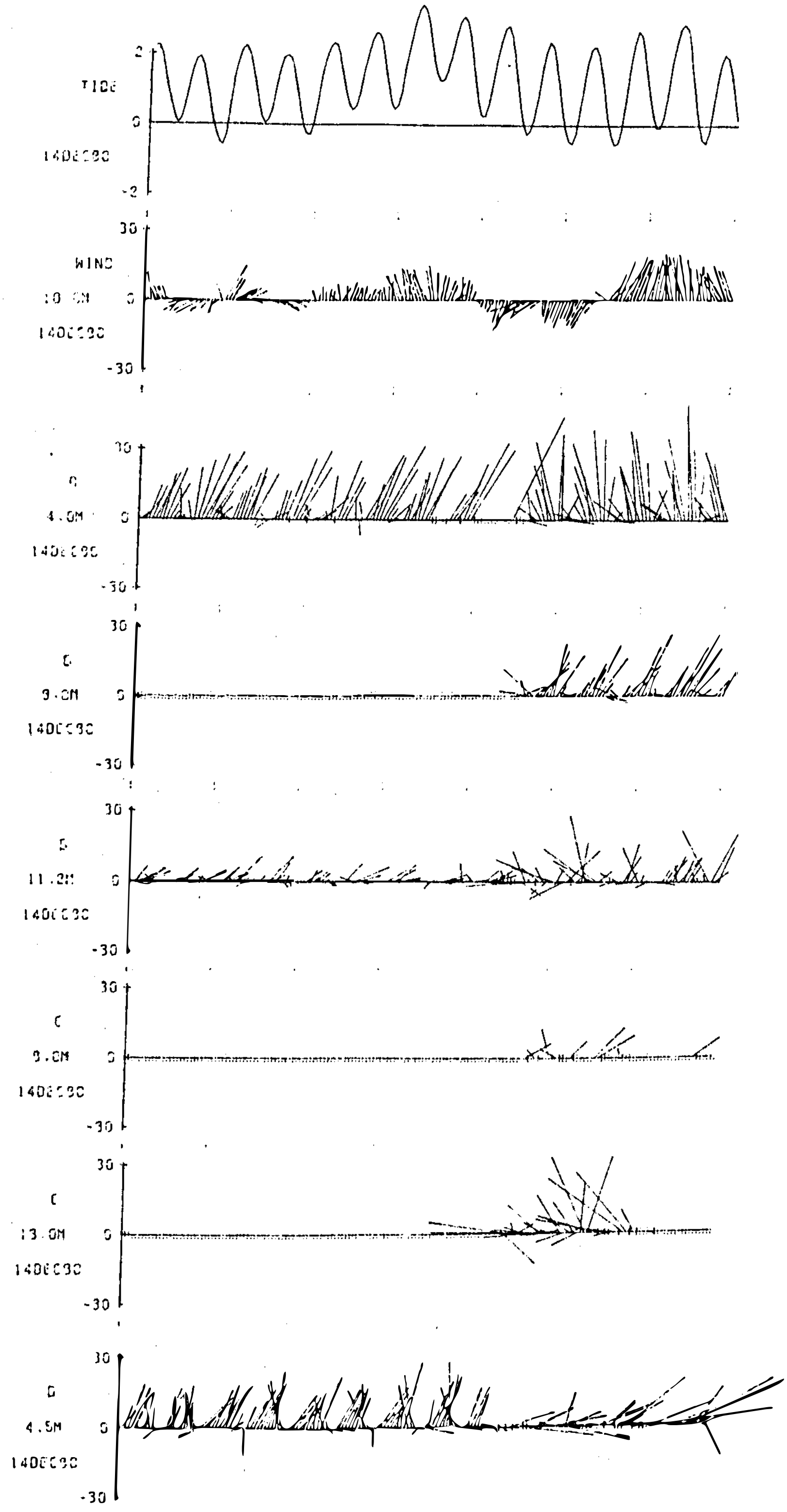


TIDE
23NOV90
2
0
-2
WIND
10.5M
23NOV90
30
0
-30
4.0M
23NOV90
9.0M
23NOV90
11.2M
23NOV90
9.0M
23NOV90
13.0M
23NOV90
4.5M
30NOV90

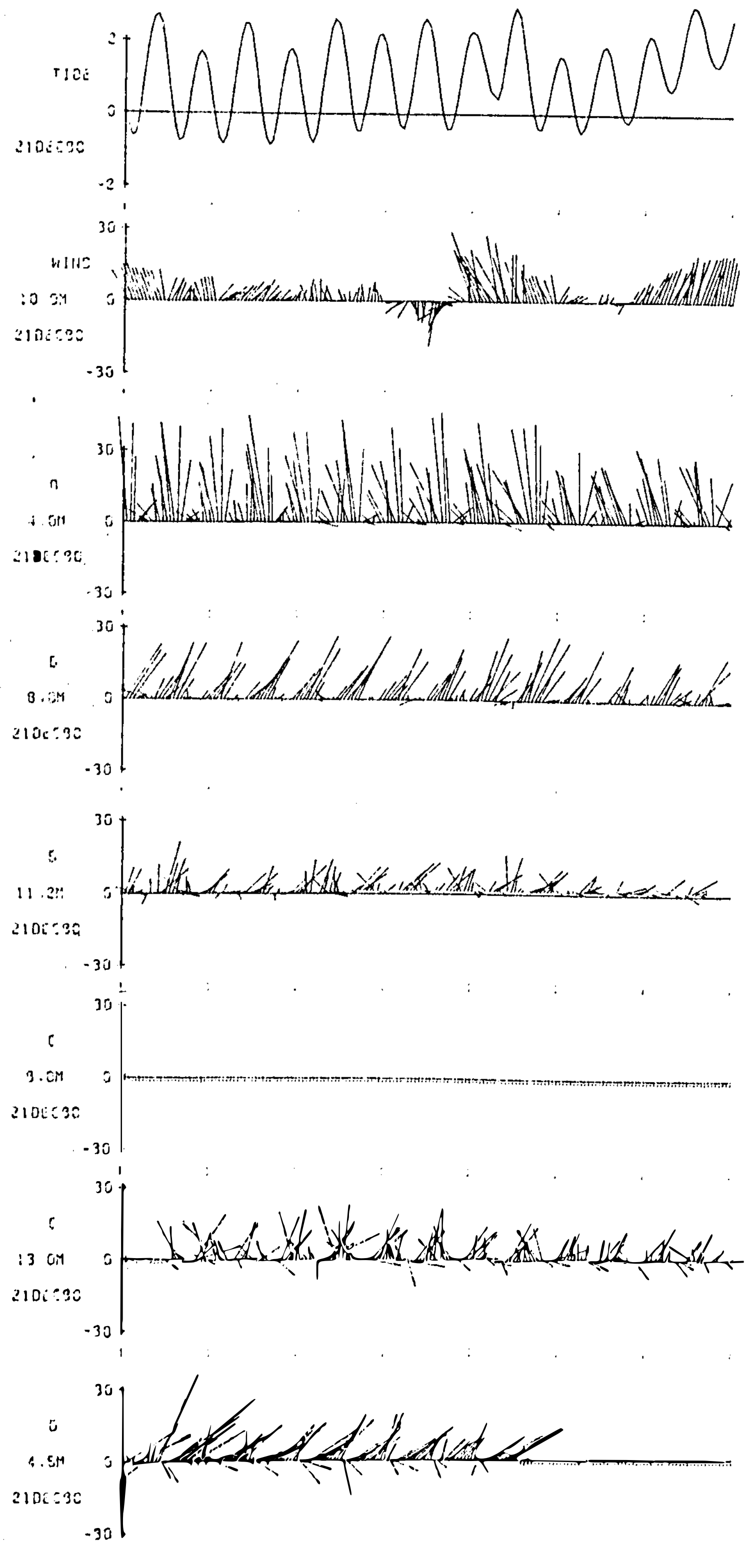

TIDE
30NOV80
2
0
-2
WIND
30
-30
4.0M
9.0M
11.2M
13.0M
4.5M
23NOV80

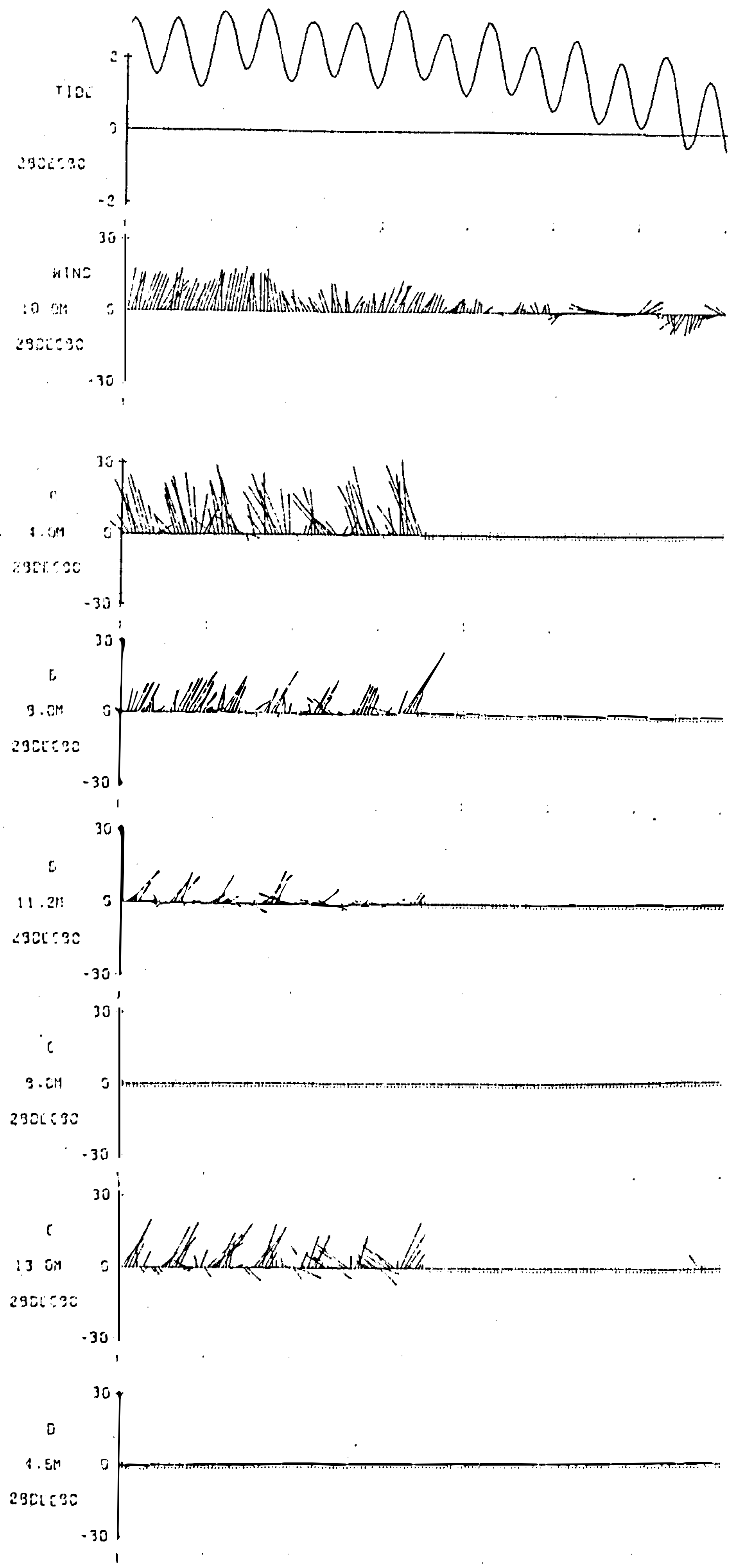


TIDE
2
0
-2
WIND
30
0
-30

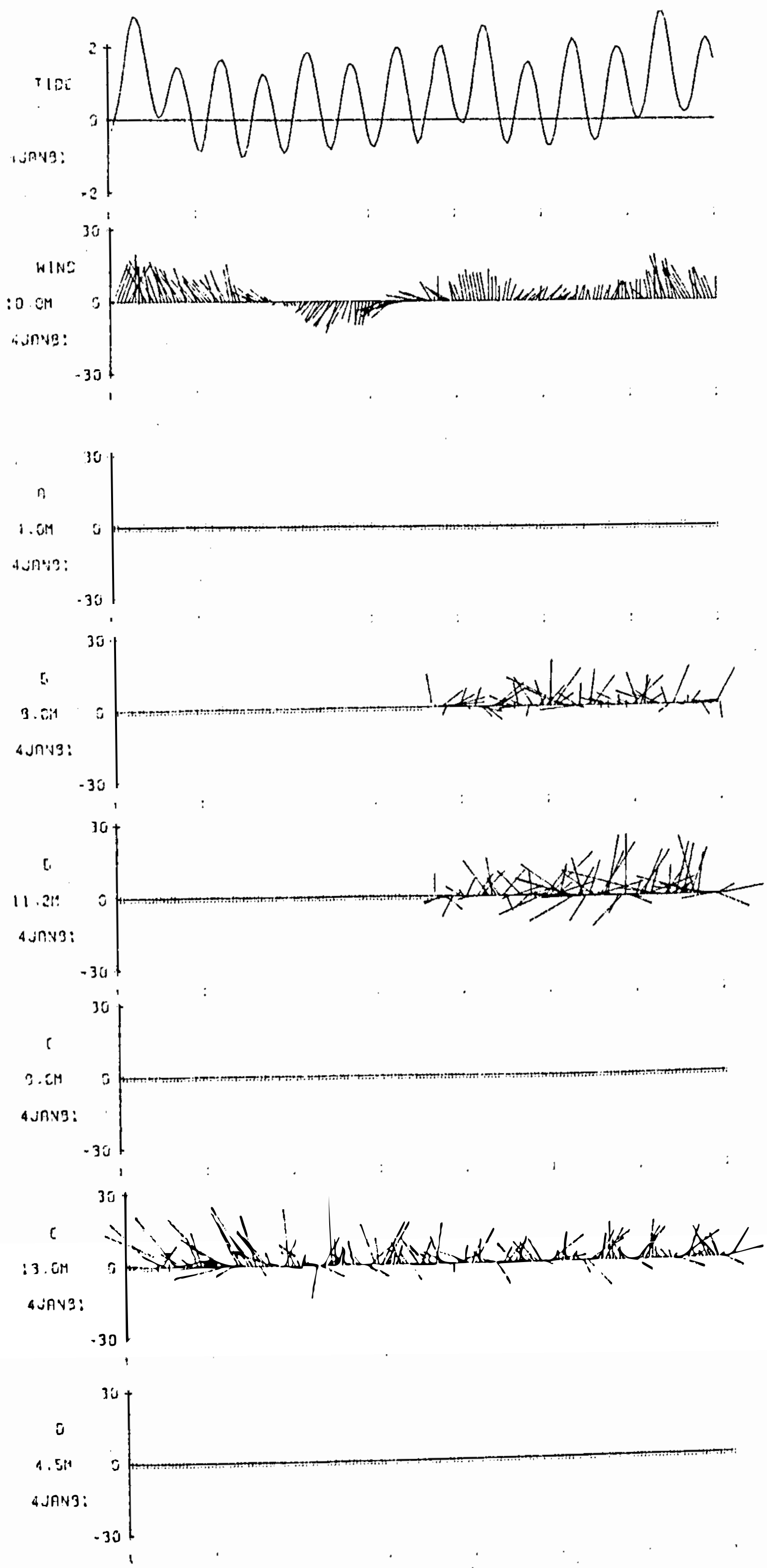


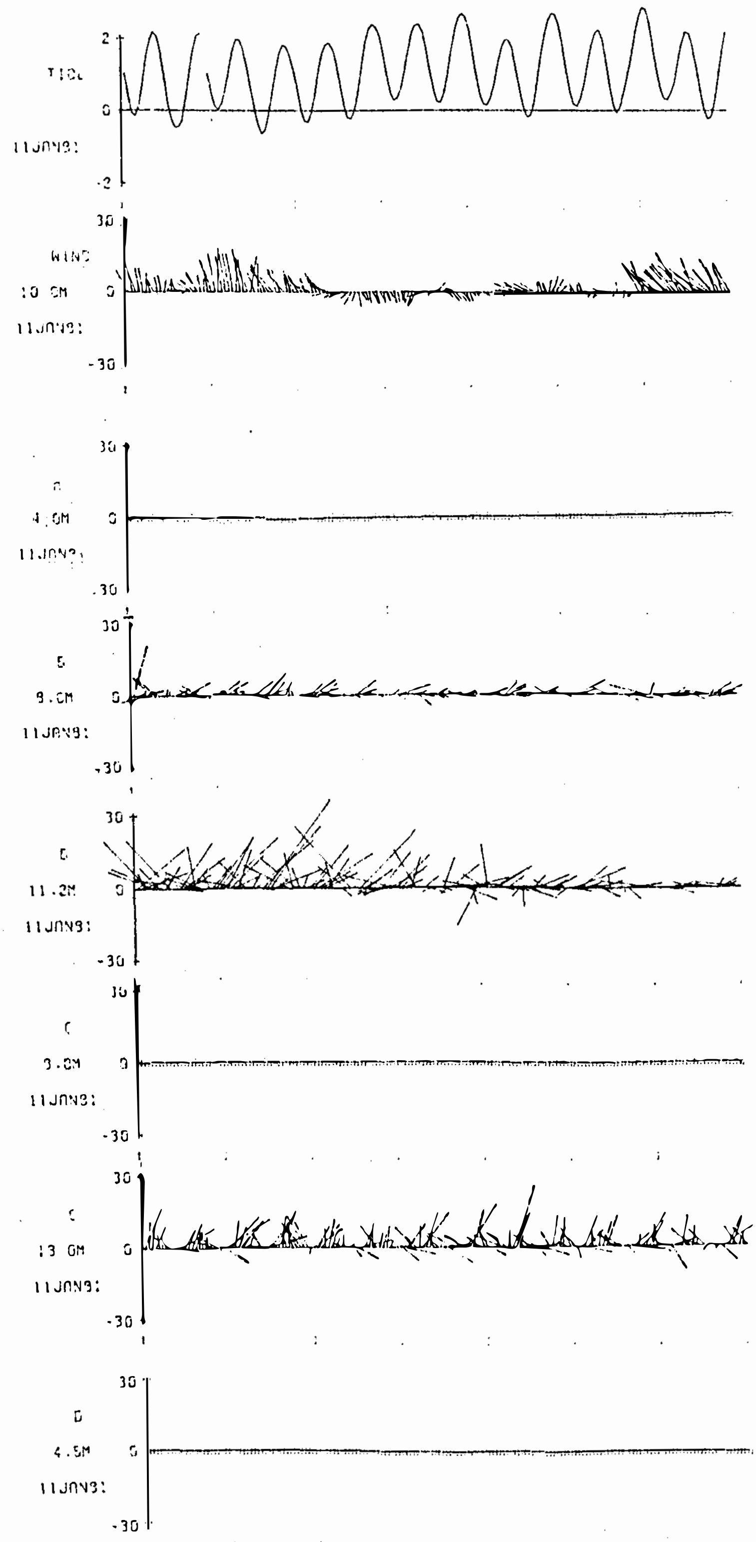
TIDE
WIND
30
0
-30


TIDE
210690
WIND
10.5M
210690
4.0M
210690
8.0M
210690
11.2M
210690
9.0M
210690
13.0M
210690
4.5M
210690



TIDE
2
0
-2
29DEC90
WIND
30
0
-30
29DEC90
4.0M
29DEC90
B
9.0M
29DEC90
B
11.2M
29DEC90
C
9.0M
29DEC90
C
13.0M
29DEC90
D
4.5M
29DEC90

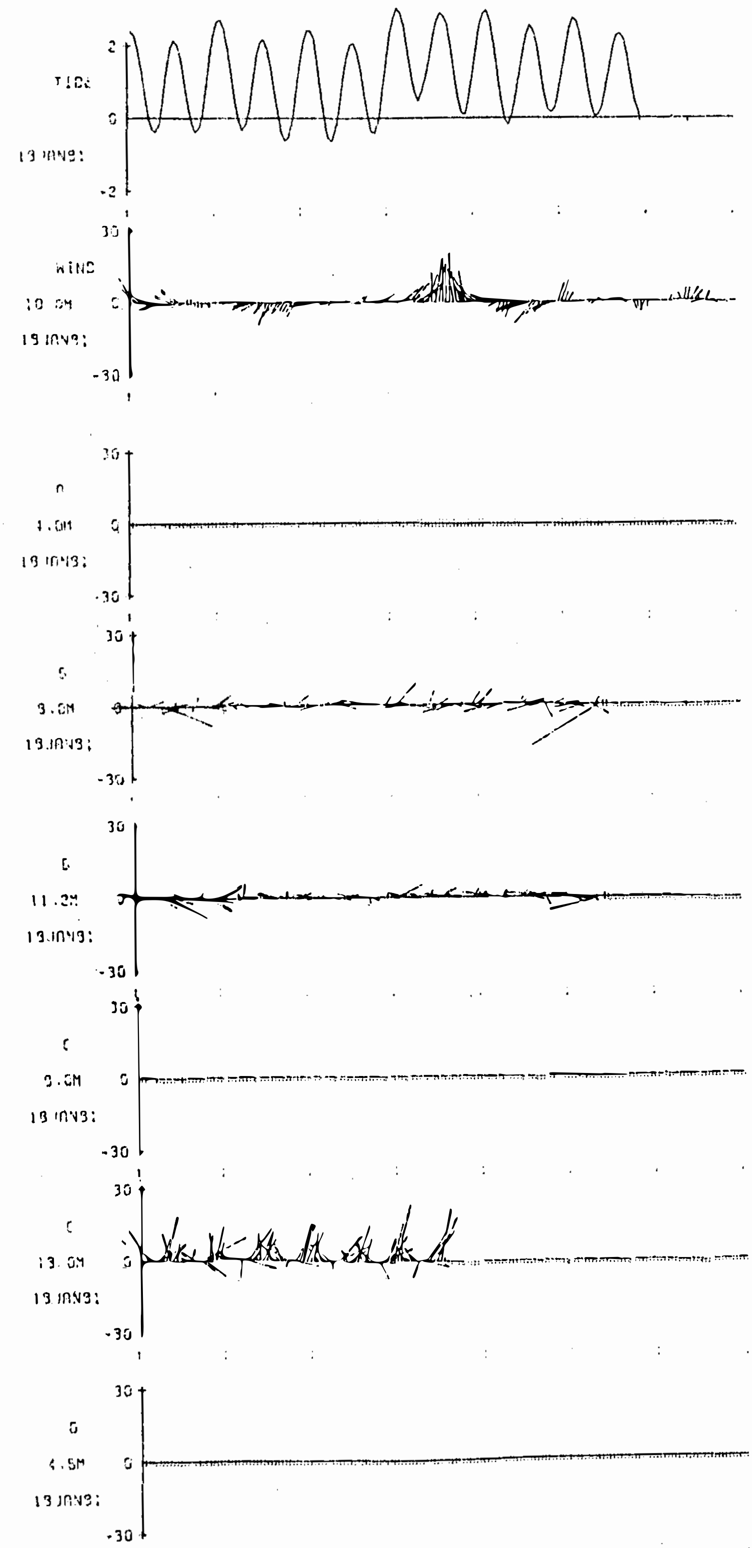

TIDE
2
0
-2
WIND
10.0M
30
0
-30
1.0M
9.0M
11.2M
13.0M
4.5M
4JAN83



2
0
-2
WIND
30
0
-30
30
0
-30
30
0
-30
30
0
-30
0
-30
30
0
-30
30
0
-30

APPENDIX C:

Fouling Organism Data Collected in Hampton Roads



Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 1 Nov. 13						
W	12	0.6	50	0.2	100	0.1
W	13	2.1	70	0	--	0.4
MGE	14	3.0	80	0	--	0
MGW	15	1.3	80	0.1	100	0
MGE	16	10.0	80	0	--	0
MGE	17	13.3	80	0	--	0
B3	18	1.0	80	0	--	0
A4	19	0.1	80	0	--	0
Cruise 2 Nov. 18						
SP1	26	0	--	0	--	0.4
SP	27	0.4	10	0	--	0
WB	28	1.1	80	0	--	0
WB	29	0.2	80	0	--	0
WB	30	16.0	0	0	--	0
WB	31	0.5	80	0.2	100	0.3
Pit	32	0.2	30	0	--	0
Al shallow	33	3.0	80	0	--	0
Cl	34	16.5	80	0.5	100	5.3
NP1	35	2.3	70	0	--	0
NP2	36	0.3	50	0	--	0
JR2	37	0	--	0	--	0.3
MGE	39	4.5	80	0	--	0
B3	40	2.1	50	0	--	0
Cruise 3 Nov. 19						
Old Pt. Comfort	47	0	--	6.8	100	0
W	48	4.0	10	0.8	100	0
W	49	4.0	80	0	--	0
Al shallow	50	2.3	80	0	--	0
Al deep	57	1.6	95	0	--	0
Al on Bar	52	0.4	90	0	--	0
Cl deep	53	16.0	90	0	--	2.0
Cl Top of Bar	54	0	--	0	--	0
C2	55	10.6	90	0	--	0

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 4 Nov. 24						
PH	69	0.4	20	2.8	100	0.3
CE	70	4.5	10	1.6	100	0.8
C	71	0.9	50	0.2	100	0
ER1	72	0.8	50	0	--	0
ER2	73	0.1	50	0	--	0
ER3	74	0	--	0	--	0
B3	75	0	--	0.1	100	0
B4	76	0	--	0	--	0
B3	77	0.5	60	0	--	0
C5	78	8.2	20	0	--	0
MGE	79	13.3	80	0.3	100	0
MGW	80	5.0	80	0	--	0
W	81	3.3	40	0	--	0
Cruise 5 Nov. 25						
PH	93	1.4	100	1.5	100	0
CE	94	1.5	100	4.2	100	2.8
W	96	2.9	70	Trace	100	0.3
W	97	5.4	70	Trace	100	0
C1	98	17.2	60	Trace	100	1.2
C2	99	6.7	80	Trace	100	0.3
A1 shallow	100	0.2	90	Trace	100	1.6
A1 deep	101	1.6	90	Trace	100	0.2
Pit	102	1.4	50	0	--	0.4
WB	103	1.9	70	Trace	100	0.2
WB	104	2.1	100	Trace	100	0
WB	105	7.4	70	0.4	50	0
WB	106	0.7	90	0	--	0.3
WB	107	heavy *Mytilus* set				
WB	108	0.2	100	0.9	100	0.4
WB	109	0	--	0.8	100	13.6
Cruise 6 Dec. 1						
PH	125	0.3	50	6.8	100	0.2
CE	126	2.4	50	6.7	100	2.8
C	127	1.8	90	0.3	100	0
B3	128	0	--	0	--	0

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 6 (continued)						
B3	129	0.2	90	0	--	0
C5	130	7.8	50	0	--	0
MGE	131	23.3	80	0.3	100	0
MGW	132	4.3	60	0	--	0
JR1	133	2.8	60	0	--	0
NP2	134	0.2	100	0	--	4.0
NP1	135	0.3	100	0	--	1.4
C1	136	17.2	90	0	--	1.2
C2	137	2.3	70	0	--	0
C3	138	2.9	95	0	--	0
C4	139	12.8	80	6.3	100	0
B2	140	6.2	80	0.2	100	0
A4	141	0.9	60	0	--	0
A3	142	5.0	80	0	--	0
W	143	8.3	10	0	--	0
A1 deep	144	12.6	80	1.6	100	6.3
A1 shallow	145	6.8	100	0	--	0.9
Cruise 7 Dec. 2						
PH	157	0.1	80	0.9	100	0.6
CE	158	3.2	80	1.2	40	0.6
JR2	159	0.5	90	0	--	0
JR3	160	Trace	100	0	--	0
JR3 shallow	161	Trace	100	0	--	0
JR4	162	Trace	100	0	--	0
W	163	1.8	85	0	--	0
Cruise 8 Dec. 8						
PH	172	0.1	80	0.4	100	0.1
CE	173	1.8	60	4.2	90	0.4
C	174	1.2	90	Trace	100	Trace
WB	175	Trace	100	0	--	0
WB	176	0	--	0	--	0
WB	177	0.2	90	0	--	0
WB	178	0.5	100	0	--	0
WB	179	0.4	90	0	--	0
WB	180	Trace	100	0	--	0

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 8 (continued)						
WB	181	0	--	0	--	0
WB	182	0	--	0	--	0
WB	183	0.3	90	0	--	0.4
WB	184	0	--	0	--	0
WB	185	Trace	90	0	--	0
WB	186	0	--	5.2	100	0
Cruise 9 Dec. 9						
PH	197	0.7	70	4.7	100	0.2
CE	198	4.1	50	Trace	100	0.5
C	199	2.1	60	0	--	Trace
W	200	0.1	50	Trace	100	0
Cruise 10 Dec. 11						
A4	208	1.4	90	0	--	0
B3	209	2.7	50	0	--	Trace
C5	210	4.6	70	0.4	100	Trace
MGE	211	18.9	90	0	--	0
MGW	212	9.9	80	Trace	100	0
C4	213	24.6	90	1.6	100	0.9
C3	214	0.7	90	0	--	0
C2	215	15.4	80	1.6	100	1.7
C1	216	24.7	80	0	--	1.0
B2	217	0.5	70	0	--	Trace
B1	218	0.8	60	0.1	100	0
A3	219	1.7	70	0.8	100	0
A1	220	9.1	90	2.2	100	2.1
SP	221	1.9	90	5.2	100	0
SP1	222	9.5	80	8.3	100	0.3
Cruise 11 Dec. 15						
PH	238	3.0	90	5.3	100	0.3
CE	239	2.9	70	0.4	20	0.4
C	240	6.2	70	2.2	100	Trace

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 11 (continued)						
MGE	241	20.0	90	0	0	Trace
MGW	242	5.0	90	0	0	0
W	243	0.5	60	0	0	0
Cruise 12 Dec. 16						
PH	268	0.4	90	2.7	80	Trace
CE	269	2.2	20	0.1	100	Trace
C	270	0.8	20	0		Trace
C5	271	11.4	60	4.2	100	0
C4	272	18.0	80	0.2	100	Trace
C3	273	2.0	100	0	--	0
C2	274	0.1	100	0	--	0
C1	275	24.5	80	Trace	100	2.3
B3	276	3.2	70	Trace	100	0
B2	280	3.0	60	0.1	100	0
B1	281	0.8	60	Trace	100	0
A4	282	0.1	95	Trace	100	0
A3	283	0.1	95	0.1	100	0
Cruise 14 Dec. 22						
MGE	330	13.0	95	Trace	100	0.2
MGE	331	15.0	90	1.0	100	Trace
C1	332	42.0	90	0	--	5.0
C2	333	1.5	90	0	--	0
C3	334	3.5	80	1.5	100	0
C4	335	23.0	50	Trace	100	0
C5	336	22.0	60	2.0	100	0
B4	337	Trace		0	--	Trace
B3	338	2.0	70	0	--	0
B2	339	2.0	70	0	--	0
B1	340	0.5	50	0.4	100	0
A1	341	9.0	90	1.5	100	1.5
W	342	7.0	40	Trace	100	0
W	342	3.5	40	1.5	100	0
A3	343	3.5	50	0.5	100	0
A4	344	2.0	40	0	--	0
ER1	345	3.0	70	0	--	0

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 15 Dec. 23						
PH	365	13.0	90	46.0	100	Trace
CE	366	3.0	30	5.0	80	1.0
C	367	6.0	20	0	--	0
A3	368	5.5	50	Trace	100	0
A4	369	0.5	50	0	--	0
B3	370	Trace	50	0	--	0
B2	371	4.0	50	0	--	0
B1	372	1.0		Trace	100	0
C5	373	9.0	60	Trace	100	0
C4	374	37.0	70	Trace	100	Trace
C3	375	1.5	90	1.5	100	Trace
C2	376	Trace	100	Trace	100	Trace
C1	377	31.0	90	Trace	100	2.0
A1	378	11.5	90	17.0	90	2.5
W	379	1.5	90	4.0	100	Trace
Cruise 16 Dec. 30						
PH	392	10.4	90	54.0	100	0.2
CE	393	6.0	50	3.5	50	1.5
C	394	0.7	100	0	--	0
MGE	395	12.0	100	0	--	0.4
C5	396	27.0	50	0	--	0
C4	397	21.5	60	1.6	100	0
C3	398	3.2	90	0.6	100	0.2
C2	399	1.1	40	0	--	0
C1	400	23.0	50	0.1	100	1.0
B1	401	0.7	60	0	--	0
W	402	9.5	50	6.0	20	1.4
B3	403	2.1	50	0	--	0
B2	404	4.4	50	0	--	0
A4	405	0.8	50	0	--	0
A3	406	3.4	30	0	--	0
Cruise 17 Jan. 5						
PH	421	9.6	90	34.5	100	1.7
CE	422	18.5	90	16.5	100	4.0
C	423	0.7	90	Trace	100	0

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 17 (continued)						
A4	424	1.2	90	0	--	0
A3	425	3.0	90	Trace	100	0
W	426	6.8	50	Trace	100	0
A1	427	23.0	90	Trace	100	0
Cruise 18 Jan. 6						
PH	442	10.0	80	21.0	100	1.5
CE	443	6.5	20	0.5	100	0
C	444	0.5	100	1.0	100	Trace
MGE	445	15.0	90	1.0	100	0
C5	446	14.0	70	0	--	0
C4	447	20.0	70	0	--	0
C3	448	0.5	100	Trace	100	Trace
C2	449	1.0	100	0	--	Trace
C1	450	38.0	90	0.5	100	0
B3	451	6.0	50	0.5	100	0
B2	452	1.5	90	0	--	0
B1	453	1.0	100	0	--	0
Cruise 19 Jan. 16						
PH	472	6.5	60	8.0	90	Trace
CE	473	9.5	60	22.5	95	Trace
C	474	1.0	50	Trace	100	Trace
A4	475	3.0	100	0	--	0
A3	476	8.0	90	0.5	100	0
W	477	1.0	60	3.0	100	0
A1	478	5.0	100	1.0	100	0
B1	479	0.5	70	0	--	0
B2	480	2.5	90	0	--	0
B3	481	5.5	90	0	--	0.5
Cruise 20 Jan. 19						
PH	489	5.5	80	9.0	100	Trace
CE	490	4.5	80	22.0	100	1.0
C	491	1.0	70	Trace	100	Trace

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 20 (continued)						
MGE	492	14.5	85	Trace	100	0
C5	493	26.0	70	0	--	0
C4	494	30.0	70	Trace	100	0
MGW	495	7.0	70	0	--	0
C3	496	1.0	90	3.0	100	0
C2	497	Trace	90	0	--	0
C1	498	42.5	90	Trace	100	1.0
Cruise 23 Jan. 26						
PH	558	9.5	80	27.0	80	Trace
CE	559	3.0	40	Trace	100	Trace
C	560	1.0	50	Trace	100	Trace
Cruise 24 Jan. 27						
A4	571	0.5	95	0	--	0
A3	572	5.0	90	0	--	0
B1	573	Trace	70	0	--	0
B2	574	3.5	60	0	--	0
B3	575	12.0	50	2.5	100	0
C5	576	17.0	70	0	--	0
C4	577	38.0	80	0	--	0
C3	578	7.5	60	0	--	0
C2	579	1.5	80	0	--	0
C1	580	40.0	80	1.0	100	1.5
MGE	581	17.0	85	0	--	0
MGW	582	9.5	85	0	--	0
W	583	3.5	70	0	--	0
A1	584	8.5	100	2.5	100	0
PH	588	3.0	70	4.5	100	2.0
CE	589	Trace	100	0	--	0
C	590	3.0	40	0	--	0
Cruise 27 Feb. 23						
PH	690	4.0	40	3.0	100	0
CE	691	1.0	30	0	--	0

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 27 (continued)						
C	692	1.0	10	0	--	0
A3	693	2.0	50	0	--	0
B1	694	Trace	100	0	--	0
B2	695	3.0	70	0	--	0
B3	696	6.0	85	0	--	0
C5	697	41.0	90	Trace	100	0
MGE	698	43.0	90	Trace	100	0
C4	699	42.0	90	0	--	0
C3	700	7.0	95	0	--	0
C2	701	2.5	90	0	--	0
C1	702	30.0	90	0	--	0
A1	703	21.0	90	1.0	100	1.0
W	704	2.0	90	0	--	0
Cruise 28 Feb. 24						
PH	723	8.0	60	44.0	40	Trace
CE	724	6.0	50	1.0	80	1.0
C	725	1.0	60	Trace	100	Trace
MGE	726	18.0	90	0	--	Trace
MGE	727	29.0	90	Trace	100	0
C5	728	23.0	80	0	--	0
C4	729	33.0	85	Trace	100	Trace
C3	730	1.0	80	0	--	0
C2	731	Trace	80	0	--	0
C1	732	43.5	80	Trace	100	0
B1	733	1.0	70	0	--	0
B2	734	8.5	80	1.5	100	0
B3	735	16.0	80	2.5	100	0
A4	736	4.0	70	0	--	0
A3	737	3.5	70	0	--	0
W	738	14.0	70	0	--	0
Cruise 30 Mar. 16						
PH	778	1.3	95	Trace	100	0
CE	779	8.5	60	4.5	60	0
C	780	2.0	85	0	--	0
MGE	781	7.5	95	0	--	0

Place*	Drag #	Hydroid	% live	Bryozoan	% live	Other
Cruise 30 (continued)						
MGW	782	10.5	85	0	--	0
C5	783	20.0	90	Trace	100	0
C4	784	25.0	85	0	--	0
C3	785	1.5	90	0	--	0
C2	786	11.0	85	0	--	0
C1	787	26.5	90	Trace	100	Trace
B1	788	1.0	50	0	--	0
B2	789	2.5	90	0	--	0
B3	790	2.0	90	0	--	0
B4	791	Trace	100	0	--	0
A4	792	1.2	60	0	--	0
A3	793	15.5	80	0	--	0
W	794	3.0	85	0	--	0
A1	795	2.0	85	0	--	0
Cruise 31 Mar. 18						
WB	796	1.0	90	0.2	100	0.5
WB4	797	5.0	55	5.0	100	0
WB2	798	8.0	90	Trace	100	0
SP	799	0	--	0	--	0
JR4	800	1.5	90	0	--	0
JR3	801	1.0	80	0	--	0
JR2	802	10.0	80	0	--	0
JR1	803	2.0	80	0	--	0
NP2	804	1.5	90	0	--	0
NP1	805	13.5	90	Trace	100	2.0

*Place - See Figure 1 for location.

Drag # - Sequential number given for each sample taken during study.

Hydroid - Wet weight of hydroids in Kilograms (one Kg is equivalent to a gallon of hydroids and weighs 2.2 pounds).

% live - is the percentage of hydroids that were alive when collected.

Bryozoans - wet weight of bryozoans in Kg.

% live - is the percentage of bryozoans that were alive when collected.

Other - is the combined wet weight of all other potential fouling organisms collected. Usually consisted of sponges and red algae.