# EXPERT ON BOARD

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# How to work out the tidal stream

John Goode looks at several ways of calculating the rate and set of a tidal stream – and touches on allowances that we may need to make in practice

**Whenever we set sail on the up, down and sideways-moving seas that surround our shores, it's wise to be able to make full use of any source of tidal stream information that we may have at our disposal.**

Although presented in different formats, with varying degrees of sophistication and claimed accuracy, most sources available to yachtsmen use exactly the same core data – as provided by the Admiralty's UK Hydrographic Office. In some cases this data can be quite basic, many decades old and obtained primarily for the benefit of larger, deeper-draught shipping.

For times when we need to know more than just whether a weak or strong stream is with or against us, or when it will turn, it's good seamanlike practice to have a prepared means of extracting precise stream rates already to hand – on standby to be used if more detailed tidal chartwork is required.

As well as illustrating several classic ways of predicting the set (direction) and rate (speed) of a tidal stream, I've also touched on some of the limitations that we should be aware of in practice. That's because, no matter how accurately we might work out the 'predicted' speed of a stream (whether it's the realistic numbers from a printed atlas or charted tidal diamond, or that computed for us to a precision of one hundredth of a knot by an electronic chartplotter), it remains only a mathematical calculation – and one that can occasionally be subject to less than predictable influences.

While it isn't possible to make precise allowances for all potential influences (such as storms surges, floodwater pouring out of estuaries or strong winds blowing continually from the same direction), we can sometimes – with the help of a dependable electronic log and depth sounder – check out the actual speed of the tide or find an elusive back eddy. Generally, though, in good weather most of the tidal streams that we encounter should be flowing at a speed that's within 20 per cent of the predicted rate – no matter what source we used to obtain it.

PHOTOS: JOHN GOODE UNLESS OTHERWISE STATED

PHOTO: REAR ADMIRAL ROY CLARE

*Download John Goode's previous articles on tidal height calculations, log calibration and quick course to steer:*
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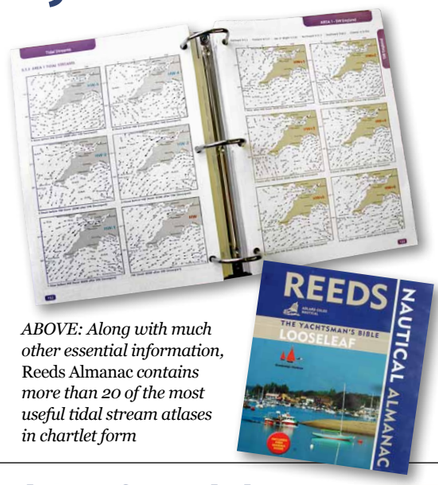
# Predictions, rainstorms and back eddies

## Prediction sources

Whatever our preferred method of navigation, it's always worth bearing in mind that the core tidal stream data used by most printed and electronic sources is exactly the same.

So too are the basic principles used for any ensuing chartwork – whether it's applied to a paper chart ourselves after extracting the tide's speed and direction from a nautical almanac, or having it all computed for us by a chart plotter's electronic programme. And don't forget that a tidal 'prediction' from any source can sometimes be subject to a less than predictable influence.



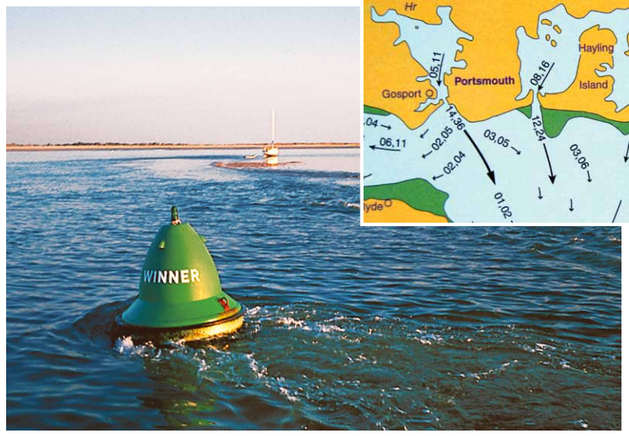

*ABOVE: Along with much other essential information,* Reeds Almanac *contains more than 20 of the most useful tidal stream atlases in chartlet form*

*ABOVE: Most electronic chartplotters can incorporate software that displays the tidal stream's rate and set in graphic or digital format at the touch of a button*

## Effect of heavy rain and storm force winds

Approaching the narrow entrance of a tidal estuary after a long period of heavy rainfall (as we've had this summer), be prepared for the ebb tide's already faster stream to be considerably accelerated by floodwater pouring down from higher ground.

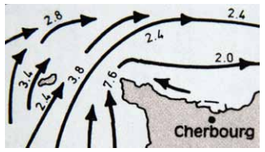
In the open sea around our shores, a strong wind blowing continually from the same direction as the tidal stream can increase its speed – and slow it down when it runs towards the blow. As a rough guide, a Force 6 blowing in the same direction for around 12 hours can increase/decrease the tidal stream's speed by about ½ knot – and about 1 ¼ knots if a Force 9 gale persists for a couple of days.



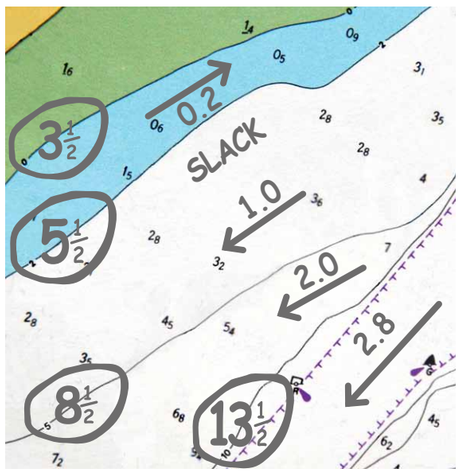

*ABOVE: Entering Chichester harbour when the tide is ebbing against a southerly blow can be risky – and even more so when the stream is being accelerated by floodwater*

## Harness the height of tide to beat a foul stream

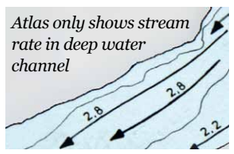
While not all tidal eddies (such as the prominent and much used one off the Cherbourg peninsula) are recorded, there are numerous smaller counter-streams – or at least areas of slacker water – that we can often harness to make better progress against a foul tide.




*ABOVE: Taking advantage of the inshore eddy east of Cap de la Hague can give us an extra two hours of favourable tidal stream on a run from Cherbourg to the Channel Islands*



Because the tide runs faster the deeper the water, with confidence in our tidal height sums and an echo sounder that shows overall depth (see *YM* Summer '12 issue), we can often edge far enough inshore to pick up a much reduced, slack, or even slightly favourable stream.



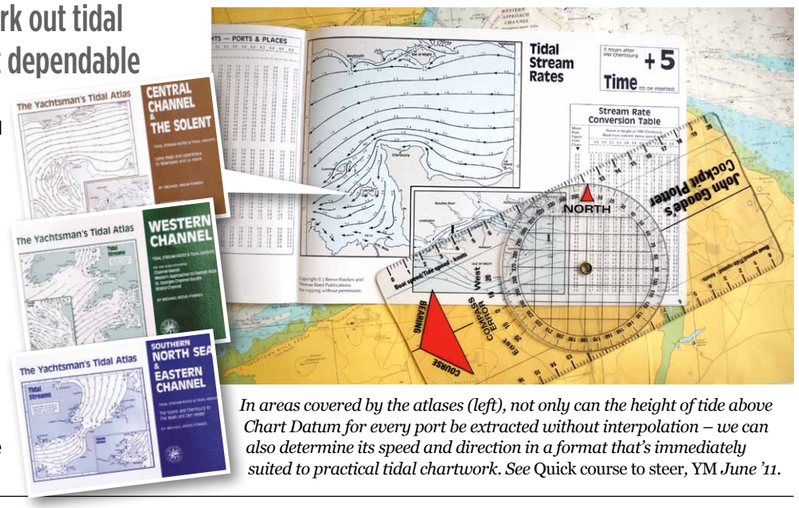
# Tidal streams at a glance

## By far the easiest way to work out tidal stream rates – and the most dependable

**METHOD ONE**

For accuracy and simplicity, my preferred sources of tidal data are the *Yachtsman's Tidal Atlases* – compiled specifically for small boat sailors by the late Michael Reeve-Fowkes and currently published by Adlard Coles.

Based solely on the time and height of High Water Cherbourg (extracted from our nautical almanac), the atlas's pages are marked up the same way as any other tidal atlas – i.e. 6 hrs before and 6 hrs after the time of HW. Their ability to provide the height of tide without undue interpolation was illustrated in my earlier article (*YM* Summer 2012 issue). They are just as quick and easy to use for 'instantly' extracting the rate and set of a tidal stream.



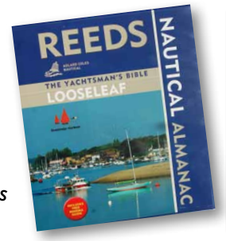

*In areas covered by the atlases (left), not only can the height of tide above Chart Datum for every port be extracted without interpolation – we can also determine its speed and direction in a format that's immediately suited to practical tidal chartwork. See* Quick course to steer, YM *June '11.*

## Example: find the stream rate at all places on 1st October

**1 Cherbourg high water**

**Get the time and height of HW Cherbourg on 1st October – here from** *Reeds Nautical Almanac.*

**Note:** ***during the summer Cherbourg's TIME ZONE –0100 conveniently equates to British Summer Time.***




TIME ZONE -0100
Subtract 1 hour for UT
For French Summer Time add ONE hour in **non-shaded areas**

**CHERBOURG** LAT 49°39'N LONG
TIMES AND HEIGHTS OF HIGH AND LOW WAT

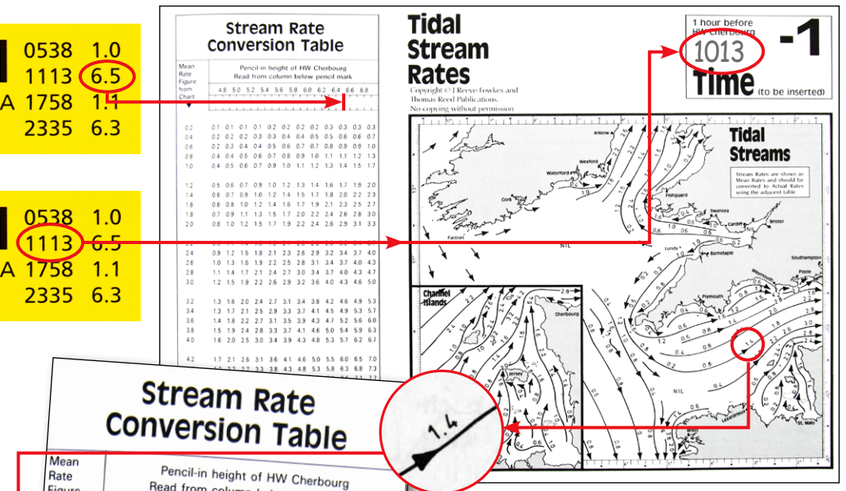
| SEPTEMBER | | | | OCTOBER | | | | NOVEM | |
|---|---|---|---|---|---|---|---|---|---|
| Time | m | Time | m | Time | m | Time | m | Time | m |
| 1 0520 | 0.6 | 16 0513 | 1.5 | 1 0538 | 1.0 | 16 0512 | 1.8 | 1 0005 | 5.8 |
| 1058 | 6.6 | 1041 | 6.0 | 1113 | 6.5 | 1038 | 5.9 | 0650 | 2.1 |
| TH 1737 | 0.8 | F 1727 | 1.6 | SA 1758 | 1.1 | SU 1730 | 1.8 | TU 1220 | 5.8 |
| 2314 | 6.7 | 2256 | 5.9 | 2335 | 6.3 | 2300 | 5.7 | 1918 | 2.0 |

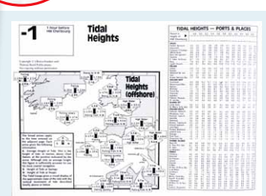
**2** Mark up the *Atlas's stream rate coversion table*. Pencil-in (the same on all 12 pages) the Cherbourg HW height of 6.5 metres.

| | | |
|---|---|---|
| 1 | 0538 | 1.0 |
| | 1113 | 6.5 |
| SA | 1758 | 1.1 |
| | 2335 | 6.3 |

**3** Mark up the *time* boxes either side of HW Cherbourg. Fill in each page for the 6 hours before/after Cherbourg's HW time of 1113. Here, on the HW –1 page, we subtract one hour and write 1013; on the HW +1 page we add an hour and so on.

| | | |
|---|---|---|
| 1 | 0538 | 1.0 |
| | 1113 | 6.5 |
| SA | 1758 | 1.1 |
| | 2335 | 6.3 |




**The page facing the tidal stream data gives 'instant' tidal heights for all ports.** *(See YM Summer '12 issue)*

**4** We can establish the stream's rate anywhere on the atlas by comparing its 'mean rate' (shown alongside each arrow) with the Stream Rate Conversion Table. Here, simply by casting an eye over the table the 'mean' rate of 1.4 knots immediately converts to a predicted Rate of 2.0 knots at 1013 hrs (1 hr before HW Cherbourg).





**'It is worth spending a few minutes holding station by an outer mark'**

### Hold station to gauge rate and set

Before entering a complex pilotage situation where accurate allowance for cross-tide is critical, it's worth spending a few minutes holding station by an outer mark.

By stemming the stream while noting the reciprocal of our heading and, provided its accurate (see YM June '12 issue) the speed shown on our electronic log, we can get a fairly reliable indication of the actual speed and direction of the stream we'll encounter when we get under way again.

### Stream flows faster in deep water channels

Be aware when crossing a main channel that its deeper water will be flowing much faster than in the shallow water on either side. It's all too easy to be swept down onto a large buoy or anchored vessel after being taken by surprise by the sudden acceleration in stream rate.

# Admiralty tidal stream atlases

## How to make full use of the most comprehensive source of tidal data

**METHOD TWO**

The most comprehensive source of tidal information is the Admiralty's United Kingdom Hydrographic Office (UKHO). Based on the daily range and time of High Water at suitably positioned Standard Ports, their extensive series of tidal atlases cover all of our own tidal waters – and far beyond – in varying degrees of scale.

The arrows indicating tidal stream direction are shown at different thicknesses and lengths to indicate approximate strength of flow.

More precisely, the figures alongside the arrows give predicted neap and spring Rates, with the comma indicating the approximate position at which the observations were made.

### 1 Look up standard port time of HW

From the almanac, get the time of HW at the atlas's reference port. Here, it's 1112 UT (GMT) at Dover on 16 June.

**DOVER** LAT 51°07'N LONG 1°19'E

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

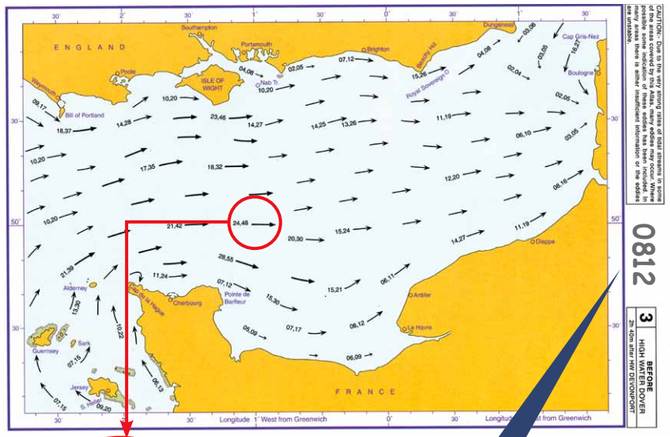
Dates in red are SPRINGS
Dates in blue are NEAPS

| m | JUNE Time | m | Time | m | JULY Time | m | Time | m | AUGUST Time | m | Time | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.9 | **1** 0531 | 1.3 | **16** 0623 | 1.0 | **1** 0551 | 1.2 | **16** 0701 | 1.1 | **1** 0707 | 0.9 | **16** 0024 | 6.5 |
| 6.5 | 1036 | 6.2 | 1112 | 6.5 | 1050 | 6.3 | 1144 | 6.6 | 1152 | 6.9 | 0747 | 1.1 |
| 0.9 | W 1750 | 1.2 | TH 1843 | 0.9 | F 1812 | 1.1 | SA 1921 | 0.9 | M 1930 | 0.7 | TU 1237 | 6.7 |
| 6.7 | ● 2248 | 6.2 | 2338 | 6.6 | ● 2306 | 6.3 | | | | | 2004 | 1.0 |

### 2 Mark up the tidal stream atlas

Mark up the pages of the atlas by filling in the time boxes for 6 hrs before and 6 hrs after Dover's HW time of 1112 hrs. On the page of the atlas shown (right), at **0812** hrs (3 hours before HW Dover) the highlighted stream Rate indicates a speed of **2.4** knots at neaps and **4.8** knots at springs.

If, as here, we're between neap and spring tides it's usually sufficient to make a quick estimation of the stream's Rate simply by looking at the numbers.




CAUTION: Due to the very strong rates of tidal streams in some of the areas covered by this atlas, many eddies may occur. Where many arrows, there is active navigation information on the globe and off charts.

0812
3 HOURS BEFORE HIGH WATER DOVER
BEFORE
3 HIGH WATER DOVER
2h 40m after HW DEVONPORT

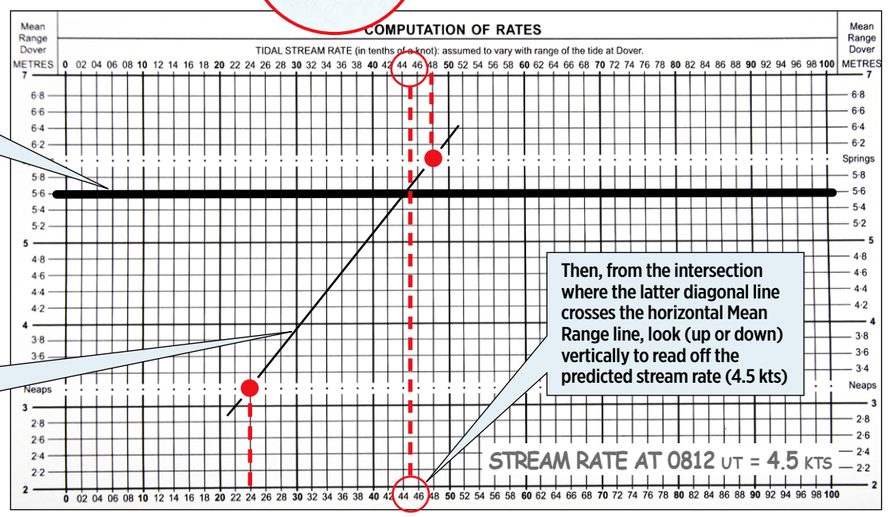
24,48

### 3 Computations of rates

When it's likely that more tidal stream accuracy (between neaps and springs) will be required during the day ahead, its worth going one step further by taking just a few minutes to mark up the Computation of Rates table – printed on the atlas's inside front cover – before setting sail. This requires going back to the *Nautical Almanac* for the LW and HW tidal height predictions that will give us the day's Mean Range. Here, at Dover on 16th June it is **5.6** metres.

| | | | |
|---|---|---|---|
| **16** | 0623 | 1.0 | |
| | 1112 | 6.5 | RANGE 5.5m |
| TH | 1843 | 0.9 | RANGE 5.6m |
| | 2338 | 6.6 | RANGE 5.7m |

**The day's *mean* range 5.6m**




By ruling a pencil-line across the Mean Range scale at 5.6m on the Computation of Rates table, we can extract a more accurate prediction from anywhere on the atlas...

With the horizontal line for the day's Mean Range already pencilled in, hold any straight edge between the dots representing the required neap (2.4) and spring (4.8) rates...

Then, from the intersection where the latter diagonal line crosses the horizontal Mean Range line, look (up or down) vertically to read off the predicted stream rate (4.5 kts)





# Charted tidal diamonds

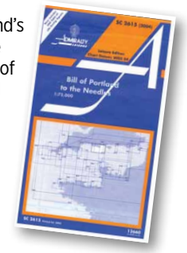
## How to establish basic rate and set using the chart and an almanac

**METHOD THREE**

Although not as comprehensive as a dedicated tidal atlas, limited stream information can be obtained at the strategic positions marked on a chart by lettered Tidal Diamonds.

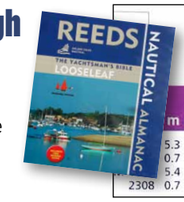
These relate to a boxed-out table (usually printed on the face of the chart, but sometimes you'll find it on the back) that gives the predicted direction, and neap and spring rates, at the diamond's geographical position. The table is based on the time of High Water at its allocated standard port.

Note that the chart in the example below, has 10 tidal diamonds – far fewer reference points than you'd get from a dedicated tidal atlas.



### 1 Get time of High Water at the standard port

From the Almanac, get the time of HW at the atlas's reference port. Here it's 1730 UT (GMT) at Plymouth on 1 June.




**PLYMOUTH** LAT 50°22'N LONG 4°11'W

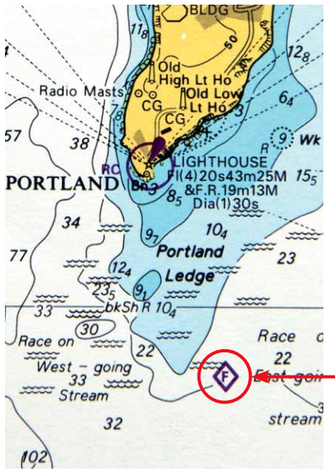
TIMES AND HEIGHTS OF HIGH AND LOW WATERS

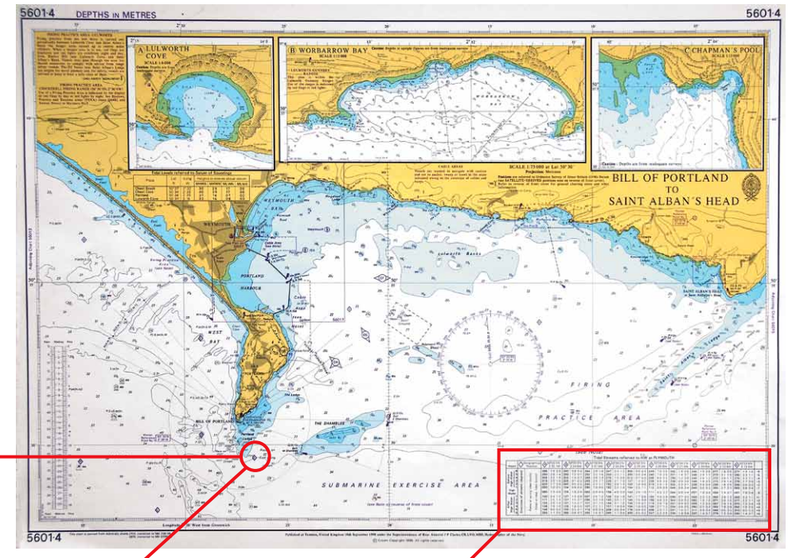
Dates in red are SPRINGS
Dates in blue are NEAPS

YEAR **2011**

| m | JUNE Time | m | Time | m | JULY Time | m | Time | m | AUGUST Time | m | Time | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.3 | **1** 0513 | 5.0 | **16** 0546 | 5.2 | **1** 0535 | 5.0 | **16** 0018 | 0.8 | **1** 0036 | 0.7 | **16** 0116 | 0.8 |
| 0.7 | 1119 | 1.2 | 1205 | 0.9 | 1138 | 1.2 | 0619 | 5.1 | 0647 | 5.3 | 0707 | 5.2 |
| 5.4 | W 1730 | 5.2 | TH 1806 | 5.4 | F 1750 | 5.3 | SA 1237 | 0.9 | M 1255 | 0.7 | TU 1329 | 0.9 |
| 0.7 | ● 2342 | 1.2 | | | ● | | 1832 | 5.4 | 1859 | 5.6 | 1917 | 5.4 |

### 2 Mark up the tidal diamonds table




Tidal Streams referred to HW at PLYMOUTH

| Hours | | Geographical Position | A 50°29·5N 2 35·1W | B 50°36·1N 2 34·1W | F 50°29·6N 2 26·6W | G 50°34·2N 2 21·9W | 50°33·8N 2 12·6W | |
|---|---|---|---|---|---|---|---|---|
| Before High Water | 6 | Directions of streams (degrees) | 286 | 290 | 249 | 232 | 077 | -6 |
| | 5 | | 290 | 299 | 240 | 231 | 080 | -5 |
| | 4 | | 302 | 302 | 236 | 230 | 078 | -4 |
| | 3 | | 318 | 325 | 228 | 239 | 079 | -3 |
| | 2 | | 323 | 045 | 219 | 332 | 096 | -2 |
| | 1 | | 000 | 104 | 112 | 048 | 063 | -1 |
| High Water | | | 080 | 129 | 111 | 034 | 081 | 0 |
| After High Water | 1 | | 100 | 127 | 102 | 030 | 083 | +1 |
| | 2 | | 111 | 127 | 109 | 344 | 077 | +2 |
| | 3 | | 124 | 131 | 119 | 231 | 070 | +3 |
| | 4 | | 126 | 138 | 224 | 055 | +4 |
| | 5 | | 148 | 209 | 231 | 310 | +5 | |
| | 6 | | 283 | 300 | 247 | 230 | 280 | +6 |

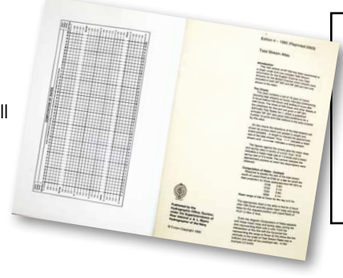
| Hours | | Rates at spring tides (knots) | Rates at neap tides (knots) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Before High Water | 6 | | 1·6 0·8 | 0·9 0·3 | 7·0 3·5 | 1·6 0·8 | 1·9 1·0 | | | | 1130 |
| | 5 | | 2·8 1·4 | 1·5 0·4 | 7·0 3·5 | 1·4 0·7 | 2·3 1·1 | | | | 1230 |
| | 4 | | 3·2 1·6 | 1·4 0·3 | 6·4 3·2 | 1·2 0·6 | 2·3 1·1 | | | | 1330 |
| | 3 | | 2·9 1·5 | 0·7 0·7 | 4·8 2·4 | 0·9 0·4 | 1·7 0·8 | | | | 1430 |
| | 2 | | 1·7 0·9 | 0·8 | 2·9 1·5 | 0·3 0·1 | 0·6 0·3 | | | | 1530 |
| | 1 | | 1·0 0·5 | 1·1 | 0·9 0·5 | 0·8 0·4 | 0·8 0·4 | | | | 1630 |
| High Water | | | 1·3 0·6 | 1·0 | 4·5 2·2 | 0·8 0·4 | 1·9 0·9 | | | | 1730 |
| After High Water | 1 | | 2·4 1·2 | 0·8 | 5·6 2·8 | 0·7 0·3 | 2·2 1·1 | | | | 1830 |
| | 2 | | 2·5 1·3 | 0·8 | 4·6 2·3 | 0·5 | 2·2 1·1 | | | | 1930 |
| | 3 | | 2·6 1·3 | 1·4 0·7 | 3·8 1·9 | 0·4 | 1·9 0·9 | | | | 2030 |
| | 4 | | 1·9 1·0 | 1·0 0·5 | 2·7 1·3 | 0·9 | 1·0 0·5 | | | | 2130 |
| | 5 | | 0·5 0·2 | 0·4 0·2 | 2·2 1·1 | 1·2 | 0·5 0·3 | | | | 2230 |
| | 6 | | 1·1 0·5 | 0·5 0·2 | 5·2 2·6 | 1·0 | 1·4 0·7 | | | | 2330 |

The table can be marked up by pencilling (on the chart alongside the box) the times that indicate 6 hrs before and 6 hrs after Plymouth's High Water time of **1730**.

Here, at Tidal Diamond <F> to the south of Portland Bill, at 1430 (3 hrs before HW Plymouth) the direction of tide is 228° True – with a stream rate of 4.8 kts at springs and 2.4 kts at neaps.

### 3 Computation of rates requires stream atlas

To establish a more precise stream rate between neap and spring tides, we'd still have to work out the day's mean range and use the computation of rates table (inside the front cover of the relevant tidal atlas, pictured right) as shown at the bottom of the opposite page.



John Goode's series of booklets and DVDs on essential navigation and seamanship are available through his website **www.marinepublications.co.uk** or by calling **01633 411090** (24 hr answerphone).

**Thanks to Southern Sailing School, Southampton Tel: 01489 575511 Website: www.southern.co.uk**