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TIDAL CURRENT ATLAS FOR LONG ISLAND SOUND AND SAN FRANCISCO BAY--ETC(U)

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TIDAL CURRENT ATLAS FOR LONG ISLAND SOUND AND SAN FRANCISCO BAY

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ABSTRACT

A computerized Tidal Current Model for Long Island Sound and San Francisco Bay has been developed by the Coast Guard Oceanographic Unit. The model is a digitized version of the National Ocean Survey's Tidal Current Tables and the Tidal Current Charts for Long Island Sound and Block Island Sound and San Francisco Bay. Tests were conducted to verify the accuracy of these sources of Tidal Current information using a drift pole survey of surface currents for Long Island Sound published by the Coast and Geodetic Survey and The Army Corp of Engineers Hydraulic Model Bay and Delta Model for San Francisco. The Long Island Sound test showed complete agreement between the model and observations 83.2% of the time, and 100% agreement at 40% of the positions tested. The San Francisco Bay test showed under prediction of speeds by 0.5 to 1.0 knots in 3 of 4 regions and over prediction by 0.6 knots in the 4th region. The predicted directions were deflected to the right of the observed directions 75% of the time by $49.15 - 66.11^\circ$. These comparisons indicate that the data for Long Island Sound is reliable and that for San Francisco Bay should be used with caution.

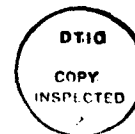


TABLE OF CONTENTS

	Page
Title Page.....	i
Abstract.....	ii
Table of Contents.....	iii
List of Illustrations.....	iv
List of Tables.....	v
Introduction.....	1
System Description.....	2
Special Features of Long Island Sound.....	4
Verification of the Long Island Sound Program.....	6
Discussion of the Long Island Sound Program.....	9
Conclusion on the Long Island Sound Program.....	9
Special Features of San Francisco Bay.....	11
Verification of the San Francisco Bay Program.....	13
Comparative Method.....	13
Discussion.....	28
Conclusions.....	29
Appendix I.....	31
Appendix II.....	35
Appendix III.....	38
Appendix IV.....	49

LIST OF ILLUSTRATIONS

	Page
Figure 1a. The currents (in knots) for an example station from LITSF and Lalachur and Sammons (1932).....	10
Figure 1b. The directions of the currents from LITSF and Lalachur and Sammons (1932).....	10
Figure 2. Overall view of San Francisco Bay.....	14
Figure 3a. Northern San Francisco Bay and San Pablo Bay LITSF grid and test stations.....	15
Figure 3b. Southern San Francisco Bay and San Pablo Bay LITSF grid and test stations.....	16
Figure 4. LITSF and Hydraulic model tidal curves for 10/11 March 1977 at the Golden Gate.....	17
Figure 5. LITSF and Hydraulic model tidal curves for 14/15 May 1977 at the Golden Gate.....	18
Figure 6. LITSF and Hydraulic model tidal curves for 16/17 October 1977 at the Golden Gate.....	19

LIST OF TABLES

Table 1a.	Geographical grouping of sampling stations in San Francisco Bay for analysis	20
Table 1b.	Regional values form statistical and general comparison between computerized and hydraulic model of San Francisco Bay. Speed in knots, Direction in degrees.....	21
Table 2.	Statistical and general analysis values for the far regions of Figure 2.	24
Table 3.	Variations in direction in the four regions of Figure 2.	25
Table 4.	Variations of magnitude in the four regions of Figure 2	25
Table 5.	The standard error range for direction in the four regions of Figure 2.	25
Table 6.	Percentage of high and low magnitude values relative to the mean. Percentage of left and right occurrence relative to the mean	26

INTRODUCTION

An automated system for providing tidal current information for *Long Island Sound and San Francisco Bay* has been developed for use in the Coast Guard's Search and Rescue (SAR) planning and in Marine Environmental Protection (MEP) such as forecasting pollutant drift. The system is a digitized version of the National Ocean Survey's tidal current charts for Long Island Sound and San Francisco Bay. The new system is an updated version of the original system developed by Morgan et al. (1974) for Long Island Sound with San Francisco Bay added. The objectives of these systems is to provide tidal current information for use with the Computer Assisted Search Planning (CASP) in a timely manner. The current values generated are the tidal currents and estuarine flow. They do not include currents generated by any other environmental parameters.

Long Island Sound is classified by Swanson (1975) as having a semidiurnal tide with a slight diurnal inequality. The inequality in the range is reflected in the magnitude of the ebb and flood tide currents. In San Francisco Bay there is also a diurnal inequality which is more pronounced than it is in Long Island Sound. This makes for a greater variation in the magnitude of the ebb and flood tides occurring during a single tidal day, 24 hours and 50 minutes. That is to say the flood tides in a given day may have significantly different magnitudes. The same, of course, is true of the ebb tides. This inequality is produced primarily by the lunar declination and is independent of whether the moon is north or south of the equator. The diurnal inequality has a maximum magnitude at approximately 14 days intervals (Defant 1961 and Disney et al. 1925). This diurnal inequality in the magnitude of tidal currents makes long term drift forecasting a very tedious process. It is necessary to update drift forecast positions at intervals of one hour or less and to make multiple runs of the tidal current program to obtain the correct tidal vectors.

The average period for the flood tide in Long Island Sound is 5.9 hours and the average period for the ebb is 6.6 hours based on the month of January 1975. By dividing the flood tide into six equal periods and the

ebb into seven equal periods, a total of thirteen tidal hours of approximately equal length can be produced. These tidal hours are 0.98 and 0.94 solar hours in length for the flood and ebb respectively. As a result the time steps may be treated as equivalent to solar hours.

The flood tide in San Francisco Bay is longer than the ebb tide, 6.71 hours versus 5.71 hours (Disney 1925). Even with this inequality of ebb to flood time the tidal sequences are divided into equal intervals for both sequences. These tidal hours are roughly equivalent to solar hours being 1.12 hours for flood and 0.95 hours for ebb.

SYSTEM DESCRIPTION

The tidal currents are obtained from the National Ocean Survey tidal current charts: San Francisco Bay 6th edition 1973 and Long Island Sound and Block Island Sound 6th edition 1977. These charts are based on direct current measurements with Roberts Current Meters and Richardson Current Meters (Hicks, 1967). The horizontal distribution of the current vectors in these charts is too random to permit the needed precision required in Coast Guard SAR and MEP applications. To overcome this weakness current values were interpolated between known values and a more complete array developed.

The resultant current vector arrays have a horizontal resolution of 2 x 2 nmi. This is 2' of latitude by 3' of longitude in Long Island Sound and 2' of latitude by 2.5' of longitude in most of San Francisco Bay and San Pablo Bay. In the approaches to the Golden Gate and the parts of the Bay near Angel Island, Treasure Island, Yerba Buena Island and Alcatraz Island the horizontal resolution is 1 x 1 nmi or 1' of latitude by 1.25' of longitude.

To use the models an operator needs certain parameters which are used by the computer model to calculate the tidal currents. These input parameters are the local date, time and position. The position is given to the nearest minute for Long Island Sound and the nearest 0.25 minute for San Francisco Bay. The output of the program is the tidal current speed and direction in degrees true and knots plus the tidal cur-

rents at the reference station for the date of occurrence. The Long Island Sound currents are referenced to the Race and the San Francisco Bay currents are referenced to the Golden Gate.

The computer program LITSF, which is used to generate the tidal currents, is a computerized version of (a) the annual Tidal Current Tables published by the National Ocean Survey for the East and West coast and (b) the Tidal Current Charts, also published by the National Ocean Survey. The main part of the program is the National Ocean Survey's Tidal Current Prediction Program which is used to generate the tidal current information in (a). The Tidal Current Charts have been digitized and stored on a disk file in the computer's memory. These files are accessed by a subroutine, SLACK, in the program.

When a date, time, and position of occurrence is fed into the compute, the program uses the date to calculate the tidal current information for the reference station in the Tidal Current Tables. This information is then used by the subroutine SLACK to generate the correct tidal current for the time and place of occurrence. In short the computer is doing the same steps as a man using the two references above in generating a tidal current vector.

A listing of the program, digitized tidal current charts and an explanation of how the charts are digitized are included in Appendix III.

SPECIAL FEATURES OF LONG ISLAND SOUND

The tides in Long Island Sound are co-oscillating tides displaying a mixture of standing wave and progressive wave characteristics. The loss of energy due to bottom friction is such that only a partial reflection of the tidal wave occurs. This is most clearly seen in Long Island Sound in the increased amplitude of the western end of the sound. The primary tidal current and tidal waves enter the eastern end of Long Island Sound through the Race. The tide belatedly enters the Sound from the west by way of New York's Hell Gate. This tends to dampen the flood and ebb currents in the western end of the Sound. As the tide enters Long Island Sound through the Race frictional forces retard its propagation through the area. There are very strong currents in the area of the Race reaching speeds as great as 5.3 knots (272.8 cm/s) during ebb and 4.3 knots (221.3 cm/s) during flood. High water requires an hour to travel or extend from Montauk Point to the Race and three and a half hours to extend into the relatively small Peconic Bays to the south of the Race. The lag from Montauk Point to Throgs Neck is three hours. As a result the flood current begins at the eastern end of the sound and moves progressively westward. The currents at any given point in the Sound reach their maximum midway between slack water times.

The high current speeds in the region of the Race require frequent updating of the position of the drift object to obtain the most accurate tidal current information. For example, a 4.3 knot (215 cm/sec) current will carry a drifting object from one 2 x 2 nmi grid square through a second and into a third in one hour. Therefore, it is necessary to put in a corrected position at thirty minute intervals to insure use of the correct tidal current vector in forecasting the drift of an object.

Another area of interest in SAR/MEP planning is on the south side of Long Island Sound between Northport, 73°20'W and Stony Brook, 73°10'W. In this area there occurs a counter current during most of the flood tide. This counter current flows eastward with speeds of up to 0.5 knots (25.5 cm/s). There is a weak extension of this counter current as far east as Port Jefferson, 73°03'W during the latter stages of the flood

tide. A similar westward flowing counter current forms during ebb tide in the same area. Great care should be taken in establishing the start position for drift forecasting in these areas. If the position is not known with certainty, then alternate start positions should be considered.

VERIFICATION OF THE LONG ISLAND SOUND PROGRAM

The assumption upon which the LITSF program is based is that current vectors obtained from Roberts Current Meters at depths of 10 to 15 m may be used for surface tidal currents. To test the validity of this assumption, the tidal current vectors in the LITSF program for Long Island Sound are compared with surface tidal current vectors obtained by a current pole survey in Long Island Sound (La Lacheur and Sammons 1932). The current poles were 15 ft. (4.6 m) long and weighted at one end so that they floated vertically with 1 ft. (0.3 m) sticking out of the water. The pole is allowed to drift for a time with a line attached to the upper end. The length of line which pays out is taken as equal to the distance the pole had drifted. This is divided by the drift time to determine the speed. The direction is determined by observation from the survey ship. This method gives a vertically integrated measure of the upper 4.3 m of the current, both tidal and estuarine flow.

The accuracy of the direction of drift observation made with current poles is estimated to be $\pm 20^\circ$ and the accuracy in magnitude to be no better than ± 0.2 knots (10 cm/sec). The Roberts Current Meters have a ± 10 cm/sec accuracy in magnitude (Hicks 1967). Agreement between the two measurements is defined as occurring whenever the error bars overlap. That is to say, whenever the direction is within 30° the precision of the measurements does not allow us to identify any real difference. Similarly whenever the speeds were within ± 0.4 knots (20 cm/sec) it was not possible to identify any significant difference in the magnitude of the current. Ten stations were selected for examination. They were selected as areas where one might expect the tidal current program to give poor results. As a result the test sample is not a random sample and should in fact give a worst case evaluation of Long Island Sound. The surface currents recorded by La Lacheur and Sammons (1932) are average currents for a one year period. They are compared to the yearly averages of the currents in the Long Island Sound Program.

Station 1. At Throgs Neck, $41^\circ 54'N$, $73^\circ 40'W$, the speed and direction values were in agreement 100% of

the time. A graphical representation of the magnitudes and directions is given in Figure 1 of this section.

Station 2. This station is located at $40^{\circ}56'N$, $73^{\circ}27'W$ is midway between the northern and southern shores at the western end of the Sound. The speed of the current and the direction of the LITSF program agree with the test observations 100% of the time.

Station 3. This station is located on the southern shore at $40^{\circ}58'N$, $73^{\circ}06'W$. This station is in the area where a back flow was predicted in the LITSF program. The surface observations also show evidence of the back flow. At station 3, however, the observed flood is one hour longer than the flood tide predicted by the LITSF program, and the ebb is one hour shorter. This produces significant differences in the direction for a period equal to $1/4$ of the tidal cycle. If the directions are disregarded, then the magnitude agrees to the precision of the observations. This back flow appears to be the result of bottom and/or sidewall interaction with the flow. It varies with depth and very probably varies significantly in the horizontal as well.

Station 4. This station is located on the southern shore at $40^{\circ}56'N$, $72^{\circ}45'W$. At this station there is also a back flow in the surface, but it is different from that at station 3. That is, the observed surface flood tide is six hours long and the observed ebb is seven hours long. The LITSF program flood is 7 hours long and the ebb is six hours long. As with the observations at station 3 this back flow and temporal variation is probably due to boundary layer effects. The errors in the LITSF program could only be corrected by a detailed current meter project in the area. The magnitude of the currents is in agreement 85% of the time at this station, and if the currents are averaged over the entire tidal cycle they agree to the precision of the measurements. The observed currents are twice as large of the LITSF program currents for 15% of the time, one hour during each ebb tide.

Station 5. This station, located at $41^{\circ}08'N$, $72^{\circ}45'W$ is near the geographical center of Long Island Sound. The magnitude of the observed surface currents and the LITSF program currents are in agreement 100% of the time to the precision of the measurements. There is not, however, a similar agreement in the direction.

The LITSF program currents are 30° to the right of the observed surface currents during the flood tide and 30° to the left during the ebb tide. That is, the LITSF currents were northwest and northeast of the observed surface currents. This was the worst case for directional agreement and the only one with complete disagreement.

Station 6. The observed surface currents and the LITSF currents at this station, $41^\circ 14'N$, $72^\circ 42'W$, agreed in both magnitude and direction 100% of the time.

Station 7. This station is off the mouth of the Connecticut River at $41^\circ 16'N$, $72^\circ 21'W$. The directions agree within the precision of the measurements. The direct observations of the surface currents, however, show that on the surface the current begins to ebb about one hour before it does at the mid-level depth of the current meter used to generate the tidal currents for the LITSF program. Such vertical variations are not uncommon in river channels and at the mouths of rivers. The directions agree to the precision of the measurement, except for the last hour of flood.

Station 8. This station is located midway between the northern and southern shores at the eastern end of Long Island Sound at $41^\circ 04'N$, $72^\circ 15'W$. The observed surface currents and the LITSF program currents agree in magnitude and direction 100% of the time.

Station 9. This station is on the Connecticut shore just west of the mouth of the Thames River at $41^\circ 16'N$, $72^\circ 06'W$. The LITSF program currents agree in direction 85% of the tidal cycle. The magnitude agrees with surface observations throughout the flood tide, but on the ebb tide the LITSF program currents are 180% of the observed values. This overestimation lasts for three hours or approximately 23% of the total tidal cycle. As in the case of station 7 these changes are primarily due to the effects of the river outflow.

Station 10. Station 10 is at the Race, $41^\circ 14'N$, $72^\circ 03'W$. The LITSF program currents agreed in direction 92% of the tidal cycle when compared with surface observations. The LITSF program currents were faster, 110%, than the observed values during the flood. During the ebb currents, the LITSF program currents

were 90% of the observed surface currents. The differences amounted to a half a knot in absolute values on the average.

DISCUSSION

Although this test was designed to give a worst case view of the LITSF program, it showed that complete agreement in speed and direction was observed 83.2% of the time. At 40% of the stations the agreement was 100% of the time. Only one station was off for the entire tidal cycle. That station was 30° off in direction for the entire tidal cycle. Disagreement appears to occur most often near the coast and/or near river mouths. In both cases, the influence of the bottom topography and variable river flow are large. The bottom topographic features such as sand bars are also subject to a relatively slow variation with time. This makes correcting the model for such influences a very difficult process and one of limited value. Because both the LITSF values and the current pole survey are direct current observations, the differences are to some extent a measure of the natural variability in the currents.

CONCLUSIONS

The use of mid level current observations to infer surface currents is apparently a valid assumption. It is recommended that the currents from the National Ocean Survey Tidal Current Charts for Long Island Sound be used.

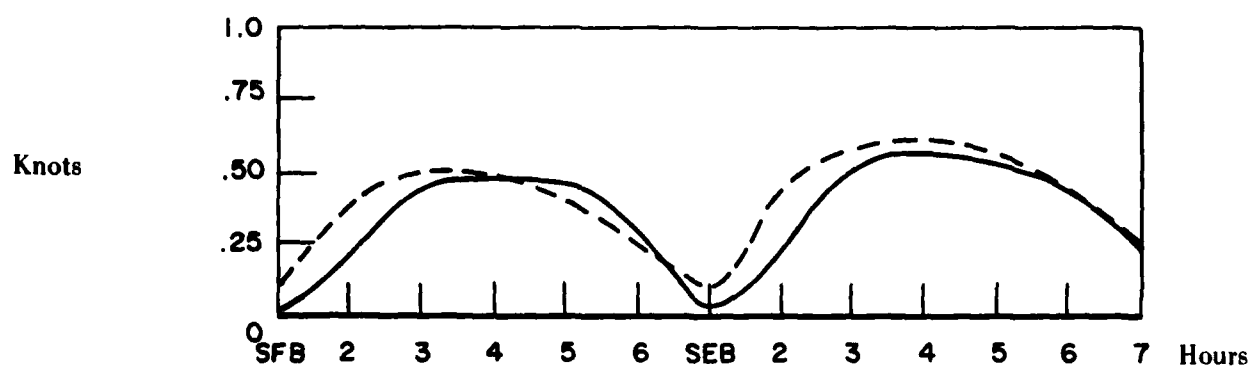


Figure 1a. The currents are given in knots -- La Lacheur and Sammons LITSF currents. SEB - Slack Water Ebb Begins at the Race. SFB - Slack Water Flood Begins at the Race.

	LaLacheur	LITSF
SFB	050	055
2	---	234
3	235	235
4	240	235
5	230	236
6	230	235
SEB	235	060
2	---	058
3	050	058
4	055	055
5	060	055
6	050	063
7	050	063

Figure 1b. The directions are given in degrees true

SPECIAL FEATURES OF SAN FRANCISCO BAY

Although San Francisco Bay is an extensive embayment, it possesses only one entrance located at the Golden Gate region (Figure 2). In addition to this restricted entrance, the bay can be divided into two distinct tidal regimes; a standing and a progressive tidal wave. The Golden Gate and Southern Bay region, contain a tidal scheme similar to a standing wave, as evidenced by simultaneous changes in the tide throughout the area (Disney et. al. 1925). The northern bay region and San Pablo Bay exhibit a progressive wave phenomenon. This occurrence shows up as a progressively later flood or ebb current as one moves north to San Pablo Bay. The time of occurrence of these currents also lags the southern regions' current changes.

In the San Francisco Bay system, friction is the most significant factor modifying the tidal currents. This shows up vividly in the Golden Gate area (bounded by (1) $37^{\circ} 48'N - 122^{\circ} 22.5'W$ (2) $37^{\circ}50'N - 122^{\circ}32.5'W$ (3) $37^{\circ}48'N - 122^{\circ} - 32.3'W$ and (4) $37^{\circ}50'N - 122^{\circ} 22.5'W$) as a very pronounced horizontal current variability. This variability presents itself as a set of eddies formed by lateral friction on the northern and southern shores near the western approach to Golden Gate. These eddies produce near shore counter currents on both the ebb and flood tides. As a result, a drifting object near shore and just seaward of the Golden Gate Bridge may travel westward on a flood tide or into the bay on an ebb tide. This feature makes it extremely important to know the initial position and start time for any SAR case when predicting a drift path.

The duration of flood and ebb tides as well as the magnitude of the currents is also found to be variable within the bay. The flood to ebb duration was found by Disney (1925) to be 6.71 hours to 5.71 hours (1.18:1). This ratio persists throughout most of San Francisco Bay with the exception of San Pablo Bay where the influence of river run off causes a revised ratio. Also, in the northern portion of the Bay and San Pablo Bay, the initial flood current is sub-surface and moves vertically to the surface, while the ebb exhibits the reverse (Disney 1925). The magnitude of the currents through the Bay at times exceeds 2 knots

(102.1 cm/sec). In an area of great horizontal variability, they may be as high as 4 knots (204 cm/sec).

To model the San Francisco Bay current fields with the above noted variability, a flexible grid pattern and set time interval were selected. In areas of high current variability, a small grid square (1 x 1 nautical miles) was utilized, while a larger grid (2 x 2 nautical miles) was set up in the rest of the Bay (Figure 3). Even with the noted inequality of the ebb to flood time, the tidal sequence was divided into equal time intervals. These modeled tidal hours are equivalent to solar hours set at 1.12 hours for the flood and 0.95 hours for ebb. These parameters of grid size and time interval, do however, require that in drift studies the calculated tidal current vector be updated on an hourly basis or less if in an area of high currents.

VERIFICATION OF THE SAN FRANCISCO BAY PROGRAM

To establish the validity of the total current vectors calculated by the San Francisco Bay computer program, comparisons between calculated and measured values were made at fifty one stations in the Bay (Figure 3a and 3b). The measured current values were obtained from the hydraulic tests run on the U.S. Army Corps of Engineers, San Francisco Bay Delta Model, Sausalito, California. These tests were run in May 1978 during a simulation of the 1977 Delta dynamics involving a net river flow (Sacramento and San Joaquin Rivers) of 4700 cubic feet per second (133.09 m³/sec), an ocean salinity of 33.00‰ and a 19 year mean tidal curve as the repetitive forcing function near the mouth of San Francisco Bay. The computerized tidal current vectors utilized in the verification were calculated for three, twenty four hour time periods at the fifty one sampling stations. The time periods were selected so that the computer generated currents would be in two categories: (1) a set in which the tidal height curve near the mouth of the Bay approached the 19 year mean and (2) a set in which the tidal current curve near the mouth of the Bay approached the Delta Model Tidal Current values measured at the Golden Gate Bridge. The first set was obtained from two time periods; 10-11 March and 14-15 May 1977 (Figures 4 and 5) and the second was matched with a period during 16-17 October 1977 (Figure 6).

COMPARATIVE METHOD

The degree of agreement between the observed and calculated tidal currents at the sampling stations was analyzed using portions of the Student-t formula (equation 1, Peterson, 1973) and an hourly comparison of the speed and direction values. Normally, the calculation of the Student-t values for a paired data set would involve the construction of a hypothesis test to determine the probability that the sample means differed by some set value (in this study the value was set at zero in equation 1). However, this course of evaluation would have been inconclusive, because even through the difference in the means approaches

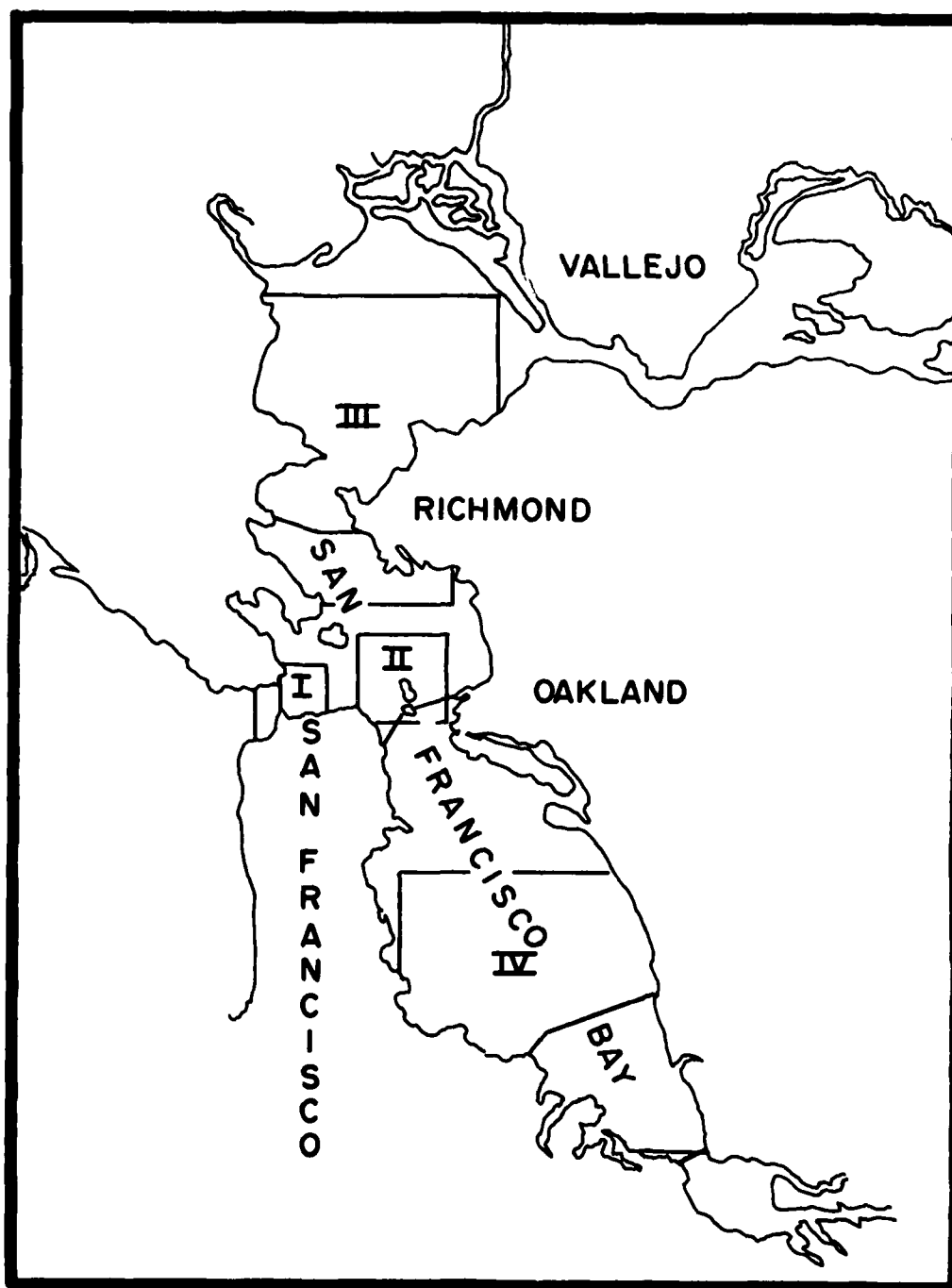


Figure 2. Overall view of San Francisco Bay - Showing complete system. Heavy Double lines denote Hydroulic Model boundries, I, II, III, IV, denotes current station sampling areas.

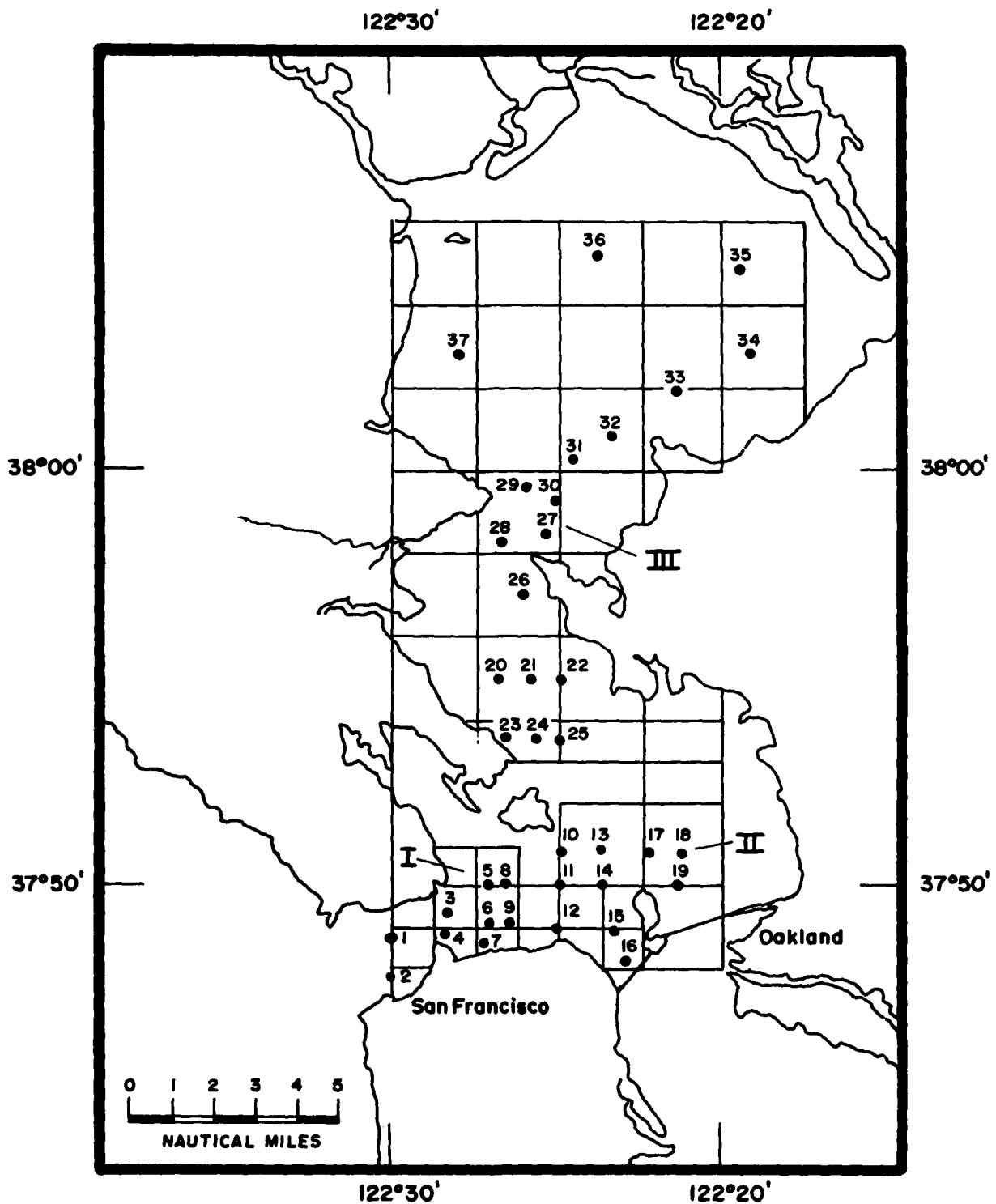


Figure 3a. Northern Section of San Francisco Bay showing partial grid layout of current file and sampling stations 1-37.

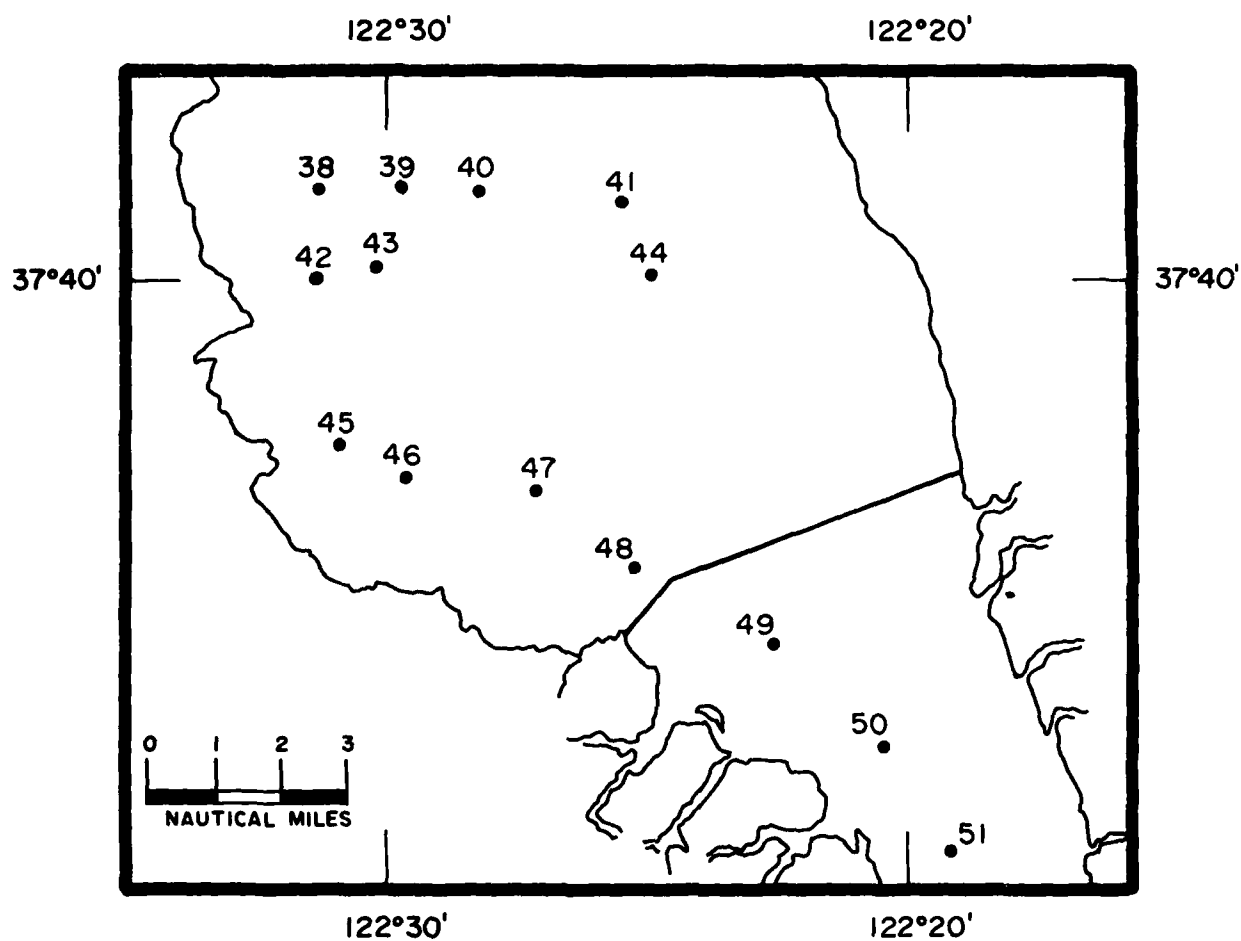


Figure 3b. Southern Section of San Francisco Bay showing partial grid layout of current file and sampling stations 38-51.

ELEVATION (Ft) - PRESIDIO DATUM MLLW - (Mean Lower Low Water)

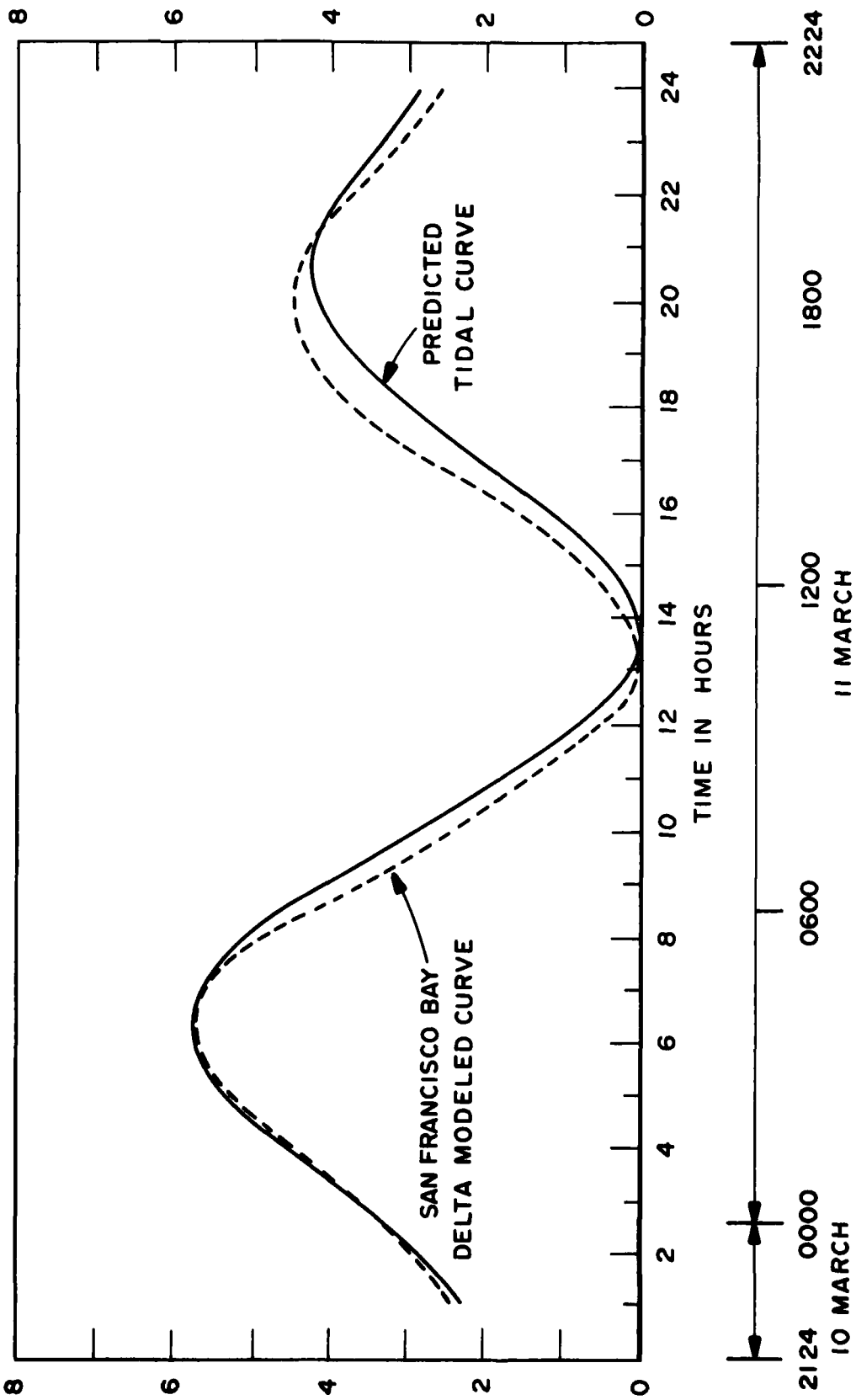


Figure 4. Modeled and predicted tidal height curve at San Francisco's Golden Gate. Modeled curve represents 19 year mean versus predicted curve for period 2124 10 March to 2224 11 March 1977.

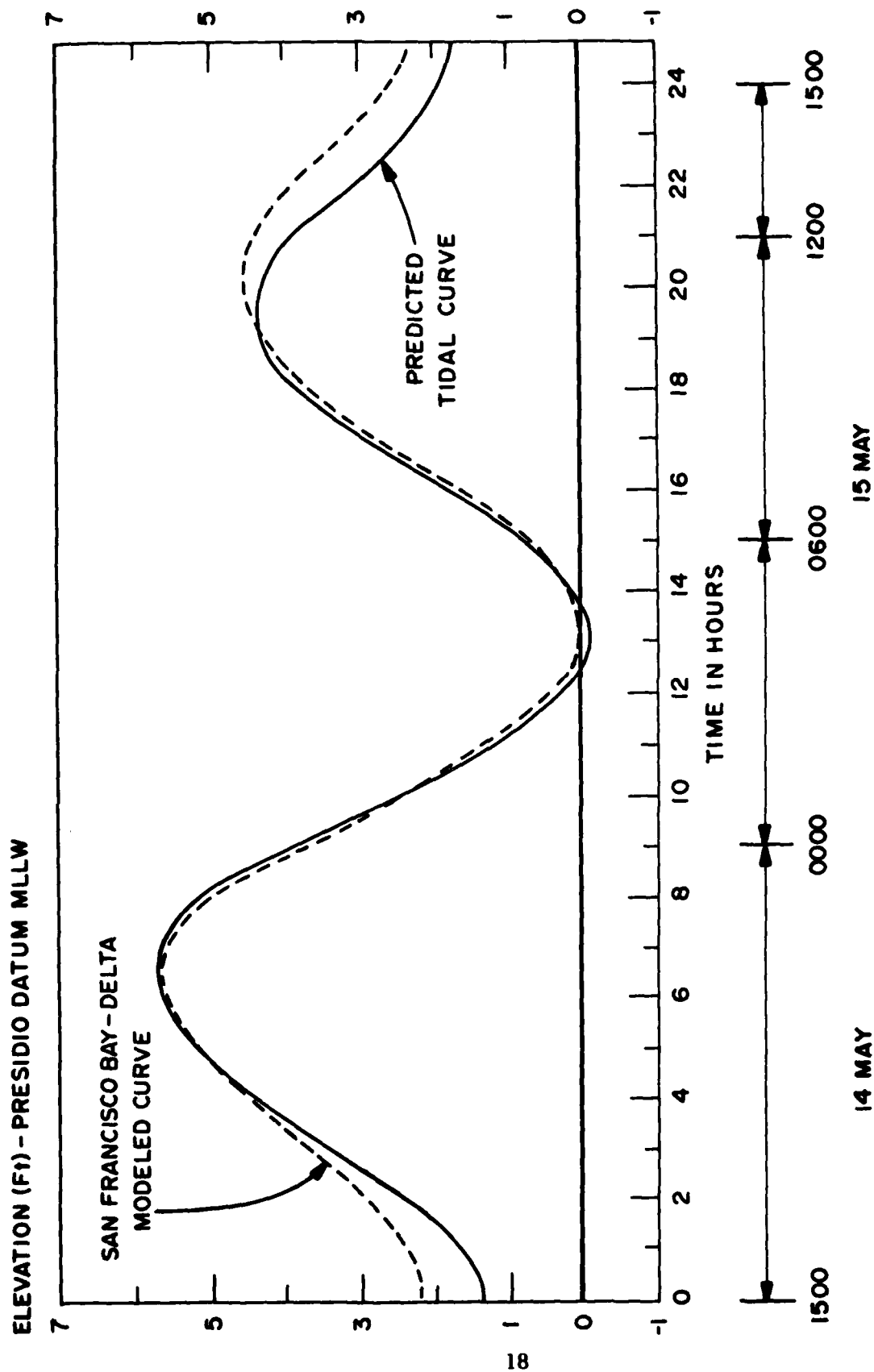


Figure 5. Modeled and predicted tidal height curve at San Francisco's Golden Gate. Modeled curve represents 19 years mean and predicted curve for period 1500 14 May to 1600 15 May 1977.

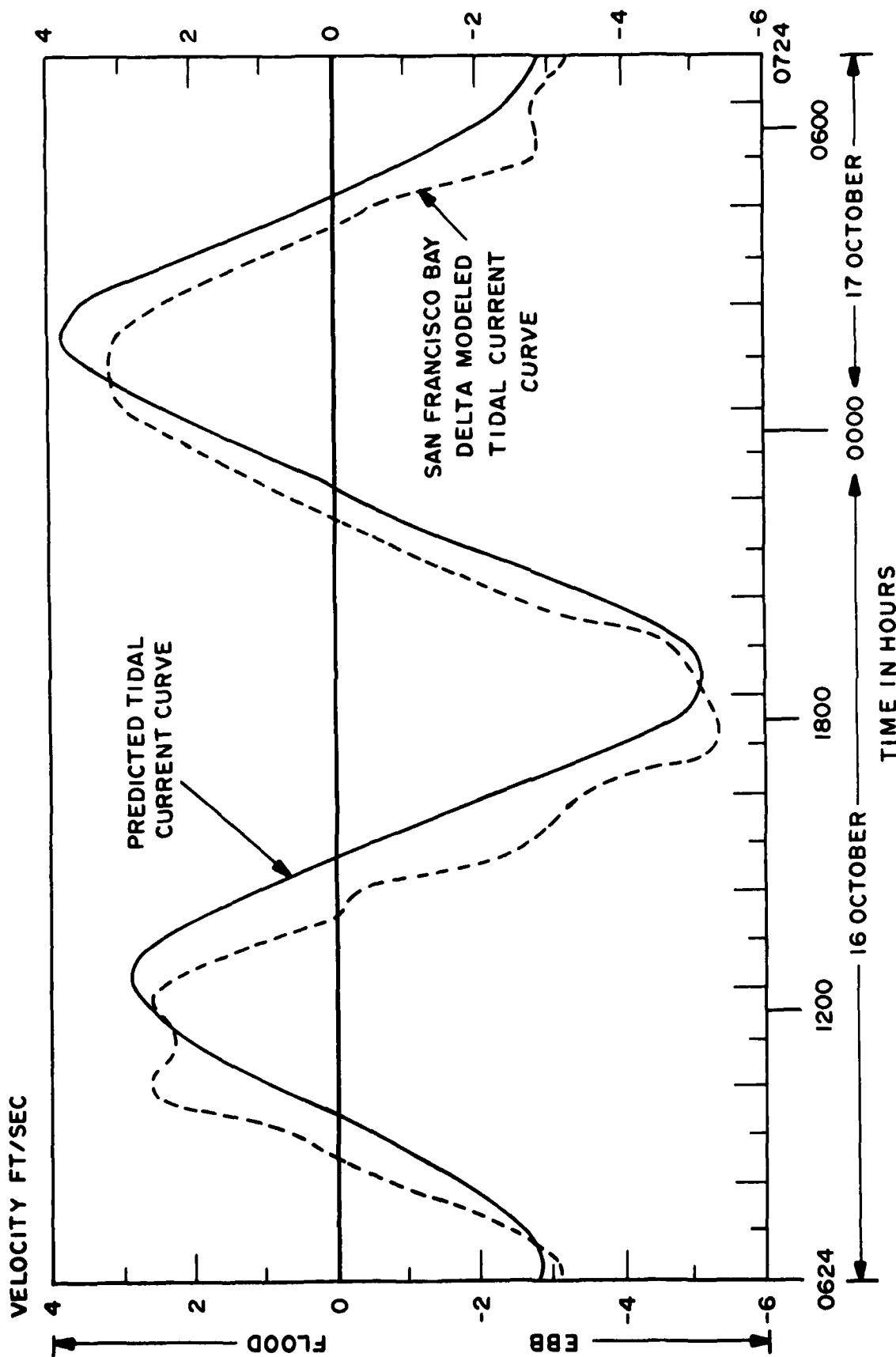


Figure 6. Modeled and predicted tidal current curve at San Francisco's Golden Gate. Modeled curve represents measured values from Delta Bay Hydraulic Model 1977 Delta experiment and predicted curve for period 0624 16 October to 0724 17 October 1977.

The standard deviation (B) was then used to calculate the standard error:

$$C = \sqrt{1 + \frac{1}{n_1 + n_2}} \quad [B] \quad (2)$$

where:

$$\sqrt{1 + \frac{1}{n_1 + n_2}} \quad \text{the adjustment value required when using the standard deviation in the calculations.}$$

(B) = the standard deviation from equation 1

(C) = the standard error.

The non statistical methodology utilized in the hourly comparisons, consisted of determining the number of times per complete tidal cycle that the computer model's speed or direction values were higher/lower or left/right of the hydraulic model values. These values were then computed as a percentage and a mean value for all catagories.

Once all station values both statistical and general, were calculated, these were grouped into four geographical areas (Table 1a; and Figure 2) and a quantitative set of values was determined for the region (Table 1b). The regional set of values consisted of: (1) a mean difference range; (2) the standard error range; (3) percentage range of computer values, high or low, left or right of the hydraulic model; (4) mean percentage of occurrences high/low, or left/right of the hydraulic model and (5) mean value for occurrence high/low or left/right of hydraulic model.

TABLE 1a
Geographical grouping of sampling stations in San Francisco Bay for analysis

STATIONS	BOUNDARIES	GENERAL DESCRIPTION
01-09	37.78° to 37.83°N 122.50° to 122.33°W	Entrance to San Francisco Bay
10-19	37.80° to 37.85°N 122.33° to 122.42°W	Area surrounding Yerba Beuna Islands

TABLE 1b
Regional values from statistical and general comparison between computerized and hydraulic model of San Francisco Bay. Speed in knots, direction in degrees.

STATION	MEAN DIFFERENCE RANGE SPEED DIRECTION (KNS) (°T)	RANGE STANDARD ERROR SPEED DIRECTION (KNS) (°T)	RANGE PERCENTAGE DIFFERENCE (MEAN PERCENTAGE)	COMPUTER VS HYDRAULIC MODEL [MEAN VALUE KNS/°T]	
				RIGHT	LEFT
March 01-09	-.68 to .74	-51.98 to -2.70	.30 to .51	17.60 to 45.20	
				19.88% (49%) [.74]	12.81% (51%) [.88]
10-19	-.15 to .51	-74.11 to 11.70	.12 to .39	24.33 to 27.59	
				08.65% (38%) [.28]	35.92% (62%) [.44]
20-37	-.27 to .36	-32.78 to 110.23	.09 to .38	19.55 to 46.69	
				35.77% (57%) [.27]	23.65% (43%) [.54]
38-51	-.11 to .21	-61.29 to 13.84	.14 to 1.02	20.25 to 28.79	
				31.77% (51%) [.34]	23.69% (46%) [.40]
May 01-09	-.78 to .71	-56.50 to -2.70	.33 to .54	24.96 to 28.71	
				19.81% (46%) [.82]	19.81% (54%) [.86]
10-19	-.15 to .46	-72.96 to 11.94	.06 to .42	24.83 to 29.69	
				19.73% (40%) [.31]	27.81% (60%) [.44]
20-37	-.28 to .37	-32.78 to 10.92	.09 to .43	19.65 to 27.40	
				38.73% (53%) [.58]	27.62% (47%) [.60]
				16.100% (79%) [61.58]	00.84% (21%) [.36.46]
				08.100% (76%) [62.27]	00.92% (24%) [.39.42]
				56.100% (93%) [47.86]	00.44% (07%) [.63.34]
				85.100% (97%) [44.60]	00.15% (03%) [.64.14]
				20.96% (77%) [59.33]	04.80% (23%) [.67.25]
				12.100% (76%) [62.67]	00.88% (24%) [.66.09]
				27.100% (71%) [48.43]	00.73% (29%) [.55.45]

STATION	MEAN DIFFERENCE RANGE SPEED DIRECTION (KNS) (°T)	RANGE STANDARD ERROR SPEED DIRECTION (KNS) (°T)	RANGE PERCENTAGE DIFFERENCE COMPUTER VS HYDRAULIC MODEL [MEAN VALUE KNS/°T]			
			(MEAN PERCENTAGE)		DIRECTION	
			HIGH	LOW	RIGHT	LEFT
38-51	-.15 to .31	-54.06 to 13.84	23.54% (43%) [.46]	46.77% (57%) [.43]	44.100% (90%) [45.95]	00.56% (10%) [-68.39]
October 1-09	-.82 to .87	-50.02 to -7.38	27.69% (50%) [1.18]	31.73% (50%) [1.29]	31.96% (77%) [65.78]	04.69% (23%) [-85.62]
10-19	-.65 to .64	-74.76 to 9.66	27.62% (43%) [.56]	38.73% (57%) [.81]	13.96% (77%) [73.38]	04.87% (23%) [-107.63]
20-37	-.33 to .41	-26.50 to 49.15	46.65% (55%) [.95]	35.54% (45%) [1.0]	31.96% (62%) [51.15]	04.69% (38%) [-108.65]
38-51	-.76 to .32	-50.31 to 47.30	35.38% (51%) [.71]	42.65% (49%) [.79]	32.100% (81%) [50.13]	00.68% (18%) [-91.14]

zero, the shapes of the two curves could be completely different. Therefore, the Student's-t formula (equation 1) was used only to determine a mean difference and a standard error for each set of paired station data. The above noted values for each set of paired station data were determined using the Student's-t statistics evaluation program (comparison of population means) as contained in the library programs of Texas Instruments TI 58/59 programmable calculator (Applied Statistics, 1977). The program involved the use of the bivariate data entry program and a two sample test to calculate the individualized student-t values of each station, the difference of the means and then the standard deviation, which was adjusted to be the standard error. The equations utilized by this TI 58/59 program, as stated by Perterson (1973) are:

$$t = \frac{\bar{X}_1 - \bar{X}_2 - \mu}{\left(\frac{1}{N_1} + \frac{1}{N_2}\right)^{1/2} \underbrace{\left(\frac{\sum x_{1i}^2 - N_1 \bar{X}_1^2 + \sum x_{2i}^2 - N_2 \bar{X}_2^2}{N_1 + N_2} \right)}_B} \quad (1)$$

where:

- t = Student-t value with $n_1 + n_2 - 2$ degrees of freedom
- $\bar{X}_1$ = 24 hour means for the computer generated currents/direction
- $\bar{X}_2$ = 24 hour mean for the hydraulic model currents/direction
- μ = hypothetical mean difference value; set at zero
- N_1 = number of computer model observations
- N_2 = number of hydraulic model observations
- and $n_1 = n_2$
- B = standard deviation
- $\bar{X}_1 - \bar{X}_2$ = difference between the means

STATIONS	BOUNDARIES	GENERAL DESCRIPTION
20-37	37.83° to 38.06°N 122.48° to 122.29°W	Northeastern San Francisco Bay and San Pablo Bay
38-52	37.50° to 37.70°N 122.35° to 122.13°W	Southern San Francisco Bay

RESULTS

The statistical and general analysis values (Table 2) show that the two models differ significantly in the magnitude and direction of the tidal current vectors each produce. The range in the speed and direction mean differences were found to be approximately equal for the months of March and May for speed and all three months for direction, but they differed in magnitude region by region. The observed speed ranges were (largest to smallest range):

TABLE 2
Statistical and general analysis values for the four regions of Figure 2

REGION	MONTHS	VALUE RANGE IN KNOTS
I	All	-.82 to .87
III	March and May	-.28 to .37
	All	-.33 to .41
II	March and May	-.15 to .51
	All	-.65 to .64
IV	March and May	-.15 to .31
	All	-.76 to .32

The relative size of the overall range in the mean direction differences did not coincide with the speed distribution. Rather, the distributions from the largest to the smallest were:

TABLE 3
Variations in direction in the four regions of Figure 2

REGION	MONTHS	VALUE RANGE IN DEGREES
III	All	-32.78 to 110.03
IV	March and May	-61.29 to 13.84
	All	-61.29 to 47.30
II	All	-74.11 to 11.94
I	All	-56.50 to -2.70

To further expand how significant the mean difference values are, an examination of the overall range in the standard error is necessary. This gives some indication as to the agreement between a set of curve shapes and to the overall agreement between the two models. Examining the regions for speed, the greatest to the least range in standard error are:

TABLE 4
Variations of magnitude in the four regions of Figure 2

REGION	RANGE IN KNOTS
II	0.06 to 1.67
IV	0.14 to 1.02
I	0.10 to 0.95
III	0.09 to 0.83

The sequence of the standard error range for direction varied from the speed distributions as follows:

TABLE 5
The standard error range for direction in the four regions of Figure 2

REGION	RANGE IN DEGREES
I	17.60 to 45.20
III	19.55 to 46.69
IV	6.73 to 28.79
II	23.76 to 29.69

Even though these values appear to be small in magnitude, overall 0.09 to 1.02 knots (4.6 to 52.0 cm/sec) for speed and 6.73° to 46.69° for direction, they indicate that a significant disagreement in curve shapes or values exists. To more clearly determine how large the disagreement is between the computerized and the hydraulic model, the curve values were compared on an hour by hour basis. The results of Tables 4 and 5; are further summerized below as an overall percentage of occurrence and a mean value for a specific region to give a clearer picture of agreement/disagreement. These values were found to be:

TABLE 6
Percentage of high and low magnitude values relative to the mean
SPEED (KNOTS)

REGION	HIGH % OF OCCURRENCE	VALUE	LOW % OF OCCURRENCE	VALUE
I	48.33	0.91	51.67	-1.01
II	40.30	0.38	59.70	-0.56
III	55.00	0.60	45.00	-0.71
IV	48.33	0.50	51.67	-0.54

Percentage of left and right occurence relative to the mean
DIRECTION

REGION	RIGHT % OF OCCURRENCE	VALUE	LEFT % OF OCCURRENCE	VALUE
I	77.67	62.23	22.33	-63.11
II	76.33	66.11	23.67	-71.05
III	75.33	49.15	24.67	-75.81
IV	89.33	46.89	10.67	-71.21

It can be seen that speed is under predicted in Regions I, II, and IV over 50% of the time by 0.5 to 1.0 knots (25.5 to 51.479 cm/sec) and over predicted in Region III over 50% of the time by 0.6 knots (30.6 cm/sec). Where as, direction is predicted high or to the right of the observed values over 75% of the time by

values ranging from 49.15° to 66.11° . The speed curves show that the absolute value of the current magnitudes varied from .06 knots to 3.38 knots (3.1 to 172.4 cm/sec). Thus the predicted difference was high 18 to 100% depending on the magnitude of current vector. Since direction is not an increasing magnitude, the sector of agreement/disagreement ranged from 118.10° to 137.16° in width, which far out ways any usefulness.

DISCUSSION

The development of the computerized San Francisco Bay tidal current model was an attempt to create a quick access reference of the tidal current at any point or time in the Bay for application to Search and Rescue drift programs. The statistical and general comparisons of the tidal data produced by the model to the hydraulic model of the Army Corps of Engineers was an attempt to determine if the two data bases were comparable. The Bay hydraulic model was utilized as a reference source to simplify data collection (no ship time or current meters required) and analysis by eliminating any wind drift vectors produced in real world sampling.

The San Francisco Bay Hydraulic Model is driven by a repetitive 19 year mean tidal forcing function at the ocean entrance and comes to equilibrium throughout the Bay after spin-up. This allows for repetitive sampling of data curves, but does not match real world conditions since the real ocean entrance tidal curve is continually being modified by tidal constituents. To overcome part of this problem, the ocean entrance curves were matched for tidal height (March and May) and tidal current speeds (October) and the assumption made that all other geographic locations may approach agreement. However, as seen by Table 1b, this was not the case. This can be seen in the large speed and direction disagreements. Another reason for this nonagreement is felt to be due to the fact that the computerized tidal current charts are based on a 1954 tidal current survey by the National Ocean Survey. Therefore, comparisons of a 1954 survey to 1977 tidal conditions, as modeled by the hydraulic model, should show disagreement. NOS is in the process of resurveying the Bay and plans for completion of field work in 1980.

CONCLUSIONS

The comparison between the data sets of the computerized tidal current model and the hydraulic San Francisco Bay Model revealed that a significant disagreement in speed and direction exists. It is recommended that the National Ocean Survey tidal current chart data be used with caution. The disagreement in the tidal current speed was found to be best represented by the hour by hour analysis, which showed the computer model underpredicting speeds and overpredicting direction. The speed values were underpredicted in magnitude in Regions I, II and IV over 50% of the time by from 0.5 to 1.0 knots (25.5 to 51.0 cm/sec) and overpredicted in Region III over 50% of the time by 0.6 knots (30.6 cm/sec). The underprediction of speed was found to be approximately 18% to 1000% of the magnitude of a current generated by the San Francisco Bay hydraulic model, another indication of significant disagreement. The direction values were predicted high or to the right of an observed value over 75% of the time for all regions by a value between 49.15° to 66.11° . The Coast Guard Oceanographic Unit is planning a field test of the accuracy and utility of the Army Corp of Engineers Hydraulic Model and the National Ocean Survey Tidal Current Charts as sources of tidal current information. Should this field test show the Hydraulic Model to be a superior source of tidal current data a new set of tidal current charts will be generated based on it.

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APPENDIX I

INSTRUCTIONS FOR RUNNING THE PROGRAM

The program LITSF and the current velocity by position grid are generally stored on disk. The following program is required to obtain the tidal current information from the tidal current program for Long Island Sound (See listing at the end of this section).

The first six cards are called the job control cards, utilized by the Coast Guard's CDC 3300 computer. They will remain unchanged for every job run.

Card LITS 1 is the station name and meridian card. It is always the same for Long Island Sound.

Card LITS 2 contains the permanent current indexing parameters and directions for Long Island Sound. These are entered in the following format: Columns. 1-6 Permanent current (PERMC) 3 decimals, Columns 7-8 IND1, Columns 9-10 IND2, Columns 11-12 IND3, Columns 13-14 IND4, Columns 15-16 IND5, Columns 17-18 IND6, Columns 19-22 Flood Direction (NFDIR), Columns 23-26 Ebb Direction (NEDIR). The function of each of the indexing parameters is given in Table 1 at the end of this section. Normally these indexing parameters are never changed.

Cards LITS 3-8 are the station constants which determine the amplitude and phase lag for the reference station. These constants are supplied by the National Ocean Survey Production Division and need not be changed. The constituents are entered in the following format: Columns 1-4 station number, Columns 5-8 station card sequence number, Columns. 9-13 constituent amplitude (3 decimal places), Columns. 14-17 constituent epoch (1 decimal place), Columns 18-71 repetition of Columns 9-17.

Cards LITS 9-23 are the year constant cards. The format is given by Morgan, et al. 1975 is as follow: "Columns 1-4 year-example = 1979, Columns 5-6 year type identifier = 0 for a common year, = 1 for a leap year, Columns 7-8 year card sequence number, Columns 9-12 Node factor (f) for the first constituent, Columns 13-16 Greenwich V + u for the first constituent (0h, Jan. 1), Columns 17-72 repetitions of columns

9-16. Each year the node factor (f) and equilibrium argument ($V + u$) must be added for the following twenty six constants: $M_2, S_2, N_2, K_1, M_4, O_1, M_6, (MK)_3, S_4, (MN)_4, \nu_2, S_6, \mu_2(2N)_2, (00)_1, \lambda_2 S_1, M_1, J_1, Mm, Ssa, Sa, MSf, Mf, \rho, Q_1, T_2, R_2, (2Q)_1, P_1, (2SM)_2, M_3, L_2, (2MK)_3, M_8$ and $(MS)_4$. These constituents are found in (Schureman 1958).

Card LITS 24 is the Date Control Card which is the first card which the user must supply. This card is to have the following format: Columns 1-2 month number, Columns 3-4 beginning day, Columns 5-6 ending day, Columns 7-72 repetition of the above as needed. The maximum period for a single calculation is 32 days. If the desired time periods are not consecutive, use individual date control cards in separate computer runs.

Card 25 is the Termination Control Card. This card determines if the tides will be calculated for one or more than one reference station or time. It has the following format: Columns 1-4 (MS) = 0. The new problem is for the same station; = 1. The new problem is for a different station, Columns 5-8 (MY) = 0. The new problem is for the same year; = 1. The new problem is for a different year, Columns 9-12 (MD) = 0. The new problem is for the same day; = 1. The new problem is for a different day. The job is terminated if all three cards are zero. This is the format which is always used in calculating tidal currents.

Card LITS 26 this card may be used to call for a listing of the tidal currents at the reference station for the period given in the Date Control Card. If this is desired a 1 is entered in column 1. If not a 0 is entered in column 1. When using the model to calculate tidal currents a 0 is entered in the column.

Cards 26-29 are repeated for each additional time or position for which a tidal vector is needed.

Cards LITS 30 is the last Month List card it is always blank.

Card LITS 31 is the final Day Count and Station I.D. card.

Card LITS 32 is the last position card. A latitude of 99 is entered in columns one and two. This signals the end of the input data cards.

The last two cards in the deck are the job termination control cards used in the Coast Guard's CDC 3300, they never change.

\$JOB.GCOMT622.19995CSE.5.500
 \$SCHED.CORE=60.TIME=1,CLASS=C,441=1(16),SCH=1
 \$*DEF(0.,LITS,WKLYTMPF,LITS.01,CGOU,I)
 \$*DEF(0.,1,WKLYTMPF,LITD,01,CGOU,I)
 \$MAP=N
 \$COMP.LITS
 1 THE RACE, N.Y. T.M. 75 W.
 -00250 1 1 3 0 0 0 295 100
 5781 1030822485005232584007432228002010304000521228001170631
 5781 2 001442263 000491971
 5781 3 000222531
 5781 4 000230795000312586
 5781 5 000670309 000862742 001422580
 5781 6000681495
 1977 1103510181000000010352743 491 14110722036 822 85711103053 9231159
 1977 2100000001072 2111035 25310000000103520281035 968 517126510353582
 1977 310001800 8701986 642198611231825100020111000240510352582 6521104
 1977 4 822 92 82226321000 2010001780 822 807100034951035258210541527
 1977 51179 997 9561894 76320761149 47110351014
 1977 6
 1977 7
 1977 8
 1977 9
 1977 10
 1977 11
 1977 12
 1977 13
 1977 14
 1977 15
 013131020101

2 1
 4116 7147
 0001.02.01.1977

2 1
 4116 7147
 0001.02.03.1977

2 1
 4116 7147
 0001.03.01.1977

1 1
 99
 \$*DEF(C,W.,11)
 11

LITS 27

APPENDIX II

INSTRUCTIONS FOR RUNNING THE MODEL FOR SAN FRANCISCO BAY

The following small program is required to run the tidal current model for San Francisco Bay. The listing is identical to the Long Island Sound program for all job control cards, but exhibits necessary changes for program data and instructions.

The first six cards are called the job control cards. They will remain constant for every job run.

Card 1. Selects the reference tidal station and the time meridian longitude. It is always the same for San Francisco Bay.

Card 2. Contains the permanent current indexing parameters and directions for San Francisco Bay. The format used is the same as that used in the program for Long Island Sound (See Instructions For Running The Program For Long Island Sound Section).

Card 3-9. Are the station constants consisting of the amplitude and phase lag for each tidal forcing function at the reference station. The format is the same as that in the program for Long Island Sound.

Cards 9-23. Are the year constant cards. The format for these cards and method of determining these constituents is outlined in the section giving instructions for running the model for Long Island Sound.

Card 24. Is the date control card. Its purpose is to set the month(s), start and stop day that tidal currents are to be computed for. It has the same format as Card 24 for Long Island Sound (See Appendix I).

Card 25. Is the termination control card which is used to separate different reference stations and time controlled calculations. The format for this card is given in the section giving instructions for the running of the program for Long Island Sound.

Card 26. Is the month list card. This card specifies that a listing of the times of slack water maximum ebb and flood for the interval given on the date control card is to be printed. A one in column (1) causes only a listing to be printed. A zero causes the program to calculate the tidal current at the position of

Cards 25 and 26. Are used to consecutively run two or more differing tidal current information request for information at reference stations. They are normally blank when being used in operational work.

Card 27. Is the station ID and Day count card. The format and use of this card is described in Appendix I.

Card 28. Is the position card specifying the geographic position where tidal current information is required. The latitude is given to the nearest minute and the longitude to the nearest 0.25 minute. The format is given in the section on Long Island Sound.

Card 29. Is the date time card. This card inputs the date time group of the occurrence. Its format is given in the section on Long Island Sound.

The set of cards, 26-29. Are repeated for each additional time or position for which a tidal current vector is needed.

Card 30. Is the last month list card and is placed at the end of all series of time and position cards. It is always blank.

Card 31. Is the last day count and station ID card. It is formatted the same as card 27.

Card 32. Is the final position card. A latitude of 99 degrees is always entered in columns 1 and 2. This signals the end of the data end put cards.

The final two cards are the job termination control cards, and are formatted as shown. These two cards like the first six cards are always the same.

1	THE GOLDEN GATE CA	T.M. 122.5 W	LITS	1
-00200	1 1 3 0 0 000650245		LITS	2
6229	1030303060006803060005702830008000420001603380006000360001200920		LITS	3
6229	2	001202950	000602650	LITS 4
6229	3000300410000403110	000300360000500370	0602650	LITS 5
6229	4	000200220001000220001001660	0602650	LITS 6
6229	5000200170002500430	000903290	001903000	LITS 7
6229	6			LITS 8
1979	11036301910000000103630190890006810732438081929691112185709223087			LITS 9
1979	21000000010732438103624441000000010362444103630200512253010361794			LITS 10
1979	31000180013610418083900491124000010002001100028011036058106472480			LITS 11
1979	40819239408192970100000251000177508192940100034991036058110540928			LITS 12
1979	50994130909552370076019421151127510363019			LITS 13
1979	6			LITS 14
1979	7			LITS 15
1979	8			LITS 16
1979	9			LITS 17
1979	10			LITS 18
1979	11			LITS 19
1979	12			LITS 20
1979	13			LITS 21
1979	14			LITS 22
1979	15			LITS 23
082325				

1 2
3749 1222500
0800

1 2
3749 1222500
0900

1 2
3749 1222500
1000

1 2
3749 1222500
1100

1 2
3749 1222500
1200

1 2
3749 1222500
1300

1 2
99

APPENDIX III

PRODUCTION OF THE TIDAL CURRENT FILES

The tidal current files are prepared using tidal current charts from the National Ocean Survey (NOS). The most recent charts should be used in making these files. The charts are available from the National Ocean Survey Office, Rockville, Maryland. The first step is the construction of a grid overlay for the tidal current chart. These are either done using a template or drawn in with pencil so that the lines lie on whole minutes of latitude and longitude.

A grid square measuring approximately 2 x 2 nautical miles has been found to work best. This grid size corresponds to a 2' x 3' along much of the U.S. coast line. A tidal current speed and direction is assigned to each grid square for the entire chart of currents. These values are either based on direction measurements or from interpolation. When an interpolated value is required, the speed and direction of the currents are assumed to change linearly with changes of equal value between each grid square. That is, if there are 5 blank grid squares between two observations, then the change from one block to the next will be 1/5 of the difference between the two observations. The same is true for the directions. An example is given below:

Observed						Observed
2.0 knots	1.8	1.6	1.4	1.2	1.0	0.8
180 T	185	190	195	200	205	210

The current is always assumed to parallel the coast line unless observed to do otherwise. Upon completion of each tidal chart the current values are transferred from the array set up to a computer listing with one computer card for each grid square. The cards have the following format:

Line 1-4. The latitude in degrees and minutes for the south east corner of the grid square.

Line 6-9. The longitude in degrees and minutes for the south east corner of the grid square.

Line 11-14. The speed in 10th of knots and direction in 10s of degrees for slack water at the reference station.

Line 16-19. The same as lines 11-14 for one hour after slack water at the reference station.

This sequence may be repeated for each interval of the tide up to 13 times. All multiples of 5 are to be left as blanks.

A program is produced by copying LISND and changing only the five character name to the first five characters in the name of the body of water being modeled.

```

$JOB.GCOMP622.1991745E.1.50
$SCHED.CORE=39,SCH=2,CLASS=H,B4]=1(16)
$*DEF(R,.WKLYTMPF,LISND,01,C600,0001,ALL)
$*DEF(A,.WKLYTMPF,LISND,01,C600,0001,80,1000,...,B41,16)
$*DEF(O,.1,WKLYTMPF,LISND,01,C600,0)
$MAP=N
$FTNU(X)

```

```

PROGRAM LISND
DIMENSION CUR(1000),MDIR(1000)
INTEGER CUR
INTEGER MDIR
N=0
50 READ(60,3) LAD,LAM,LOD,LOM,(CUR(I),MDIR(I),I=1,13),IAR
WRITE(1,3) LAD,LAM,LOD,LOM,(CUR(I),MDIR(I),I=1,13),IAR
3 FORMAT (I2,I2,I3,I2,1X,13(I2,I2,1X),I2)
N=N+1
IF (LOD.EQ. 999) GO TO 200
GO TO 50
200 WRITE (61,250)
250 FORMAT (1H ,*DATA FOR LONG ISLAND SOUND ON DISC*)
WRITE (61,350) N
350 FORMAT (1H ,I5,* CARDS READ*)
STOP
END

```

LISND 1

FINIS

\$X.LGO

4114	7127	0133	0828	0828	0628	0628	0228	0110	0309	0608	1009	0409	0104	0130
4114	7127	0127	0628	0628	0728	0727	0428	0127	0308	0909	1009	0408	0509	0308
4118	7127	0127	0627	0728	0727	0728	0527	0127	0309	0609	0509	0409	0409	0207
4120	7127	0527	0628	0827	0228	0625	0416	0114	0209	0616	0412	0410	0309	0230
4106	7130	0329	1028	1530	1830	0627	0327	0216	0219	1514	0121	0120	0120	0125
4108	7130	0124	0000	0125	0323	0324	0324	0223	0224	0224	0223	0224	0124	0125
4110	7130	0433	0435	0434	0433	0234	0134	0217	0319	0317	0316	0216	0233	0220
4112	7130	0730	0830	0830	0630	0430	0130	0217	0417	0516	0416	0216	0230	0529
4114	7130	0233	0930	1029	0628	0629	0230	0110	0409	0506	1209	0806	0134	0433
4116	7130	0000	0628	1028	0828	0728	0428	0127	0308	1208	1408	0908	0508	0508
4118	7130	0226	0627	0728	0727	0728	0527	0128	0309	0709	0609	0508	0409	0207
4120	7130	0423	0627	0828	0626	0423	0224	0109	0311	0611	0409	0410	0309	0227
4106	7133	1030	2029	1833	1930	1029	0427	0414	1017	2116	1418	0615	0219	0325
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4110	7239	0226	0726	1126	0926	0726	0326	0206	0808	1108	1208	1008	0808	0307
4112	7239	0526	1026	1226	1126	0826	0326	0106	0908	1008	1208	0808	0508	0107
4114	7239	0227	0822	0924	1024	0624	0222	0104	0806	0304	1005	0505	0405	0106
4058	7242	0427	0726	1026	0828	0526	0227	0107	0608	0608	0809	0608	0105	0108
4100	7242	0628	0929	1028	1028	0728	0328	0207	0607	0807	0807	0607	0106	0329
4102	7242	0427	0628	0927	0927	0728	0327	0106	0706	1006	0906	0706	0406	0208
4104	7242	0000	0526	0826	0826	0726	0326	0104	0705	1005	1005	0906	0705	0304
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4114	7242	0127	0530	0829	1028	0530	0229	0111	0811	0312	1012	0412	0412	0111
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4100	7245	0228	0729	0728	0729	0529	0229	0108	0508	0708	0808	0608	0308	0129
4102	7245	0229	0627	0827	0827	0627	0327	0106	0607	0807	0907	0708	0506	0108
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4104	7248	0226	0626	0925	1026	0825	0526	0125	0407	0707	0807	0706	0506	0207
4106	7248	0000	0526	0826	0926	0725	0526	0126	0406	0708	0908	0707	0606	0308
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4108	7251	0000	0426	0726	0827	0726	0427	0125	0406	0708	0807	0707	0506	0307
4110	7251	0127	0426	0726	0627	0626	0228	0107	0406	0608	0706	0608	0407	0207
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4058	7254	0127	0628	0927	1028	0428	0228	0109	0509	0409	0809	0709	0309	0209
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4102	7254	0000	0527	0827	0628	0728	0328	0127	0507	0707	0908	0708	0607	0208
4104	7254	0000	0526	0726	0726	0625	0426	0000	0406	0607	0707	0607	0506	0307

4106	7254	0000	0427	0726	0727	0626	0327	0000	0406	0608	0807	0607	0506	0207
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4106	7257	0000	0427	0728	0727	0627	0327	0000	0406	0607	0707	0606	0506	0206
4108	7257	0127	0427	0728	0728	0628	0328	0000	0406	0607	0706	0606	0406	0206
4110	7257	0126	0327	0526	0426	0426	0226	0107	0406	0507	0606	0406	0306	0106
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4108	7300	0127	0426	1127	0727	0726	0327	0000	0408	0608	0607	0606	0408	0207
4110	7300	0226	0424	0525	0424	0326	0124	0207	0408	0506	0507	0407	0208	0000
4058	7303	0631	0330	0731	1126	0111	0211	0211	0212	0209	0610	0809	0206	0610
4100	7303	0309	0327	0927	1126	0927	0527	0109	0608	0909	1109	1109	1209	0810
4102	7303	0227	0727	1027	1127	0926	0628	0127	0308	0709	0908	0908	0707	0308
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4054	7309	0000	0206	0506	0103	0204	0106	0134	0325	0324	0226	0224	0000	0104
4056	7309	0100	0102	0503	0101	0202	0102	0133	0314	0502	0412	0316	0000	0301
4058	7309	0227	0127	0527	0827	0424	0126	0108	0409	0709	0606	0708	0407	0507
4100	7309	0109	0225	0726	0824	0524	0324	0124	0306	0606	0807	0907	0806	0508
4102	7309	0125	0126	0826	0926	0725	0525	0126	0208	0507	0707	0706	0606	0306
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4102	7312	0105	0125	0626	0724	0624	0524	0224	0107	0405	0506	0505	0405	0206
4104	7312	0227	0627	0926	0927	0826	0627	0325	0000	0406	0506	0406	0306	0106
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4056	7315	0108	0309	0307	0426	0128	0125	0127	0206	0208	0806	0104	0308	0209
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4102	7315	0106	0226	0726	0525	0624	0526	0226	0108	0306	0606	0506	0405	0206
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4104	7321	0130	0430	0524	0631	0625	0723	0123	0304	0505	0604	0407	0104	0214
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4056	7324	0107	0318	1027	1026	1024	0924	0120	0204	0804	1308	0604	1105	0706
4058	7324	0206	0429	1128	1628	1327	0728	0128	0606	1308	1508	1408	1307	0808
4100	7324	0305	0326	0626	0927	0925	0727	0226	0105	0705	1005	1007	0706	0604
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4054	7327	0000	0313	0613	0000	0000	0412	0112	0230	0430	0727	0926	0606	0426
4056	7327	0505	0110	0628	1025	1126	0926	0327	0226	0307	0906	1006	1010	0710
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4100	7327	0526	0525	0925	0926	0825	0626	0424	0125	0706	0908	0508	0408	0125
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4056	7330	0305	0106	0626	1126	1125	0724	0524	0224	0406	0905	1006	0906	0706
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4054	7333	0608	0507	0208	0127	0526	0626	0526	0326	0126	0206	0508	0706	0708
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4058	7333	0408	0108	0426	0726	0826	0726	0526	0225	0106	0608	0908	0907	0708
4054	7336	0206	0000	0524	0724	0722	0521	0324	0127	0305	0406	0606	0605	0506
4056	7336	0207	0000	0626	0926	0824	0725	0424	0125	0406	0704	0805	0706	0504
4058	7336	0209	0112	0232	0530	0731	0630	0425	0131	0206	0606	0611	0809	0710
4052	7339	0706	0111	0318	0320	0322	0421	0323	0219	0100	0405	0204	0504	0202
4054	7339	0205	0000	0224	0424	0423	0423	0324	0000	0205	0506	0606	0505	0405
4056	7339	0304	0000	0625	0825	0825	0725	0426	0125	0403	0704	0804	0704	0504
4054	7342	0105	0125	0524	0625	0624	0424	0224	0000	0306	0406	0407	0406	0206
4056	7342	0106	0124	0524	0427	0228	0233	0000	0000	0103	0408	0506	0408	0308
4054	7345	0504	0105	0105	0204	0124	0224	0000	0000	0000	0000	0306	0206	0105

999

*DEF(C..1)

*DEF(M.W,WKLYTMPF,LISND,01,CGOU,OU01,.....I,999999)

*DEF(R.W,WKLYTMPF,LISND,01,CGOU,OU01,UNUSE0)

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$J09,GCOMP622,199245E,1,50
$SCHFD,CORE=40,TIME=1,CLASS=C,R41=1(16),SCR=2
$*DEF(R,,CGOU-TAM,SANFR,01,CGAS,DP01,ALL)
$*DEF(A,,CGOU-TAM,SANFR,01,CGAS,DP02,R0,1000,...,R41,16)
$*DEF(O,,1,CGOU-TAM,SANFR,01,CGAS,0)
$MAP=N

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$FTNU(X,L)
PROGRAM SANFRAN
DIMENSION CUR(1000),MDIR(1000)
INTEGER CUR
INTEGER MDIR
N=0
50 READ(60,3) LAD,LAM,LOD,LOM,(CUR(I),MDIR(I),I=1,12),IAR
WRITE(1,3) LAD,LAM,LOD,LOM,(CUR(I),MDIR(I),I=1,12),IAR
3 FORMAT (I2,I2,1X,I3,I4,1X,12(I2,I2,1X),5X,I2)
N=N+1
IF (LOD.EQ. 999) GO TO 200
GO TO 50
200 WRITE (61,250)
250 FORMAT (1H,*,DATA FOR SAN FRANCISCO ON DISK FILE*)
WRITE (61,350) N
350 FORMAT (1H,*,I5,*,CARDS READ*)
WRITE(1,4)
4 FORMAT(5X,3H999)
STOP
END
FINIS

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$X.LGO
3730 12205      332 1118 1718 1818 1518 918      32 1032 1832 2032 1732 1032      1
3732 12205      127 318 518 518 418 218      127 227 427 527 427 227      1
3730 122075000332 1109 1709 1809 1509 909      32 1032 1832 2032 1732 1032      1
3732 122075000233 614 914 914 814 514      133 533 933 1033 933 533      1
3734 122075000134 418 618 618 518 318      134 334 634 734 634 334      1
3736 122075000127 218 418 418 318 218      127 227 327 427 327 227      1
3730 12210      100 509 909 909 709 409      100 500 900 1000 800 500      1
3732 12210      332 1114 1714 1814 1514 914      132 1032 1832 2032 1732 1032      1
3734 12210      132 414 614 614 514 314      114 332 632 732 632 332      1
3736 12210      132 314 414 514 414 214      132 232 432 532 432 332      1
3738 12210      132 318 418 518 418 218      132 332 432 532 432 332      1
3740 12210      134 218 418 418 318 218      134 234 434 534 434 234      1
3742 12210      127 218 318 318 318 218      127 227 327 427 327 227      1
3732 122125000100 509 809 909 709 409      100 500 900 1000 800 500      1
3734 122125000331 1113 1713 1813 1613 913      131 1031 1831 2031 1731 1031      1
3736 122125000232 614 914 914 814 514      132 532 932 1032 832 532      1
3738 122125000132 414 614 614 514 314      132 332 632 732 632 332      1
3740 122125000132 314 514 414 314 214      132 332 432 532 332 232      1
3742 122125000127 312 412 512 412 212      127 327 427 527 427 227      1
3734 12215      231 1109 1809 1909 1609 909      131 1031 1631 1831 1631 931      1
3736 12215      232 1114 1714 1914 1614 914      132 1032 1832 1932 1632 932      1
3738 12215      134 1016 1516 1416 1116 616      234 1134 1734 1834 1334 534      1
3740 12215      416 1116 1216 1016 616 116      334 1334 1534 1334 734 134      1
3742 12215      332 614 714 414 114      232 732 832 732 432 132      1
3744 12215      218 418 518 418 318 118      227 527 627 527 327 127      1
3802 12215      2927 1627 227 1105 2005 2305 2005 1205 127 1627 2827 3227      1
3804 12215      2027 1027 127 811 1411 1611 1411 811 127 1027 1827 2127      1
3734 122175000130 509 909 1009 809 509      130 530 830 930 830 530      1
3736 122175000132 1214 1914 2014 1614 814      132 1232 1832 2032 1632 832      1
3738 122175000134 1216 1916 2016 1616 816      234 1234 1834 2034 1634 834      1
3740 122175000216 1116 1616 1816 1416 716      334 1334 1834 1934 1534 734      1
3742 122175000216 1216 1616 1516 1216 716      334 1334 1934 2134 1534 634      1
3744 122175000616 1216 1316 1116 716 116      434 1434 1634 1434 834 134      1
3746 122175000218 318 418 318 218 118      227 327 327 327 227 127      1
3750 122175000127 200 200 100 100 0      127 327 327 327 227 127      1

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3752	122175000127	118	218	218	218	118	127	127	227	327	227	227	1		
3800	122175000827	427	127	400	600	600	400	200	127	527	827	1027	1		
3802	122175002525	1125	107	1207	1807	1907	1607	807	525	1625	2625	2925	1		
3804	122175001228	528	110	610	910	1010	810	410	110	828	1228	1428	1		
3806	122175000227	118	218	218	318	218	118	127	227	327	427	327	1		
3734	12220	0	109	209	209	109	0	100	200	200	200	100	1		
3736	12220	114	414	514	514	414	214	100	200	300	600	500	300	1	
3738	12220	214	916	1016	916	616	216	134	734	1234	1234	834	334	1	
3740	12220	317	1017	1117	1017	717	317	235	835	1335	1335	935	435	1	
3742	12220	818	1218	1818	1718	1318	418	500	1500	1900	1600	1100	600	1	
3744	12220	417	1417	1917	1817	1317	717	535	1735	2135	2135	1735	735	1	
3746	12220	316	1516	2016	1816	1516	1216	434	1534	2134	2234	1634	734	1	
3748	12220	818	1918	2018	1818	1318	518	834	2534	3134	3034	2134	734	1	
3750	12220	409	709	809	609	409	109	327	827	1027	827	527	127	1	
3752	12220	222	204	404	604	604	404	204	222	422	722	622	422	1	
3754	12220	127	118	218	218	218	118	118	127	227	327	227	227	1	
3800	12220	327	127	109	209	309	309	309	109	127	327	427	427	1	
3802	12220	2124	624	306	1206	1706	1706	1306	606	224	1624	2424	2624	1	
3804	12220	222	204	304	404	404	304	204	122	322	522	522	422	1	
3806	12220	220	102	202	302	302	202	102	120	220	320	320	220	1	
3808	12220	118	127	227	227	227	127	127	118	218	218	218	218	1	
3738	122225000118	209	209	209	109	109	100	100	200	200	100	100	100	1	
3740	122225000118	218	218	218	118	118	100	100	200	200	100	100	100	1	
3742	122225000118	218	218	218	118	118	104	104	204	204	104	104	104	1	
3744	122225001316	916	1016	1016	816	116	500	1300	2000	1000	1400	716	1	1	
3746	122225000516	1616	1916	1816	916	116	900	1800	2200	2100	1500	500	1	1	
3748	122225000514	1614	2114	1914	1414	614	732	2132	2932	3032	2532	1232	1	1	
3748	122237500209	1309	1609	1509	1109	409	1030	2030	2530	2430	1830	930	1	1	
3749	122225000514	1314	1414	1314	1114	514	532	1532	2532	2832	1832	532	1	1	
3749	122237500412	1312	1512	1412	1012	312	630	1630	2430	2630	1730	630	1	1	
3750	122225000622	604	1104	1204	1104	604	632	1222	1522	1622	1322	922	1	1	
3752	122225000418	300	700	1000	1000	700	400	418	1218	1418	1218	818	1	1	
3754	122225001613	327	727	1027	1027	727	427	413	1213	1713	1613	1213	1	1	
3758	122225000327	127	200	300	300	300	200	100	327	427	427	427	1	1	
3800	122225002122	622	504	1304	1604	1504	1104	404	522	1722	2422	2622	1	1	
3802	122225000420	302	702	802	802	602	302	120	720	1020	1020	820	1	1	
3804	122225000418	400	800	900	800	700	400	118	818	1018	1018	818	1	1	
3806	122225000418	400	800	900	800	700	400	118	818	1018	1018	818	1	1	
3808	122225000418	0	0	0	0	0	0	118	818	1018	1018	818	1	1	
3748	12225	309	1109	1309	1109	709	327	1027	2127	2427	2227	1627	727	1	1
3748	122262500209	909	909	609	309	427	1527	2327	2527	2327	1527	727	1	1	
3749	12225	309	1309	1609	1509	1109	409	1027	2127	2427	2227	1727	727	1	1
3749	122262500226	1508	2608	2908	2608	1708	526	2126	3226	3726	3126	1826	1	1	
3750	12225	726	508	908	808	608	308	533	1726	2326	2626	2326	1726	1	1
3750	122262500323	505	905	805	605	305	533	1623	2323	2323	2023	1423	1	1	
3751	12225	227	309	409	409	309	109	227	427	627	727	627	327	1	1
3751	122262500103	1203	1903	2203	2003	1303	121	1021	1721	2021	1721	921	1	1	
3752	12225	518	1004	1204	1204	904	404	418	1418	2118	2518	2318	1818	1	1
3754	12225	618	600	1400	1800	1700	800	800	218	1218	1818	1718	1318	1	1
3756	12225	718	200	1200	1800	2000	1600	900	218	1518	1818	2018	1718	1	1
3758	12225	2019	103	1203	2103	2303	2003	1203	219	1919	3119	3419	3019	1	1
3800	12225	620	502	1102	1402	1602	1502	802	320	1520	2020	2020	1820	1	1
3802	12225	620	502	1102	1402	1602	1502	802	320	1520	2020	2020	1820	1	1
3804	12225	315	533	833	933	833	733	433	315	915	915	915	815	1	1
3806	12225	209	227	427	527	427	327	227	109	309	509	509	409	1	1
3747	122287501300	700	300	427	827	1327	1327	1127	627	100	1400	1500	1	1	
3748	122275000209	909	909	609	309	327	1627	2327	2527	2327	1627	727	1	1	
3748	122287501024	1506	2806	3306	3006	1906	124	1624	3724	4524	4124	2724	1	1	
3749	122275000508	2208	3008	3108	2508	1508	126	1026	1526	1426	1126	526	1	1	
3749	122287500509	2209	3009	3109	2509	1409	124	1024	1524	1424	1124	524	1	1	
3750	122275000306	1506	2206	2606	2206	1306	124	1024	1624	1624	1324	1024	1	1	
3751	122275000135	435	435	435	235	135	119	419	519	519	319	119	1	1	
3751	122287500100	100	100	100	100	100	109	109	109	109	109	109	1	1	
3752	122275000033	33	33	33	33	33	118	218	218	218	218	118	1	1	
3754	122275001009	100	800	900	700	300	809	2009	2109	1909	1509	1409	1	1	
3756	122275001218	100	800	1200	1200	1000	500	218	1218	1818	2118	1618	1	1	

3758	122275000318	104	304	404	404	304	204	118	318	518	618	518	1
3800	122275000415	527	827	1027	1127	1027	627	315	1015	1315	1315	1015	1
3802	122275000415	527	827	1027	1127	1027	627	315	1015	1315	1315	1015	1
3804	122275000118	200	400	500	400	300	200	118	418	418	418	318	1
3806	122275000409	27	27	27	27	27	27	209	709	1009	1109	609	1
3744	12230	400	900	1000	900	600	100	418	1118	1318	1218	818	1
3746	12230	400	700	1000	900	600	100	422	1122	1322	1222	822	1
3748	12230	822	1404	2604	3104	2804	1704	122	1522	3522	4322	3922	1
3748	122312500822	1404	2604	3104	2804	1704	122	1522	3522	4322	3922	2522	1
3749	12230	709	209	627	1127	1127	1027	827	827	527	209	909	1
3749	122312500712	1612	1812	1812	1412	912	112	727	927	727	527	127	1
3744	122325000423	905	1605	1505	1105	205	423	1323	2023	2023	1723	1123	1
3746	122325000423	1005	1605	1505	1105	205	423	1323	2023	2023	1723	1123	1
3748	122325000427	1409	2209	1709	1309	709	109	827	1027	727	327	127	1
3744	12235	121	803	903	1003	803	603	214	1021	1721	1521	1121	1
3746	12235	121	803	903	1003	803	603	212	1021	1721	1521	1121	1
3748	12235	121	803	903	1003	803	503	212	1021	1721	1521	1121	1

999

\$*DEF (C.,1)

\$*DEF (M.,W.,CGOU-TAM,SANFR,01,CGAS,DP02,.....,I,999999)

\$*DEF (R.,CGOU-TAM,SANFR,01,CGAS,DP02,UNUSED)

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APPENDIX IV
LISTING OF LITSF

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$JNH,GCOMP622,1991RFSE,3,1000
$SCHFD,CORE=40,SCH=9,TIMF=3,CLASS=C,H41=1(16)
$*DEF(R,W,CGOU-TAM,LITSF,01,CGAS,DP02,ALL)
$*DEF(A,,CGOU-TAM,LITSF,01,CGAS,DP02,1280,400,...,H41,16)
$*OFF(0,W,LITS,CGOU-TAM,LITSF,01,CGAS,0)
$M&P=N
$FTNU(X=LITS,L)
PROGRAM TIDALCUR
DIMENSION A(37),AMP(37),EPOC(37),XODE(114),VPU(114),MO(13),SP(37),LTSF
1NRDAY(13),NEDAY(13),XCOS(1025),SP0(37),ARG(37),TABHR(24),AKU(55),LTSF
2ANG(37),KDAY(32),STORX(816),EXTIM(780),JXTIM(260),VEL(260),S(37),LTSF
3EPOCH(37),AMPA(37),JJXTI(16),JSTIM(260),LTSF
4IYR(15),NUM(15),ISTA(6),NU(6),JJSTI(10),XVEL(10)LTSF
COMMON YVEL(10),JJJST(10)LTSF
DATA TABHR/
1 4320., 5064., 5808., 6528., 7272., 7992., 8720., 9416.,LTSF
2 2160., 2880., 3624., 4344., 5088., 5832., 6552., 7296., 8016.,LTSF
DATA AKU/
1 7.9, 7.9, 8.0, 8.0, 8.0, 8.1, 8.1, 8.1, 8.2, 8.2, 8.2, 8.3, 8.3,LTSF
2 8.4, 8.4, 8.4, 8.5, 8.5, 8.5, 8.6, 8.6, 8.7, 8.7, 8.7, 8.8, 8.8,LTSF
3 8.8, 8.9, 8.9, 9.0, 9.0, 9.0, 9.1, 9.1, 9.2, 9.2, 9.2, 9.3, 9.3,LTSF
4 9.3, 9.4, 9.4, 9.4, 9.5, 9.5, 9.5, 9.6/LTSF
DATA A/
1 15.0410686, 57.9682084, 13.9430356, 86.9523127, 44.0251729,LTSF
2 60.0000000, 57.4238337, 28.5125831, 90.0000000, 27.9682084,LTSF
3 27.8953548, 16.1391017, 29.4556253, 15.0000000, 14.4966939,LTSF
4 15.5854433, 0.5443747, 0.0821373, 0.0410686, 1.0158958,LTSF
5 1.0980331, 13.4715145, 13.3986609, 29.9589333, 30.0410667,LTSF
6 12.8542862, 14.9589314, 31.0158958, 43.4761563, 29.5284789,LTSF
7 42.9271398, 30.0821373, 115.9364169, 58.9841042/LTSF
NNDAY=0LTSF
C DEVELOP COSINE TABLELTSF
H=.00153398LTSF
R=2.0-H*HLTSF
MART=64LTSF
NART=0LTSF
DO 35 I=1,16LTSF
NART1=NART+1LTSF
NART2=NART+2LTSF
PART=NARTLTSF
PHIA=PART*HLTSF
PHIH=PHIA+HLTSF
XCOS(NART1)=COS(PHIA)LTSF
XCOS(NART2)=COS(PHIH)LTSF
MART1=MART-1LTSF
DO 30 J=NART2,MART1LTSF
XCOS(J+1)=H*XCOS(J)-XCOS(J-1)LTSF
30 CONTINUELTSF
NART=MARTLTSF
MART=MART+64LTSF
35 CONTINUELTSF
XCOS(1025)=0.0LTSF
MS=1LTSF
MY=1LTSF
MO=1LTSF
CON=1024./90.LTSF
DO 90 J=1,37LTSF
A(J)=A(J)*CONLTSF
90 CONTINUELTSF
NCO=0LTSF
95 NSEQ=1LTSF
IF (MS) 120,120,110LTSF
110 READ 550LTSF

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READ 532. PERMO.IND1.IND2.IND3.IND4.IND5.IND6.NFDIR.NEDIR	LTSF	57
READ 531. ISTA(1).NO(1).(AMP(J).EPOC(J).J=1.7).ISTA(2).NO(2).	LTSF	58
1(AMP(J).EPOC(J).J=8.14).ISTA(3).NO(3).(AMP(J).EPOC(J).J=15.21).	LTSF	59
2ISTA(4).NO(4).(AMP(J).EPOC(J).J=22.28).ISTA(5).NO(5).(AMP(J).	LTSF	60
3EPOC(J).J=29.35).ISTA(6).NO(6).(AMP(J).EPOC(J).J=36.37)	LTSF	61
DO 115 L=1.5	LTSF	62
IF (ISTA(L).NE. ISTA(L+1)) GO TO 451	LTSF	63
115 CONTINUE	LTSF	64
ISTA1=ISTA(1)	LTSF	65
DO 114 L=1.6	LTSF	66
IF (NO(L).NE. L) GO TO 450	LTSF	67
114 CONTINUE	LTSF	68
120 IF (MY) 131.131.125	LTSF	69
125 READ 533. IYR(1).LY1.NUM(1).(XODE(J).VPU(J).J=1.8).IYR(2).LY2.	LTSF	70
1NUM(2).(XODE(J).VPU(J).J=9.16).IYR(3).LY3.NUM(3).(XODE(J).VPU(J).	LTSF	71
2J=17.24).IYR(4).LY4.NUM(4).(XODE(J).VPU(J).J=25.32).IYR(5).LY5.	LTSF	72
3NUM(5).(XODE(J).VPU(J).J=33.40).IYR(6).LY6.NUM(6).(XODE(J).VPU(J).LTSF	LTSF	73
4J=41.48).IYR(7).LY7.NUM(7).(XODE(J).VPU(J).J=49.56).IYR(8).LY8.	LTSF	74
5NUM(8).(XODE(J).VPU(J).J=57.64).IYR(9).LY9.NUM(9).(XODE(J).VPU(J).LTSF	LTSF	75
6J=65.72).IYR(10).LY10.NUM(10).(XODE(J).VPU(J).J=73.80).IYR(11).	LTSF	76
7LY11.NUM(11).(XODE(J).VPU(J).J=81.88).IYR(12).LY12.NUM(12).	LTSF	77
8(XODE(J).VPU(J).J=89.96).IYR(13).LY13.NUM(13).(XODE(J).VPU(J).	LTSF	78
9J=97.104).IYR(14).LY14.NUM(14).(XODE(J).VPU(J).J=105.112).IYR(15).LTSF	LTSF	79
1LY15.NUM(15).(XODE(J).VPU(J).J=113.114)	LTSF	80
DO 127 L=1.14	LTSF	81
IF (IYR(L).NE. IYR(L+1)) GO TO 452	LTSF	82
127 CONTINUE	LTSF	83
DO 130 L=1.15	LTSF	84
IF (NUM(L).NE. L) GO TO 453	LTSF	85
130 CONTINUE	LTSF	86
IYR0=MOD(IYR(1).100)	LTSF	87
IYR1=IYR(1)	LTSF	88
131 IF (MO) 160.160.140	LTSF	89
140 READ 534. (MO(J).NHDAY(J).NEDAY(J).J=1.12)	LTSF	90
C SET UP TABLES FOR NO=ZERO CONSTITUENTS	LTSF	91
NHDY=NHDAY(1)		
MO1=MO(1)		
NEDY=NEFDAY(1)		
160 K=0	LTSF	92
DO 180 I=1.37	LTSF	93
IF (AMP(J)) 180.180.170	LTSF	94
170 K=K+1	LTSF	95
AMPA(K)=AMP(J)*XODE(J)	LTSF	96
TEMX=VPU(J)-EPOC(J)	LTSF	97
IF (TEMX.GE. 0.) GO TO 171	LTSF	98
TEMX=TEMX+3*0.	LTSF	99
171 EPOCH(K)=TEMX*CON	LTSF	100
SPD(K)=A(J)	LTSF	101
SP(K)=SPD(K)/10.	LTSF	102
S(K)=SPD(K)/50.	LTSF	103
180 CONTINUE	LTSF	104
NOCON=K	LTSF	105
C OPERATING TABLES NOW STORED AS AMPA(K).EPOCH(K).SPD(K)	LTSF	106
DO 4000 JP=1.12	LTSF	107
IF (MO(JP)) 4005.4005.185	LTSF	108
185 MO(13)=MO(JP)	LTSF	109
NHDAY(13)=NHDAY(JP)	LTSF	110
NEDAY(13)=NEDAY(JP)	LTSF	111
NNEDA=NEDAY(13)+1	LTSF	112
NODAYS=NEDAY(13)-NHDAY(13)+2	LTSF	113
NOHRS=NODAYS*24	LTSF	114
IF (MO(13).NE. 12) GO TO 190	LTSF	115
NOHRS=NOHRS+24	LTSF	116
190 HRS=NOHRS	LTSF	117
C DETERMINE FIRST HOUR OF TIME PERIOD	LTSF	118
IF (LY1) 200.200.210	LTSF	119

200 K=MO(13)	LTSF 120
GO TO 215	LTSF 121
210 K=MO(13)+12	LTSF 122
215 HDAY=NRDAY(13)	LTSF 123
FIRST=TABHW(K)+HDAY*24.	LTSF 124
NFIRST=FIRST	LTSF 125
GO 220 J=1.416	LTSF 126
STORX(J)=0.	LTSF 127
220 CONTINUE	LTSF 128
C CURRENT=PERMC+AMPA(K)*COS(4(K)*T+EPOCH(K))	LTSF 129
KOUNT=0	LTSF 130
KT=0	LTSF 131
DO 340 K=1.NOHRS	LTSF 132
IF (KOUNT.GT. 0) GO TO 240	LTSF 133
KOUNT=1	LTSF 134
231 DO 250 J=1.NOCN	LTSF 135
ARGU=SPD(J)*FIRST+EPOCH(J)	LTSF 136
ARG(J)=AMOD(ARGU,4096.)	LTSF 137
250 CONTINUE	LTSF 138
GO TO 240	LTSF 139
260 DO 280 J=1.NOCN	LTSF 140
ARG(J)=ARG(J)+SPD(J)	LTSF 141
270 IF (ARG(J).LT. 4096.) GO TO 240	LTSF 142
ARG(J)=ARG(J)-4096.	LTSF 143
GO TO 270	LTSF 144
280 CONTINUE	LTSF 145
290 DO 374 J=1.NOCN	LTSF 146
IF (ARG(J)-1024.) 320,320,300	LTSF 147
300 IF (ARG(J)-2048.) 350,350,310	LTSF 148
310 IF (ARG(J)-3072.) 360,360,330	LTSF 149
320 ARG(J)=ARG(J)	LTSF 150
GO TO 340	LTSF 151
330 ARG(J)=4096.-ARG(J)	LTSF 152
340 NP=ARG(J)+1.5	LTSF 153
STORX(K)=STORX(K)+AMPA(J)*XCOS(NP)	LTSF 154
GO TO 374	LTSF 155
350 ARG(J)=2048.-ARG(J)	LTSF 156
GO TO 370	LTSF 157
360 ARG(J)=ARG(J)-2048.	LTSF 158
370 NP=ARG(J)+1.5	LTSF 159
STORX(K)=STORX(K)-AMPA(J)*XCOS(NP)	LTSF 160
374 CONTINUE	LTSF 161
IF (K.NE. NOHRS) GO TO 340	LTSF 162
IF (KT.EQ. 1) GO TO 374	LTSF 163
FIRST=FIRST+HRS-1.	LTSF 164
KT=1	LTSF 165
CHECK=STORX(K)	LTSF 166
STORX(K)=0.	LTSF 167
GO TO 231	LTSF 168
378 CKSUM=CHECK-STORX(K)	LTSF 169
380 CONTINUE	LTSF 170
IF (IND4.NE. 1) GO TO 395	LTSF 171
DO 385 K=1.NOHRS	LTSF 172
IF (STORX(K)) 381,385,382	LTSF 173
381 NEF=0	LTSF 174
STORX(K)=STORX(K)*(-1.0)	LTSF 175
GO TO 383	LTSF 176
382 NEF=1	LTSF 177
383 STORX(K)=SQRT(STORX(K))	LTSF 178
IF (NEF.EQ. 1) GO TO 385	LTSF 179
STORX(K)=STORX(K)*(-1.0)	LTSF 180
385 CONTINUE	LTSF 181
395 DO 400 K=1.NOHRS	LTSF 182
STORX(K)=STORX(K)+PERMC	LTSF 183
400 CONTINUE	LTSF 184
GO TO (414,401,401).IND1	LTSF 185

401 KDAY(1)=NMDAY(13)	LTSF 186
NODAYS=NODAYS-1	LTSF 187
DO 410 I=2,NODAYS	LTSF 188
KDAY(I)=KDAY(I-1)+1	LTSF 189
410 CONTINUE	LTSF 190
PRINT 550	LTSF 191
PRINT 555, IYP1,MO(13),CKSUM,NFDIR,NEDIW	LTSF 192
PRINT 556	LTSF 193
PRINT 537, (KDAY(I),STORX(24*I-23),STORX(24*I-22),STORX(24*I-21),	LTSF 194
1STORX(24*I-20),STORX(24*I-19),STORX(24*I-18),STORX(24*I-17),	LTSF 195
2STORX(24*I-16),STORX(24*I-15),STORX(24*I-14),STORX(24*I-13),	LTSF 196
3STORX(24*I-12),KDAY(I),STORX(24*I-11),STORX(24*I-10),	LTSF 197
4STORX(24*I-9),STORX(24*I-8),STORX(24*I-7),STORX(24*I-6),	LTSF 198
5STORX(24*I-5),STORX(24*I-4),STORX(24*I-3),STORX(24*I-2),	LTSF 199
6STORX(24*I-1),STORX(24*I),I=1,NODAYS)	LTSF 200
419 IF (IND1.EQ. 3) GO TO 4000	LTSF 201
ITEMS=0	LTSF 202
EXTIM(1)=4000.	LTSF 203
K=1	LTSF 204
NST=1	LTSF 205
NOHRS=NOHPS-1	LTSF 206
IJOB=1	LTSF 207
DO 3000 I=1,NOHRS	LTSF 208
GO TO (1038,1055).IJOB	LTSF 209
1038 GO TO (1039,2576,2621,2681,2691).NST	LTSF 210
1039 TIME=NFIRST*10	LTSF 211
1040 NHR=0	LTSF 212
NWMOA=1	LTSF 213
NARC=1	LTSF 214
GO TO 1060	LTSF 215
1050 TIME=(NFIRST+I-2)*10	LTSF 216
NHR=0	LTSF 217
1055 NARC=1	LTSF 218
1060 STORX=0.	LTSF 219
GO TO (1075,1100).NARC	LTSF 220
1075 DO 1090 J=1,NOCON	LTSF 221
IF (NHR.EQ. 1) GO TO 1076	LTSF 222
ARGU=SP(J)*TIME+EPOCH(J)	LTSF 223
GO TO 1089	LTSF 224
1076 ARGU=S(J)*TIME+EPOCH(J)	LTSF 225
1089 ARG(J)=AMOD(ARGU,4096.)	LTSF 226
1090 CONTINUE	LTSF 227
GO TO 1120	LTSF 228
1100 DO 1110 J=1,NOCON	LTSF 229
IF (NHR.EQ. 1) GO TO 1101	LTSF 230
ARG(J)=ARG(J)+SP(J)	LTSF 231
GO TO 1105	LTSF 232
1101 ARG(J)=ARG(J)+S(J)	LTSF 233
1105 IF (ARG(J).LT. 4096.) GO TO 1110	LTSF 234
ARG(J)=ARG(J)-4096.	LTSF 235
GO TO 1105	LTSF 236
1110 CONTINUE	LTSF 237
1120 DO 1220 J=1,NOCON	LTSF 238
IF (ARG(J)-1024.) 1150,1150,1130	LTSF 239
1130 IF (ARG(J)-2048.) 1180,1180,1140	LTSF 240
1140 IF (ARG(J)-3072.) 1190,1190,1150	LTSF 241
1150 ARG(J)=ARG(J)	LTSF 242
GO TO 1170	LTSF 243
1160 ARG(J)=4096.-ARG(J)	LTSF 244
1170 NP=ARG(J)+1.5	LTSF 245
STORX=STORX+AMPA(J)*XCOS(NP)	LTSF 246
GO TO 1220	LTSF 247
1180 ARG(J)=2048.-ARG(J)	LTSF 248
GO TO 1200	LTSF 249
01190 ARG(J)=ARG(J)-2048.	LTSF 250
1200 NP=ARG(J)+1.5	LTSF 251

STOXR=STOXR-AMPA(I)*XCOS(NP)	LTSF 252
1220 CONTINUE	LTSF 253
IF (INQ4 .NE. 1) GO TO 1225	LTSF 254
IF (STOXR) 1221,1225,1223	LTSF 255
1221 NEF=0	LTSF 256
STOXR=STOXR*(-1.0)	LTSF 257
GO TO 1224	LTSF 258
1223 NEF=1	LTSF 259
1224 STOXR=SQRT(STOXR)	LTSF 260
IF (NEF .EQ. 1) GO TO 1225	LTSF 261
STOXR=STOXR*(-1.0)	LTSF 262
1225 STOXR=STOXR+PERMC	LTSF 263
GO TO (2500,2505,2510,2710,2692,2684,2682,2693,2715).NWH0A	LTSF 264
2500 NWH0A=?	LTSF 265
NARC=?	LTSF 266
P1=STOXR	LTSF 267
GO TO 1060	LTSF 268
2505 NWH0A=3	LTSF 269
P2=STOXR	LTSF 270
GO TO 1060	LTSF 271
2510 P3=STOXR	LTSF 272
IF (P1) 2515,2520,2525	LTSF 273
2515 IF (P2) 2530,2535,2575	LTSF 274
2520 IF (P2) 2545,2550,2544	LTSF 275
2525 IF (P2) 2620,2565,2570	LTSF 276
2530 IF (P1-P2) 2575,2580,2585	LTSF 277
2535 IF (P2-P3) 2543,2595,2595	LTSF 278
2543 TIME=TIME+1.	LTSF 279
2544 JSW=1	LTSF 280
GO TO 2731	LTSF 281
2545 JSW=2	LTSF 282
GO TO 2731	LTSF 283
2550 IF (P3) 2670,2600,2685	LTSF 284
2561 TIME=TIME+1.	LTSF 285
GO TO 2545	LTSF 286
2565 IF (P2-P3) 2605,2605,2561	LTSF 287
2570 IF (P1-P2) 2610,2625,2520	LTSF 288
2575 JSW=1	LTSF 289
NSW=2	LTSF 290
NST=2	LTSF 291
NFOE=1	LTSF 292
2576 IF (STORX(I)) 2577,2630,2630	LTSF 293
2577 IF (STORX(I)-STORX(I+1)) 2999,2640,2640	LTSF 294
2590 IF (P2-P3) 2660,2600,2670	LTSF 295
2585 IF (P2-STORX(I+1)) 2675,2675,2680	LTSF 296
2595 JSW=2	LTSF 297
NSW=2	LTSF 298
2596 TIME=(TIME+1.)*6.-3.	LTSF 299
2597 EXTIM(K)=4000.	LTSF 300
EXTIM(K+3)=4000.	LTSF 301
GO TO 2402	LTSF 302
2600 TIME=TIME+1.	LTSF 303
GO TO 1040	LTSF 304
2605 JSW=1	LTSF 305
NSW=1	LTSF 306
GO TO 2596	LTSF 307
2610 IF (P2-STORX(I+1)) 2690,2695,2695	LTSF 308
2620 JSW=2	LTSF 309
NSW=1	LTSF 310
NST=3	LTSF 311
NFOE=2	LTSF 312
2621 IF (STORX(I)) 2630,2630,2623	LTSF 313
2623 IF (STORX(I)-STORX(I+1)) 2700,2700,2999	LTSF 314
2625 IF (P2-P3) 2645,2600,2705	LTSF 315
2630 NWH0A=4	LTSF 316
GO TO 1050	LTSF 317

2640	NWMOA=5	LTSE	318
	JSW=2	LTSE	319
2641	EXTIM(K)=4000.	LTSE	320
	EXTIM(K+3)=4000.	LTSE	321
2642	IF (MO(13) .NE. 1) GO TO 1050	LTSE	322
	IF (I .NE. 1) GO TO 1050	LTSE	323
	TIME=NFIRST*10	LTSE	324
	NHR=0	LTSE	325
	GO TO 1055	LTSE	326
2660	JSW=3	LTSE	327
	NSW=1	LTSE	328
2661	TIME=NFIRST*60	LTSE	329
	GO TO 2402	LTSE	330
2670	JSW=2	LTSE	331
	NSW=2	LTSE	332
	TIME=NFIRST*60	LTSE	333
	GO TO 2597	LTSE	334
2675	TIME=TIME+2.	LTSE	335
	POINT1=P2	LTSE	336
	JSW=3	LTSE	337
	NSW=1	LTSE	338
	NWMOA=6	LTSE	339
	IJOB=2	LTSE	340
	NHR=0	LTSE	341
	GO TO 3000	LTSE	342
2680	NWMOA=7	LTSE	343
	JSW=3	LTSE	344
	NSW=1	LTSE	345
	NST=4	LTSE	346
2681	IF (STORX(I)-STORX(I+1)) 2642,2642,2999	LTSE	347
2682	NWMOA=6	LTSE	348
2683	POINT1=STORX	LTSE	349
	NARC=2	LTSE	350
	TIME=TIME+1.	LTSE	351
	GO TO 1060	LTSE	352
2684	IF (POINT1-STORX) 2900,2686,2740	LTSE	353
2685	JSW=1	LTSE	354
	NSW=1	LTSE	355
	TIME=NFIRST*60	LTSE	356
	GO TO 2597	LTSE	357
2686	OTIME=TIME	LTSE	358
	TIME=TIME*6.-6.	LTSE	359
	GO TO 2402	LTSE	360
2690	NWMOA=5	LTSE	361
	JSW=4	LTSE	362
	NSW=2	LTSE	363
	NST=5	LTSE	364
2691	IF (STORX(I)-STORX(I+1)) 2999,2642,2642	LTSE	365
2692	NWMOA=8	LTSE	366
	GO TO 2683	LTSE	367
2693	IF (POINT1-STORX) 2740,2686,2900	LTSE	368
2695	TIME=TIME+2.	LTSE	369
	POINT1=P2	LTSE	370
	JSW=4	LTSE	371
	NSW=2	LTSE	372
	NWMOA=8	LTSE	373
	IJOB=2	LTSE	374
	NHR=0	LTSE	375
	GO TO 3000	LTSE	376
2700	NWMOA=7	LTSE	377
	JSW=1	LTSE	378
	GO TO 2641	LTSE	379
2705	JSW=4	LTSE	380
	NSW=2	LTSE	381
	GO TO 2691	LTSE	382
2710	NWMOA=4	LTSE	383

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POINT1=STOXR
NARC=2
TIME=TIME+1.
GO TO 1060
2715 IF (STOXR .EQ. 0.) GO TO 2740
GO TO (2720,2725).NEOF
2720 IF (STOXR .GT. 0.) GO TO 2755
2721 TIME=TIME+1.
POINT1=STOXR
GO TO 1060
2725 IF (STOXR .LT. 0.) GO TO 2755
GO TO 2721
2730 IF (NRR .EQ. 1) GO TO 2735
2731 EXTIM(K)=TIME*6.
GO TO 2995
2735 EXTIM(K)=TIME
GO TO 2995
2740 TIME=TIME+1.
POINT1=STOXR
GO TO 1060
2755 IF (NRR .EQ. 0) GO TO 2760
NRR=0
GO TO 2735
2760 NRR=1
NWHOA=4
TIME=(TIME-1.)*6.
GO TO 1055
2900 OTIME=TIME
TIME=TIME*6.-9.
2902 AM=0.
DO 2980 L=1.7
STOX=7.
IF (L .GT. 1) GO TO 2915
DO 2910 J=1.NOCUN
ARGU=S(J)*TIME+EPOCH(J)
ARG(J)=AMOD(ARGU,4096.)
2910 CONTINUE
GO TO 2930
2915 DO 2925 J=1.NOCUN
ARG(J)=ARG(J)+S(J)
2920 IF (ARG(J) .LT. 4096.) GO TO 2925
ARG(J)=ARG(J)-4096.
GO TO 2920
2925 CONTINUE
2930 DO 2950 J=1.NOCUN
IF (ARG(J) - 1024.) 2935,2935,2932
2932 IF (ARG(J) - 2048.) 2943,2943,2933
2933 IF (ARG(J) - 3072.) 2944,2944,2940
2935 ARG(J)=ARG(J)
GO TO 2941
2940 ARG(J)=4096.-ARG(J)
2941 NP=ARG(J)+1.5
STOX=STOX+AMPA(J)*XCUS(NP)
GO TO 2950
2943 ARG(J)=2048.-ARG(J)
GO TO 2945
2944 ARG(J)=ARG(J)-2048.
2945 NP=ARG(J)+1.5
STOX=STOX-AMPA(J)*XCOS(NP)
2950 CONTINUE
IF (IND4 .NE. 1) GO TO 2955
IF (STOX) 2951,2955,2953
2951 NEF=0
STOX=STOX*(-1.)
2953 NEF=1
GO TO 2954

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2954	STOX=SQRT(STOX)	LTSE	450
	IF (NEF .EQ. 1) GO TO 2955	LTSE	451
	STOX=STOX*(-1.)	LTSE	452
2955	STOX=STOX+PERMC	LTSE	453
	IF (L .EQ. 1) SAVIT=STOX	LTSE	454
	GO TO (2960,2956),NSW	LTSE	455
2956	IF (SAVIT .GE. STOX) GO TO 2960	LTSE	456
	GO TO 2962	LTSE	457
2960	IF (SAVIT .LE. STOX) GO TO 2960	LTSE	458
2962	SAVIT=STOX	LTSE	459
	AM=L-1	LTSE	460
2980	CONTINUE	LTSE	461
	EXTIM(K+1)=TIME+AM	LTSE	462
	EXTIM(K+2)=SAVIT	LTSE	463
	IF (K .EQ. 1) GO TO 2990	LTSE	464
	IF (EXTIM(K+1) .GT. EXTIM(K-2)) GO TO 2990	LTSE	465
	TIME=OTIME+1.	LTSE	466
	POINT1=STOXR	LTSE	467
	GO TO 1055	LTSE	468
2990	K=K+3	LTSE	469
	ITEMS=ITEMS+3	LTSE	470
2995	GO TO (2690,2680,2575,2620),JSW	LTSE	471
2999	IJOB=1	LTSE	472
3000	CONTINUE	LTSE	473
	IF (IND5) 3081,3081,3075	LTSE	474
3075	JITEM=ITEMS-3	LTSE	475
	DO 3080 K=1,JITEM,3	LTSE	476
	IF (EXTIM(K+2) .GE. .05) GO TO 3080	LTSE	477
	IF (EXTIM(K+2) .LE. -.05) GO TO 3080	LTSE	478
	EXTIM(K)=4000.	LTSE	479
	EXTIM(K+3)=4000.	LTSE	480
3080	CONTINUE	LTSE	481
3081	KAY=ITEMS/3	LTSE	482
	J=0	LTSE	483
	DO 3150 K=1,ITEMS,3	LTSE	484
	KL=K	LTSE	485
	J=J+1	LTSE	486
	M=0	LTSE	487
	IF (EXTIM(KL) .NE. 4000.) GO TO 3105	LTSE	488
	JSTIM(J)=4000	LTSE	489
	GO TO 3106	LTSE	490
3105	JHRS=EXTIM(KL)	LTSE	491
	JDAY=MOD(JHRS,1440)	LTSE	492
	JHR=JDAY/60	LTSE	493
	JMIN=MOD(JDAY,60)	LTSE	494
	IF (M .EQ. 1) GO TO 3110	LTSE	495
	JSTIM(J)=JHR*100+JMIN	LTSE	496
3106	KL=KL+1	LTSE	497
	M=1	LTSE	498
	GO TO 3105	LTSE	499
3110	JXTIM(J)=JHR*100+JMIN	LTSE	500
	VEL(J)=EXTIM(K+2)	LTSE	501
	IF (VEL(J)) 3115,3150,3150	LTSE	502
3115	IF (VEL(J) .LE. -.05) GO TO 3150	LTSE	503
	VEL(J)=VEL(J)*(-1.)	LTSE	504
3150	CONTINUE	LTSE	505
	KK=KAY	LTSE	506
	IF (JP .EQ. 1) GO TO 3170	LTSE	507
	IF (JXTIM(1)-NSAV) 3152,3155,3160	LTSE	508
3152	KA=KAY-1	LTSE	509
	DO 3153 K0=1,KA	LTSE	510
	JSTIM(K0)=JSTIM(K0+1)	LTSE	511
	JXTIM(K0)=JXTIM(K0+1)	LTSE	512
	VEL(K0)=VEL(K0+1)	LTSE	513
3153	CONTINUE	LTSE	514
	GO TO 3170	LITS	518

3155 JSTIM(I)=NSAVS	LITS 514
GO TO 3170	LITS 520
3160 JSTIM(KK+1)=JSTIM(KK)	LITS 521
JXTIM(KK+1)=JXTIM(KK)	LITS 522
VEL(KK+1)=VFL(KK)	LITS 523
KK=KK-1	LITS 524
IF (KK .EQ. 0) GO TO 3165	LITS 525
GO TO 3160	LITS 526
3165 JSTIM(I)=4000	LITS 527
JXTIM(I)=NSAV	LITS 528
VEL(I)=SAV	LITS 529
3170 NDAY=NRDAY(13)	LITS 530
NCOUNT=0	LITS 531
NNJ=1	LITS 532
K=1	LITS 533
GO TO (3174,3174,3174).IND2	LITS 534
3174 PRINT 550	LITS 535
PRINT 555,IYH1,MO(13),CKSUM,NFDIR,NEDIR	LITS 536
PRINT 575	LITS 537
3174 IF (IND5 .EQ. 1) GO TO 3185	LITS 538
KAYK=KAY-1	LITS 539
DO 3180 J=1,KAYK	LITS 540
IF (VFL(J) .GT. .25) GO TO 3180	LITS 541
IF (VFL(J) .LT. -.25) GO TO 3180	LITS 542
JSTIM(J)=4000	LITS 543
JSTIM(J+1)=4000	LITS 544
3180 CONTINUE	LITS 545
3185 IF (IND6) 3200,3200,3186	LITS 546
3186 DO 3193 I=1,KAY	LITS 547
IF (VFL(I) .GE. 12.95) GO TO 3191	LITS 548
IF (VEL(I) .LE. -12.95) GO TO 3192	LITS 549
IF (VEL(I) .GE. 7.55) GO TO 3187	LITS 550
IF (VEL(I) .GT. -7.55) GO TO 3193	LITS 551
TEMP=VEL(I)*(-1.)	LITS 552
LPN=1	LITS 553
GO TO 3188	LITS 554
3187 TEMP=VEL(I)	LITS 555
LPN=2	LITS 556
3188 N=TEMP*10.0-74.5	LITS 557
GO TO (3189,3190).LPN	LITS 558
3189 VEL(I)=AKU(N)*(-1.)	LITS 559
GO TO 3193	LITS 560
3190 VEL(I)=AKI(N)	LITS 561
GO TO 3193	LITS 562
3191 VEL(I)=9.6	LITS 563
GO TO 3193	LITS 564
3192 VEL(I)=-9.6	LITS 565
3193 CONTINUE	LITS 566
3200 DO 3350 I=1,KAY	LITS 567
IF (JSTIM(I) .LT. 4000) GO TO 3215	LITS 568
3210 IF (JXTIM(I) .GT. JXTIM(I+1)) GO TO 3250	LITS 569
JJXTI(K)=9999	LITS 570
JJXTI(K)=JXTIM(I)	LITS 571
XVEL(K)=VEL(I)	LITS 572
GO TO 3310	LITS 573
3215 IF (JXTIM(I) .LT. JSTIM(I)) GO TO 3210	LITS 574
IF (JXTIM(I) .GT. JXTIM(I+1)) GO TO 3230	LITS 575
JJXTI(K)=JSTIM(I)	LITS 576
JJXTI(K)=JXTIM(I)	LITS 577
XVEL(K)=VEL(I)	LITS 578
GO TO 3310	LITS 579
3230 JJXTI(K)=JSTIM(I)	LITS 580
JJXTI(K)=JXTIM(I)	LITS 581
XVEL(K)=VEL(I)	LITS 582
IF (JSTIM(I+1) .EQ. 4000) GO TO 3260	LITS 583
IF (JXTIM(I) .GT. JSTIM(I+1)) GO TO 3260	LITS 584

GO TO 3300	LITS 585
3250 IF (JSTIM(I+1) .EQ. 4000) GO TO 3255	LITS 586
IF (JXTIM(I) .GT. JSTIM(I+1)) GO TO 3290	LITS 587
GO TO 3295	LITS 588
3255 JJSTI(K)=9999	LITS 589
JJXTI(K)=JXTIM(I)	LITS 590
XVEL(K)=VEL(I)	LITS 591
3260 NLAST=NNJ+NCOUNT	LITS 592
GO TO (3264,3264,3265).IND2	LITS 593
3264 PRINT 585, NDAY,(JJSTI(J),JJXTI(J),XVEL(J),J=1,K)	LITS 594
IF (IFLG .EQ. 1) GO TO 7502	LITS 595
IRC=1	LITS 596
7502 DO 7500 L=1,5	LITS 597
JJJST(IRC)=JJSTI(L)	LITS 598
YVEL(IRC)=XVEL(L)	LITS 599
IRC=IRC+1	LITS 600
7500 CONTINUE	LITS 601
7504 IFLG=1	LITS 602
IF (IND2 .EQ. 1) GO TO 3275	LITS 603
3265 JK=K+1	LITS 604
DO 3266 N=JK,5	LITS 605
JJSTI(N)=9999	LITS 606
JJXTI(N)=9999	LITS 607
XVEL(N)=99.9	LITS 608
3266 CONTINUE	LITS 609
IF (IND3 .EQ. 3) GO TO 3267	LITS 610
IF (IND3 .EQ. 1) GO TO 3268	LITS 611
3267 CONTINUE	LITS 612
3268 NSEQ=NSEQ+1	LITS 613
IF (K .GT. 5 .AND. IND2 .EQ. 3) GO TO 3288	LITS 614
3275 NNJ=NLAST+1	LITS 615
NCOUNT=0	LITS 616
K=1	LITS 617
NDAY=NDAY+1	LITS 618
NNDAY=NNDAY+1	LITS 619
IF (NDAY .NE. NNEDA) GO TO 3350	LITS 620
IF (MO(13) .NE. 12) GO TO 3287	LITS 621
IF (NDAY .NE. 32) GO TO 3287	LITS 622
PRINT 550	LITS 623
PRINT 565, IYR1,ISTAT	LITS 624
PRINT 580	LITS 625
PRINT 585, NDAY,(JSTIM(J),JXTIM(J),VEL(J),J=NNJ,KAY)	LITS 626
3287 NSAVS=JSTIM(I+1)	LITS 627
NSAV=JXTIM(I+1)	LITS 628
SAV=VEL(I+1)	LITS 629
GO TO 4000	LITS 630
3288 PRINT 570	LITS 631
NNLAS=NLAST+1	LITS 632
PRINT 595,ISTAT,MO(13),NDAY,IYR1,(JSTIM(J),JXTIM(J),VEL(J),	LITS 633
I J=NNJ,NNLAS)	LITS 634
GO TO 3275	LITS 635
3290 JJSTI(K)=9999	LITS 636
JJXTI(K)=JXTIM(I)	LITS 637
XVEL(K)=VEL(I)	LITS 638
GO TO 3260	LITS 639
3295 JJSTI(K)=9999	LITS 640
JJXTI(K)=JXTIM(I)	LITS 641
XVEL(K)=VEL(I)	LITS 642
3300 K=K+1	LITS 643
JJSTI(K)=JSTIM(I+1)	LITS 644
JJXTI(K)=9999	LITS 645
XVEL(K)=99.9	LITS 646
GO TO 3260	LITS 647
3310 NCOUNT=NCOUNT+1	LITS 648
K=K+1	LITS 649
3350 CONTINUE	LITS 650

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4000 CONTINUE
4005 HEAD 53H,MS,MY,MD
      IF (MS+MY+MD) 4020,4020,95
4020 CALL SLACK(JJST,YVEL,NNDAY,NBDY,MO,IYR1,NEDY)
      IF(NNDAY.NE.0) GO TO 4020
      STOP
450 PRINT 501
      STOP
451 PRINT 502
      STOP
452 PRINT 503
      STOP
453 PRINT 504
      STOP
501 FORMAT(27H STATION CARDS OUT OF ORDER)
502 FORMAT(31H STATION NUMBERS NOT CONSISTENT)
503 FORMAT(28H YEAR NUMBERS NOT CONSISTENT)
504 FORMAT(24H YEAR CARDS OUT OF ORDER)
531 FORMAT(2I4,F5.3,F4.1,F5.3,F4.1,F5.3,F4.1,F5.3,F4.1,F5.3,F4.1,
      1F5.3,F4.1,F5.3,F4.1)
532 FORMAT(F6.3,6I2,2I4,54X)
533 FORMAT(I4,2I2,F4.3,F4.1,F4.3,F4.1,F4.3,F4.1,F4.3,F4.1,
      1F4.3,F4.1,F4.3,F4.1,F4.3,F4.1,F4.3,F4.1)
534 FORMAT(36I2,8X)
537 FORMAT(I9,12F9.1)
538 FORMAT(3I4)
550 FORMAT(80H
      1
555 FORMAT(/32H PREDICTED TIDAL CURRENT YEAR,I5,8H MONTH,I3,12H
      1 CHECKSUM,F12.7/17H FLOOD DIRECTION,,I4,7H TRUE,,15X18HEHR (-) DIRECTION,,I4,7H TRUE,/28H NOAA, NATIONAL OCEAN SURVEY/)
556 FORMAT(27H HOURLY VELOCITIES IN KNOTS/7X111HDAY HOURS HOURS HOURS HOURS HOURS HOURS HOURS HOURS
      1 HOURS HOURS HOURS HOURS HOURS HOURS HOURS HOURS
      2HOURS HOURS HOURS/14X103H0/12 1/13 2/14 3/15
      3 4/16 5/17 6/18 7/19 8/20 9/21 10/22 11/
      423/)
565 FORMAT(/35H PREDICTIONS BEGINNING DECEMBER 32,,I5,5X10HSTA. NO. ,
      1I4/)
570 FORMAT(///23H TROUBLE DAY FOLLOWS /)
575 FORMAT(5X111HSLACK MAXIMUM SLACK MAXIMUM SLACK MAXIMUM SLACK MAXIMUM
      1M SLACK MAXIMUM SLACK MAXIMUM SLACK MAXIMUM SLACK MAXIMUM/5X111H
      2WATER CURRENT WATER CURRENT WATER CURRENT WATER
      3CURRENT WATER CURRENT WATER CURRENT/118H DAY TIME TIME
      4 VELOC TIME TIME VELOC TIME TIME VELOC TIME TIME VELOC
      5TIME TIME VELOC TIME TIME VELOC/118H H.M. H.M. KNOTS
      6H.M. H.M. KNOTS H.M. H.M. KNOTS H.M. H.M. KNOTS H.M. H.M.
      7. KNOTS H.M. H.M. KNOTS)
580 FORMAT(119H DAY TIME TIME VELOC TIME TIME VELOC TIME TIME
      1 VELOC TIME TIME VELOC TIME TIME VELOC TIME TIME VELOC)
585 FORMAT(1H0,I3,6(I6,I6,F7.2)/4X,6(I6,I6,F7.2)/4X,6(I6,I6,F7.2))
590 FORMAT(I2,I4,3I2,5(I4,I4,F5.1),I3)
595 FORMAT(15H STA. NO. ,I4,10H MONTH ,I2,8H DAY ,I2,9H
      1 YEAR ,I4//6X6(I6,I6,F7.1)/6X6(I6,I6,F7.1))
      END
      SURROUTINE SLACK (JSLAK,CEL,NNDAY,NBDY,MO,IYR1,NEDY)
      DIMENSION CUR(12),MDIR(12),JHR(10),JMIN(10)
      DIMENSION JSLAK(10),CEL(10)
      INTEGER DAYCNT
C CUR(12) - CURRENT SPEEDS IN KNOTS AND
C MDIR(12) - ASSOCIATED CURRENT DIRECTIONS IN DEGREES TRUE FOR
C 1/12TH OF TIDAL CYCLE,6 EACH FOR EBB AND FLOOD.
C AT DESIRED LOCATION IN POSITION MATRIX.
C JSLAK(10) - TIMES OF SLACK WATER (ZONE TIME) FOR EITHER ONE OR
C TWO DAYS OF THE YEAR (PASSED FROM MAIN PROGRAM).
C CEL(10) - CURRENT SPEDS IN KNOTS ASSOCIATED WITH TIMES OF MAXIMUM
C FLOW.

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C	JHR(10) AND JMIN(10) - ARRAYS USED IN CALCULATION OF NUMBER OF HOURS	LITS 717
C	OF OCCURRENCE BEFORE OR AFTER CLOSEST SLACK WATER TIME (JSLAK)	LITS 718
	READ (60.797) MONLIST	LITS 719
	READ (60.797) DAYCONT, IDISC	LITS 720
797	FORMAT (11,1X,11)	LITS 721
	IF (DAYCONT.EQ.2) NEDY=NEDY	LITS 722
C	READ POSITION OF OCCURRENCE	LITS 723
	IF (IDISC.EQ.1) GO TO 4199	LITS 724
	READ(60.13) ILAD,ILAM,ILOD,ILOM	LITS 725
13	FORMAT (12,12,1X,13,14)	LITS 726
	IF (ILAD.EQ.99) GO TO 94	LITS 727
	GO TO 4099	LITS 728
4199	READ(60.4013) ILAD,ILAM,ILOD,ILOM	LITS 729
4013	FORMAT(12,12,13,12)	LITS 730
	IF (ILAD.EQ.99) GO TO 94	LITS 731
C	READ TIME AND DATE OF OCCURRENCE	LITS 732
4089	READ(60.1) NHM,NMIN	LITS 733
1	FORMAT(12,12)	LITS 734
	IF (MONLIST.EQ.1) GO TO 93	LITS 735
	NTIME=NHM*100+NMIN	LITS 736
	DO A K=1,10	LITS 737
	JHP(K)=JSLAK(K)/100	LITS 738
9	JMIN(K)=JSLAK(K)-(JHR(K)*100)	LITS 739
	IF (DAYCONT.EQ.1) NNDAY=1	LITS 740
	IF (DAYCONT.EQ.2) NNDAY=2	LITS 741
	K=5*NNDAY-4	LITS 742
C	DETERMINE TIME OF SLACK WATER CLOSEST TO TIME OF OCCURRENCE	LITS 742
5	IF (JSLAK(K).EQ.9999.AND.NTIME.GT.JSLAK(K+1)) GO TO 800	LITS 744
	IF (NTIME.GT. JSLAK(K) .AND. NTIME.LT. JSLAK(K+1) .AND. JSLAK	LITS 745
1(K+1)	.NE. 9999) GO TO 700	LITS 746
	IF (JSLAK(K) .EQ. 9999 .AND. NTIME.LT. JSLAK(K+1)) GO TO 700	LITS 747
	IF (NTIME.GE. JSLAK(K) .AND. JSLAK(K+1) .EQ. 9999) GO TO 700	LITS 748
	IF (NTIME.GT. JSLAK(K) .AND. JSLAK(K+1) .EQ. 0) GO TO 700	LITS 749
	IF (JSLAK(K).GT.NTIME) GO TO 700	LITS 750
	GO TO 800	LITS 751
700	IF (JSLAK(K).EQ.9999.OR.JSLAK(K).GT.NTIME) K=K-1	LITS 752
	IF (JSLAK(K).EQ.0) K=K-1	LITS 753
	KKK=K	LITS 754
	KSLAK=JSLAK(K)/100	LITS 755
	XSLAK=KSLAK*100.	LITS 756
	YSLAK=JSLAK(K)-XSLAK	LITS 757
	ZSLAK=YSLAK/60.	LITS 758
	TSLAK=KSLAK+ZSLAK	LITS 759
	IF (JSLAK(K+1).EQ.9999) K=K+1	LITS 760
	IF (JSLAK(K+1).EQ.0) GO TO 701	LITS 761
	KSLAK=JSLAK(K+1)/100	LITS 762
	XSLAK=KSLAK*100.	LITS 763
	YSLAK=JSLAK(K+1)-XSLAK	LITS 764
	ZSLAK=YSLAK/60.	LITS 765
	TTSLAK=KSLAK+ZSLAK	LITS 766
	IF (JSLAK(K+1).LT.JSLAK(K)) TTSLAK=TTSLAK+24.	LITS 767
702	TSPAN=TTSLAK-TSLAK	LITS 768
	GO TO 703	LITS 769
701	IF (JSLAK(K+2).EQ.9999) K=K+1	LITS 770
	KSLAK=JSLAK(K+2)/100	LITS 771
	XSLAK=KSLAK*100.	LITS 772
	YSLAK=JSLAK(K+2)-XSLAK	LITS 773
	ZSLAK=YSLAK/60.	LITS 774
	TTSLAK=KSLAK+ZSLAK	LITS 775
	TTSLAK=TTSLAK+24.	LITS 776
	GO TO 702	LITS 777
703	PERCOL=TSPAN/A.	LITS 778
	GO TO 20	LITS 779
800	K=K+1	LITS 780
	IF (K.3T.(NNDAY*5)) GO TO 95	LITS 781
	GO TO 5	LITS 782

20 K=KKK	LITS 783
XMIN=NMIN/60.	LITS 784
XNTIME=NHR+XMIN	LITS 785
IF (JSLAK(K).GT.NTIME) XNTIME=XNTIME+24.	LITS 786
HRAFT=XNTIME-TSLAK	LITS 787
XJJI=HRAFT	LITS 788
C DETERMINE FACTOR BY WHICH CURRENT SPEEDS AT DESIRED LOCATION ARE	LITS 789
C TO BE MULTIPLIED TO GET ACTUAL CURRENT	LITS 790
IF (CFL(K).EQ.99.9) K=K+1	LITS 791
IF (CFL(K).EQ.0.) K=K+1	LITS 792
IF (CFL(K).GT.0.) GO TO 122	LITS 793
IF (IDISC.EQ.2) GO TO 500	LITS 794
C CORRECTIONS FOR THE RACE LONG ISLAND SOUND	LITS 795
IF (ABS(CEL(K)).GE.1.8 .AND. ABS(CEL(K)).LT.2.2) FAC=.5	LITS 796
IF (ABS(CEL(K)).GE.2.2 .AND. ABS(CEL(K)).LT.2.6) FAC=.6	LITS 797
IF (ABS(CEL(K)).GE.2.6 .AND. ABS(CEL(K)).LT.3.0) FAC=.7	LITS 798
IF (ABS(CEL(K)).GE.3.0 .AND. ABS(CEL(K)).LT.3.4) FAC=.8	LITS 799
IF (ABS(CEL(K)).GE.3.4 .AND. ABS(CEL(K)).LT.3.8) FAC=.9	LITS 800
IF (ABS(CEL(K)).GE.3.8 .AND. ABS(CEL(K)).LT.4.2) FAC=1.0	LITS 801
IF (ABS(CEL(K)).GE.4.2 .AND. ABS(CEL(K)).LT.4.6) FAC=1.1	LITS 802
IF (ABS(CEL(K)).GE.4.6 .AND. ABS(CEL(K)).LT.5.0) FAC=1.2	LITS 803
IF (ABS(CEL(K)).GE.5.0 .AND. ABS(CEL(K)).LT.5.4) FAC=1.3	LITS 804
GO TO 4	LITS 805
500 CONTINUE	LITS 806
C CORRECTIONS FOR THE GOLDEN GATE	LITS 807
IF (ABS(CEL(K)).GT.0.0 .AND. ABS(CEL(K)).LT.0.7) FAC=0.0	LITS 808
IF (ABS(CEL(K)).GE.0.7 .AND. ABS(CEL(K)).LT.1.2) FAC=0.2	LITS 809
IF (ABS(CEL(K)).GE.1.2 .AND. ABS(CEL(K)).LT.1.6) FAC=0.3	LITS 810
IF (ABS(CEL(K)).GE.1.6 .AND. ABS(CEL(K)).LT.2.1) FAC=0.4	LITS 811
IF (ABS(CEL(K)).GE.2.1 .AND. ABS(CEL(K)).LT.2.5) FAC=0.5	LITS 812
IF (ABS(CEL(K)).GE.2.5 .AND. ABS(CEL(K)).LT.3.0) FAC=0.6	LITS 813
IF (ABS(CEL(K)).GE.3.0 .AND. ABS(CEL(K)).LT.3.4) FAC=0.7	LITS 814
IF (ABS(CEL(K)).GE.3.4 .AND. ABS(CEL(K)).LT.3.9) FAC=0.8	LITS 815
IF (ABS(CEL(K)).GE.3.9 .AND. ABS(CEL(K)).LT.4.3) FAC=0.9	LITS 816
IF (ABS(CEL(K)).GE.4.3 .AND. ABS(CEL(K)).LT.4.8) FAC=1.0	LITS 817
IF (ABS(CEL(K)).GE.4.8 .AND. ABS(CEL(K)).LT.5.2) FAC=1.1	LITS 818
IF (ABS(CEL(K)).GE.5.2 .AND. ABS(CEL(K)).LT.5.7) FAC=1.0	LITS 819
IF (ABS(CEL(K)).GE.5.7 .AND. ABS(CEL(K)).LT.6.1) FAC=1.3	LITS 820
IF (ABS(CEL(K)).GE.6.1 .AND. ABS(CEL(K)).LT.6.6) FAC=1.4	LITS 821
IF (ABS(CEL(K)).GE.6.6 .AND. ABS(CEL(K)).LT.7.1) FAC=1.5	LITS 822
GO TO 14	LITS 823
122 IF (IDISC.EQ.2) GO TO 501	LITS 824
C CORRECTIONS FOR THE RACE LONG ISLAND SOUND	LITS 825
IF (ABS(CEL(K)).GE.1.2 .AND. ABS(CEL(K)).LT.1.6) FAC=.4	LITS 826
IF (ABS(CEL(K)).GE.1.6 .AND. ABS(CEL(K)).LT.1.9) FAC=.5	LITS 827
IF (ABS(CEL(K)).GE.1.9 .AND. ABS(CEL(K)).LT.2.3) FAC=.6	LITS 828
IF (ABS(CEL(K)).GE.2.3 .AND. ABS(CEL(K)).LT.2.6) FAC=.7	LITS 829
IF (ABS(CEL(K)).GE.2.6 .AND. ABS(CEL(K)).LT.2.9) FAC=.8	LITS 830
IF (ABS(CEL(K)).GE.2.9 .AND. ABS(CEL(K)).LT.3.3) FAC=.9	LITS 831
IF (ABS(CEL(K)).GE.3.3 .AND. ABS(CEL(K)).LT.3.6) FAC=1.0	LITS 832
IF (ABS(CEL(K)).GE.3.6 .AND. ABS(CEL(K)).LT.4.0) FAC=1.1	LITS 833
IF (ABS(CEL(K)).GE.4.0 .AND. ABS(CEL(K)).LT.4.3) FAC=1.2	LITS 834
IF (ABS(CEL(K)).GE.4.3 .AND. ABS(CEL(K)).LT.4.6) FAC=1.3	LITS 835
GO TO 4	LITS 836
501 CONTINUE	LITS 837
C CORRECTIONS FOR THE GOLDEN GATE	LITS 838
IF (ABS(CEL(K)).GT.0.0 .AND. ABS(CEL(K)).LT.0.5) FAC=0.0	LITS 839
IF (ABS(CEL(K)).GE.0.5 .AND. ABS(CEL(K)).LT.0.9) FAC=0.2	LITS 840
IF (ABS(CEL(K)).GE.0.9 .AND. ABS(CEL(K)).LT.1.2) FAC=0.3	LITS 841
IF (ABS(CEL(K)).GE.1.2 .AND. ABS(CEL(K)).LT.1.5) FAC=0.4	LITS 842
IF (ABS(CEL(K)).GE.1.5 .AND. ABS(CEL(K)).LT.1.9) FAC=0.5	LITS 843
IF (ABS(CEL(K)).GE.1.9 .AND. ABS(CEL(K)).LT.2.2) FAC=0.6	LITS 844
IF (ABS(CEL(K)).GE.2.2 .AND. ABS(CEL(K)).LT.2.5) FAC=0.7	LITS 845
IF (ABS(CEL(K)).GE.2.5 .AND. ABS(CEL(K)).LT.2.9) FAC=0.8	LITS 846
IF (ABS(CEL(K)).GE.2.9 .AND. ABS(CEL(K)).LT.3.2) FAC=0.9	LITS 847
IF (ABS(CEL(K)).GE.3.2 .AND. ABS(CEL(K)).LT.3.5) FAC=1.0	LITS 848

IF (ABS(CEL(K)).GE.3.5.AND. ABS(CEL(K)).LT.3.8) FAC=1.1	LITS 849
IF (ABS(CEL(K)).GE.3.8.AND. ABS(CEL(K)).LT.4.2) FAC=1.2	LITS 850
IF (ABS(CEL(K)).GE.4.2.AND. ABS(CEL(K)).LT.4.5) FAC=1.3	LITS 851
IF (ABS(CEL(K)).GE.4.5.AND. ABS(CEL(K)).LT.4.8) FAC=1.4	LITS 852
IF (ABS(CEL(K)).GE.4.8.AND. ABS(CEL(K)).LT.5.2) FAC=1.5	LITS 853
C FIND DESIRED LOCATION WITH CURRENT SPEEDS AND DIRECTIONS FOR	LITS 854
C 12 HOUR PERIOD	LITS 855
14 READ(1,103)LAD,LAM,LOD,LOM,(CUR(I),MDIR(I),I=1,12),IAR	LITS 856
103 FORMAT(I2,I2,1X,I3,I4,1X,I2(F2.1,I2,1X),5X,I2)	LITS 857
IF (LOD.EQ. 999) GO TO 93	LITS 858
IF (37.EQ.ILAD)GO TO 104	LITS 859
104 IF (ILAM.GE.4H.AND.ILAM.LE.50)GO TO 105	LITS 860
GO TO 114	LITS 861
105 IF (ILOM.GE.2250.AND.ILOM.LT.3250)GO TO 106	LITS 862
GO TO 114	LITS 863
106 KLOM=LOM+125	LITS 864
KLAM=LAM+1	LITS 865
IF (LOD.EQ.ILOD)GO TO 136	LITS 866
GO TO 14	LITS 867
136 IF (ILOM.GE.LOM.AND.ILOM.LT.KLOM)GO TO 137	LITS 868
GO TO 14	LITS 869
137 IF (LAD.EQ.ILAD)GO TO 139	LITS 870
GO TO 14	LITS 871
139 IF (ILAM.GE.LAM.AND.ILAM.LT.KLAM)GO TO 25	LITS 872
GO TO 14	LITS 873
114 LLOM=LOM+250	LITS 874
LLAM=LAM+2	LITS 875
IF (LOD.EQ.ILOD)GO TO 116	LITS 876
GO TO 14	LITS 877
116 IF (ILOM.GE.LOM.AND.ILOM.LT.LLOM)GO TO 117	LITS 878
GO TO 14	LITS 879
117 IF (LAD.EQ.ILAD) GO TO 119	LITS 880
GO TO 14	LITS 881
119 IF (ILAM.GE.LAM.AND.ILAM.LT.LLAM) GO TO 25	LITS 882
GO TO 14	LITS 883
C FIND DESIRED LOCATION WITH CURRENT SPEEDS AND DIRECTIONS FOR	LITS 884
C 13 HOUR PERIOD IN LONG ISLAND SOUND	LITS 885
4 READ(1,3)LAD,LAM,LOD,LOM,(CUR(I),MDIR(I),I=1,13),IAR	LITS 886
3 FORMAT(I2,I2,I3,I2,1X,I3(F2.1,I2,1X),I2)	LITS 887
IF (LOD.EQ.999)GO TO 93	LITS 888
JLOM=LOM+3	LITS 889
JLAM=LAM+2	LITS 890
IF (LOD.EQ. ILOD) GO TO 6	LITS 891
GO TO 4	LITS 892
6 IF (ILOM .GE. LOM .AND. ILOM .LT. JLOM) GO TO 7	LITS 893
GO TO 4	LITS 894
7 IF (LAD .EQ. ILAD) GO TO 9	LITS 895
GO TO 4	LITS 896
9 IF (ILAM .GE. LAM .AND. ILAM .LT. JLAM) GO TO 4025	LITS 897
GO TO 4	LITS 898
4025 WRITE (6,4026)	LITS 899
4026 FORMAT (1H0,15X,*CURRENT SPEEDS FOR EACH HOUR OF THE CURRENT*)	LITS 900
WRITE(6,4027) (CUR(I),I=1,13)	LITS 901
4027 FORMAT(1H0,13(F4.1,2X))	LITS 902
XJJ1=XJJ1/PERCOL	LITS 903
XJJ1=XJJ1+.5	LITS 904
JJ1=XJJ1	LITS 905
IF (CFL(K) .LT. 0.) GO TO 4040	LITS 906
IF (JJ1 .NE. 0) JJ1=JJ1+1	LITS 907
IF (JJ1.GT.6) JJ1=6	LITS 908
IF (JJ1 .EQ. 0) JJ1=1	LITS 909
IF (JSLAK(K).EQ.9999) GO TO 4099	LITS 910
IF (JSLAK(K+1).EQ.9999) GO TO 4099	LITS 911
4099 IF (CUR(JJ1) .EQ. 0.0) GO TO 100	LITS 912
FCUR=CUM(JJ1)*FAC	LITS 913
MDIR=MDIR(JJ1)*10	LITS 914

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GO TO 4050
4040 JJ2=JJ1+7
IF (JJ2.GT.13) JJ2=13
IF (CUR(JJ2).EQ. 0.0) GO TO 100
FCUR=CUR(JJ2)*FAC
NDIR=NDIR(JJ2)*10
4050 K=KKK
IF (IDISC.EQ.2) GO TO 57
WRITE(61,4051) MO,NBDY,IYR1,NTIME,JSLAK(K),FCUR,NDIR,ILAD,ILAM,
1ILOD,ILOM,FAC
4051 FORMAT(1H0,3HON ,I2.1H/,I2.1H/,I4.4H AT ,I4.", WITH SLACK WATER ATLITS 925
1 THE PACE AT ",I4.1H,./," THE CURRENT VELOCITY IS ",F4.2,10 LITS 926
2H KNOTS AT ,I3,* DEGREES AT POSITION *,I2.1X,I2.2HN.,1X,I3.1X,I2.2LITS 927
3HW,* FACTOR IS *,F3.1) LITS 928
GO TO 93 LITS 929
25 WRITE (61,26) LITS 930
26 FORMAT (1H0,15X,*CURRENT SPEEDS FOR EACH HOUR OF THE CURRENT*) LITS 931
WRITE(61,27) (CUR(I),I=1,12) LITS 932
27 FORMAT(1H0,12(F4.1,2X)) LITS 933
XJJ1=XJJ1/PERCOL LITS 934
XJJ1=XJJ1+.5 LITS 935
JJ1=XJJ1 LITS 936
IF (CFL(K).LT. 0.) GO TO 40 LITS 937
IF (JJ1.NE. 0) JJ1=JJ1+1 LITS 938
IF (JJ1.GT.6) JJ1=6 LITS 939
IF (JJ1.EQ. 0) JJ1=1 LITS 940
IF (JSLAK(K).EQ.9999) GO TO 99 LITS 941
IF (JSLAK(K+1).EQ.9999) GO TO 99 LITS 942
99 IF (CUR(JJ1).EQ. 0.0) GO TO 100 LITS 943
FCUR=CUR(JJ1)*FAC LITS 944
NDIR=NDIR(JJ1)*10 LITS 945
GO TO 50 LITS 946
40 JJ2=JJ1+7 LITS 947
IF (JJ2.GT.12) JJ2=12 LITS 948
IF (CUR(JJ2).EQ. 0.0) GO TO 100 LITS 949
FCUR=CUR(JJ2)*FAC LITS 950
NDIR=NDIR(JJ2)*10 LITS 951
50 K=KKK LITS 952
IF (IDISC.EQ.2) GO TO 52 LITS 953
WRITE(61,51) MO,NBDY,IYR1,NTIME,JSLAK(K),FCUR,NDIR,ILAD,ILAM, LITS 954
1ILOD,ILOM,FAC LITS 955
51 FORMAT(1H0,3HON ,I2.1H/,I2.1H/,I4.4H AT ,I4.", WITH SLACK WATER ATLITS 956
1 THE PACE AT ",I4.1H,./," THE CURRENT VELOCITY IS ",F4.2,10 LITS 957
2H KNOTS AT ,I3,* DEGREES AT POSITION *,I2.1X,I2.2HN.,1X,I3.1X,I2.2LITS 958
3HW,* FACTOR IS *,F3.1) LITS 959
GO TO 93 LITS 960
52 WRITE(61,53) MO,NBDY,IYR1,NTIME,JSLAK(K),FCUR,NDIR,ILAD,ILAM, LITS 961
1ILOD,ILOM,FAC LITS 962
53 FORMAT(1H0,3HON ,I2.1H/,I2.1H/,I4.4H AT ,I4.", WITH SLACK WATER ATLITS 963
1 THE GOLDEN GATE AT ",I4.1H,./," THE CURRENT VELOCITY IS ",F4.2,10LITS 964
2H KNOTS AT ,I3,* DEGREES AT POSITION *,I2.1X,I2.2HN.,1X,I3.1X,I4.2LITS 965
3HW,* FACTOR IS *,F3.1) LITS 966
GO TO 93 LITS 967
100 WRITE(61,101) ILAD,ILAM,ILOD,ILOM,NTIME LITS 968
101 FORMAT(1H0,*THERE IS NO CURRENT AT POSITION *,/, LITS 969
1I3.1X,I2.2HN.,1X,I3.1X,I4.1HW,* AT *,I4) LITS 970
93 REWIND 1 LITS 971
RETURN LITS 972
94 NNDAY = 0 LITS 973
RETURN LITS 974
END LITS 975

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FINIS
$*DEF(C.,LITS)
$*DEF(M.,CG01-TAM,LITSF.01,C6AS,DP02,.....,I,999999)
$*DEF(W.,CG01-TAM,LITSF.02,C6AS,DP02,(UN)ISED)

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FILMED
5-8