



Poltips

for Microsoft Windows

version 4.0



2023 Edition

Coastal Tide Table Calculation Software

Developed by National Oceanography Centre Innovations Ltd.
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Please read this user guide thoroughly before using the software.

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Important Information Before You Start

Note to Publishers

If you intend to publish the tides computed by Poltips-4, please ensure that you read this user guide carefully, that you fully understand how to use the software and have a Publishers Version of the software.


Installation

Please read the installation instructions on page 11 carefully before you install the software.

Contact Information

If you have any questions on the use of this software please contact the Marine Information Products and Services team – Part of the National Oceanography Centre Innovations Ltd.

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Warranty and Liability

1. If any media or materials supplied are defective the NOC will replace them at no charge.
2. Information on new versions of the software will be made available on our Marine Applications Platform. You can link straight to the relevant page by clicking the 'News...' button in the Poltips-4 application.
3. The NOC will provide basic technical support for all Poltips-4 users. This will be limited to installation problems or problems / suspected bugs in the software.
4. We do not guarantee that the functions contained in Poltips-4 will meet your requirements or that the operation of the program will be either error free or appear precisely as described in any documentation or publicity material.
5. No responsibility can be accepted by the National Oceanography Centre for any consequential loss or damage arising from any use that is made of Poltips-4 and output from the software howsoever caused.
6. All implied warranties, terms, representations and conditions, including (by way of example only) the implied conditions of satisfactory quality and fitness for any purpose of the information, are excluded to the fullest extent permitted by law.
7. This Agreement is governed by English law and the parties submit to the exclusive jurisdiction of the English courts.

Software Use and Licensing

Poltips-4 is one of a number of software products developed by the National Oceanography Centre (which includes a mix of Windows desktop and cloud-based applications).

Poltips was first released in 1993 as a DOS based product for PCs. The success of the software has led to a number of refinements over the years. The current version is the most powerful and user-friendly to date. Hidden behind the simple to use interface is a powerful mathematical engine for computing tides. This is coupled with sophisticated graphing and data layout features that give you a complete system for producing commercial quality tide tables.

Poltips Licences

Due to the different requirements of the wide variety of Poltips users, we have created three different versions of the software. They all utilise the same core software but each one has certain restrictions on features and what can be done with the data computed.

- Standard Version
- Publishers/Custom Version
- User-Data Version

Ensure that you purchase the correct version of the software. If you want to publish the data for resale, you must purchase a publisher's licence.

If you have any questions about the licensing of the software or the general terms and conditions, please contact us.

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National Oceanography Centre
Joseph Proudman Building
6 Brownlow Street
Liverpool
L3 5DA
United Kingdom.
products@noc-innovations.com

All 3 licences are restricted to a set number of calendar years. Although the software will run indefinitely, you will only be able to make tidal calculations within the years of the purchased licence.

Standard Version

This version is usually purchased with a 3 or 5 year licence and contains an extensive database of locations around the UK. The user is allowed to make predictions for the licenced period and these can be used for recreational purposes. Users are not permitted to publish and/or resell the data from the software in any form. Users can distribute tide tables from the software free of charge within a membership club (e.g. sailing club).

The software may have some of the more advanced tide table features disabled, and the data may not be the most up to date available so predictions may vary slightly from the publishers/custom version. For consultancy/engineering use, we highly advise the use of the custom version of Poltips.

Publishing / Custom Version

This licence is purchased on a per port basis, usually with a 2 or 3 year licence. Users are permitted to publish the output from the software in any form and resell this data in any printed publication for which they own the complete copyright (i.e. users **cannot** purchase the software and then sell the results on to third party publishers). See below for information about publishing online.

User-Data Version

The software is supplied with no database of harmonics – this licence is designed for users who want to include their own harmonics, or use it in conjunction with our TASK tidal harmonic analysis software. The version is usually purchased with a 3, 5 or 10 year licence.

Publishing Data on the Internet

Users of the standard version can publish online 14 days in advance of the current date for one location only.

Users of the publishing/custom or user-data versions of the software can publish data ...

- on a free to access website for up to 3 months in advance of the current date for all the ports which they are licenced to use.
- on a subscription-based website for the full duration of their Poltips licence.

Checking Your Licence

The details of your licence appear when you first run the software. It is also available at any time by clicking the 'About...' button.

This will show you:

- the start and end year for which tidal data can be computed
- the licence type (standard, publishing/custom, userdata)
- whether it is a full or a demo version of the software
- whether you have permission to install on a network
- whether custom tide tables are available
- whether use of your own harmonic constants is available
- whether you have access to limited ports (listed) or all ports

Tides, Analysis and Prediction

Tides

Anyone who has spent more than a few days at the coast will be familiar with the regular rise and fall of the tide. If you were to measure the tidal level every hour for a whole year, you would notice some regular patterns in the rise and fall. For the majority of locations around the UK you would notice:

- the time between one high water and the next is, on average, around 12 hours 25 minutes – thereby giving two high waters and two low waters on most days, with the time of high water moving on about 50 minutes each day.
- often, the high waters alternate between a slightly higher high water and a slightly lower one.
- every 14 days, the tides appear to be slightly higher than average (usually 1-2 days after full and new moon)
- The highest tides of the year usually occur close to one of the equinoxes

Observing Sea Level

There are a large number of natural phenomena that cause the sea level to change. These include:

- Tides
- Storm Surges
- Long-term changes in the mean level
- Waves
- Seiches
- Tsunamis

For the majority of places in the world, tides are the dominant factor, although with all the public interest in climate change, it is often the small rises in mean sea level that attracts the most media attention.

Tides

The tidal level is the change in sea level caused by the ocean's response to the gravitational attraction of the Moon and the Sun. The tides are usually the dominant signal in a sea level record and are easy to distinguish from other components of sea level variation as they have well-defined periods. The tidal level is affected by numerous factors such as:

- the relative position of the three bodies in the Earth-Moon-Sun system.
- the variation in the Moon's and Sun's distance from Earth.
- the variation in the position (declination) of the Moon and the Sun.
- the local land masses and the shape of the coast.
- the depth of water at the location and surrounding areas.

The phenomena that affect tidal level are highly predictable (for example we know the position of the Moon to an incredible accuracy), or change very slowly over time (coastlines evolve over decades, not months). Therefore, it makes sense that tidal levels should also be predictable with a high level of accuracy and for dates well into the future.

It was discovered as far back as Isaac Newton (1642-1727) that the individual influences on the tide can be modelled by summing up combinations of sine waves – a mathematical function very closely related to circular motion (in our case, motion of water on a rotating Earth), however the modern harmonic method of analysing and computing the tide was refined by Arthur Thomas Doodson and published in 1921 when he was secretary of the Liverpool Tidal Institute (one of the many previous names for what is now the Liverpool site of the National Oceanography Centre).

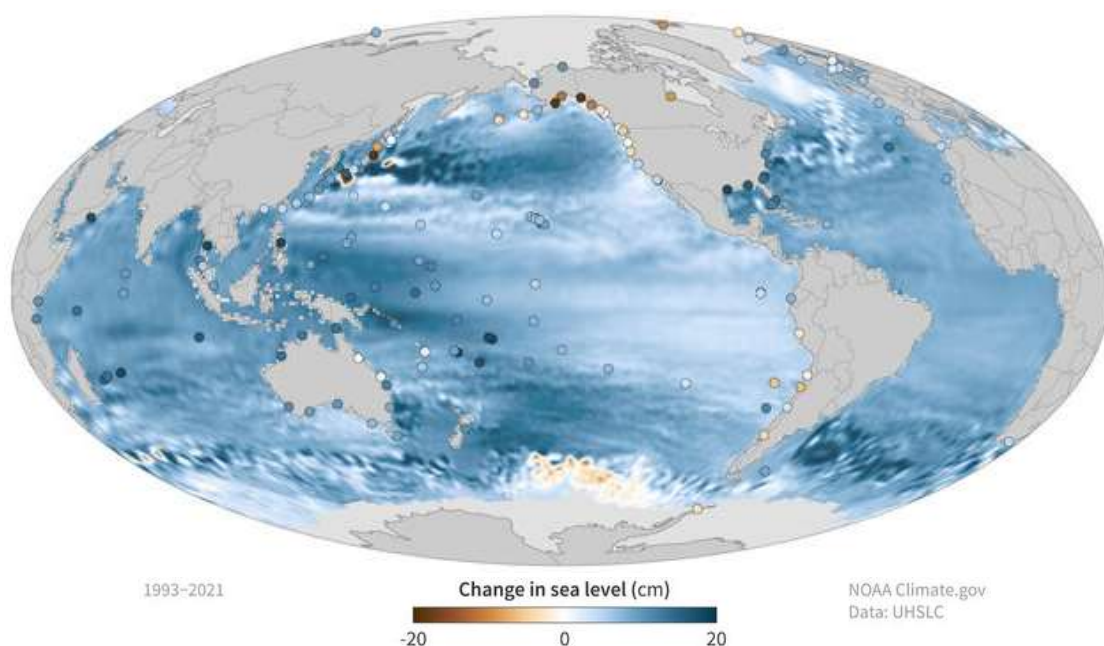
Storm Surge

The variation in water level caused by meteorological phenomena (wind, atmospheric pressure etc.) is called a storm surge. As we know the weather is notoriously difficult to predict, and as such, storm surge levels are also challenging to get right.

The National Oceanography Centre is a world leader in storm surge modelling, however even using some of the most powerful computers in the country, predicting a surge level more than a few days ahead can be unreliable as errors start to become significant and the accuracy drops off rapidly.

Mean Sea Level

This is the average level of the tide calculated over a long period of time - usually a minimum of one year but often decades if looking for long-term trends. This has generally increased globally by about 21-24cm since 1880 however this has accelerated recently with the current rate of rise being about 3.6mm per year. There are some regional variations and even a few places where the sea level appears to be falling; however, this is caused by the land rising faster than the sea. Below shows the global change since 1993.



Prediction Methods

Harmonic Constants

A set of harmonic constants exists for the majority of major ports around the coast. Although these are often called **standard ports**, in many cases they will not actually be a shipping port.

The use of harmonic constants is widely accepted as the most accurate way to predict the tide for the vast majority of locations. To derive a set of harmonics for any location a tide gauge must first be installed (ideally for as long a time period as possible) to record sea-level measurements. Harmonic analysis is then carried out on the data to generate a unique set of harmonic constants for that location.

For locations that have harmonic constants, Poltips can compute both high/low waters as well as equal interval tidal data (for example tidal height every 15 minutes).

Differences to a Reference Port

For many locations around the UK a set of harmonic constants does not exist and only the time and height differences to a nearby major port are known. These can be used to compute high and low water times and heights (although equal interval data will not be available).

Other Methods

A few locations use a hybrid approach called the shallow water correction method. These ports have additional factors called shallow water corrections, used to make small adjustments to the high and low water times and heights at a reference location.

This method was usually adopted when tide gauge observations were available but only the times and heights of high and low water were known. This method is also used for locations that experience a double high water (for example Southampton and Lymington). Although uncommon, a small number of locations in the Poltips UK database still use this approach.

Equal interval predictions cannot be made for ports with shallow water corrections.

NOC is also carrying out research into other approaches to predicting the tide in advance, in particular for locations up estuaries where the harmonic method may have a reduced accuracy.

Installing the Software

There are two steps to installing the software.

Step 1: Download and Install the program

The software can be downloaded freely from our Marine Applications Platform (MAP). Open your browser and navigate to the following page:

<http://apps.noc-innovations.com/desktop-software/poltips-4/download>

Download the Setup.exe file from this page and save it onto your machine. This will most likely save into your downloads folder from where you can run it to install Poltips-4.

This will install the software with a demonstration licence – this will permit you to make predictions for either a previous year or the current year, and all tide table outputs will have "POLTIPS-4 DEMO VERSION" written across them.

Step 2: Install/Copy the Licence File

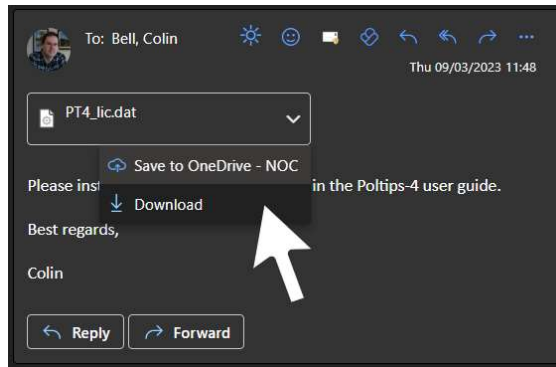
The licence file will usually be provided when you first purchase the software or renew your licence. This is an encrypted file that tells the software what years you are permitted to compute tidal data for, as well as the type of licence, and if there's any port or feature restrictions on your use of the software.

When you purchase a full licence for the software, you will be sent a file (most likely by email) called **PT4_lic.dat**. This needs to be saved into the folder: C:\ProgramData\Poltips4. This can be done in two ways:

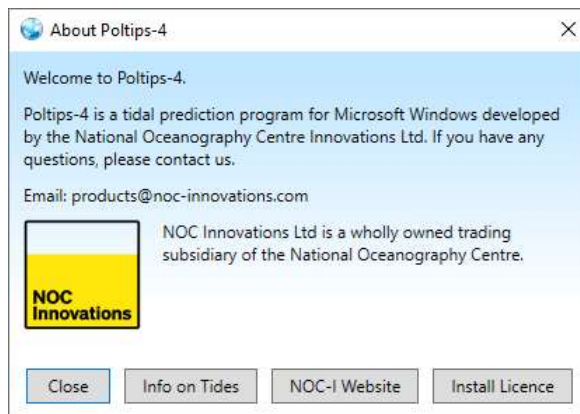
- If your email software allows you to save the file directly to the above location you can do this.
- If your email software downloads the file to your **downloads** folder, then you can ask Poltips-4 to install this for you.

To have Poltips-4 install the licence from your downloads folder...

- Ensure the **PT4_lic.dat** file exists in your downloads folder. Most email applications will give you a download option for any attachments.



- Start Poltips-4, and click the About button.



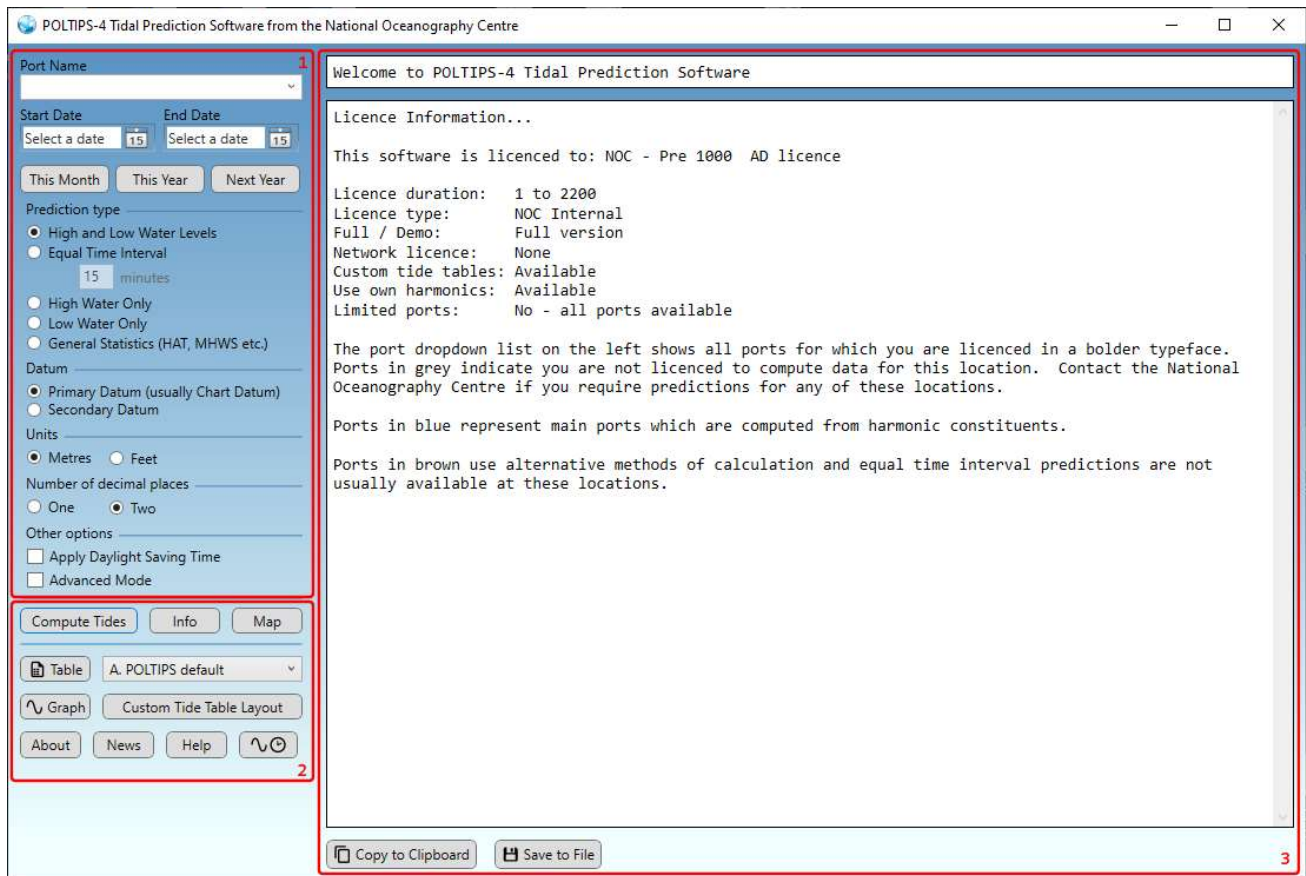
- In the dialog box that appears, click the **Install Licence** button. The file will automatically be copied from the downloads folder to C:\ProgramData\Poltips4\. You will get a message to say if the installation was successful.
- Close down Poltips-4 completely and restart it – you should see the details of your licence displayed in the output pane. Restarting Poltips is necessary to initialise the newly installed licence.

If you try to run Poltips-4 without any licence installed, you will either get an error message or it may revert back to the default demo licence which is installed with the main program.

Copying the licence file manually

Find the licence file (PT4_lic.dat). If this was emailed to you, then you will need to save this attachment onto your hard disk. Then move/copy this licence file to one of the locations on your hard disk mentioned on page 54 of this user guide.

Getting Started



Run the Poltips-4 program from your start menu by typing Poltips or double clicking the icon. You will see the Poltips-4 main window. This window is split into three main regions:

1. The data required – here you select the location, dates and preferences for the information you require. Changing any of these parameters will require you to recompute the data – the "Compute Tides" button will turn blue to show this.
2. Action buttons – chose one of these action buttons once you've set the data you require in section 1. Some actions require you to have already computed the data (for example the table and graph buttons will not do anything until you have computed some data).
3. The Output Box – information and results from Poltips will be shown here. When you first run Poltips-4, you will see the details of your current software licence. After computing tides for a location, this will display the raw data which can be copied to the clipboard or saved to a file.

Your Licence Information

The Poltips opening screen provides the following information about your licence:

- The company or individual that this copy of Poltips is licensed to.
- The durations of the licence – this is the years that the software will allow you to compute the tides for (not the period for which you can actually run the software). This means you can buy a licence which starts next year but use it to compute the tides well in advance.
- Licence type tells you if you have a standard, a publishing/custom or a user-data licence (see page 6 for more information on the different licences).
- If you are currently using a demonstration version of the software or a full version.
- If you have permission to install the software on a shared network device or not.
- If you have permission to use the custom tide tables feature or not.
- If you have permission to use your own harmonic constants in the software.
- Whether you have access to all ports in the database, or restricted some (named) ports only.

Note that you are not permitted to publish the data if you only have a standard licence.

Making A Tidal Prediction

Simply set the location, dates and preferences you require and click the **Compute Tides** button. Almost instantly, the data will be computed and displayed in the output box.

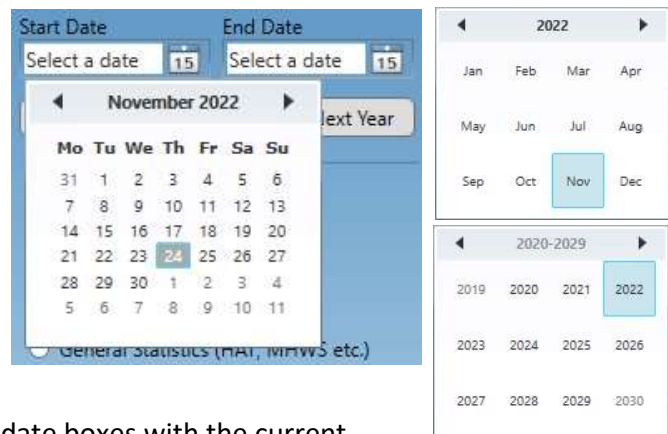
Tidal Parameters

Port Name: a drop-down list of all the locations available. Those in blue show standard ports that are computed based on harmonic constants and ports shown in brown are computed using time and height differences. Ports in grey indicate that you are not licenced to compute for that location. See page 10 for information on the different types of location.



Either choose from the list or start typing the port name and it will automatically fill in the first port beginning with those letters. Typing LON for example will show the port name LONDON BRIDGE.

Start Date and **End Date:** specify the period of data you require. Either enter the date directly in the box or click on the calendar icon and select the dates required.



An alternative way to change month and year is to click on the Month Year text at the top of the calendar (once or twice) to select any month or year quickly.

There are also buttons to automatically fill in both date boxes with the current month, the current year or the following year.

Prediction Type: select the type of data required. Not all options are available for all ports.

- High and Low waters levels: gives the time and height when the tide reaches its highest and lowest points each tidal cycle. For most location there will be 4 values per day (with 3 values around every 7th day) – these are called semidiurnal tides and are common for the majority of locations throughout the world. However, some places exhibit what are known as diurnal tides where there is only one high water and one low water each day. Ports that switch between diurnal and semidiurnal exhibit what are known as mixed tides.

Location: LONDON BRIDGE ; Datum: Chart Datum ; T-Zone: UTC ; Units: Metres		
Geographic Location: 51° 30' N, 00° 05' W		
01/01/2023	02:43	1.57
01/01/2023	08:56	6.19
01/01/2023	15:21	0.99
01/01/2023	21:33	6.22
02/01/2023	03:50	1.60
02/01/2023	09:59	6.14
02/01/2023	16:18	1.15
02/01/2023	22:38	6.13
03/01/2023	04:56	1.51

Alternatively, the times and heights of just high water or just low waters can be selected.

- Equal Time Interval: computes the height of the tide at a fixed interval of time which can be specified by the user (permitted values are 5, 6, 10, 12, 15, 20, 30 and 60. The most commonly used values are 30 or 60 minutes and these have their own unique tide table layout).

Location: LONDON BRIDGE ; Datum: Chart Datum ; T-Zone: UTC ; Units: Metres		
Geographic Location: 51° 30' N, 00° 05' W		
01/01/2023	00:00	3.16
01/01/2023	00:15	2.93
01/01/2023	00:30	2.71
01/01/2023	00:45	2.50
01/01/2023	01:00	2.30
01/01/2023	01:15	2.13
01/01/2023	01:30	1.97
01/01/2023	01:45	1.84

this shows data computed for a 15 minute time interval

- General Statistics: a summary of some of the more common tidal statistics at the selected location (e.g. Highest Astronomical Tide, Mean High Water Springs etc.) See page 24 for more information on the statistical data presented.

Datum: The level to which all heights are measured. For most locations, the first option will be Chart Datum, however a secondary datum is often available. Around the UK/Ireland, the most common secondary datums are Ordnance Datum (Newlyn, Belfast or Dublin) however Ordnance Datum (Local) is sometimes used for remote locations. Some locations may have a Special Datum (such as a dock sill and this will usually be reflected in the port name). For more information on Datums, see Appendix E.

Units: Select metres or feet (default is metres).

Number of decimal places: Select the number of decimal places required (default is two).

Daylight Saving Time: Select if you want the times of high and low water to be adjusted to account for daylight saving time (when clock move forward over the summer). It is **very important** to make sure the DST rules are set up specific for your country (see the section later in this manual on page 52).

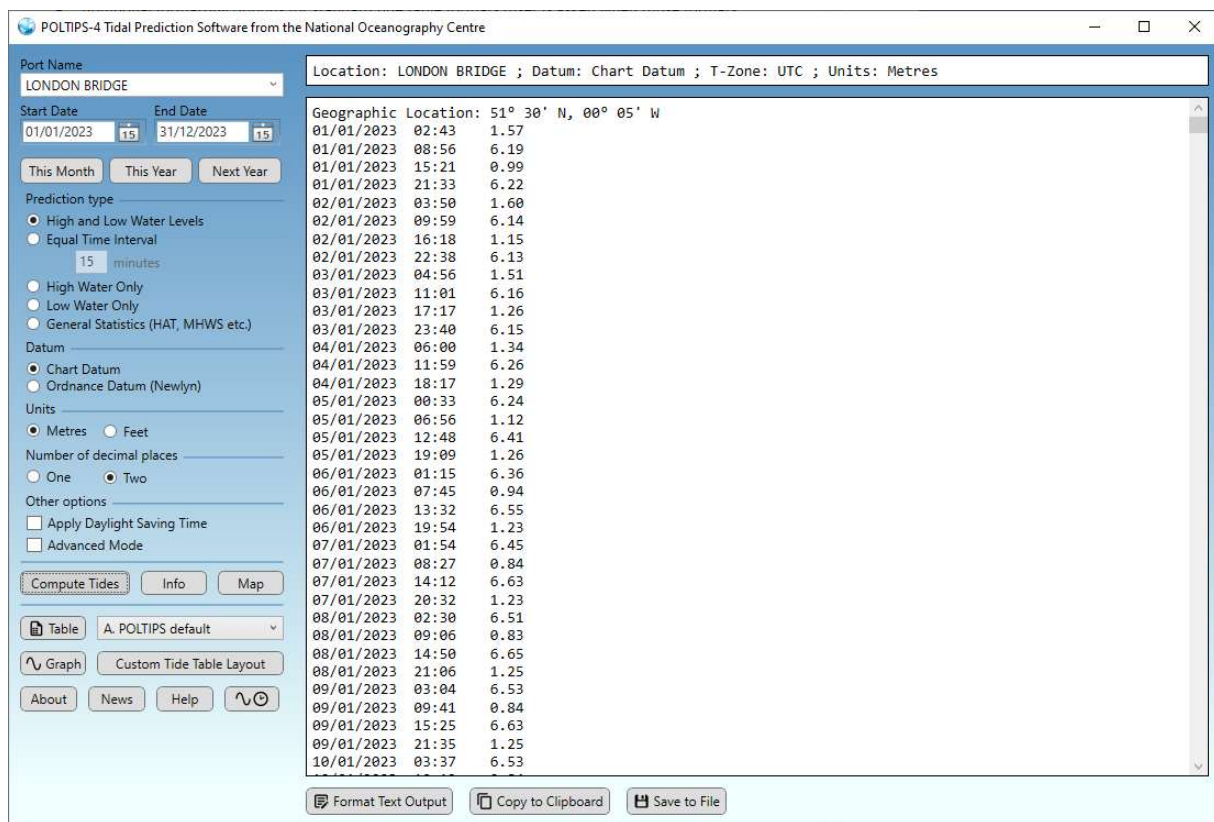
Note that daylight saving time is not available for equal time interval data or general statistics.

Advanced Mode – makes available some additional features of the software such as:

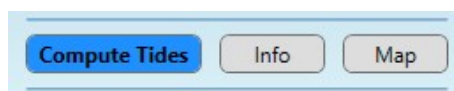
- Option to have three decimal places
- Additional formatting options for a few of the standard tide table formats
- Graph view tide-selection mode for complex tidal locations
- Additional algorithms made available for specific locations

Compute Tides

Once all the details have been specified, click the Compute Tides button. The calculated tidal data will appear in the Output Box within a second or two.



This example shows the high and low water data for London Bridge. If, after you have computed the tides, you change any of the parameters down the left-hand side, the Compute Tides button will highlight in blue to indicate that the tides shown in the output box no longer reflect the specified parameters.



Formatting the Data

When the tidal data is displayed in the output pane, you get a simple default layout of one tidal value per line (date, time and height separated by spaces). This is a simple format to understand but sometimes you may want to use the data in another piece of software such as Microsoft Excel. In this situation having the data as a **comma separated values (CSV)** file may be easier. Poltips-4 therefore offers a number of different format options accessed by clicking the **Format Text Output** button.

This will bring up the Format Text Output settings (see right) which will let you change some settings.

Layout: Select one of the options and you will see the layout in the output pane change as soon as you click confirm.

Date Format: Poltips provides different options for outputting the date. Options 1 and 2 are the most common UK formats whereas options 3 and 4 are useful to avoid confusion with people more familiar with the US date format.

Show the four main moon phases: Will output extra information to show the date on which the Moon reaches one of the four primary phases (new moon, first quarter, full moon, last quarter). The abbreviations used are:

- NM = new moon
- FQ = first quarter
- FM = full moon
- LQ = last quarter
- NO = not a primary moon phase (only appears on layout option 3)

See Appendix K for example of the text layout options.

A note about the one line per day CSV layout

This format works with any type of data (high and low waters, high waters only, low waters only or equal interval data) – the number of values per line will vary depending on the format.

Equal interval data only gives the date followed by the height values. No time information is included as this can be easily worked out. For example half-hourly interval data will have 48 height values corresponding to times of 00:00, 00:30, 01:00 ... 23:30

For High and Low Water data you will usually see 3 or 4 tides on each line, with each tide given as a time followed by a height value.

For High Waters only, this format works slightly differently. It will usually output one or two tide values (time and height) per line but these are separated into morning and afternoon tides. Sometimes you will see extra commas to show that a particular tide is missing. Here's an example...

Location: LIVERPOOL (GLADSTONE DOCK) ; Datum: Chart Datum ; T-Zone: UTC ; Units: Metres
 Geographic Location: 53° 27' N ; 03° 01' W
 Moon's Phase: NM=New Moon, FQ=First Quarter, FM=Full Moon, LQ=Last Quarter, NO=Not a primary phase

High Water Data only

01/01/2023,NO,06:32,7.76,18:52,8.11
 02/01/2023,NO,07:38,7.83,19:57,8.10
 <data removed>
 07/01/2023,NO,11:23,8.88,23:42,8.68
 08/01/2023,NO,11:57,8.94,,
 09/01/2023,NO,00:17,8.68,12:30,8.94
 <data removed>
 22/01/2023,NO,11:18,9.65,23:48,9.52
 23/01/2023,NO,,,12:07,9.91
 24/01/2023,NO,00:36,9.59,12:54,9.99
 25/01/2023,NO,01:23,9.48,13:40,9.89

	A	B	C	D	E	F
7	07/01/2023	NO	11:23	8.88	23:42	8.68
8	08/01/2023	NO	11:57	8.94		
9	09/01/2023	NO	00:17	8.68	12:30	8.94
10	10/01/2023	NO	00:50	8.63	13:03	8.87
11	11/01/2023	NO	01:24	8.52	13:36	8.75
12	12/01/2023	NO	01:58	8.36	14:11	8.57
13	13/01/2023	NO	02:35	8.16	14:48	8.37
14	14/01/2023	NO	03:15	7.94	15:30	8.15
15	15/01/2023	LQ	04:04	7.73	16:21	7.95
16	16/01/2023	NO	05:03	7.6	17:25	7.8
17	17/01/2023	NO	06:15	7.62	18:41	7.82
18	18/01/2023	NO	07:28	7.86	19:57	8.06
19	19/01/2023	NO	08:35	8.28	21:03	8.46
20	20/01/2023	NO	09:33	8.78	22:03	8.9
21	21/01/2023	NM	10:27	9.26	22:57	9.27
22	22/01/2023	NO	11:18	9.65	23:48	9.52
23	23/01/2023	NO			12:07	9.91
24	24/01/2023	NO	00:36	9.59	12:54	9.99
25	25/01/2023	NO	01:23	9.48	13:40	9.89
26	26/01/2023	NO	02:08	9.19	14:25	9.6

On the 8/01/2023, there is only one HW, but there are two extra commas at the end of the line to show the 2 missing values (time and height) are missing from the afternoon.

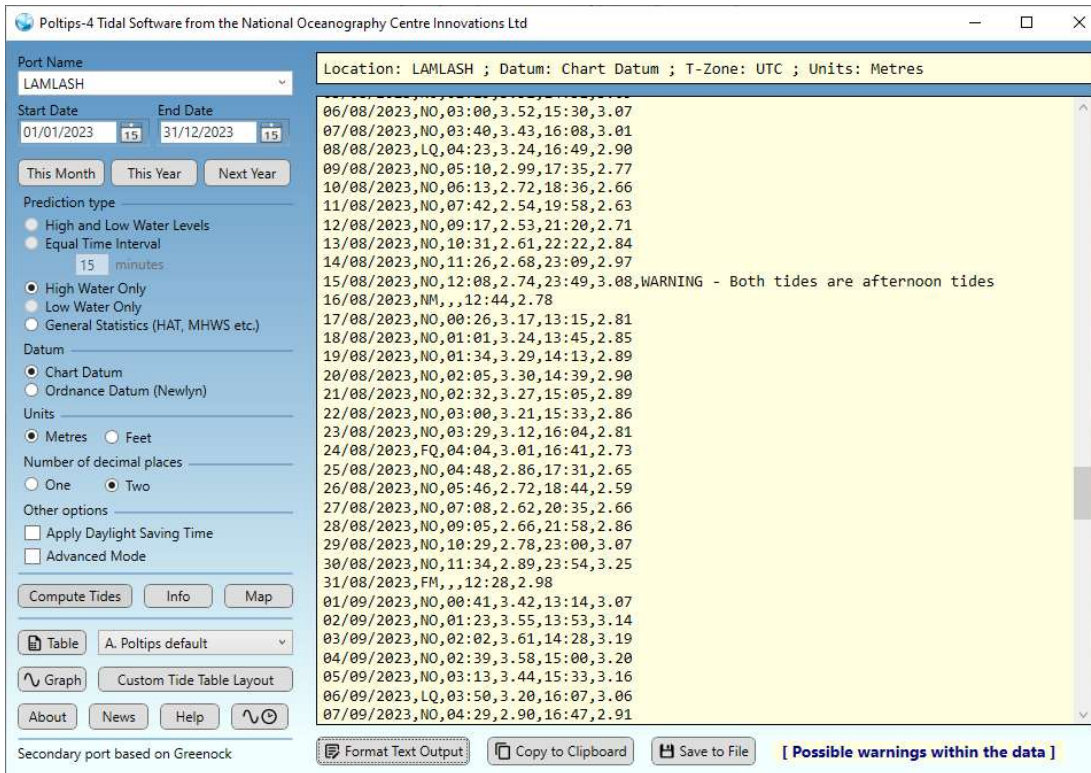
On the 23/01/2023, there is also just one tide but this occurs in the afternoon. Therefore, the extra commas for the missing data occur between the Moon's phase and the afternoon tide time.

When you load the CSV file into Excel it looks like the picture above (you can see on the 23/01/2023 it has left two blank cells before the afternoon tide).

Warning – it is possible when computing HW only or LW only for both tides to appear in the morning or in the afternoon. In this situation it will just put the two tides in as normal but it will highlight this with a warning on that line of data. Since you might not know there is a warning when you can only see the first few lines of data a few things happen.

- The background colour of the output pane turns yellow
- A message appears below saying "Possible warnings within the data"
- If you scroll through the data, the line(s) with the warning(s) on should stand out quite easily

Here's how Poltips-4 will look in this situation...



Exporting the Data

Once you have the data in a format you require you can export the raw data in one of two ways:

- Copy to the clipboard so you can paste it directly into another application
- Save the data to a text file



Simply click the button you require. Saving to a file will require you to specify a filename. By default this will open up in a folder specific to your Windows login ID (C:\Users\\Poltips4).

The format of the copied/saved data will be exactly the same as shown in the output pane of the Poltips-4 window. The default file extension will be selected based on the layout selected in the Format Text Output dialog box (either .txt or .csv).

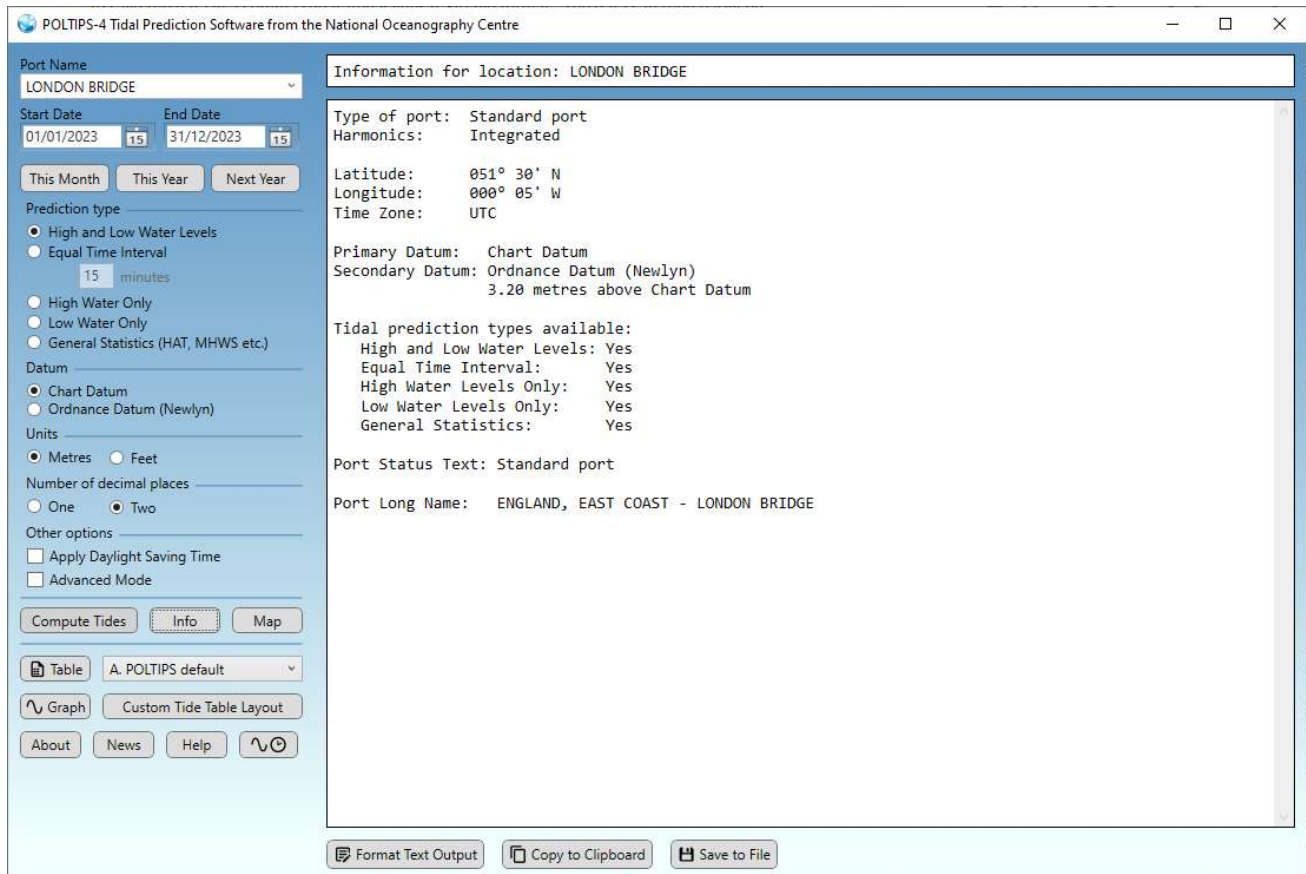
Complex Tides

For some locations, the tidal patterns can be complex. Six or more tides per day can occur which becomes a problem for tide table layouts that are limited to four or five tides on any one day.

Poltips has a couple of difference approaches for trying to identify which tides to include in the tide table and which ones to miss out. For more information on this see the section on **Dealing with Complex Tides** on page 35 of this user guide.

Getting More Information About the Location

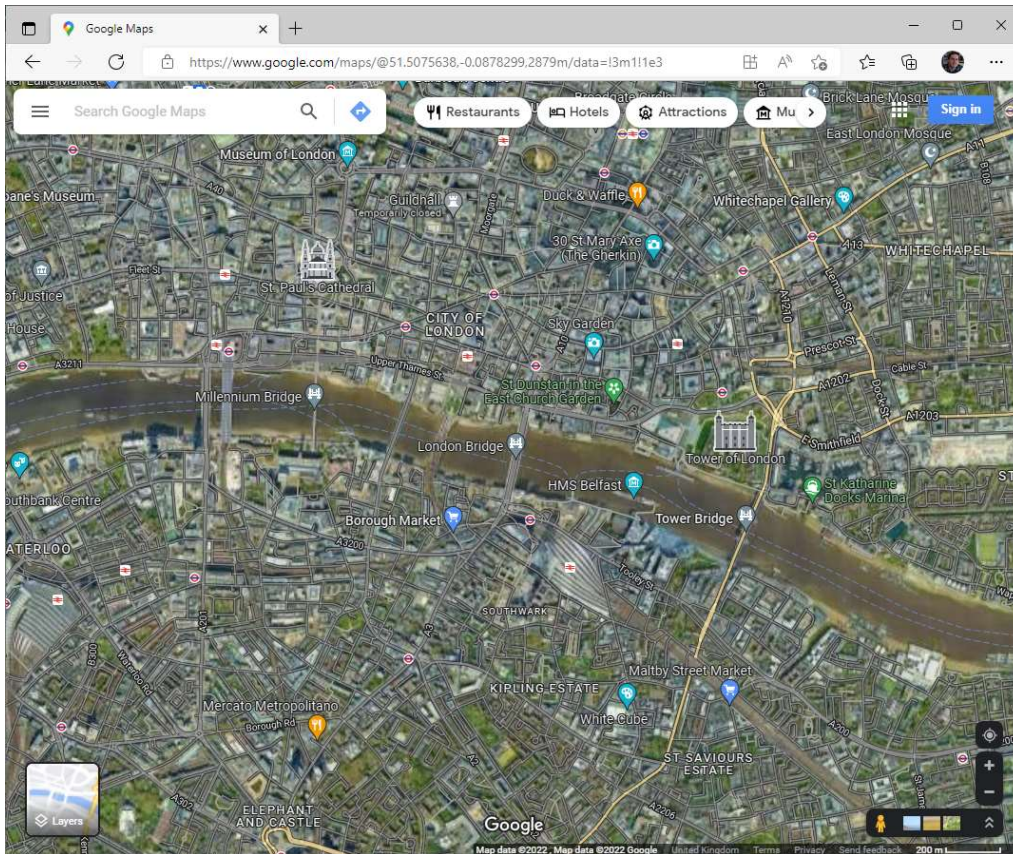
Poltips-4 offers a number of different ways to obtain additional information about the location. Clicking the **Info** button will provide basic information about the selected port.



- **Type of port** – indicates whether it is a standard port or a secondary port (see page 10)
- **Harmonics** – for standard ports, more information about the harmonics:
 - Integrated – the harmonics exist in the standard Poltips database
 - Integrated (with shallow water corrections) – special harmonics with reduced capability
 - User defined – user has included their own harmonics into the software
- **Data based on** – for secondary ports, this is the reference port on which the time and height differences are based
- **Latitude, Longitude** – approximate location
- **Time Zone** – the time zone in which the data will be computed
- **Primary Datum** – see Appendix E
- **Secondary Datum** – if available will state what this is and give the position of it relative to the primary datum
- **Tidal prediction types available** – the different types of prediction available for this location – can vary by port
- **Port status text** – some additional information on the location
- **Port Long Name** – the extended port name that is used on some of the tide table formats

Map

Clicking the **Map** button will take you to Google Maps centred on the approximate location of the selected port. This will open in a separate browser window.



Site Information and Real Time Information

If the location is one of the sites on the UK National Tide Gauge Network, clicking the **Info** button will generate two additional buttons below the output box. These both launch a separate browser windows when clicked.

Site info will provide historic and statistical information on the gauge itself.

Real Time will show the data coming straight off the tide gauge in near real-time. The blue dots represent the 15 minute readings of the water level. The red line is the predicted level. The difference between them is usually the influence of weather (meteorological) conditions such as wind or variations in atmospheric pressure.

Liverpool tide gauge site | Natick x +
 https://www.ntsif.org/tgi/portinfo?port=Liverpool

National Tidal and Sea Level Facility

Tides ▾ Storm surges ▾ Products ▾ About us ▾

Home / Tides / UK National Tide Gauge Network / Liverpool tide gauge site


Liverpool tide gauge site

The tide gauge is located within the Old Lock Keeper's Office at the entrance to Gladstone Dock. The pressure points are located on the seaward side of Gladstone Lock. Click [here](#) to see a map of the site in a separate window.

Tide gauge building

The tide gauge consists of a pneumatic bubbler system supplying two full tide pressure points. These are mounted on steelwork attached to an access ladder on the seaward side of the dock entrance. Both pressure lines, wind speed and direction are monitored by the POL data logger.

The tide gauge is levelled to the tide gauge bench mark supported by Ordnance Survey auxiliary marks.



Tide gauge location

Location	
Latitude	53° 26.981'N
Longitude	3° 1.086'W
Grid ref	SJ 3248 9525
Earliest data	1991

Tidal levels	
HAT	10.37 m
LAT	0.02 m
MHWS	9.39 m
MHWN	7.45 m
MLWN	3.16 m
MLWS	1.12 m
H for 2022	9.94 m
L for 2022	0.45 m
H for 2023	10.20 m
L for 2023	0.19 m
MSR	8.27 m
MNR	4.29 m

External users

Sea level pressures and/or elevations from this site are supplied to the following authority:

- Environment Agency, North West Region

Site history

- 1991 – DATARING system installed with two full tide pressure points and datum probe
- 1995 – Wind speed and direction instruments installed
- 2000 – POL data logger installed
- 2001 – Mid-Tide pressure point installed
- 2003 – Wind speed & direction instrument failed

Abbreviations

- HAT – highest astronomical tide
- LAT – lowest astronomical tide
- MHWS – mean high water springs
- MHWN – mean high water neaps
- MLWN – mean low water neaps
- MLWS – mean low water springs
- H – highest for year
- L – lowest for year
- MSR – mean spring range
- MNR – mean neap range

Real-time/near real-time data display for Liverpool
 https://www.ntsif.org/data/realtime?port=Liverpool

National Tidal and Sea Level Facility

Menu

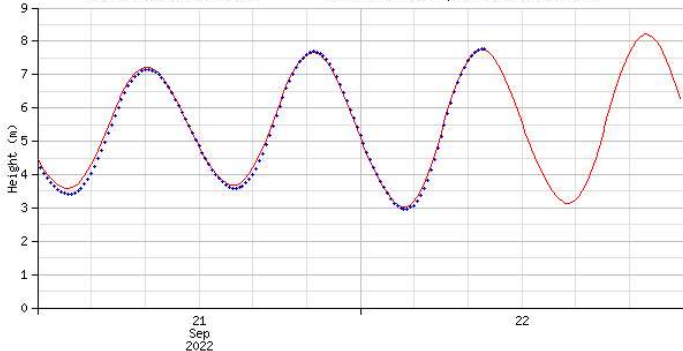
Home / Tides / UK National Tide Gauge Network / Real-time/near real-time data display for Liverpool

Real-time/near real-time data display for Liverpool

Real-time data | Tidal predictions | Check tide gauge operational status

Today & yesterday | Last week | Last month | Custom dates

Tidal elevations for Liverpool Latest value 7.78m at 9:15 GMT
 Observations (blue) Astronomical predictions (red)



General Statistics

Selecting General Statistics as the Prediction Type and clicking **Compute Tides** gives a number of different statistical calculations of the tide at the chosen port.

The screenshot shows the POLTIPS-4 Tidal Prediction Software interface. The window title is "POLTIPS-4 Tidal Prediction Software from the National Oceanography Centre". The main window is titled "Statistics for location: LONDON BRIDGE".

Port Name: LONDON BRIDGE

Start Date: 01/01/2023 **End Date:** 31/12/2023

Prediction type: General Statistics (HAT, MHWS etc.)

Datum: Chart Datum

Units: Metres

Number of decimal places: Two

Other options: Daylight Saving not available, Advanced Mode

Compute Tides (button)

Table (button) | A. POLTIPS default (dropdown)

Graph (button) | Custom Tide Table Layout (dropdown)

About (button) | **News** (button) | **Help** (button) | **Copy to Clipboard** (button) | **Save to File** (button)

Statistics for location: LONDON BRIDGE

Location: 51° 30' N, 00° 05' W
 Selected Period: 01-Jan-2023 to 31-Dec-2023
 Status Information: Standard port
 Datum of information: Chart Datum
 Additional Datum Info: Chart Datum is 3.20 metres below Ordnance Datum (Newlyn)
 Time Zone for Data: UTC

Prediction Types: High/Low Waters Fixed Interval HW only LW only

Highest Tide in period: 7.50m on 02-Sep-2023
 Lowest Tide in period: -0.19m on 02-Sep-2023
 Highest Tide Possible: 7.66m on 30-Sep-2015
 Lowest Tide Possible: -0.25m on 12-Aug-2010

Mean High Water Springs: 6.8m
 Mean High Water Neaps: 5.4m
 Mean Low Water Neaps: 1.9m
 Mean Low Water Springs: 0.5m

Mean High water: 6.1m
 Mean Low water: 1.2m

Mean Range: 4.9m
 Mean Spring Range: 6.3m
 Mean Neap Range: 3.5m

Tide type: 0.082 (Semi-diurnal)
 Shallow Water Influence: 0.060 (Very low shallow water influence)
 Mean High Water Interval: 1.15 hours
 Age of the tide: 66.25 hours

The general statistics output shows some basic information about the port as well as a number of different statistical results. A few of these require the calculation of a long period of data so this can sometimes take a few seconds to compute (depending on the speed of your computer).

- Highest/Lowest tide in period: the highest and lowest predicted values in the specified period (between the start and end dates). The height is given, along with the date it occurs.
- Highest/Lowest tide possible: these are commonly known as the Highest Astronomical Tide (HAT) and Lowest Astronomical Tide (LAT) and are computed by calculating the tides for a 20 year period (1997 to 2016) at the specified location and extracting the highest values. It will also show the date it occurred.
- Mean High/Low Water Springs/Neaps: computed either directly from the harmonics (in the case of standard ports) or derived directly from the Poltips database (for secondary ports). This information is only given to the nearest 10cm.
- Mean High/Low water: derived directly from harmonics and will not be shown for secondary ports.
- Mean Range / Mean Spring Range / Mean Neap Range: the average difference between high water and low water.
- Tide Type: A numerical value that indicates the tidal characteristics at the location.

Value	Tide Type
0.00 to 0.25	Semidiurnal
0.25 to 1.50	Mixed tide (mainly semidiurnal)
1.50 to 3.00	Mixed tide (mainly diurnal)
greater than 3.00	Diurnal

- Shallow Water Influence: A numerical value that gives an indication of how complex the tidal patterns are.

Value	Description
less than 0.1	very low influence – tide should have a typically sinusoidal profile.
0.1 to 0.2	moderate influence – tide may show slightly unusual features, particularly during neap tides.
0.2 to 0.3	significant influence – tide is complex and will probably have more than 4 tides per day.
greater than 0.3	very significant influence – tide may have a very unusual profile, possibly switching between semidiurnal and diurnal tides. Will certainly show more than 4 tides per day.

- Mean High Water Interval: sometimes known as the *lunitidal interval*, this is the time between the Moon's transit and the next high water. This value is sometimes used by tidal watches which can give a rough estimate for the times of high water.
- Age of the tide: this is an old term for the lag between new or full moon and the maximum spring tidal range. This is usually between 30 and 48 hours although it can be as low as just a few hours or in excess of 60 hours.

Producing Tide Tables

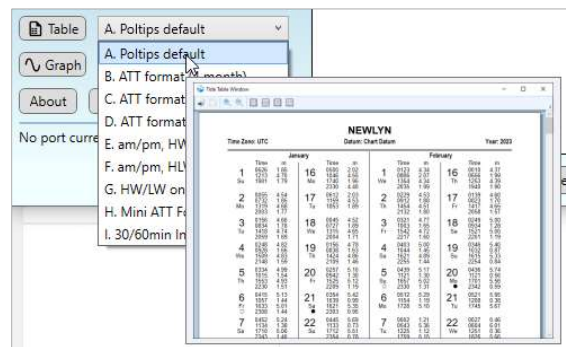
Once data has been computed, you have the option to generate a fully formatted tide table. There are a number of different preset layouts as well as the option to tailor your own layout using the custom tide table feature.

If you want to produce a PDF file from the tide table layout you will need to use a third-party PDF generator (the most popular being Adobe Acrobat Pro). These will install an additional printer driver which you can select when printing from the tide table window but which will create a PDF file rather than send the data to an actual printer.

Preset Layouts

Select a layout from the drop-down list and then click the 'Table' button. The various preset layouts are designed to work with different types of tidal data.

- Formats A-D, F and H will work with high and low water data or HW/LW only data.
- Formats E and G will only work with 'high water only' or 'low water only' calculations.
- Format I is for fixed interval data (it currently supports both 60 and 30 minute data).



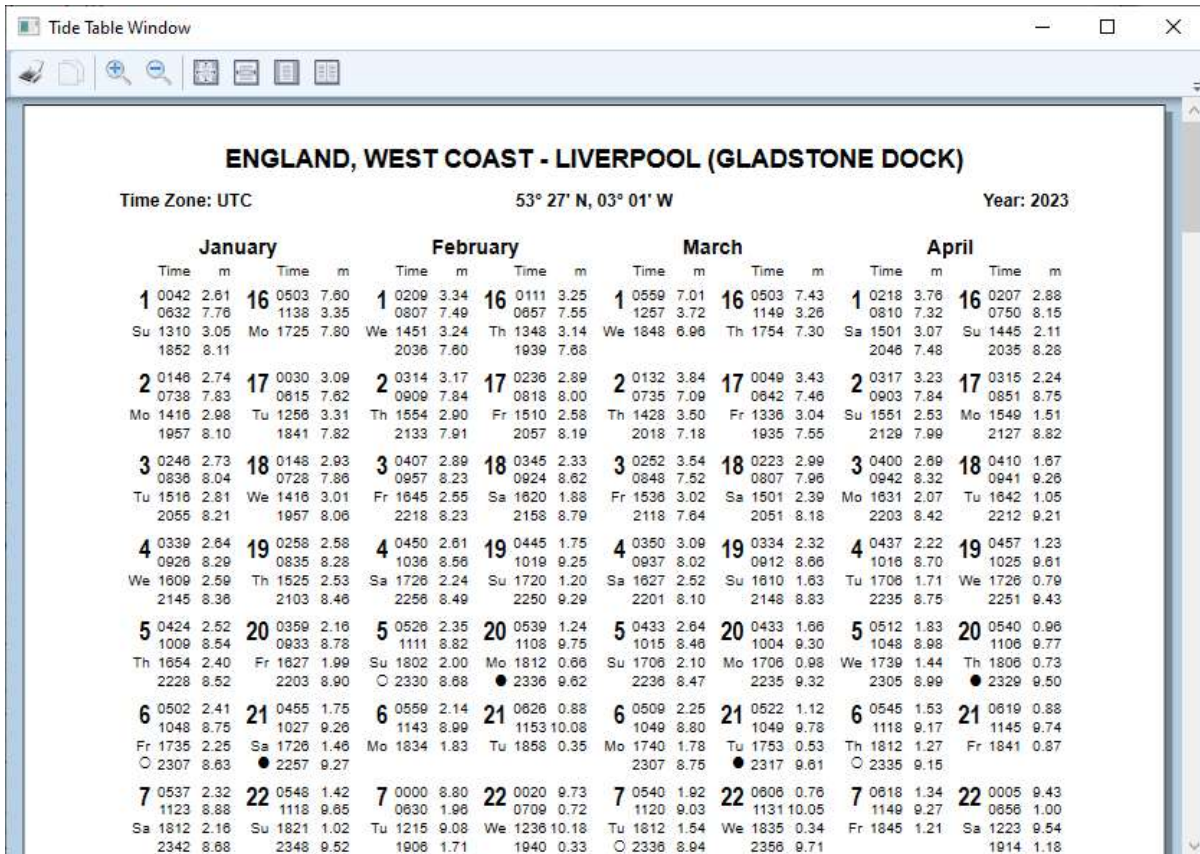
If you choose a format that is not suitable for the data computed you will get a warning message suggesting a different layout be selected.

Hovering the mouse cursor over one of the preset layouts will show a small image preview of the tide table layout.

Appendix L has samples of the different tide table layouts.





Tide tables appear in a separate window once they've been generated. They are displayed in a document style viewer that allows you to zoom in/out, scroll and print the complete table.

Up to three tide table windows can be open at one time. These can be different layouts for the same location or for completely different locations (just compute a different location and click the 'Table' button again).



Note that formats G and I are designed to be printed in landscape format. Although many modern printers will automatically detect this and print the pages correctly, some printers require you to manually change the printer page orientation in the print settings dialog box to landscape before printing one of these tide tables.

Four of the toolbar buttons inside the document viewer allow you to set the zoom to a preset size easily. Each button has a shortcut key:

				
100% scaling	Page width	Whole page	Two pages	
Ctrl + 1	Ctrl + 2	Ctrl + 3	Ctrl + 4	

A quick option to zoom is hold down the control key and move the mouse wheel.

Options not available:

- Copy tide table to clipboard – if you require an image of the tide table in another application, maximize the tide table window and then use the Alt+PrintScreen key to capture the window, or use the Microsoft Snipping Tool. Alternatively generate a high-resolution PDF file using one of the many PDF generators available from third parties (some are freely available).
- Printing subset of pages – if you only require a couple of months of data, compute just the data you require. Tide tables do not need to be complete years

Some formats have extra 'advanced mode' options that are available only when 'Advanced Mode' is enabled before you click the 'Table' button. The table below shows which options are available on the different preset layouts.

Option...	Tide table selected...								
	A	B	C	D	E	F	G	H	I
Lines shown on tide table	✓					✓			
Empty slots on tide table filled					✓	✓	✓		
Slot filled statement added					✓				
Border on tide table					✓				
Daylight saving time statement added							✓		
"British Summer Time" over "Daylight Saving Time"							✓		

When advanced mode is selected you get additional dialog boxes appear to ask your preference.

AM/PM Tide Table Formats

Formats E and F are slightly different from the other formats in that they allocate the tides into either a morning or afternoon column. This can lead to potential issues for some locations where it is possible to get two turning points in the same morning or afternoon. This image shows format F.

SHEERNESS			JANUARY 2023							
Date	High Water				Low Water					
	Morning		Afternoon		Morning		Afternoon			
	Time	m	Time	m	Time	m	Time	m		
1 Su	07:30	5.06	20:21	5.04	01:03	1.54	14:03	1.10		
2 Mo	08:38	5.01	21:24	5.04	02:10	1.55	15:05	1.18		
3 Tu	09:42	5.04	22:21	5.11	03:18	1.48	16:03	1.22		
4 We	10:41	5.13	23:12	5.20	04:20	1.34	16:54	1.21		
5 Th	11:31	5.24	23:56	5.30	05:15	1.17	17:36	1.18		
6 Fr			12:16	5.34	06:03	1.03	18:15	1.13		
7 Sa	00:36	5.36	12:56	5.40	06:46	0.94	18:51	1.10		
8 Su	01:11	5.39	13:32	5.41	07:25	0.89	19:24	1.09		
9 Mo	01:44	5.39	14:06	5.41	08:00	0.87	19:55	1.08		
10 Tu	02:15	5.38	14:39	5.38	08:33	0.86	20:27	1.08		
11 We	02:48	5.35	15:14	5.33	09:06	0.87	21:00	1.13		
12 Th	03:21	5.30	15:50	5.25	09:40	0.92	21:34	1.22		
13 Fr	03:55	5.21	16:28	5.14	10:15	1.00	22:09	1.33		
14 Sa	04:33	5.12	17:11	5.02	10:50	1.09	22:48	1.43		
15 Su	05:16	5.02	18:01	4.90	11:31	1.17	23:37	1.53		
16 Mo	06:11	4.91	19:03	4.83			12:24	1.25		
17 Tu	07:20	4.85	20:13	4.85	00:42	1.60	13:36	1.31		
18 We	08:37	4.91	21:24	4.98	02:03	1.59	15:00	1.27		
19 Th	09:51	5.10	22:30	5.18	03:27	1.42	16:14	1.14		
20 Fr	10:57	5.37	23:30	5.37	04:41	1.18	17:18	0.99		
21 Sa	11:57	5.64			05:49	0.92	18:16	0.87		
22 Su	00:23	5.55	12:50	5.86	06:50	0.66	19:08	0.77		

You can see that for most days there will be a tide in all four columns (morning HW, afternoon HW, morning LW, afternoon LW). However on some days one of them will be missing as around every 7 days, there will only be three tides on that day.

Some people prefer the empty slots to be filled with an arbitrary character so it is clear that it's not just missing data. This is an option that is available in advanced mode.

4	We	10:41	5.13	23:12	5.20
5	Th	11:31	5.24	23:56	5.30
6	Fr	###:##	#####	12:16	5.34
7	Sa	00:36	5.36	12:56	5.40
8	Su	01:11	5.39	13:32	5.41

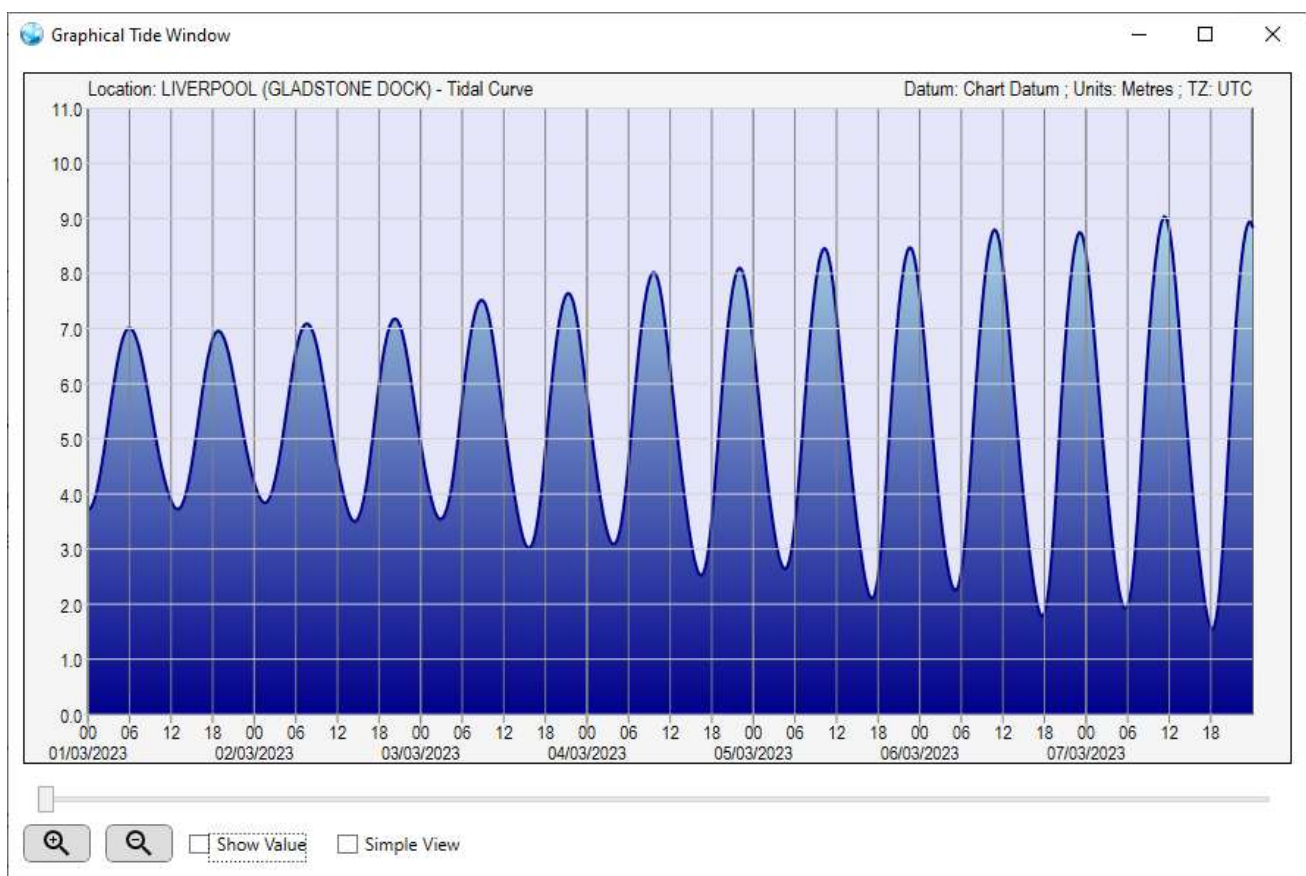
Tidal Graphs

Poltips-4 gives you the option to look at the tidal data graphically. How this appears depends on whether you are looking at equal interval data or high/low water data.

To view the graph, simply click the **Graph** button after computing the data. As with tide tables this will appear in a separate window and you can have up to three graph windows open at once.

Equal Interval Tidal Graphs

If you compute tidal data at an equal interval you will get a graph that looks something like this...



The shorter the time interval, the smoother the tidal curve will look (5 to 15 minutes recommended).

If you compute more than 7 days of data you will see the first 7 days, otherwise you will see the period you have requested.

The vertical axis will scale automatically so as to be able to show the highest and lowest values in the computed data.

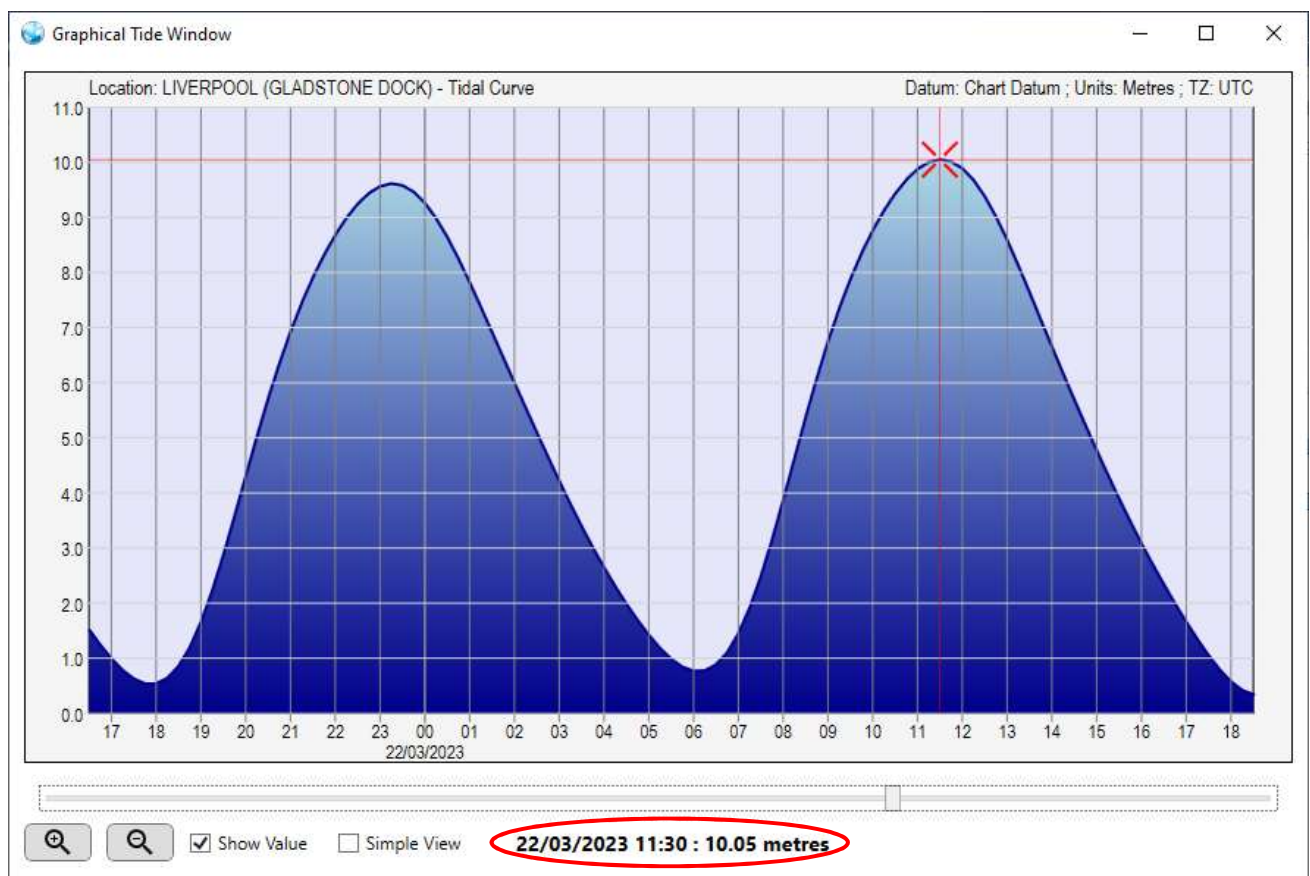
Scroll horizontally through the data using the slider bar underneath the data.

Zoom in on the graph using either the buttons at the bottom, or using the scroll wheel on your mouse. Although the graph will initially show you the first 7 days of data from your current prediction, you can zoom out further to see more data if you require up to a maximum of 31 days.

The **Simple View** option removes some of the colour from the graph which may be useful if you use the image within other software such as PowerPoint, or for printing purposes where less ink/toner will be used.

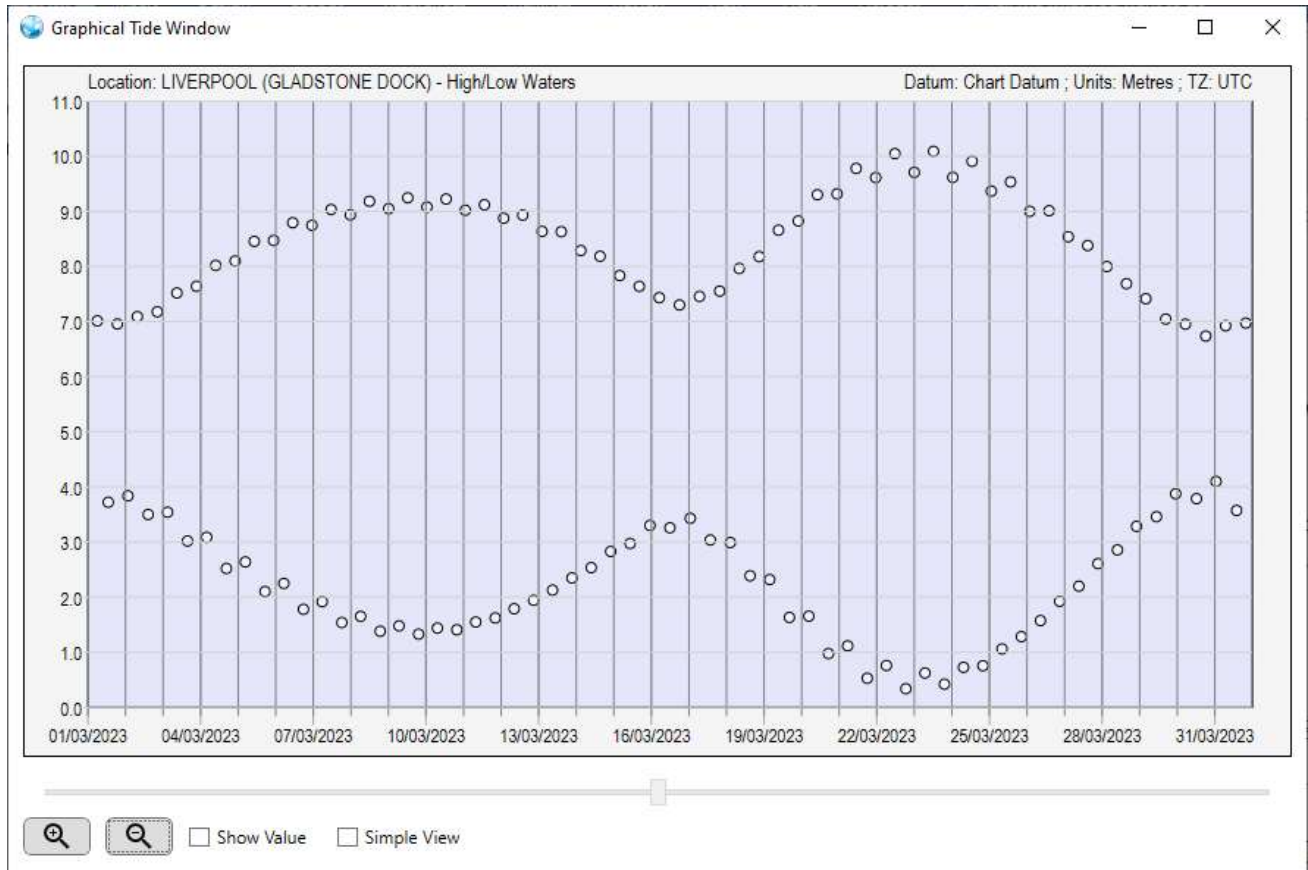
Show Value

You can read off the data directly from a graph by making sure the **Show Value** box is checked, and then hovering your mouse pointer over the graph. The date, time and height are shown beneath the graph for the location shown by the red cross.



High and Low Water Tidal Graphs

If you have computed high and low water data, then you can still produce a graph that will look something similar to this...



The graph above shows a whole month of high and low waters. You can clearly see the spring-neap cycle which gives higher than average tides around the 10th and 23rd March (spring tides), and lower than average tides around 1st, 17th and 31st March (neap tides).

As with the equal interval graphs, you can read off individual values by checking the **Show Value** box and hovering your mouse over the graph.

For locations with complex tides, some of them may have been removed to leave a maximum of 5 on any one day. The removed tides are shown as red dots. See the section on Complex Tides on page 35 for more information.

Custom Tide Table Layout

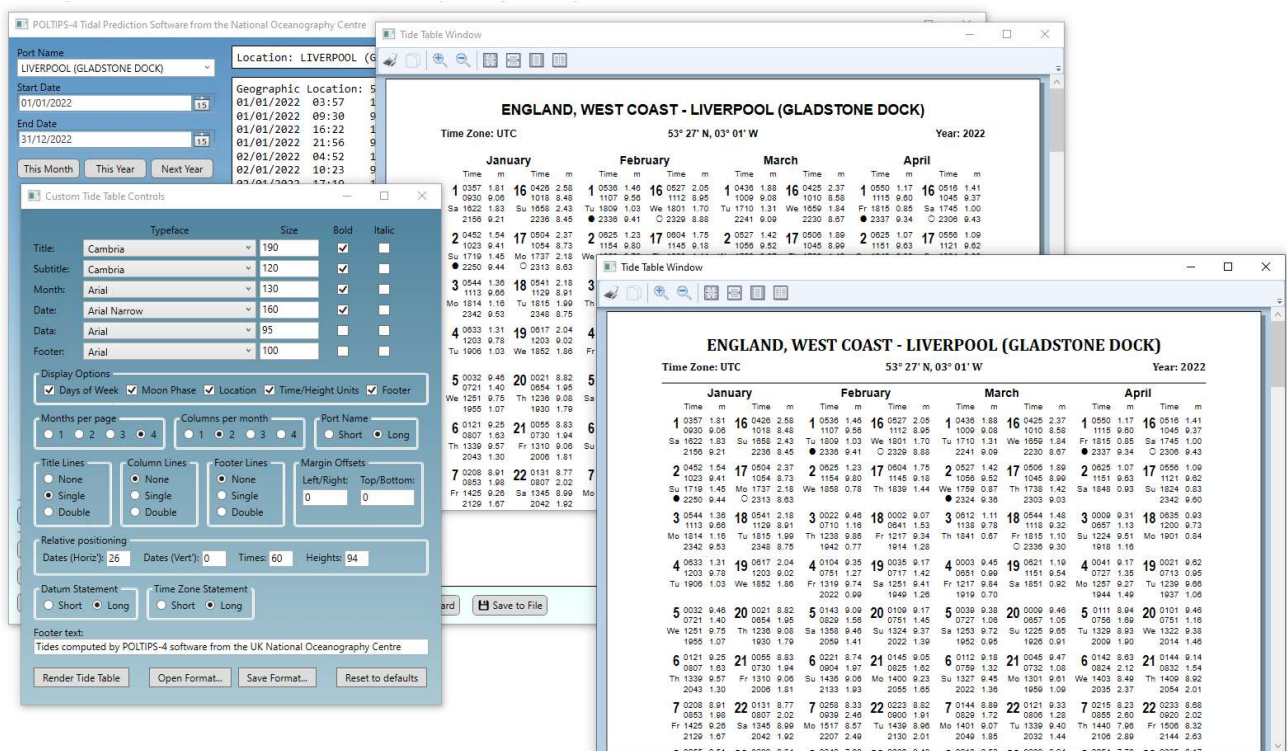
If you want to generate a tide table layout that is a little different from the preset tables, then Poltips-4 provides you with the capability to create your own.

Compute your high and low water data as normal but then click the **Custom Tide Table Layout** button.

You will get the usual Tide Table Window appearing, however you will now also get a second dialog box with a number of different options that allow you to fine tune the tide table.

If you make any changes to the options in the Custom Tide Table Controls dialog box, then simply click the **Render Tide Table** button to bring up an additional window. You can have up to three tide table windows open at once to allow you to compare the different layouts you create.

When you are happy with a layout, you can click the **Save Format** button to save all the parameter settings so that you can open that format again in the future. You can always revert back to the default layout by clicking the **Reset to defaults** button at any time.



Fonts (Typefaces) Available in Custom Tide Table Layout

Seven of the more popular fonts found in Windows are available for selection when creating a custom tide table layout. These are: Arial, Arial Narrow, Calibri, Cambria, Consolas, Times New Roman and Verdana. These should be available on nearly all Microsoft Windows based computers all have very clear rendering of the numeric characters which are obviously important for tide tables.

Font sizes are specified in an arbitrary internal unit which allows the more precise specification of the size of the font. Change the values and re-render the tide table until you get the text the precise size you require.

Arial 1 2 3 4 5 6 7 8 9 0	Arial Narrow 1 2 3 4 5 6 7 8 9 0	Calibri 1 2 3 4 5 6 7 8 9 0
Cambria 1 2 3 4 5 6 7 8 9 0	Consolas 1 2 3 4 5 6 7 8 9 0	Times New Roman 1 2 3 4 5 6 7 8 9 0
Verdana 1 2 3 4 5 6 7 8 9 0		

Margin Offsets

This allows you to increase or decrease the default margins around a tide table. A setting of zero means the default margins will be used; any other number changes the margins by that percentage of the page width/height.

Relative Offsets

Allow you to move the position of the date (horizontally and vertically), the tide times and the heights (horizontally only). You can use them to subtly change the spacing or you could for example swap around the position of the times and heights. These are specified as a percentage position within the cell for that day (a cell is shown in the image on the right).

	Time	m
1	0150	9.00
Sa	0842	2.15
	1415	8.70
	2059	2.36

Port Name (short or long)

Some ports have both a short and long name. They are usually in a format like this:

- Short name: LIVERPOOL (GLADSTONE DOCK)
- Long name: ENGLAND, WEST COAST – LIVERPOOL (GLADSTONE DOCK)

Not all ports have a long port name, in which case the short name will be used instead.

Datum Statement (short or long)

The short datum statement just states what the datum is for the prediction. The long datum statement will give the datum as well as showing the position of it relative to the secondary datum. For example, the datum statements for Liverpool are:

- Short datum:
- Chart Datum
 - Ordnance Datum (Newlyn)
- Long datum:
- Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)
 - Ordnance Datum (Newlyn) : 4.93 metres above Chart Datum

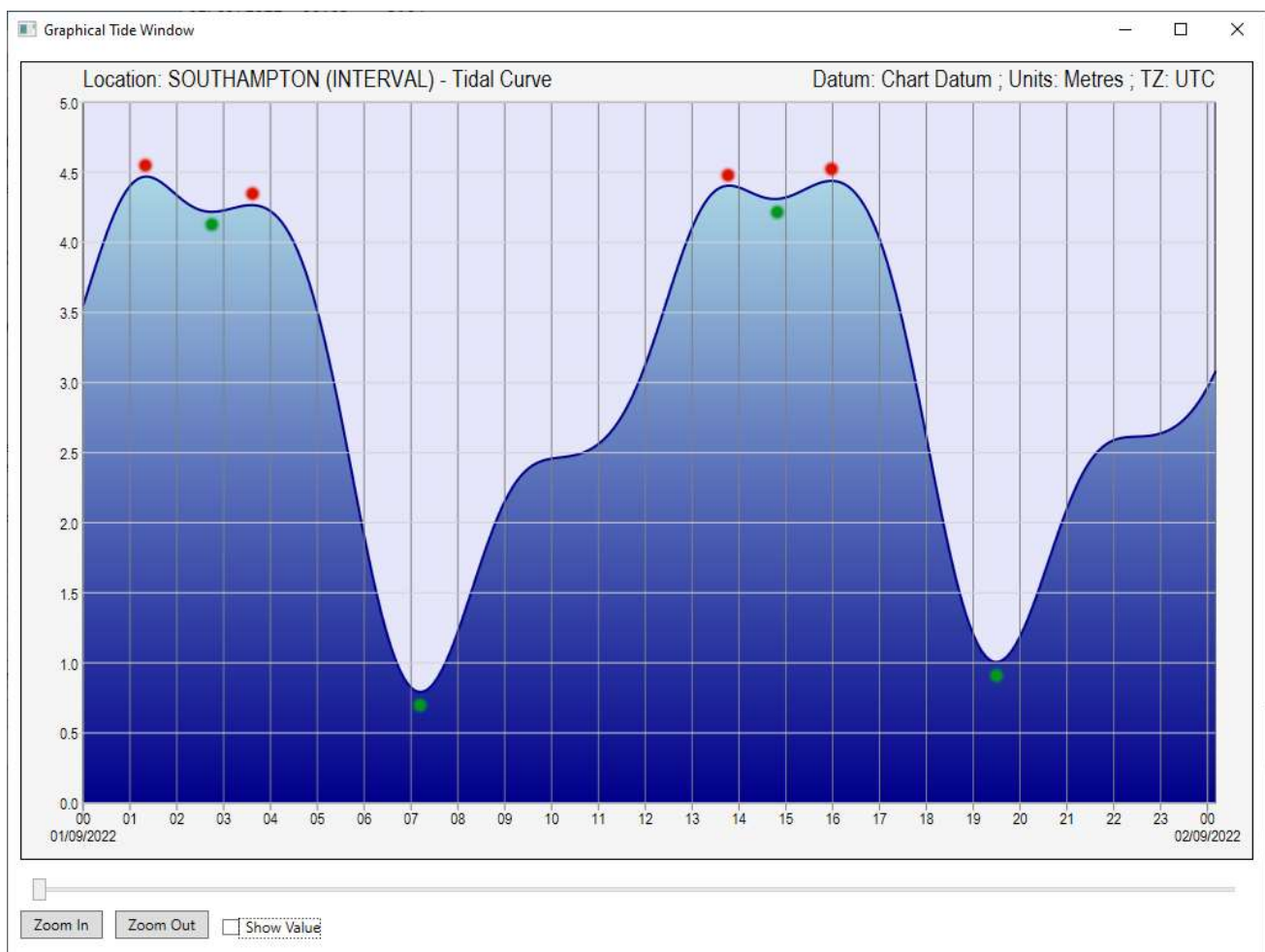
Dealing with Complex Tidal Locations

Most locations around the world exhibit what are known as semidiurnal tides – meaning there are on average two tidal cycles per day (two high tides and two low tides). Most tide tables are designed on this basis and allow for 4 (or occasionally 5) tides on any given day.

	Time	m
1 Sa	0150	9.00
	0842	2.15
	1415	8.70
	2059	2.36

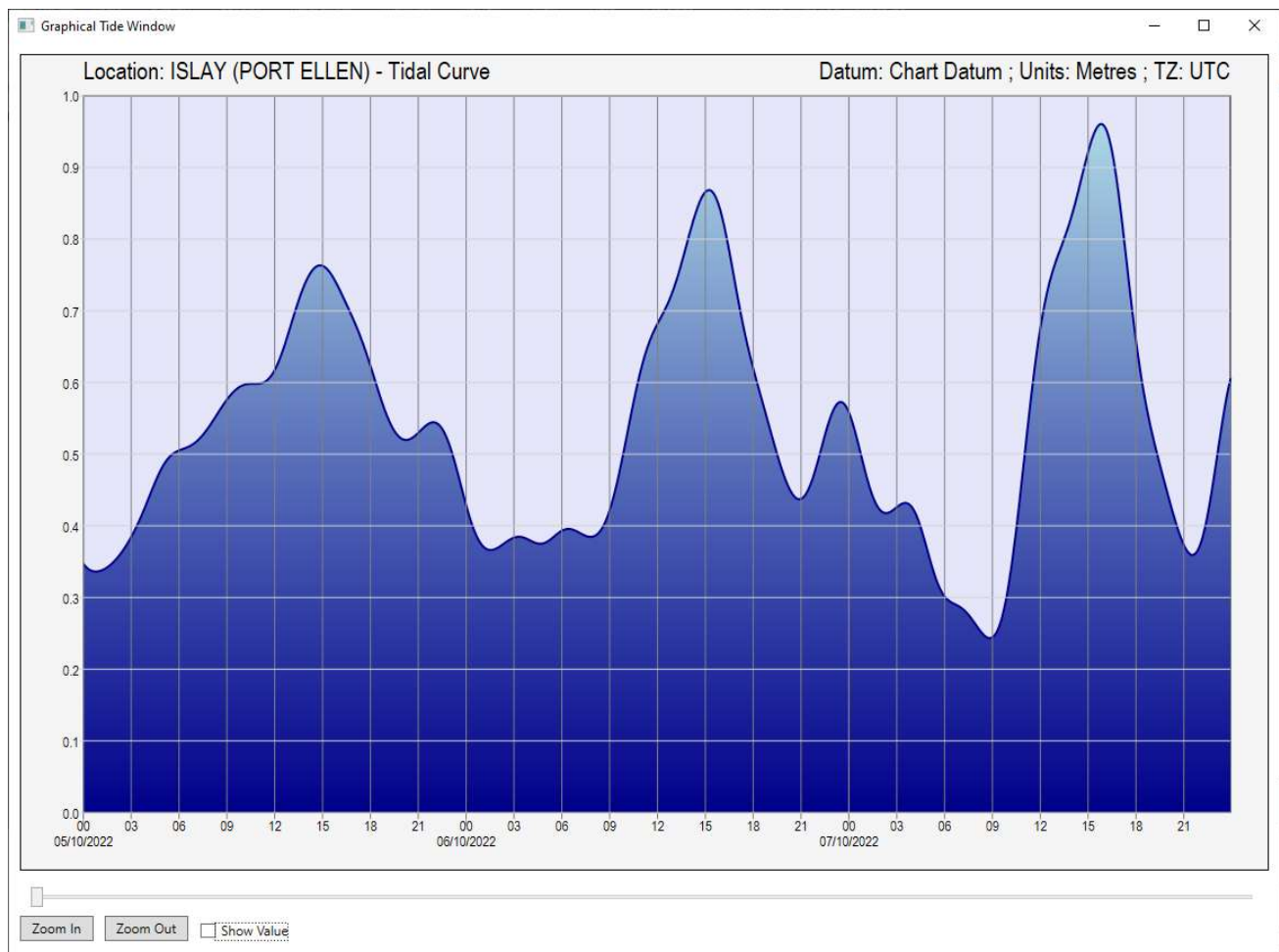
Some locations however may exhibit more unusual tidal behaviour such as additional turning points, ripples on the rising or falling tide or times in the year were the tide almost completely disappears. These locations can be problematic for tide tables that aren't suitable in situations when there may be 6 or more tides on a day.

The graph below shows a typical spring tide at Southampton where 8 turning points can be seen in a 24 hour period (4 high waters marked with red dots, and 4 low waters marked with green dots).



You can see that the four high waters all have a valid claim to be classed as high waters, however two of the low waters are just the minima turning point between the high waters. This is why Southampton is generally referred to as a double high-water port.

Some locations have even more complex tides that make it hard to identify if the port is a double high water or double low water.



This tidal graph shows the tide at Islay (Port Ellen) over 3 days. Since the primary purpose of Poltips is the production of tide tables, picking out just 2 high waters and 2 low waters on each day is an important feature. The software must distinguish between the 'real' turning points and the secondary turning points such as ripples, or the 'low' waters that occur between a double high water.

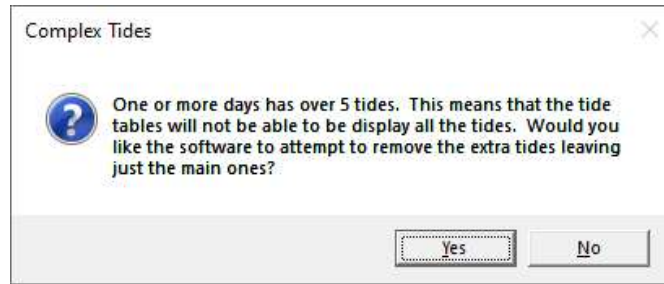
Dealing with more than 4 tides per day

After computing the high and low waters for the requested time period, Poltips will count the number of tides on each day. If the maximum number on any day is four, then there will not be any issues with the standard tide table layouts.

If there is a maximum of 5 on any one day, then Poltips will adjust the spacing of the tide table to fit in the extra tide (see right).

7	0651	2.11
	1151	0.61
	1327	0.72
	1515	0.63
8	1917	1.89
	0004	0.56
	0729	2.14
	1229	0.58
Su	1402	0.68
	1547	0.61

On any day where there are more than 5 tides, the tide table won't be able to displaying all of them. Therefore the user will be informed, and asked if they want Poltips to attempt to identify the primary tides, and delete the secondary ones to bring the maximum on a day to 5 or less.



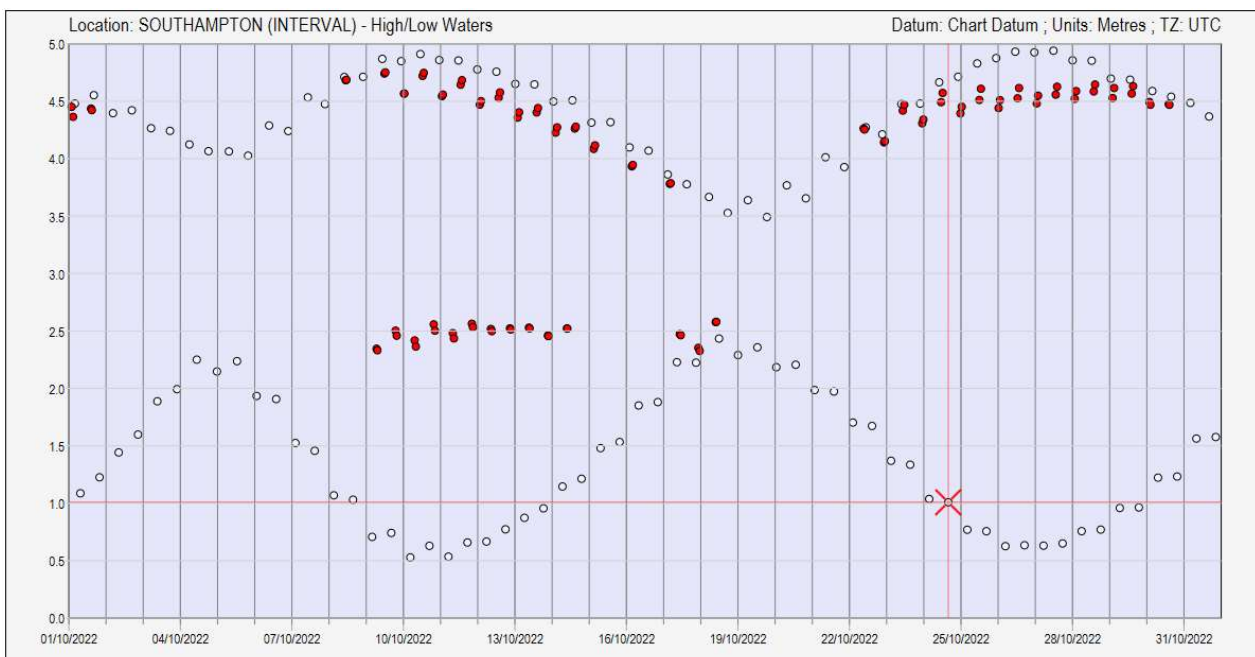
If the user clicks 'Yes', then the software will remove extra tides based on one of two algorithms.

- Identify if the tide is a double high water or double low water. If a double-HW, then retain the first HW, even if this is not the highest of the two. This creates better consistency in the timing of the high waters.
- Always retain the highest HW and the lowest LW in each tidal cycle. This may cause the tides to appear to jump around more erratically in time.

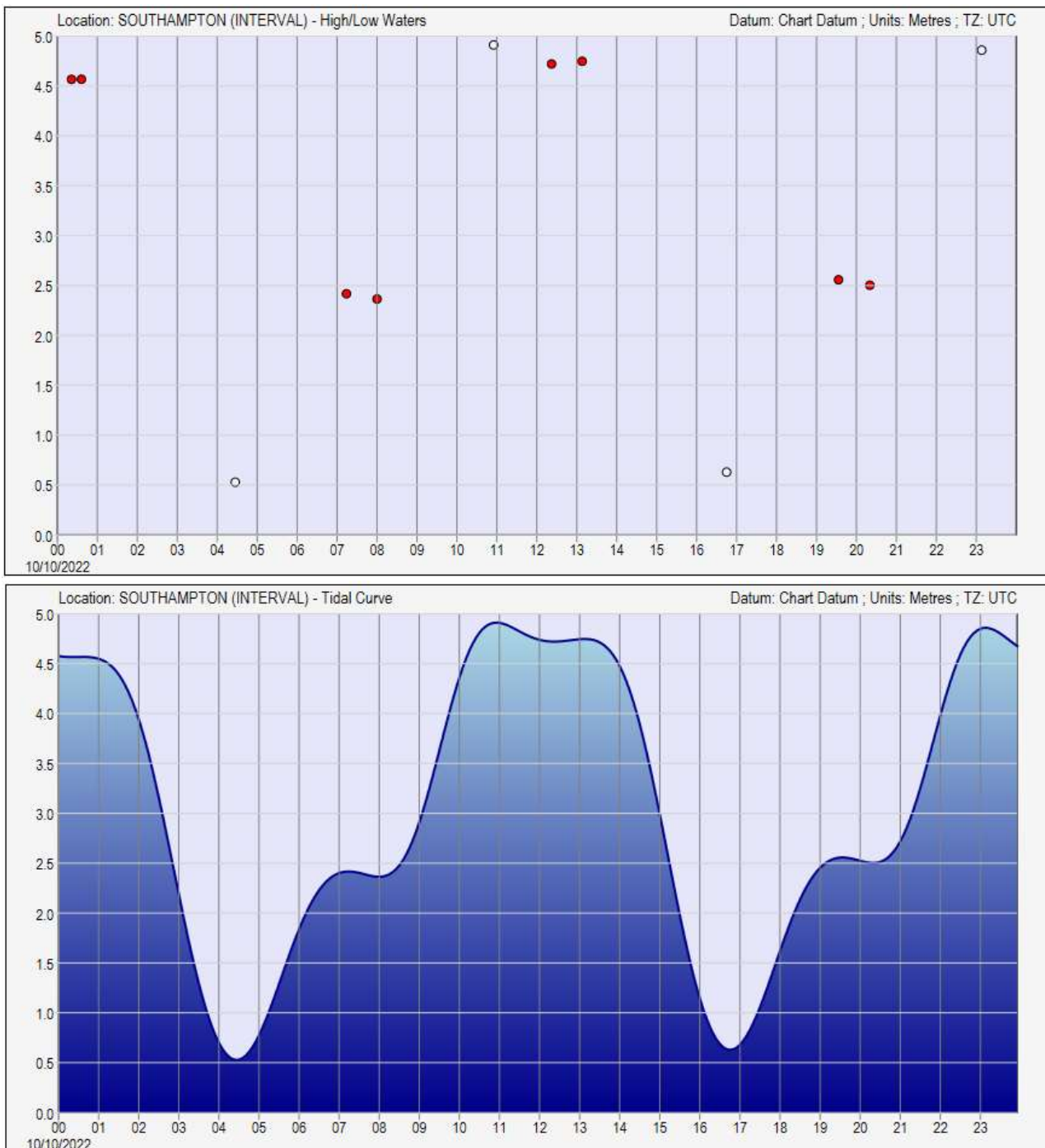
The algorithm used is dependent on the location and is set by the NOC to best suit the location.

What happens to the removed tides?

When tides are removed by one of the two algorithms mentioned above, they are actually still left in the data, but flagged as tides that should not be shown on the tide tables. You can see these tides if you look at the graph of the turning points. Here's an example showing the high and low waters for Southampton. White dots represent what the software considers the primary tides, and the red dots are flagged as secondary tides and will not be shown on a tide table.



If you look at just one day, the double high water here occurs around midday, however there are other turning points that have also been removed. You can see those clearly when you look at the tidal curve by plotting the graph of the 5-minute predicted data (lower graph).



Poltips has correctly identified the first high water and removed the ripples on the rising tide, the 2nd high water, and the 'low water' between the two high waters, which has reduced the number of tides on that day from 12 down to 4 allowing it to be output in a traditional tide table layout.

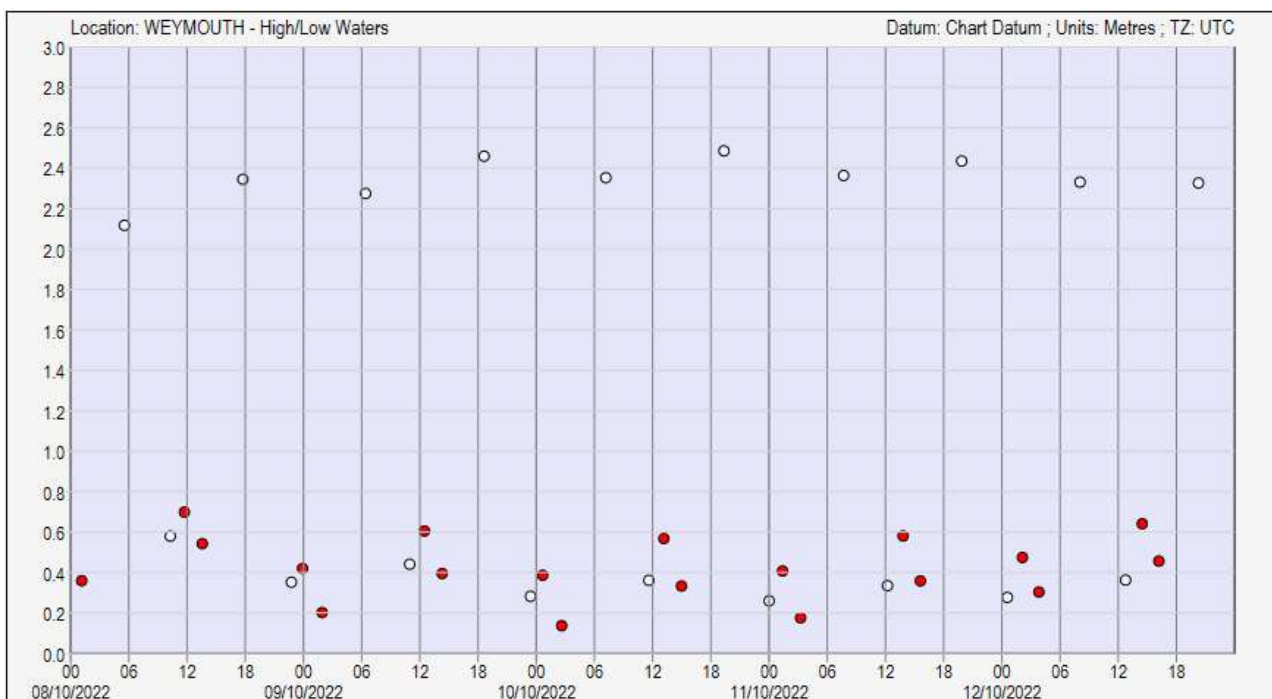
There may be rare times when the software does not correctly identify the primary tide, or you personally would prefer a different turning point be used on the tide table.

Tidal Manipulation (Advanced Mode Feature)

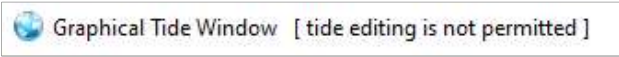
Read this part of the user guide carefully before you use this feature.

This feature is only available when you have computed data for a location with more than 5 tides per day. The Advanced Mode box must be checked to use this feature and therefore it may not be available for all types of licence.

To illustrate this feature, let's look at the tides for Weymouth that has a double low water. For this location Poltips will always select the **first** low water rather than the **lowest** low water. Most of the time the heights are quite close, but you may decide that if the second one is noticeably lower than the first, that you would prefer to have the second LW on the tide table instead of the first.

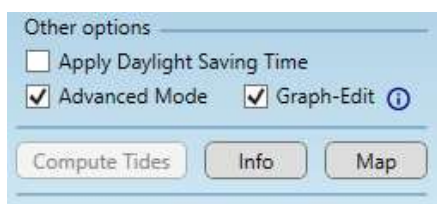


To alter the tides that have been selected, you need to enable the 'Graph-Edit' mode. Without this enabled, the top of the Graph Window will look like this...

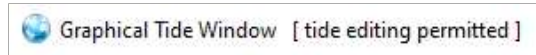


Follow these steps to enable graph editing mode:

- Close any open graph windows, then turn on the Advanced Mode
- Check the Graph-Edit box which appears in the main window under **Other options**.



- Click the graph button – the top of the Window should now look like this...

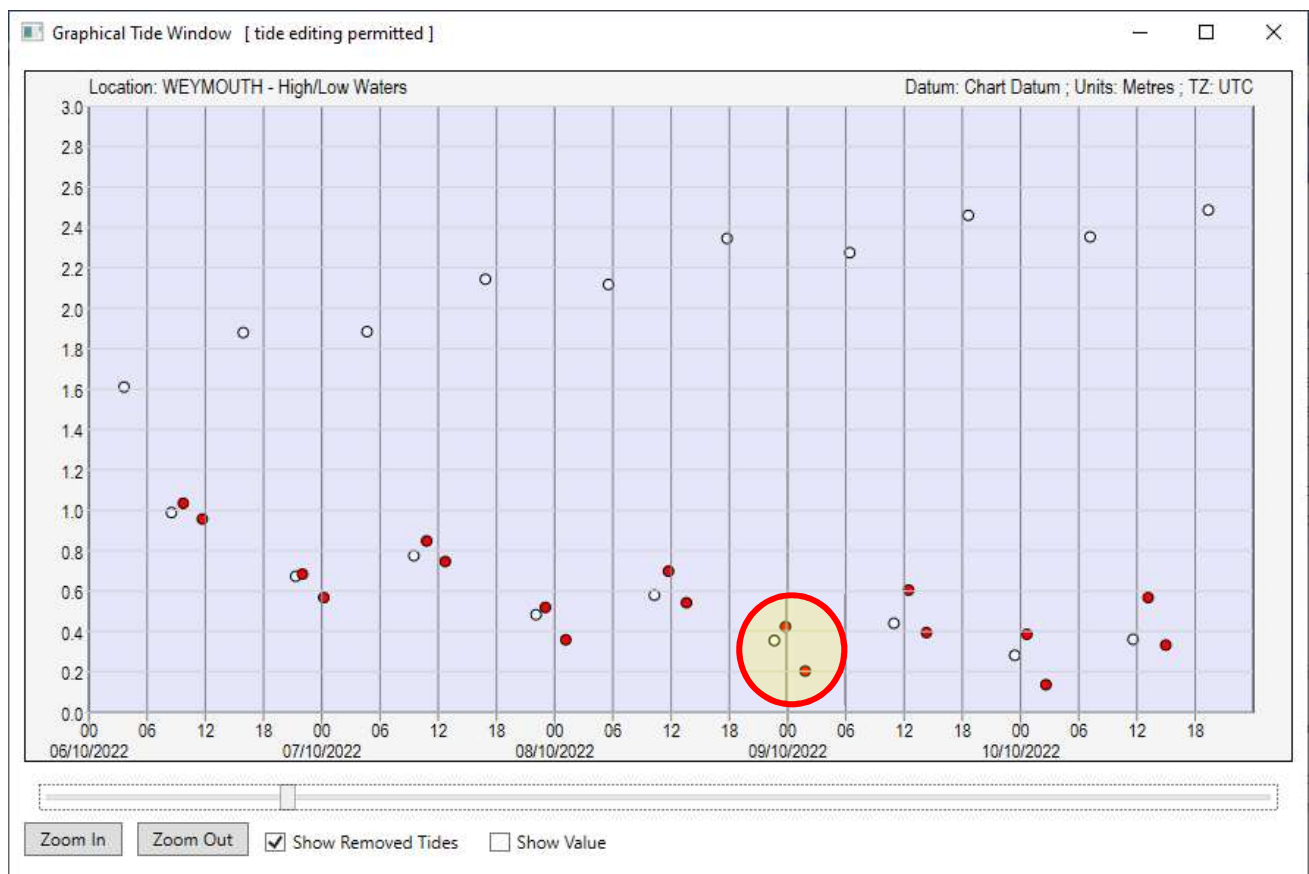


While Graph-Edit mode is enabled you will not be able to make another prediction (the **Compute Tides** button will be disabled).

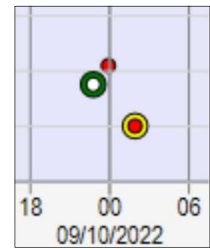
You are now in a position to swap tides. However, there are some rules that have to be followed and which Poltips will enforce.

- The sequence of tides must always alternate between high water and low water. You can't have two of the same type next to each other.
- You can only swap two tides of the same type otherwise this will break rule 1.
- You can only swap two tides if the tide between them is also not selected for inclusion otherwise this would also break rule 1.

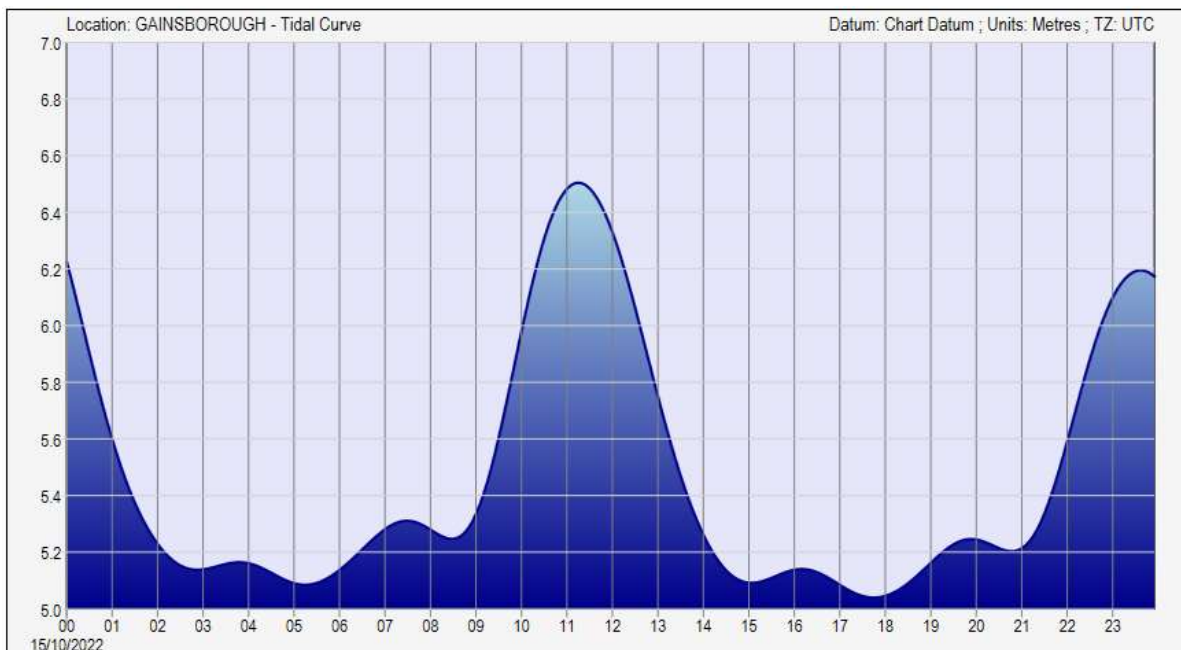
Suppose you are looking at Weymouth tides and you think the ones around 9/10/2022 00:00 would be better with the second LW selected instead of the first as it is quite a bit lower.



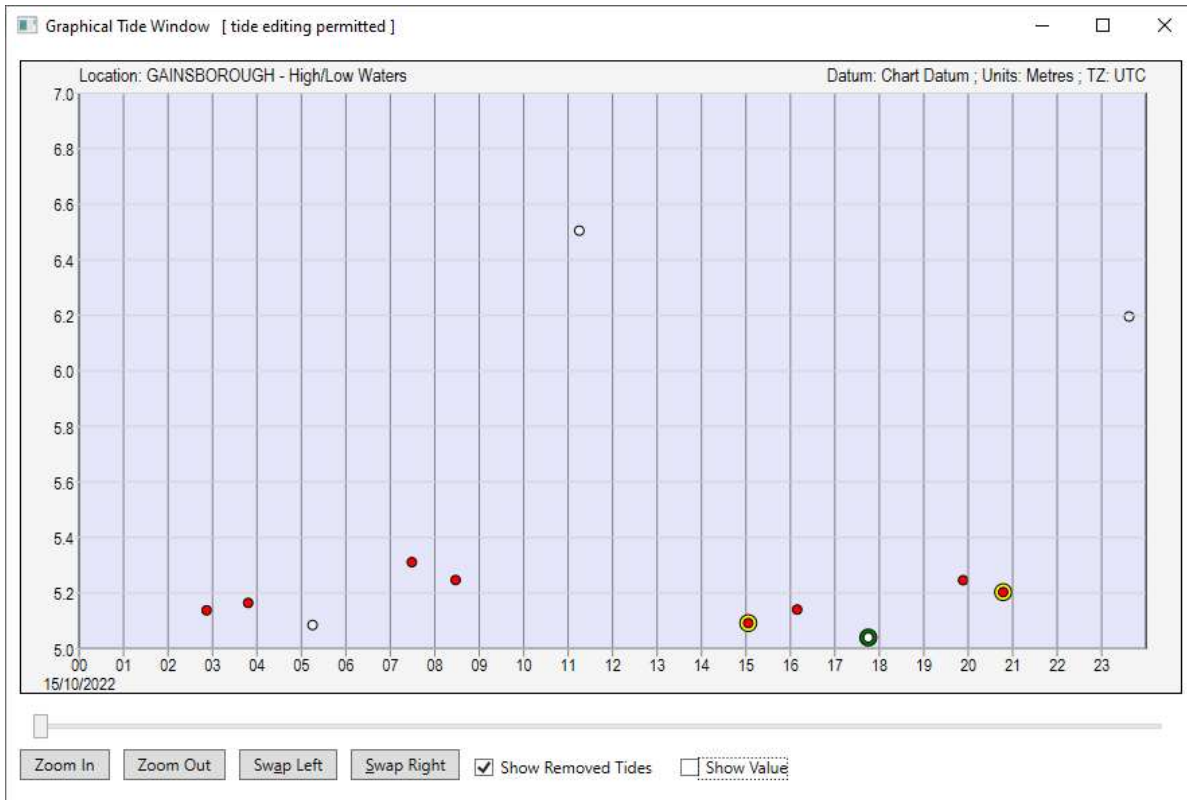
Click on the tide with the mouse that you no longer want included. Poltips will draw a green circle around it. It will also show a yellow circle around any tide that can be swapped with this without breaking any of the rules mentioned earlier (see right). If you want to swap the tides, simply click the 'Swap' button that appears below the graph or press 'S' on the keyboard – the white dot will turn red and the red dot becomes white showing in this case that you've selected the second low water instead of the first.



On rare occasions and for a very small number of locations, you may find there are two possible candidates that you could swap a tide for. This graph shows a triple low water...



If you compute the high and low waters you get the graph below and selecting the LW to swap gives you two options...

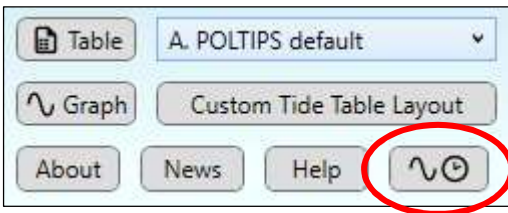


If you want to swap with the one on the right click **Swap Right** or press 'S'. If you want to swap with the one on the left, click **Swap Left** or press 'A'.

Real Time Tide Clock

A completely new feature to Poltips-4 is the real time tide clock. This lets you put a clock up on your screen which also includes additional tidal information. Note that this feature is only available for locations that have tides computed based on harmonics (blue text in the port list).

To display the real time clock, select your location of interest in the port list, and click the real-time clock button (no dates need to be entered). Ensure your computer clock is set to the right date/time.



Information shown

Real Time Tide Display

LIVERPOOL (GLADSTONE DOCK)
13:38:52

Tuesday
 11 October 2022
 Tidal Height: 7.65 metres

Waning Gibbous

Falling Tide (going out)

Next Low Water
 18:38
 1.25 metres

Next High Water
 00:03 (tomorrow)
 9.74 metres

All heights relative to Chart Datum
 Time zone: UTC

High Water: Low Water: Set Alarm

Poltips-4 Tidal Software - National Oceanography Centre Innovations Ltd

Callout Boxes:

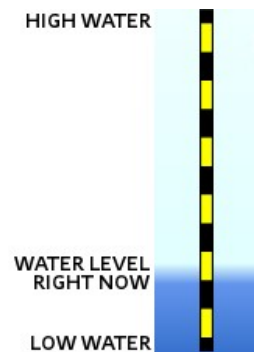
- Red box:** Location selected and current time
- Green box:** Current day, date and tidal height at this very moment
- Blue box:** The current approximate phase of the Moon
- Yellow box:** Time and height of the next high and low water
- Blue box:** Blue background shows rising & falling tide level
- Purple box:** States if the tide is currently coming in, going out, or approaching high or low water

- Red box: Selected location and the current time
- Green box: Current date and the height of the tide at this exact moment in time
- Purple box: Direction tide is currently flowing:
 - Rising Tide (coming in)
 - Approaching High Water (less than an hour to next high water)
 - Falling Tide (going out)
 - Approaching Low Water (less than an hour to next low water)

Blue box: Approximate Moon phase. This shows just one of 8 images so it not an accurate representation of how it will look. However it will give you a rough idea of when spring tides and neap tides occur.

Yellow box: The time and height of the next high water and the next low water

Note that the light and dark blue coloured background to the window also represents the height of the tide against the black/yellow tide pole. The darker blue level will move up and down as the tidal level rises and falls. It represents the level between the previous and the next turning point – so this means that even during neap tides when the range is not as large, the level will still move between the top and bottom of the tide pole.



If you want to leave the real-time window up on the screen while you continue to use the computer for other things you can close down the main Poltips window and the real time window will stay open and continue to function. Poltips will only fully close down when you close the real-time window as well.

Tidal Alarm

The real-time tide clock also gives you the option to set a warning alarm. This will change the colour of the water level to red when it either goes above the high water level or below the low water level set by the user.

Simply enter the height at which you want the alarm to trigger in one of the boxes and click the Set Alarm button. The alarm icon will highlight in green and the water level will change colour when either of the alarms are triggered.

The picture on the right shows an alarm for Sheerness on the River Thames set to trigger when the water level is above 5.5m. As the tide at the time is 5.58m, the water level turns red. As soon as the tide falls below 5.5m, the water level will return to being blue.



Using your own Harmonic Constants

This section is for advanced users only. Do not attempt to use your own harmonic constants in the software unless:

- you have a custom/publishers or UserData licence for the software, or you have purchased the TASK software from the National Oceanography Centre
- you are comfortable manually editing text files on your computer
- you are familiar with the concept of harmonic prediction and harmonic tidal constituents
- have fully read and understood this section of the user guide

Some versions of the Poltips software (for example the UserData licence or the version included with our TASK software) permit you to use your own harmonic constants to enable the software to compute the tides for locations which are not normally supported. To do this you need to create your own data files in a specific format that Poltips will be able to recognise.

About Harmonic Constants

The basis of tidal predictions is a set of harmonic constants for the location of interest. With these and the appropriate mathematics for calculating various astronomical parameters it is possible to predict the tide for any date future or past. A harmonic constituent is simply a sinusoidal wave that represents the influence of one (or part of one) astronomical phenomena in the world's seas and oceans.

To compute the tides with reasonably accuracy, you require a set of these harmonic constituents for the location of interest. These can be derived using harmonic analysis software such as TASK (which is also available from the National Oceanography Centre). This will take a period of observed data from a tide gauge and convert it into a number of harmonics – each of which is defined by a speed (or frequency), an amplitude and a phase lag. Each triple (speed, amplitude, phase) is called a harmonic constant.

Once you have a set of harmonic constants for your location of interest, you can use Poltips to compute the tides for any data (subject to your licence) forwards or backwards in time.

Information for TASK Users

The Poltips software has been written to support integration with the TASK harmonic analysis software. Provided the TASK software is correctly configured, it will be able to automatically update the database of harmonics used by Poltips, thereby allowing you to create tide tables directly from tide gauge data that has undergone a harmonic analysis process.

If the TASK software updates the Poltips-4 port database, you will need to restart Poltips-4 to access the new ports. You will however be prompted to do this as Poltips checks regularly to see if this file is changed.



For more information on Poltips and TASK integration, see the TASK user guide.

Obtaining Harmonics

There are various locations where you can obtain harmonic constituents and these can be used with Poltips provided your licence permits it.

Once you have a set of harmonics you need to configure the software by manually editing two different data files.

File: index.dat

This file has one line per port and needs to be carefully edited as spacing is important.

Character position	Description
1 to 30	Short port name (max 30 characters)
31	space character
32	Port type: 1 = port based on harmonics provided by the NOC 4 = port created with users own constants 5-9 = port will not appear in the input dialog box
33 to 36	Number to indicate how to find the correct data for the port. If port type equals 4, this number is the line number in the USERCON.DAT file were the data for this port starts.
37 to 41	If port type equals 1 or 4, this is generally be set to zero. If ports can exhibit complex tides (more than 5 turning points per day), this number can be used to indicate the selection algorithm to be used to extract the primary tides. 0: if complex tides are found, use the highest HW / lowest LW algorithm to identify the primary tides 1: if complex tides are found, use the first HW / first LW algorithm to identify the primary tides 9: if complex tides are found, do not permit removal of the additional tides (used for extremely complex tidal locations)
43 to 122	descriptive text – optional (however 80 spaces must be typed if no text is supplied). This is displayed when the port information is shown as well as in the bottom left of the main window when a port is selected. This is also where you can store additional information such as a ports location and an automatic threshold cut-off (see later in this section).
123 to end of line	long port name – optional, max of 72 characters. This is used by default on a few of the tide tables. Normally, only standard ports have a long name, although one could be added for any port in the index file.

A typical line in this file might look something like this...

```
HOGWARTS MARINA                   4   1   0 Data obtained from Wizard Port Authority
SCOTLAND, WEST COAST - HOGWARTS MARINA
```

This shows it wrapped across two lines due to the limited page width here, but it must be on one line in the index.dat file and spaced out precisely as specified in the table above.

File: usercon.dat

This file is used to store all your own sets of harmonic constants that you will want to use in Poltips.

Each port has a minimum of 4 lines of header information and then a list of the harmonic constants (one-per-line) as shown in the example.

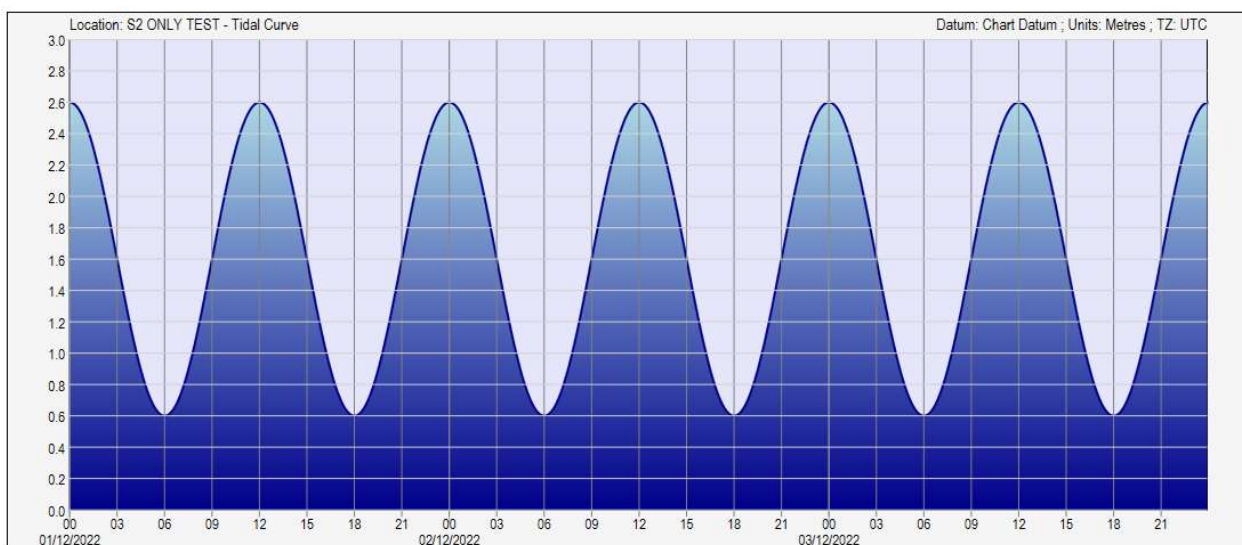
```
5 0
HOGWARTS MARINA
3.250
-1.360 ODN
2.200 35.0 31
0.950 82.3 36
0.357 295.8 28
0.234 123.4 10
0.161 7.8 17
```

The first line has two values that indicate how many standard harmonics and how many shallow water constants are used for the port (the latter value will nearly always be zero). The second line has the port name which in the example is "HOGWARTS MARINA". The third line contains the primary datum shift to get from mean sea level to your required datum. This is often called Z_0 when the preferred datum is **Chart Datum**. The fourth line is used to specify a secondary datum that can be selected within the main program. For example, in the UK it is usually used to specify a shift from Chart Datum to **Ordnance Datum**.

This is followed by one line per harmonic constant (i.e. if you specified there were 10 harmonic constants, there should be 10 additional lines). Each line has 3 values separated by one or more spaces. The three values required for each harmonic constant are the amplitude in metres, the phase lag in degrees (for information on how time zone relates to the phase lag, see section below), and the harmonic constant number. Poltips supports up to 114 of the more common harmonics which are listed in Appendix C. In the example above the first harmonic is number 36 which represent the harmonic constituent called M_2 .

When you first start to use your own harmonics, we suggest trying a simple entry with just a single S_2 harmonic which will result in a prediction that is a perfect sinusoidal wave with exactly 2 tidal cycles per day. Here's a simple example showing the entry in usercon.dat and the predicted graph.

```
1 0
S2 ONLY TEST
1.600
1.000 ODN
1.000 0.0 36
```



Specifying Datums

If you want to use different datums with your own harmonics you can specify this in the **usercon.dat** file. To change the primary datum just add the name in quotation marks directly after the value. To secondary datum always requires a 3-character code after the value – it must be one of these:

```
1 0
S2 ONLY TEST
1.600 "Dock Cill Datum"
1.000 SEC "Custom Harbour Datum"
1.000 0.0 36
```

- ODN Ordnance Datum Newlyn
- ODL Ordnance Datum Local
- ODB Ordnance Datum Belfast
- ODD Ordnance Datum Dublin
- SEC Custom secondary datum (name specified in quotation marks after it)
- XXX No secondary datum – the option to select it will be disabled

The primary datum is assumed to be **chart datum** unless otherwise specified. The value gives the height of mean sea level relative to the required datum. Since mean sea level is usually above chart datum so this value will usually be positive.

The secondary datum value is the position of the primary datum relative to the secondary datum. As an example, if this is set to ODN, since chart datum is usually below ODN, this value is usually negative.

An easy way to remember whether a datum values should be positive or negative is to know that if it is positive, the predicted values increase when you apply that datum, and if it is negative, the predicted values decrease.

See Appendix E for more information on datums.

Specifying a Locations Geographic Position (Latitude & Longitude)

Latitude and longitude form a coordinate system that allows you to uniquely specifying the location of any point on the Earth's surface. When displayed on tide tables it is usually shown in the following format (this example shows the location of Liverpool, England):

53° 27' N ; 03° 01' W

For most UK ports, the locations are included in a database which is installed with the software. However, if you use TASK to carry out your own harmonic analysis you may want to specify the latitude and longitude of the port so that it can be correctly displayed on the tide tables

The easiest way to specify the latitude and longitude of a location is to embed the information into the descriptive text part of the index.dat file. The latitude and longitude as given as two single decimal numbers. For example if you wanted to add the port of Dakar, Senegal into Poltips-4 after doing a harmonic analysis...

1. First work out the latitude and longitude for the position of the tide gauge as a decimal value. If you use an application like Google Earth to give you that latitude and longitude you may get it in degrees, minutes, seconds, compass point format. For example:

Dakar: Latitude = 14° 40' 44.45" N ; Longitude = 17° 25' 14.39" W

To convert this to a decimal value you can use the following formula:

$$\text{Decimal Value} = \text{DegreesValue} + (\text{MinutesValue} / 60.0) + (\text{SecondsValue} / 3600.0)$$

Or alternatively use an online coordinate convertor such as this one from the University of Minnesota:

<https://www.pgc.umn.edu/apps/convert/>

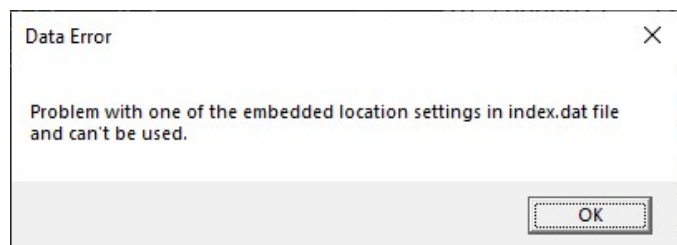
If the latitude is South, or the longitude is West then change the number to negative. Therefore:

Dakar: Latitude = 14.679014 ; Longitude = -17.420664

Now you have the latitude and longitude as a decimal value you can embed this into the descriptive text by putting the two number inside curly braces (latitude followed by longitude separated by a space). So the line of your index file might look like this:

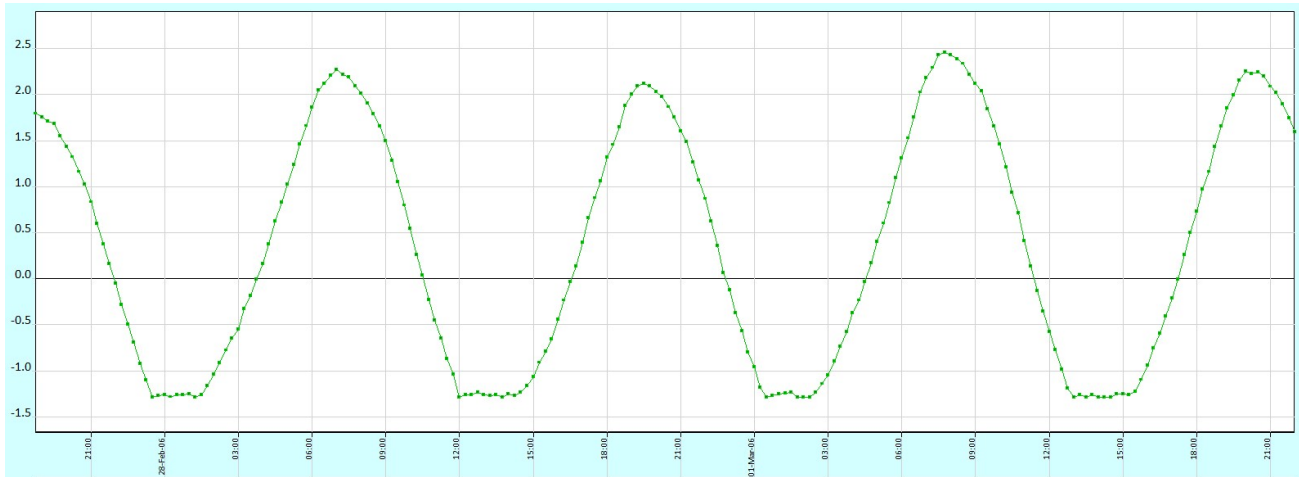
DAKAR, SENEGAL **1 234 0 Dakar Gauge A {14.679014 -17.420664}**

If the location data is entered in an incorrect format Poltips-4 will give you a warning when it first starts to say location information is incorrect on at least one of the lines in the index.dat file. The program will continue to work but the location data will not appear.

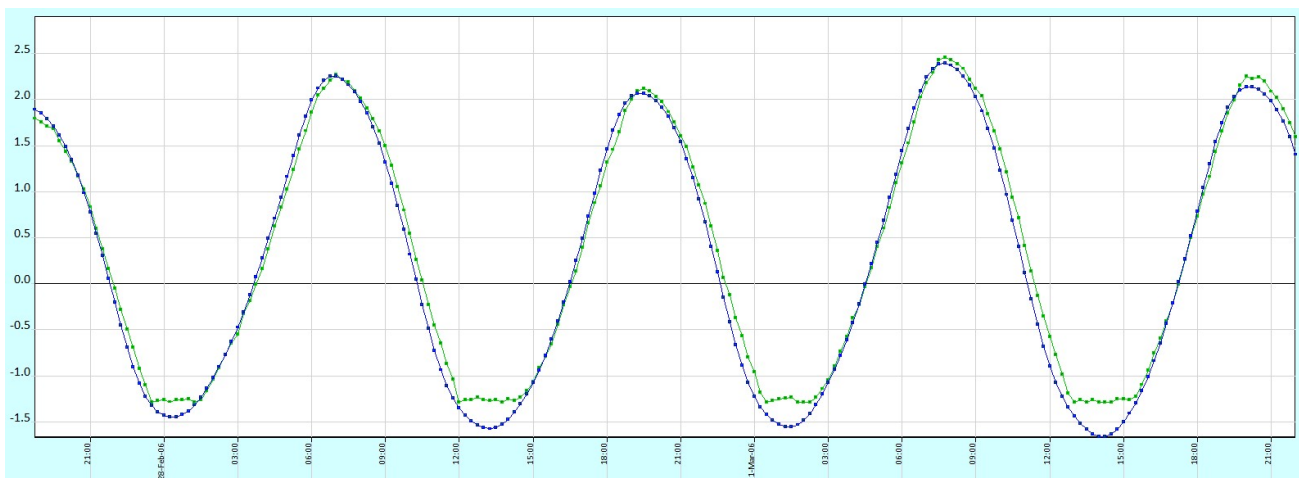


Specifying an Automatic Data Threshold

A characteristic of some locations is that as the tide approaches low water, it completely dries out. In situations like this the tide gauge will read a flat section of tidal level for a period of time. The graph below show data from a radar tide gauge at Teignmouth in the UK.



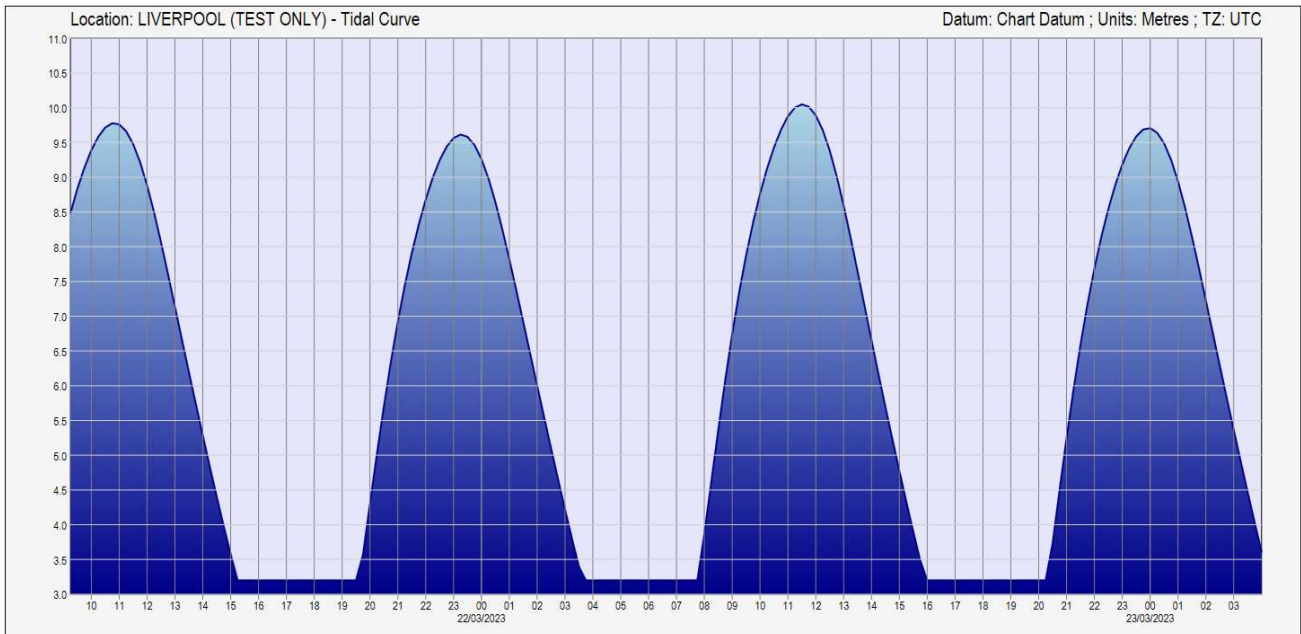
If you make a prediction for this (depending on how it is analysed), you may find that the prediction will not always accurately capture this flat low water as can be seen below which shows the predicted tide in blue.



It is possible to get Poltips-4 to adjust data based on a threshold level. You can specify a low-water threshold or a high-water threshold (the latter will be very rarely used).

If you specify a low-water threshold, then any computed data value **below** the threshold level will be set to a constant value (usually the same as the threshold value). A high-water threshold will change any value **above** the specified threshold level to the fixed value.

For illustration purposes only, here's an example of how 15-minute data might look with a low water threshold applied with the value set to 3.2metres:



As with specifying the location you can embed the information needed directly into the descriptive text section of the index.dat file in the following format:

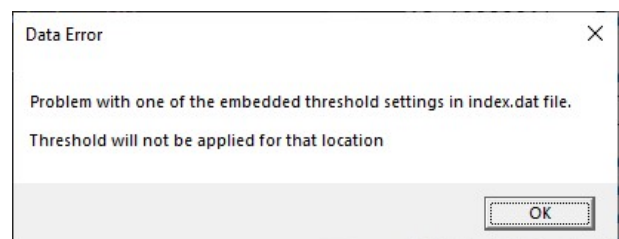
- Low water threshold adjustment [#LT: <threshold> <set_to>]
- High water threshold adjustment [#HT: <threshold> <set_to>]

To specify the threshold shown above you would put the following into the descriptive text part of the index.dat file:

```
[#LT: 3.20 3.20]
```

The threshold is applied to both turning point calculations (high and low waters) as well as equal interval calculations.

If the threshold data is entered in the incorrect format Poltips-4 will give you a warning when it first starts to say threshold information is incorrect on at least one of the lines in the index.dat file. The program will continue to work but the threshold will not be applied to the computed data until the problem is fixed.



Daylight Saving Time

The rules for daylight saving time adjustments are different for most locations around the world. **If you are going to adjust the times of the computed data to take account of daylight saving, you must check that the dates that Poltips-4 is using are correct for your country.** You will be prompted by the software to check this if you select the Daylight Saving option for any tidal calculation...



The DSTDATES.DAT file

In the main folder where the Poltips software is installed there is a file called **DSTDATES.DAT**. This contains all the information relating to when the clocks are changed for daylight saving time. The file that installs by default contains information for the United Kingdom. The first few lines of this file may look something like this...

```
2022 3 27 1 0 2022 10 30 1 0 1.0
2023 3 26 1 0 2023 10 29 1 0 1.0
2024 3 31 1 0 2024 10 27 1 0 1.0
2025 3 30 1 0 2025 10 26 1 0 1.0
2026 3 29 1 0 2026 10 25 1 0 1.0
```

An alternative file (same filename and format) can be put in the **C:\ProgramData\Poltips4** folder and this will take priority over a file in the Poltips installation folder.

This file has eleven numbers on each line corresponding to the information for a particular year. If you are wanting to adjust data for daylight saving, the periods for when the clocks are moved forward must be specified in this file.

The eleven values on each line are:

- the year the clocks move forward
- the month the clocks move forward
- the date the clocks move forward
- the time (hour) that the clocks move forward
- the time (minute) that the clocks move forward (nearly always zero)
- the year the clocks move back to the locations standard time

- the month the clocks move back to the locations standard time
- the date the clocks move back to the locations standard time
- the time (hour) that the clocks move back to the locations standard time
- the time (minute) that the clocks move back to the locations standard time
- the number of hours that the clock changes by (this is usually 1.0)

It is also important that:

- The periods listed in the file are in chronological order with the earliest first.
- The period of the data computed must be fully within the first and last dates given in the file. For example, if you want to compute the tides for all of 2030, you will need to ensure that the end date of the last entry is **after** the 31-December-2030. If the last line is:

```
2030 3 31 1 0 2030 10 27 1 0 1.0
```

you will get a warning and the data will not be adjusted as Poltips will assume it only knows the DST information up to 27-Oct-2030. You will need to add the DST dates for 2031 so that the software knows there is no missing periods of DST adjustment.

In the northern hemisphere, the clocks generally move forward by an hour in March and back to standard time in September / October. However, in the Southern hemisphere the clocks usually move forward in September / October and back to standard time in March.

It is very important that the dates/times you specify for when the clocks are adjusted are specified in standard time and not in the adjusted time. For example, in the USA the clocks will move forward at 2am (so 01:59:59 is followed by 03:00:00) therefore the time is entered as hour=**2**, minute=**0**. The clocks revert back to standard time at 02:00 in the adjusted clock which is 01:00 in standard time [i.e. 01:59:59 (DST) is followed 01:00:00 (Standard Time)]. You must therefore specify the time as hour=**1**, minute=**0**.

For 2023 in the USA, DST runs from March-12 to November-5, and so the line in the DSTDATES.DAT file would look like this:

```
2023 3 12 2 0 2023 11 5 1 0 1.0
```

If we are in New York which uses Eastern Standard Time (EST), this line in the DSTDATES.DAT file means an hour is added between 12-Mar-2023 02:00 EST and 5-Nov-2023 01:00 EST.

The file supplied with Poltips-4 has the daylight saving time information for the United Kingdom. If you want to use it for another location you will need to find the relevant information for your country and replace the data in the file with the correct information.

File Formats and Locations

File Locations

There are a number of files that Poltips requires to function correctly. Most are installed as part of the installation process; however, it is possible that some files will be supplied separately or may be automatically updated by other NOC Innovations Ltd software (for example if you are using Poltips as part of the TASK suite of software).

By default, the Poltips software is installed in the folder: **C:\Program Files (x86)\Poltips**

Some of the supplementary files mentioned here can be placed in other locations to make it more flexible for the user.

PT4_lic.dat This is the **licence file**. This may have been supplied by the NOC in an email if you are renewing your licence. This can be saved to one of a number of different locations – it will search them in the order below and stop as soon as it finds a file with this name. The searched locations are:

- C:\ProgramData\Poltips4\ *(recommended location)*
- C:\Users\userid\
- C:\Users\userid\Poltips4\
- C:\Users\userid\Desktop\
- C:\Users\userid\AppData\Roaming\
- C:\Users\userid\Documents\
- C:\Users\userid\Documents\Poltips4\
- C:\Program Files (x86)\Poltips4\ *(the installation folder)*

See page 11 of this user guide to see how Poltips can help with the installation of a licence file that has been emailed to you by the National Oceanography Centre.

index.dat You only need to be aware of this file if you are using your own harmonics (see page 45). This can exist in two different locations but the software will effectively merge the files so that they appear to Poltips as a single file. Usually one will be installed in the installation folder with a second one in a location that is more accessible by programs such as TASK (NOC Innovations Ltd harmonic analysis software). The two locations are:

- C:\Program Files (x86)\Poltips4\
- C:\ProgramData\Poltips4\

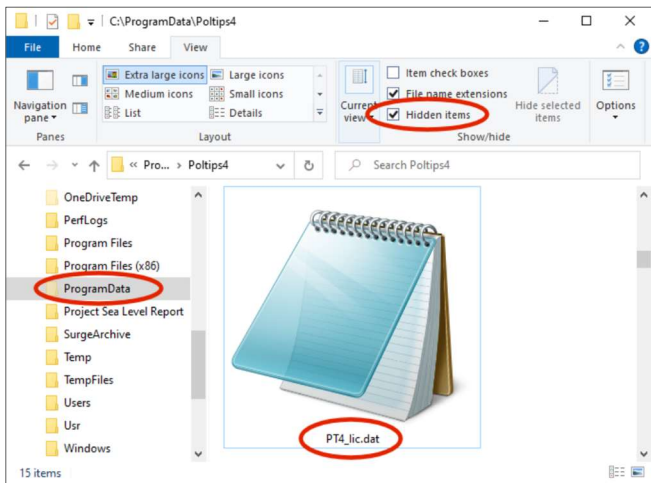
usercon.dat As with index.dat, you only need to be aware of this file if you are using your own harmonic constants. There can only be one usercon.dat file and this must reside in the folder C:\ProgramData\Poltips4\

dstdates.dat The one that installs with your software will be in the installation folder. If you need to create your own, you can either edit this, or copy it to C:\ProgramData\Poltips4\ and edit this copy. This will take priority over the one in the installation folder if both exist.

See section on Daylight Saving Time on page 52 for more information.

A note about the ProgramData folder

The folder C:\ProgramData is actually a hidden folder by default in Windows. To see this in Windows File Explorer you will need to 'show hidden items' (see image below).



Other Useful Information

Printing from Poltips-4

Poltips-4 can present tidal data to you in a number of different ways such as raw data, formatted tide tables or tidal graphs. There are times when you may want to print these results.

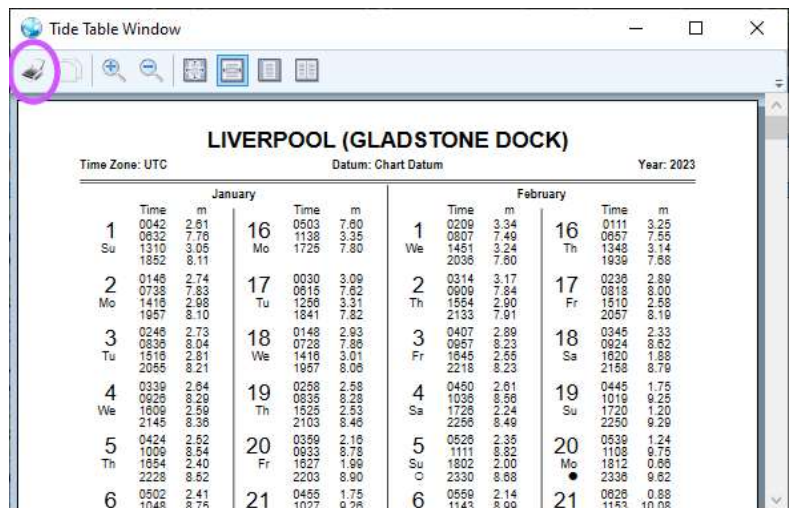
Printing raw tidal data

Poltips-4 does not directly support printing of raw tidal data since in most cases it is rare that you would want to do this in its entirety, and would often lead to a huge number of pages being produced. You can however easily save the data to file or copy it to the clipboard which would allow you to paste it directly into another program like Microsoft Word, Microsoft Excel or Notepad, which will give you more control over what you want printed and how.

Printing tide tables

When you generate a formatted tide table this will automatically appear in a separate window inside what is called a document viewer. This allows accurate printing of exactly what you see in the document by simply clicking the printer icon on the toolbar.

Note that when you print a tide table – it **always** prints the whole tide tables. If you only want a month or two of data, then just predict the exact period that you require and then you can print exactly what you need.

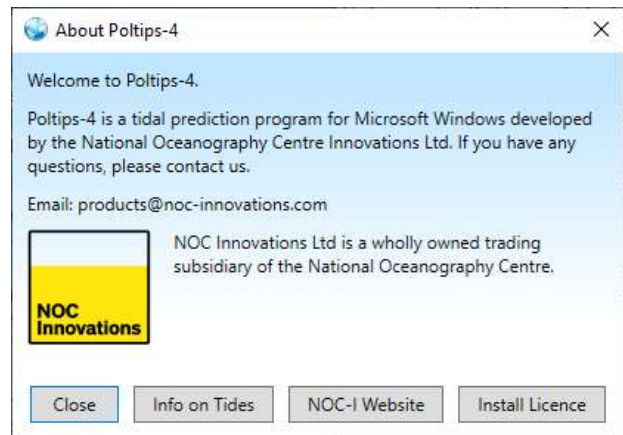


If you want to capture the image of a graph for printing – you may prefer to check the Simple View box below the graph – this will remove the blue colour gradient and lilac coloured background and therefore may look better when printed (and certainly use less ink/toner).

Other buttons (About, News, Help)

The last row of action buttons offers a quick way to find out a little more about the software, and also to easily access the user guide which is included with the software as a PDF file.

About Shows the standard about dialog box. This also contains buttons to take you to the NOC Innovations Website, view our information page on tides, or install a licence file that has been emailed to you.



News This will take you to the NOC Innovations Marine Applications Platform page for Poltips. Here you can get general up-to-date information on the Poltips software including upcoming releases and related downloads.

Help Clicking this button will initially bring up a simple step-by-step guide to making a prediction in the output window. However, if you click the button again, then it will bring up this complete user guide.

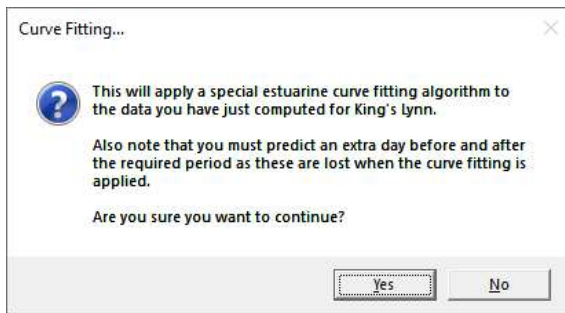
King's Lynn formats

King's Lynn uses a completely unique method of computing the tides. This will be invoked automatically when the port is selected and the **Compute Tides** button clicked.

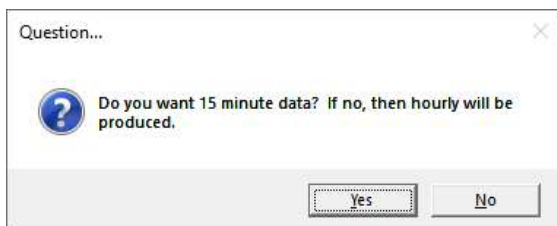
Note that when you select King's Lynn the option to compute equal time interval data is disabled. However, it is still possible to obtain hourly and 15-minute data using a special curve fitting technique built into the software. Follow these steps to get hourly or 15minute data...

1. Select King's Lynn as the port and put in the dates you require as normal.
2. Select the advanced mode checkbox Advanced Mode
3. Compute the high and low water levels
4. When these results appear, you should also see an additional button appear underneath the data window **King's Lynn Curve Fitting Algorithm**
5. You will see a message box explaining that a special technique will be applied and asking if you want to continue. It also provides a warning that you will lose one day at the start and end of your selected date range, therefore you need to predict the high and low waters with an extra day at the start and end. For example, if you want to predict April 2023, you should prediction from 31-

March-2023 to 1-May-2023. When the curve fitting is applied the data will show for 1-April-2023 to 30-April-2023.



If you continue you will then be asked if you want 15 minute or hourly data – these are the only options available using the King's Lynn curve fit technique. Select Yes for 15 minute or No for hourly data.



SWC ports / Southampton and Lymington

There are a small number of locations which use a method of predicting the tide called the Shallow Water Correction method. This approach is usually used when there was insufficient data available from the tide gauge to do a normal harmonic analysis. However, Southampton and Lymington give you the option to select both the shallow water correction method and the more common harmonic method. This is why these locations have multiple entries in the port list.

- Southampton (1HW) Uses SWC method to compute the 1st high water and the low water
- Southampton (2HW) Uses SWC method to compute the 2nd high water and the low water
- Southampton Uses traditional harmonic method to compute all high and low waters

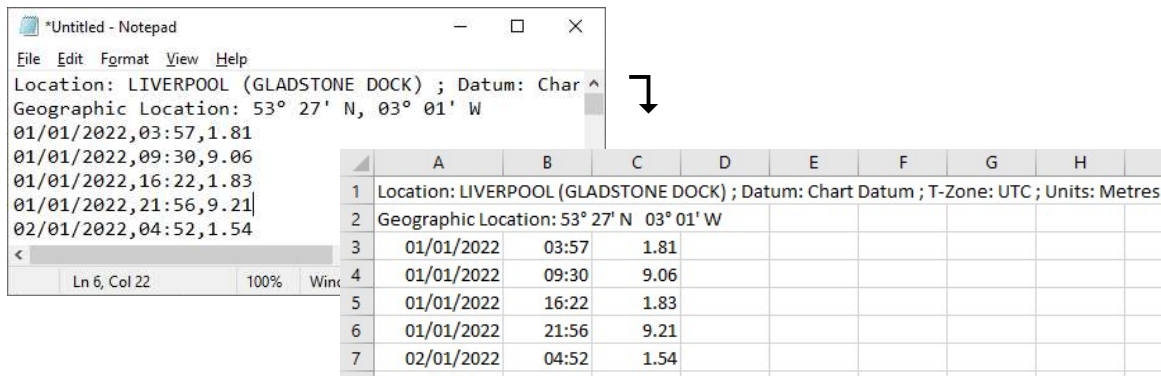
Note that when you use the SWC method you will always get 2 high waters in each tidal cycle even though in reality there may only be one. The two computed high waters will usually sit either side of the 'real' high water.

The majority of users should use the traditional harmonic location "Southampton".

Using Poltips Data in Excel

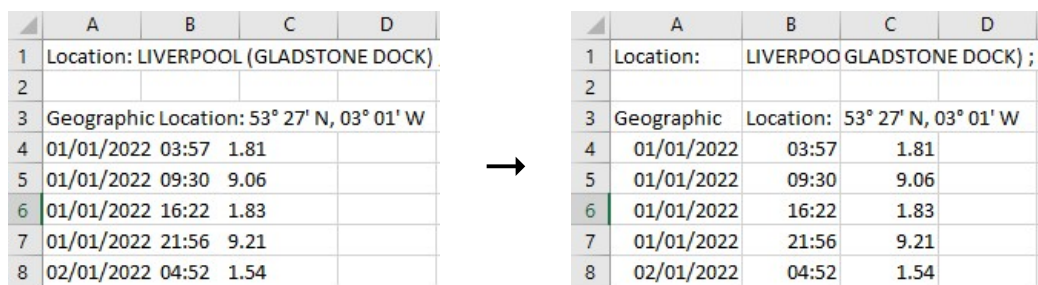
It is often useful to be able to export the computed tidal data into another piece of software – Microsoft Excel being a very popular choice. There are two ways to achieve this...

- Compute the data you require and format the output shown in the main window into a comma separated values format by clicking the **Format Text Output** button and selecting one of the CSV layouts. Then save this as a file with the .csv extension. This can be opened easily in Excel and the date, time and height information will all go into a separate column on the spreadsheet.



- Copy and paste the data directly from Poltips into Excel. For this, leave the data in the default Poltips layout (date, time and height separated by spaces). When pasted into Excel all the data will actually be in column A so you will probably want to split the date, time and height into three different columns.

To do this, select all of column A (click on the A at the top), and find the **Text to Columns** option on the toolbar – the location may vary depending on the version of Excel. Select the data type as Fixed Width, and then Excel will usually identify the three columns and put in a separator line. When you do this – the two header lines with the port name and position on may be incorrectly split so you may need to retype these manually.



Appendices

Appendix A: The National Oceanography Centre

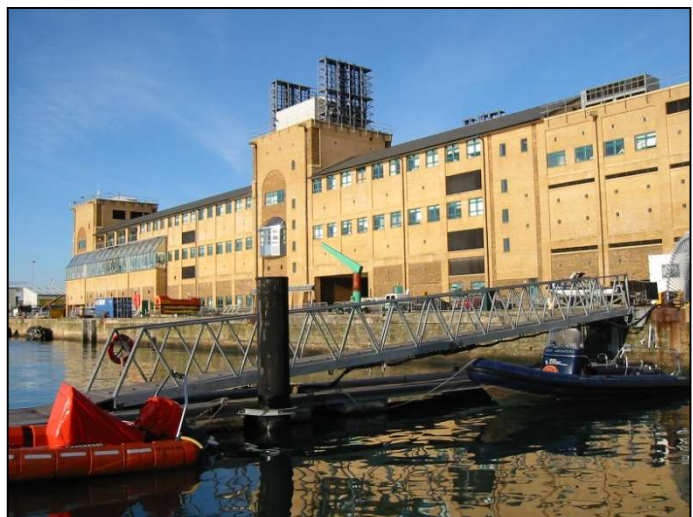
The National Oceanography Centre (NOC) is an independent, non-profit-distributing charitable company with a wholly owned trading subsidiary called NOC Innovations Ltd.

The NOC has provided a national and international tidal analysis and prediction service since 1924, in fact the modern methods of tidal analysis and prediction used throughout the world are based on the work carried out by Dr. A.T. Doodson F.R.S. between 1919 and 1960 while he was working at the Liverpool Tidal Institute (the forerunner to the National Oceanography Centre).

The NOC has continued to develop and refine the methods used to analyse tide gauge data and compute tidal levels and currents. Coupled with advances in modern computer hardware and software, we now have some of the most accurate tidal analysis and prediction software available.



The Liverpool Site
(Prior to 2010 known as the
Proudman Oceanographic Laboratory)



The Southampton Site

The NOC has offices in Liverpool and Southampton, and combined they house a staff of around 650 scientists, engineers, IT and administrative support staff. As of 2023, the NOC has an annual turnover of around £80M. It also houses various national and international facilities such as the British Oceanographic Data Centre (BODC), the Permanent Service for Mean Sea Level (PSMSL), the National Tidal and Sea Level Facility (NTSLF) and the British Ocean Sediment Core Research Facility (BOSCORF).

Marine Information Products and Services (MIPS) Team

The National Oceanography Centre has, since the 1920s, had a team of tidal experts produce tide tables for organisations all over the world. In 1992, a group dedicated to offering new products and services was set up and the range of products on offer was greatly expanded to include the results of the latest

NOC scientific research. However, oceanographic research tends to produce vast amounts of raw data with little meaning to anyone other than a trained oceanographer. The team’s mission was to provide a ‘value-added’ service, which included ensuring that the customer received the data they required in a form that was easily understood. This was achieved by creating tools to visualise the data, supplying scientific reports, or by processing the raw data to derive new data sets of more value to users in the ‘real’ world.

Over the last 20 years we have developed a range of software products that allow users to obtain scientific data. All the mathematical complexities of tidal calculations and offshore modelling are hidden behind the friendly user interface of our software products.

The MIPS team exists as part of NOC Innovations Ltd, the wholly owned trading subsidiary of the National Oceanography Centre. For more information on NOC Innovations, why not take a listen to this episode of our "Into the Blue" podcast which is available on YouTube.

Search YouTube for "Into the Blue Podcast Innovations" and click this video...



Into the Blue Podcast: Innovations (Part 1) with Huw Gullick

66 views · 2 days ago

 National Oceanography Centre

Innovative tech is taking over our podcast! In part one of a two-part special, Huw Gullick introduces our subsidiary, NOC ...

New

or type the following address into your browser: www.youtube.com/watch?v=mb9ubNZWGoY

Appendix B: Glossary of Common Tidal Terms

Chart Datum	The level to which depths on a nautical chart are measured. It is the most common datum for tidal predictions / tide tables.
Data Logger	A device which is connected to a tide gauge and records the tidal level at a fixed interval. This data can then be analysed.
Datum	A level which is defined as having the value 'zero' for the data time series. All heights must be given to a specific datum (often Chart Datum). See Appendix D for more information.
Diurnal Tides	Tides having a period of approximately 1 day (one high water and one low water approximately every 24 hours).
UTC / GMT	Coordinated Universal Time (UTC) and Greenwich Mean Time (GMT) are basically the same. UTC is the primary time standard by which the world regulates time. For most purposes, UTC is synonymous with GMT but GMT is no longer precisely defined by the scientific community.
Extreme High/Low Water	The highest or lowest elevation reached by the sea during a given period and is usually taken to mean both astronomically driven as well as influenced by weather conditions.
Harbour Datum	The horizontal plane, defined by the local harbour authority, from which levels and tidal heights are measured by that authority.
Harmonic Analysis	The process of mathematically computing a set of harmonic constants based on the observations from a tide gauge at a particular location. See page 10 for more information.
Harmonic Constant	A triplet of values (frequency, amplitude and phase lag) that defines a specific harmonic constituent for a given location. Every location will have a unique set of harmonic constants. There will typically be over 100 of these for most locations. These are the fundamental values used to predict the tides years into the future or past.
Harmonic Constituent	One of the individual sine waves of a known fixed frequency and can be identified in a tide gauge record by the process of harmonic analysis.
Highest Astronomical Tide	The highest level which can be predicted under average meteorological conditions. This is not the same as the extreme high water as storm surges may cause higher levels to occur.

Long Period Tides	Individual tidal constituents that have a period of longer than 1 week.
Lowest Astronomical Tide	The lowest level which can be predicted under average meteorological conditions. This is not the same as the extreme low water as negative storm surges may cause considerably lower levels to occur.
Mean Sea Level	The average water level at a location calculated over a long period of time.
Mixed Tide	Tides that are neither totally semidiurnal or diurnal, however one or the other is usually predominant.
National Datum	A fixed reference adopted by a country as a standard geodetic datum for elevations determined by levelling. Often used for both sea and land height measurements. In the UK and Ireland, this is called Ordnance Datum.
Neap Tide	A lower than average high tide (or higher than average low tide) occurring around the time of first and third quarter of the Moon's phase.
Oscillation	A regular and often fixed periodic change of a parameter between two extreme values. A sine wave is an example of an oscillating mathematical function.
Seiche	A short-period oscillation occurring in a harbour, bay or gulf - and unrelated to actual tides.
Semidiurnal Tides	Tides having a period of approximately half a day (so you get approximately 2 high waters and 2 low waters every 24 hours).
Spring Tide	A higher than average high tide (or lower than average low tide) occurring around the time of full moon and new moon.
Storm Surge	One of the components of sea-level caused by meteorological effects such as prolonged winds, changes in atmospheric pressure etc. Surges are not easily predicted, requiring accurate weather forecasts and complex computer models of the seas and oceans. Tide tables do <u>not</u> take account of storm surges which is why they may differ from the observed sea-level on the day.
Tide Gauge	A device used to measure the level of the water at a specific location and often based on radar technology - although many other technologies exist such as acoustic gauges, pressure gauges, float gauges etc. The gauge must be installed on a rigid stable structure, and connected to a data logger that will record the level at a fixed time interval, usually a minimum of hourly, but often more frequently.

Tide Gauge Bench Mark	A fixed vertical point near a gauge used to check levelling of the gauge. Repeated levelling from the tide gauge bench mark to other bench marks in the vicinity checks the stability of the tide gauge installation with respect to the level of the land.
Tide Gauge Zero	The datum which corresponds to a reading of 0.0 on a tide gauge. When a harmonic analysis is carried out, the Z0 constituent gives the height of this datum relative to the mean level. Sometimes called Tide Gauge Datum . When a new gauge is installed this will usually be set to a common established datum like Chart Datum or Ordnance Datum.
Tide Pole	The oldest way of recording the tide, the tide pole was basically a giant ruler stuck to the side of a dock. The values of the water level would be read off at a fixed interval by the harbour master.

Appendix C: Table of Standard Harmonics

No.	Name	Speed (°/hr)	No.	Name	Speed (°/hr)	No.	Name	Speed (°/hr)
1	Sa \mathcal{P}	0.0410686	39	MSN ₂	30.5443747	77	2(MN)S ₆	84.8476674
2	Ssa	0.0821373	40	KJ ₂	30.6265120	78	3MNS ₆	85.3920422
3	Mm	0.5443747	41	2SM ₂	31.0158958	79	4MK ₆	85.8542795
4	Msf	1.0158958	42	MO ₃	42.9271398	80	4MS ₆	85.9364168
5	Mf	1.0980331	43	M ₃	43.4761563	81	2MSNK ₆	86.3258006
6	2Q ₁	12.8542862	44	SO ₃	43.9430356	82	2MV ₆	86.4807915
7	σ_1 (sigma)	12.9271398	45	MK ₃	44.0251729	83	3MSK ₆	86.8701754
8	Q ₁	13.3986609	46	SK ₃	45.0410686	84	4MN ₆	87.4966873
9	ρ_1 (rho)	13.4715145	47	MN ₄	57.4238337	85	3MSN ₆	88.5125832
10	O ₁	13.9430356	48	M ₄	57.9682084	86	MKL ₆	88.5947204
11	MP ₁	14.0251729	49	SN ₄	58.4397295	87	2(MN) ₈	114.8476674
12	M ₁	14.4920521	50	MS ₄	58.9841042	88	3MN ₈	115.3920422
13	χ_1 (chi)	14.5695476	51	MK ₄	59.0662415	89	M ₈	115.9364168
14	π_1 (pi)	14.9178647	52	S ₄	60.0000000	90	2MSN ₈	116.4079379
15	P ₁	14.9589314	53	SK ₄	60.0821373	91	3MS ₈	116.9523127
16	S ₁	15.0000000	54	2MN ₆	86.4079380	92	3MK ₈	117.0344500
17	K ₁	15.0410686	55	M ₆	86.9523127	93	MSNK ₈	117.5059710
18	ψ_1 (psi)	15.0821353	56	MSN ₆	87.4238337	94	2(MS) ₈	117.9682084
19	ϕ_1 (phi)	15.1232059	57	2MS ₆	87.9682084	95	2MSK ₈	118.0503457
20	θ_1 (theta)	15.5125897	58	2MK ₆	88.0503457	96	4MS ₁₀	145.9364168
21	J ₁	15.5854433	59	2SM ₆	88.9841042	97	3M2S ₁₀	146.9523127
22	SO ₁	16.0569644	60	MSK ₆	89.0662415	98	4MSN ₁₂	174.3761463
23	OO ₁	16.1391017	61	2MN ₂ S ₂	26.4079379	99	5MS ₁₂	174.9205210
24	OQ ₂	27.3416965	62	3M(SK) ₂	26.8701754	100	4M ₂ S ₁₂	175.9364168
25	MNS ₂	27.4238337	63	3M ₂ S ₂	26.9523127	101	MVS ₂	27.4966873
26	2N ₂	27.8953548	64	MNK ₂ S ₂	27.5059710	102	2MK ₂	27.8860711
27	μ_2 (mu)	27.9682084	65	SNK ₂	28.3575922	103	MA ₂	28.9430356
28	N ₂	28.4397295	66	2SK ₂	29.9178627	104	MB ₂	29.0251728
29	ν_2 (nu)	28.5125831	67	2MS ₂ N ₂	31.0887494	105	MSV ₂	30.4715211
30	OP ₂	28.9019669	68	MQ ₃	42.3827651	106	SKM ₂	31.0980331
31	M ₂	28.9841042	69	2MP ₃	43.0092770	107	2MNS ₄	56.4079379
32	MKS ₂	29.0662415	70	2MQ ₃	44.5695475	108	MV ₄	57.4966873
33	λ_2	29.4556253	71	3MK ₄	56.8701754	109	3MN ₄	58.5125830
34	L ₂	29.5284789	72	3MS ₄	56.9523127	110	2MSN ₄	59.5284789
35	T ₂	29.9589333	73	2MSK ₄	57.8860711	111	NA ₂	28.3986609
36	S ₂	30.0000000	74	3MK ₅	71.9112441	112	NB ₂	28.4807981
37	R ₂	30.0410667	75	M ₅	72.4602605	113	MSO ₅	72.9271398
38	K ₂	30.0821373	76	3MO ₅	73.0092771	114	MSK ₅	74.0251728

\mathcal{P} Note that the harmonic constituent Sa has two different definitions (and therefore speeds). See the TASK user guide for more information or contact the NOC if you are using your own harmonics and need more information on this (products@noc-innovations.com).

Appendix D: Additional Reading

Each of the books listed below is given a 📖 rating to indicate the complexity level.

- 📖 This book is recommended for anyone wanting a more general understanding of tides. It provides a good overview of the subject whilst keeping the mathematics to a minimum.
- 📖📖 This book goes into more detail and will require a greater mathematical understanding.
- 📖📖📖 This is a higher-level text which should be used by those wanting a comprehensive and extensive understanding of tides and tidal harmonic analysis.

Book List

📖 This User Guide. It may be obvious but this user guide should be your first port of call for using Poltips and getting a handle on the basics of tides. We have included some articles in the Appendices which you may find interesting. There are also some useful information sheets on the **NOC Innovations** website.

📖 The IOC Manuals (volumes I to IV) on Sea-Level Measurement and Interpretation. These manuals can be downloaded at no charge from http://www.psmsl.org/train_and_info/training/manuals/ All manuals are in English, although Volume 1 is also available in French, Russian, Portuguese and Spanish, and Volume 4 is available in Arabic.

Volume 1 (pub: 1985): Basic Procedures

Volume 2 (pub: 1994): Emerging Technologies

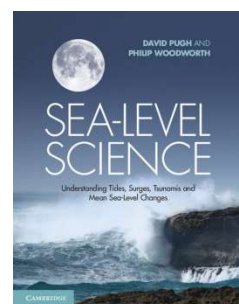
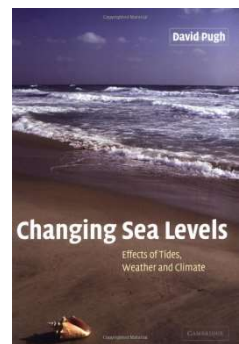
Volume 3 (pub: 2000): Reappraisals & Recommendations as of year 2000

Volume 4 (pub: 2006): An update to 2006

📖 Glossary of Terms used in Tidal Measurement and Analysis
http://www.psmsl.org/train_and_info/training/manuals/glossary.html

📖📖 Changing Sea Levels: Effects of Tides, Weather and Climate - David Pugh, 2004. This is an excellent book written by a world-renowned authority on Tides.

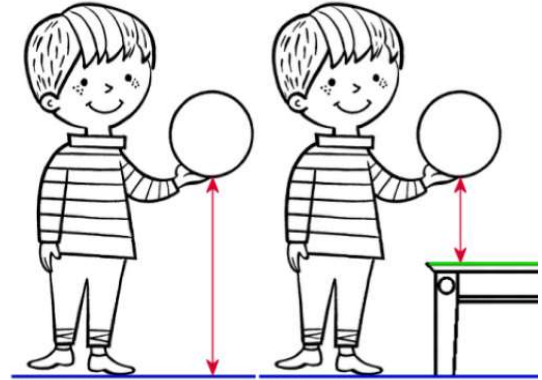
📖📖📖 Sea-Level Science: Understanding Tides, Surges, Tsunamis and Mean Sea-Level Changes. David Pugh and Philip Woodworth, 2014. To the author of much of the NOC's software this book is the scientific bible. It covers the subject in great depth and is well illustrated. Suitable for undergraduate/postgraduate level courses or for anyone wanting a comprehensive understanding of all aspects of Sea-Level Science. Some chapters do require a significant mathematical knowledge.



Appendix E: Datums

When measuring the height of a water level, it must be specified relative to some other level called the datum. In day-to-day use the height of an object is usually given relative to the floor on which the object is sitting. The floor is the datum for the height measurement. It is usually obvious what the datum is and so is rarely explicitly stated.

Here's an analogy - if I am holding a ball out at arm's length it might be 1.0m above the floor but if I move to stand by my desk it could be described as 0.5m above my desk. All that has changed is the datum (the floor or the desk). If I set the ball on the floor its height is now 0.0m to 'floor datum' and -0.5m to 'desk datum'.



You can see that if I raise the height of the datum I reduce the height of anything measured relative to that datum.

Datums and Tidal Levels

With tidal levels the datum is not so obvious and must be specified as part of any tide table. There are numerous possible datums that could be used when giving the height of the tide. The ones that might commonly be used are:

- Mean Sea Level – common when referring to rising levels due to climate change but rarely used on tide tables.
- Chart Datum – the most common one for tide tables and relates to depth information given on nautical charts. Chart datum is unique to each location, or cluster of locations, and is usually set to be close to the Lowest Astronomical Tide (see below).
- Ordnance Datum (Newlyn) – common in Great Britain. Northern Ireland has its own national datum called Ordnance Datum (Belfast), and Ireland has Ordnance Datum (Dublin). This is common for engineering work as it can relate datums directly to the height of the land.
- Lowest Astronomical Tide (LAT) – set to be the lowest level the tide will reach under normal (calm) meteorological conditions. Used more in offshore survey work than in coastal tide tables.
- WGS84 – a vertical datum used in conjunction with latitude and longitude to specify any point on the Earth. Important in satellite work and when working with GPS data.
- National datums specific to each country.
- Mars even has its own vertical datum called the Areoid, but since there's no water there – it's not really too relevant to this software.

Since a datum is just a fixed level, a tide table will often give the datum to which the data is calculated, and then specify the difference between this datum and the secondary datum so the user can easily change between them by adding or subtracting this difference. For example on a tide table for London Bridge you might see:

Datum of Predictions = Chart Datum : 3.20 metres below Ordnance Datum (Newlyn).

Since in this example the Ordnance Datum is higher than Chart Datum, changing a height on the tide table from Chart Datum to Ordnance datum requires you to subtract 3.2m (think back to the ball over the table ... if you raise the datum, you lower the height relative to that datum). So a high water at London Bridge of 6.9m above Chart Datum will be 3.7m above Ordnance Datum (Newlyn)

As you can see, height values are meaningless unless you quote the datum to which they are calculated.

Datums in the British Isles

Ordnance Datum (Newlyn) is the datum of the land levelling system used for most of the UK and is defined as the average value of the sea level recorded at Newlyn for the period 1915 to 1921 (6 years). However due to sea level rise since this time, the current mean sea level at Newlyn is about 0.2m above Ordnance Datum (Newlyn).

Ordnance Datum (Belfast) is defined as the average value of the sea level at Belfast for the period 1951 to 1956. This is approximately 2.7m above Ordnance Datum (Dublin).

Ordnance Datum (Dublin) is unusual in that it is based on the level to which the tide fell on 8- April 1837 in Dublin Bay rather than a mean sea level. This makes it much closer to Chart Datum than any of the other Ordnance Datums.

Ordnance Datum (Malin) is the same level as Ordnance Datum (Belfast).

For remote islands such as those found in the Scottish Hebrides, it is often difficult to level a tide gauge to datums on the main land and therefore it might just be specified as **Ordnance Datum (Local)**.

Appendix F: A Brief History of Tidal Prediction

It has long been known that there is a relationship between the movement of water in our seas and oceans, and the position of the Sun and Moon. Pytheas of Marseilles in the 5th Century BCE was the first credited with linking the tides to the position of the Moon. Pliny the Elder (23-79 CE) noted that for twice-daily tides, the maximum tidal ranges occur just after the full and new moon, and how in March and September, they were likely to be even larger still. Strabo (c. 54 BCE to 24 CE) also noticed that the tidal range in the Persian Gulf was greatest when the Moon is furthest from the plane of the equator, and are small and irregular when the Moon passes through the equatorial plane.

Of course, not all facts about the tide were scientifically correct. Aristotle is credited with the law that no animal can die unless the tide is going out. This legend persisted for a long time, and even as recently as 1595, Parish Registers in Hartlepool recorded the phase of the tide along with the date and time of each death.

By the mid-17th century, many theories were being proposed to explain the movements of the tide. Galileo (1564-1642) stated that tides were caused by the motion of the Earth around the Sun and its own rotation on its axis inducing motions in the sea which were modified by the shape of the sea-bed. This is closer to what actually happens than Descartes (1596-1650) theory that space is filled with an invisible matter called Ether which is compressed as the Moon passed overhead and pushes down on the oceans. However, Kepler (1571-1630) was the first to state that the Moon exerted a gravitational attraction on the water.

In the years that followed and as the laws of planetary motion and gravitation became accepted, Kepler's idea of the tides became the most plausible.

It wasn't until Isaac Newton (1642-1727) and his law of gravitational attraction that everything fell into place. He was the first to correctly explain the spring-neap cycle, and why equinoctial tides were larger than those at other times of the year.

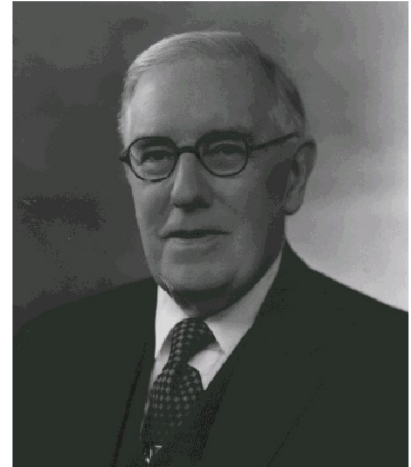
Now that tides were fully understood, scientists started to look for methods to accurately predict them for any date and time – future and past. Various methods have been devised for this, and all start with having a good series of observed sea levels, which are analysed to identify repeating patterns in the tide.

In 1832, Sir. John Lubbock developed a method of analysis and prediction based on relating the time and height of high and low water to the time of lunar transit, with corrections made for lunar and solar declination and distance.

However, the method generally considered to be the most accurate for most (but not all) locations is called Harmonic Analysis and Prediction. The basis for harmonic analysis is that the tide can be represented by a finite number of simple harmonic terms – each one a simple mathematical sine 'wave'. Each constituent, either individually or in pairs, corresponds to one of the astronomical phenomena to affect the tide.

Harmonic prediction involves simply calculating these harmonic ‘waves’ for any point in time and adding the results together to get the overall tide.

Early development of Harmonic Analysis was carried out by Laplace, Lord Kelvin and George Darwin around 1910, however the most complete algebraic expansions were completed by Dr. Arthur Doodson (*pictured right*) in 1921, then secretary of the Liverpool Tidal Institute, and from 1946 to 1960, was Director.



In 1924, the Liverpool Tidal Institute, under the directorship of Professor Proudman at Liverpool University, relocated to Bidston Observatory, and the first tide-predicting machine was installed. This machine could be ‘programmed’ with the harmonic constants for any location and used to predict the tides for any date and time. A yearly tide table took nearly a week to produce.

Five years later, the Liverpool Observatory of the Mersey Docks and Harbour Board and the Tidal Institute of the University of Liverpool amalgamated becoming the Liverpool Observatory and Tidal Institute. Dr. Doodson, now associate director, continued his ground-breaking research into new methods for the analysis of tides. Two tide-predicting machines were now in use (the only two in the British Empire), and the tidal expertise of the institute received worldwide acclaim.

During the Second World War, valuable work was carried out at the observatory. The staff worked seven days a week, from early morning to late at night, analysing and predicting tides towards the war effort. Tidal predictions were swiftly predicted for the seas around Burma, France and Holland. During these years one of the tide predicting machines was placed in a secret underground room in the Observatory grounds for security reasons. Photographic facilities were obtained, so that further copies of the predictions could be quickly provided in the event of their loss at sea.



In 1946, Dr. Doodson took over as Director at Bidston, and the Tide Prediction Service expanded. It was helped by the construction of a large 42-constituent Doodson-Légé predicting machine in 1949. This machine is still in working order and can be seen at the National Oceanography Centre in Liverpool (by appointment).

In 1961, shortly after the retirement of Dr Doodson, the Liverpool Observatory and Tidal Institute was renamed The University of Liverpool Tidal Institute and Observatory.

In 1969, the Institute became a component body of the Natural Environment Research Council (NERC) and was renamed the Institute of Coastal Oceanography and Tides (ICOT). It was around this time that an ambitious marine research programme was embarked upon, with an increase in staff.

1970 saw the installation of the institute's first mainframe computer, an IBM 1130. This speeded up the computation of tide tables immensely – a yearly table now taking less than an hour to compute. The reduction of human intervention also meant that errors were less frequent so less time was spent checking the results for typing mistakes.

In 1977 the institute was renamed yet again to the Proudman Oceanographic Laboratory in honour of Professor Joseph Proudman. It continued to develop its world-renowned reputation in tidal science by developing new analytical methods for locations that had a reputation for being difficult to predict accurately.

By this time, ocean research had moved on to encompass the much harder to predict surge component of sea level (the change in level due to meteorological effects such as wind and atmospheric pressure). The computer model run twice a day at the UK Meteorological Office to predict surges around the coast was developed by scientists at the NOC.

In 1992, the Tidal Computation and Statistics Section became known as the Applications Group and the work branched out to include offshore tidal predictions based on sophisticated computer simulations of the world's seas and oceans.

In 1994, the first version of the Poltips tidal prediction package was released for the PC and could predict a yearly tide table in well under 10 minutes on a cutting-edge (at the time) Intel 80486 computer. The latest Windows version of the software (which this user guide accompanies) can carry out the same task in about a second on a typical modern PC.

In 2004, the laboratory moved from its home in Bidston to a new building on the University of Liverpool campus, and in 2010 the Proudman Oceanographic Laboratory became part of the UK's National Oceanography Centre.

In 2019, the NOC underwent a major transformation by separating from UKRI-NERC control. NERC has been the custodian for fifty years and our role as a national institution has evolved such that the natural next step on our journey was to become an independent non-profit-distributing charitable company with a wholly owned trading subsidiary.

It is incredible to think how far we have come over the century with the help of computing technology. And even though we know a lot about the tides, there's still plenty more to discover about our seas and oceans on which our lives depend.



Appendix G: Time and Tide

Written by Valerie Doodson (daughter-in-law of Dr. Arthur Doodson mentioned earlier).

Tides are the alternating rise and fall of the surface of the seas and oceans. They are due mainly to the gravitational attraction (pull) of the Moon and Sun on the rotating Earth. Two high and two low tides occur daily around Britain and, with average weather conditions, scientists can predict their movements with considerable accuracy.

Both Moon and Sun affect the tides, but since the Moon is much closer to the Earth (240,000 miles instead of 93,000,000 miles), it has more than twice the effect of the Sun, even though it is much smaller. So, to understand tides it is best to start with the Moon and the lunar tide, before looking at the effect of the Sun.

As everyone knows, the Moon orbits around the Earth. However, the Earth is not fixed rigidly in space, and as the Moon orbits, it attracts the Earth round in a monthly orbit of its own in addition to its annual orbit around the Sun. It is the gravitational pull of the Moon on the Earth that keeps the Earth in its monthly orbit.

This is just the same as when you whirl a weight round on a piece of string. It is only by constantly pulling on the string that you prevent the object from flying off. If you stop pulling completely, by letting go on the string, the object does fly off. Gravity acts in the same way as you pulling on the string, and prevents the Earth from flying off.

However, unlike the string, the attractive pull of gravity gets weaker as the distance between the objects increases (and it becomes stronger, of course, the closer they get). The Earth is large, so the pull of gravity on the side of the Earth nearer the Moon is stronger than the pull on the side of the Earth farther from the Moon.

The pull of the Moon's gravity is just enough to keep the Earth in its monthly orbit, but it is a bit stronger on the surface of the Earth facing the Moon (near side) and weaker on the far side. This means that on the near side, the Moon tends to pull anything that's free to move towards it. In the same way, on the far side, there isn't quite enough gravitational pull, so that anything that's free to move tends to fly off, away from the Moon. Of course, though land isn't free to move, the oceans are. So, on the near side they are pulled into a bulge towards the Moon, and on the far side, they pile up into a bulge away from the Moon.

As the Earth spins, different parts of the world move under the two bulges of high water and experience high tides, giving the familiar two tides a day (semi-diurnal tides) around Britain. In some parts of the world, local effects can mean only one tide a day (diurnal tides) – for example in the South China Sea and parts of North Australia – or even no tide at all.

Between the two bulges are two troughs of low water, producing two low tides a day. The Sun also creates a very similar though smaller effect (the solar tide) and it is the interaction of the lunar and solar tides that causes spring and neap tides.

Springs and neaps

Tides change in height with low water level and high water level varying throughout the month. The tides build up to a maximum and fall to a minimum twice a month. The tides with the biggest difference between high and low water are called springs and those with the smallest are called neaps.

Spring tides happen just after every full and new moon, when the Sun, Moon and Earth are in line. That's when lunar and solar tides line up and reinforce each other, making a bigger total tide. Neap tides occur when the Moon is in the first or third quarter - when the Sun, Earth and Moon form a right angle. The lunar high tide coincides with the solar low tide and they partly cancel out, giving a small total tide.

Because of the regular motion of the Sun, Moon and Earth, spring tides occur roughly 36 to 48 hours after the full or new moons, and for any given location, always at roughly the same time of day. For example, at Liverpool, the spring tides are generally around midnight and midday.

Not all spring tides are the same size. Springs nearest the equinoxes (21 March and 21 September - when day and night are of equal length all over the world) are slightly bigger. The explanation for this is very complex and won't be given here.

Worldly effects

Back on Earth, tides are affected by more mundane things, such as weather and the shape of the coastline. In the upper reaches of estuaries the riverbed and shape of the estuary can distort the tidal pattern, producing long flood times and short ebb times. Though the time from high tide to high tide is the same as usual - roughly 12 hours 25 minutes - low tide is not half way between them. At some places, the flood tide rises quickly after a period of low water lasting maybe four or five hours. This kind of geographical effect is very important, and because of it you should use local tide tables (available from tackle shops) when possible.

Cromer, Lowestoft and Aldeburgh are fairly close to each other on the East Anglian coast. However, high tide is hours apart at these places. This is precisely the opposite to Southend and Herne Bay, which face each other across the mouth of the Thames. Their tides differ by only a few minutes. Without detailed geographical information, it is impossible to predict these differences, so stay with local tide tables.

Geography also affects the tidal range. Looking at tide tables for all of Britain, it's clear that the height of the tide varies around the country. For example, the spring tidal range at Avonmouth is 12.2m (40ft) while at Lowestoft it's only 1.9m (6ft).

Weather which can have a profound effect on the tide, is impossible to predict when calculating tide tables. Strong winds and abnormal atmospheric pressure are two of the main causes of altered tides. For example, a strong wind blowing on to land has the effect of piling up the water, giving a higher than predicted tide.

Appendix H: Tides - Frequently Asked Questions (FAQ)

The National Oceanography Centre are often contacted by people wanting to know about tides. For this reason, we compiled this Frequently Asked Questions...

1. What is a tide?

This is not as obvious as it may sound - it is not just the rise and fall of the water in our seas and oceans (tides are only one of the contributing factors in this rise and fall).

A tide is the regular and predictable movement of water caused by astronomical phenomena – specifically the way the Earth, Moon and Sun move in relation to each other and the forces generated in this system of bodies.

Movement of water caused by meteorological effects (for example winds and atmospheric pressure changes) is called a storm surge. These are not easily predictable and require powerful computers and sophisticated software to predict just a few days ahead.

Tide tables are computed yearly so therefore they can only include the tide component, not the storm surge. This is why tide table predictions do not always agree with observations.

The NOC develops the storm surge models for flood forecasting that have been run at the Met. Office since 1978. A large positive storm surge can add a few metres to the predicted tide level.

2. What causes tides?

Tides are caused by the effects of gravity in the Earth-Moon-Sun system, and the movement of those three bodies within the system. If you imagine that the Earth is completely covered in water, there are two bulges of water - one towards the Moon and another on the opposite side (see question 4). The changes in sea level are caused by the Earth rotating on its axis underneath these bulges of water. There are two tides a day because it passes under two bulges for each rotation (24 hours) (see question 7). This is called the lunar tide.

Two bulges of water are also caused by the Sun, called the solar tide - and these can either reinforce or partially cancel out the lunar tide giving rise to spring and neap tides (see question 8).

3. How far ahead can the tide be predicted?

Since the movements of the Earth, Moon and Sun can be computed to a great degree of accuracy many years in advance, so too can the changes in sea level. When NOC are looking to compute the highest possible tidal levels for a location we will often compute 50 years into the future. If you want to plan a coastal event for 5 or 10 years from now, get in touch and (for a fee) the NOC can provide you with the tide table.

4. Why are there two bulges of water caused by the Moon?

It is fairly easy to understand why there is a bulge of water under the Moon. However, one of the most common question we get asked is why there's a second bulge of water on the opposite side of the Earth.

To understand tidal forcing you need to understand three key facts:

- Most people think the Moon rotates round the Earth. In reality, the Earth and the Moon rotate around a common centre inside the Earth (which is not at the Earth's centre).
- There are two forces to consider – the force of gravity on the Earth's surface acting towards the Moon, and an inertial force cause by the 29-day rotation about the common centre.
- The tide-generating force is actually the difference between these two forces (so if they are equal strength but opposite in direction the tide-generating force is zero).

At the common centre of rotation, the two forces are in perfect balance and so there is no tide-generating force. However, on the surface of the Earth nearest the Moon, gravity is stronger greater than the inertial force, and so there is a net force towards the Moon causing a bulge towards the Moon. On the opposite side of the Earth, gravity is reduced as it is further from the Moon, and here the inertial force is stronger. Hence there is a net force away from the Moon that creates the second bulge of water. Figure 1a shows the distribution of the tide generating forces

To make the water move we only need to consider the component of the force acting horizontally and this is shown in Figure 1b.

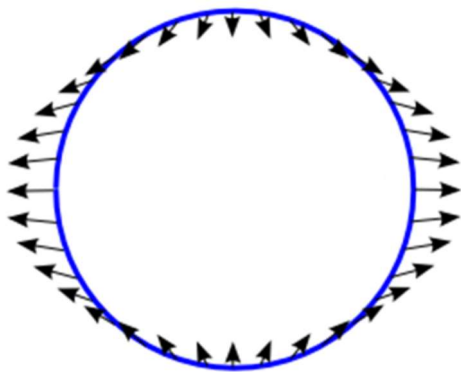


Fig 1a: The tide generating forces at the surface of the Earth

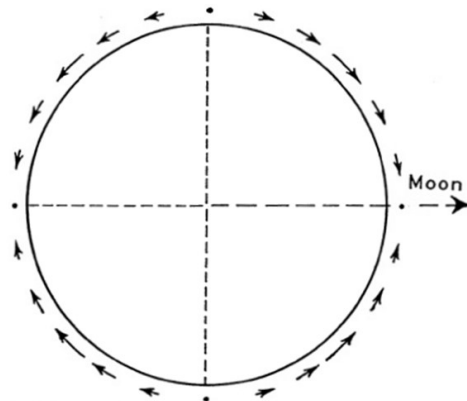


Fig 1b: Just the tangential component of this force – the one horizontal to the Earth's surface that can actually cause the water to move.

(note that even this explanation is simplified for the purposes of this user guide.)

5. Why are the tides not the same all around the coast of Britain?

You might expect that as Britain passes under the bulge of water, time of high water would be roughly the same for all points on the coast, but it isn't. The problem is caused by the land that 'gets in the way' of the moving water. As the Earth rotates, the water has to move to generate the high tides but because of the shape of coastlines and the variation in sea depth (bathymetry), there is a lag. Every location has a unique coastline and bathymetry that gives each location its unique tidal pattern.

6. How often do high tides occur?

In UK waters, high tides occur on average every 12 hours 25 minutes (these are called semi-diurnal tides). You may wonder why it is not exactly 12 hours. If there was no Moon and the tides were only caused by the Sun, then the tides would in fact be every 12 hours. But remember that the Moon is also moving around the Earth and therefore so is the bulge of water it creates.

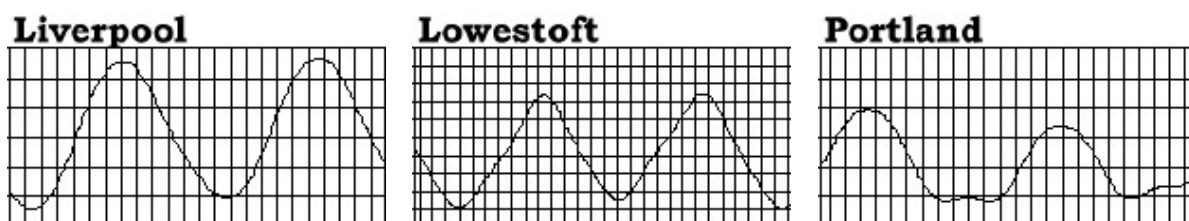
If you are on the surface of the Earth under one of the bulges of water, then after 12 hours you have almost but not quite arrived at the second bulge since it's moved. So, the Earth will need to rotate for a further 25 minutes to get directly under it.

7. Are there always two high tides a day?

No. Although most places in Britain experience approximately two tides a day (semi-diurnal) there are some places which experience what is known as a double-high water (e.g. Southampton) or double-low water (e.g. Portland). This is caused by the shape of the coastline and the bathymetry (sea depth).

Even for 'well-behaved' locations, when you look at a tide-table you will see that some days only have 3 tides. This is because the average time between high water and low water is 6 hours 12 minutes and not exactly 6 hours. Therefore, on certain days, the fourth tide actually gets pushed across into the next day.

The diagrams below show a typical tidal curve for three places round the UK coast.



In some parts of the world there is only one high and one low water each day (diurnal) – for example in Karumba, Australia. In other places, it varies between semi-diurnal and diurnal as in Musay-id in the Arabian Gulf.

8. What are spring tides and neap tides?

When the Earth, Moon and Sun are in line (during new and full moon), the bulges of water caused by the Moon and Sun occur in approximately the same place on the Earth's surface. The lunar tide and the solar tide are reinforcing each other - which leads to higher than average high tides, and lower than average low tides. These are called spring tides (nothing to do with the season of spring).

When the Earth, Moon and Sun form a right angle (which is when you observe the Moon as a semi-circle) the high water caused by the lunar tide coincides with the low water of the solar tide. This produces lower than average high waters and higher than average low waters which are called neap tides. They occur approximately 7 days after spring tides.



9. Why are they called spring and neap tides?

Neap means low - so that is an easy one. Spring tides can be confusing because they have nothing to do with the season. It is not exactly known where the word 'spring' comes from in this context but there are two possible origins. One possible source is a Scandinavian word meaning to 'leap up'. Another possibility is that it is related to the natural feature of a spring - which is a place where water wells up from the Earth.

10. Where are the highest tides in the world?

Burncoat Head in the Bay of Fundy, Canada has an average spring tidal range of 12.9 m. (The average spring tidal range is the average difference between high and low waters during spring tides).

The third largest tides in the world occur at Avonmouth in the Bristol Channel where the average spring range is 12.3 m. If you are stood on the sand at the waters edge at Avonmouth when the tide is rushing in, and average height adult would be in waist high water after just 15 minutes, and their head would be underwater 15 minutes later.

11. Do the tides follow a repeated pattern?

No. There are similarities - for example every 18.6 years, we experience larger than average tides - but they never actually repeat.

12. When during a year can we expect to find the largest tides?

For locations that have semi-diurnal tides, the largest tidal ranges usually occur a day or two after the full or new moon nearest to the equinoxes. The spring equinox is usually around the 20th March, and the autumn equinox, the 22nd or 23rd September.

Some years have tides that are notably higher than other years. 2015/16 were significant years, as will be the year 2032. For really favourable conditions - you will have to wait around until the year 3182. Even then, the tides may only be 1 or 2 cm higher than in 2015.

13. Do the planets have any affect on the tides?

The tidal force generated by a body in space is based on two things – its mass and its distance from the Earth - and it is the latter of these that is far more significant. The nearest approach of Venus to Earth is still more than 100 times further away than the Moon. Hence the tidal force is approximately 0.000054 times that of the Moon. That equates to a movement in sea level of less than a quarter of a millimetre (one hundredth of an inch). The next most significant planet is Jupiter, where the tidal force is 10 times less again. So as you can see, the effect of the planets on the tide can safely be ignored.

Even if all the planets line up such that their effects are combined, the additional force would be tiny. On the 5th May 2000, Mercury, Venus, Mars, Jupiter and Saturn lined up with the Sun and Moon. At the time a rumour circulated that the collective gravitational pull would initiate earthquakes, tidal waves and volcanic eruptions, something which of course never happened.

14. How can tide tables be produced so accurately?

There are many different steps involved in obtaining the numbers that go into a tide table. Before a prediction can be made for a port, a long sequence of tidal observations for that port are needed (called a time series). This time series will include all the astronomical effects and local coastline/depth effects which influence the tide, as well as the weather induced effects called a storm surge (see question 1).

There are certain frequencies that are known to occur in the tide. Some of the important ones are:

- 12 hours (12:00:00) repeated pattern (cycle) due to the gravity of the Sun.
- 12:25:14.164 cycle due to the gravity of the Moon.
- 24:00 and 24:50:28.328 cycles caused by the differences in the two tidal bulges.
- 27.2122 day cycle caused by change in lunar declination (Moons angle to the Earth).
- 27.5546 day cycle caused by a change in the Earth-Moon distance.
- 29.5306 day cycle caused by the phases of the Moon (see question 8).

Each of these cycles is called a tidal harmonic constituent and Poltips uses in excess of 100 of them in calculating the tides. The duration of these cycles is known very accurately (to the nearest 1/1000th of a second). Therefore it is easy to find them in a sequence of tide gauge observations using a method called harmonic analysis. Once each constituent is identified, its size (amplitude) and time of 'arrival' (phase) is stored. These pairs of values (known as harmonic constants) are unique for every location.

The amplitude and phase for each constituent combined with the fixed period of that constituent allows us to predict its contribution to the overall tide forward or backward in time almost indefinitely.

Adding up the effects of all the constituents at a given location lets us predict the overall tide at any time in the future or past.

To reduce the amount of data shown in a tide table, most of them just list the time and height when the water is at a maximum and a minimum level in each tidal cycle. This leads to approximately 2 high waters and 2 low waters every 24 hours, 50 minutes (or 4 tides a day on most days with 3 tides on every 7th or 8th day). Poltips is able to produce specialist tide tables that give the tidal height every 30 or 60 minutes as shown below. However, these can take upto 24 pages for a one year tide table.

		ENGLAND, WEST COAST - LIVERPOOL (GLADSTONE DOCK)																							
TIME ZONE: UTC		Lat 53° 27' N Long 03° 01' W																							
		UNITS: METRES																							
		JANUARY 2023																							
		0000	0030	0100	0130	0200	0230	0300	0330	0400	0430	0500	0530	0600	0630	0700	0730	0800	0830	0900	0930	1000	1030	1100	1130
		1200	1230	1300	1330	1400	1430	1500	1530	1600	1630	1700	1730	1800	1830	1900	1930	2000	2030	2100	2130	2200	2230	2300	2330
1	Su	2.79	2.63	2.65	2.86	3.28	3.84	4.51	5.22	5.91	6.53	7.04	7.43	7.67	7.76	7.69	7.47	7.11	6.66	6.15	5.63	5.12	4.64	4.19	3.78
		3.44	3.19	3.06	3.09	3.30	3.70	4.25	4.92	5.64	6.35	6.98	7.48	7.85	8.06	8.10	7.97	7.69	7.27	6.75	6.19	5.62	5.07	4.54	4.05
2	Mo	3.60	3.21	2.93	2.76	2.76	2.94	3.30	3.82	4.46	5.16	5.87	6.50	7.03	7.43	7.71	7.83	7.79	7.59	7.24	6.79	6.28	5.75	5.22	4.72
		4.25	3.81	3.44	3.16	3.00	3.00	3.18	3.54	4.08	4.75	5.49	6.22	6.87	7.40	7.79	8.03	8.10	8.00	7.73	7.31	6.79	6.22	5.64	5.08
3	Tu	4.54	4.04	3.59	3.20	2.92	2.75	2.75	2.92	3.29	3.83	4.51	5.26	6.00	6.66	7.21	7.63	7.91	8.03	7.98	7.75	7.36	6.87	6.31	5.75
		5.19	4.65	4.14	3.68	3.29	3.00	2.83	2.83	3.01	3.40	3.98	4.71	5.51	6.28	6.96	7.50	7.90	8.14	8.20	8.08	7.77	7.31	6.75	6.14
4	We	5.54	4.95	4.39	3.87	3.42	3.04	2.78	2.65	2.68	2.92	3.36	3.99	4.76	5.58	6.35	7.03	7.57	7.98	8.23	8.29	8.17	7.85	7.38	6.81
		6.19	5.57	4.97	4.40	3.87	3.40	3.02	2.74	2.60	2.65	2.90	3.38	4.06	4.89	5.75	6.55	7.23	7.77	8.14	8.34	8.34	8.13	7.74	7.19
5	Th	6.57	5.91	5.27	4.65	4.07	3.56	3.12	2.78	2.57	2.52	2.67	3.02	3.60	4.36	5.23	6.10	6.88	7.53	8.04	8.38	8.54	8.49	8.24	7.80
		7.22	6.57	5.89	5.23	4.59	4.01	3.49	3.04	2.69	2.46	2.40	2.55	2.94	3.57	4.39	5.30	6.20	6.99	7.64	8.13	8.42	8.52	8.39	8.06
6	Fr	7.55	6.91	6.22	5.52	4.84	4.21	3.64	3.16	2.77	2.51	2.41	2.49	2.80	3.33	4.08	4.97	5.90	6.76	7.49	8.07	8.49	8.71	8.73	8.53
		8.12	7.54	6.86	6.14	5.42	4.75	4.12	3.58	3.07	2.67	2.38	2.25	2.33	2.64	3.21	4.01	4.95	5.91	6.78	7.52	8.09	8.46	8.62	8.56
7	Sa	8.28	7.80	7.17	6.45	5.71	4.99	4.32	3.70	3.18	2.76	2.47	2.33	2.38	2.65	3.15	3.88	4.78	5.74	6.66	7.45	8.08	8.54	8.81	8.87
		8.71	8.33	7.76	7.07	6.32	5.58	4.86	4.21	3.61	3.10	2.67	2.35	2.17	2.19	2.45	2.97	3.74	4.68	5.68	6.61	7.40	8.02	8.45	8.66
8	Su	8.84	8.40	7.94	7.33	6.61	5.86	5.11	4.41	3.77	3.21	2.76	2.44	2.28	2.32	2.57	3.05	3.76	4.66	5.63	6.57	7.39	8.06	8.55	8.85
		8.94	8.81	8.45	7.90	7.21	6.45	5.69	4.96	4.29	3.68	3.14	2.69	2.34	2.14	2.13	2.35	2.83	3.57	4.49	5.50	6.45	7.28	7.94	8.40
9	Mo	8.84	8.66	8.44	8.01	7.41	6.70	5.95	5.20	4.49	3.84	3.26	2.79	2.45	2.27	2.29	2.53	3.00	3.69	4.57	5.54	6.49	7.32	8.00	8.51
		8.82	8.94	8.83	8.50	7.97	7.29	6.54	5.77	5.04	4.36	3.75	3.20	2.74	2.38	2.16	2.12	2.31	2.76	3.46	4.36	5.35	6.31	7.15	7.83
10	Tu	8.31	8.58	8.81	8.42	8.02	7.44	6.75	6.01	5.28	4.58	3.93	3.35	2.87	2.50	2.30	2.30	2.52	2.97	3.65	4.50	5.45	6.39	7.22	7.91
		8.42	8.74	8.87	8.79	8.49	7.99	7.33	6.60	5.84	5.12	4.45	3.85	3.30	2.83	2.46	2.22	2.16	2.32	2.73	3.39	4.25	5.20	6.15	6.99
11	We	7.67	8.17	8.45	8.51	8.35	7.98	7.44	6.77	6.06	5.35	4.67	4.05	3.49	3.01	2.63	2.40	2.37	2.55	2.97	3.61	4.43	5.34	6.26	7.08
		7.75	8.27	8.60	8.74	8.69	8.42	7.97	7.35	6.65	5.92	5.21	4.56	3.97	3.45	2.98	2.60	2.34	2.26	2.38	2.75	3.35	4.14	5.04	5.95
12	Th	6.78	7.46	7.96	8.26	8.36	8.24	7.91	7.42	6.80	6.12	5.44	4.79	4.20	3.67	3.21	2.83	2.59	2.51	2.64	3.00	3.58	4.33	5.19	6.07
		6.87	7.54	8.05	8.40	8.56	8.53	8.32	7.92	7.36	6.70	6.01	5.33	4.69	4.13	3.62	3.18	2.81	2.54	2.42	2.50	2.80	3.31	4.02	4.85
13	Fr	5.71	6.50	7.18	7.69	8.02	8.15	8.08	7.82	7.39	6.84	6.21	5.57	4.96	4.40	3.90	3.46	3.10	2.84	2.73	2.79	3.07	3.55	4.21	4.98
		5.80	6.58	7.24	7.77	8.14	8.34	8.35	8.19	7.86	7.37	6.78	6.13	5.49	4.88	4.33	3.85	3.43	3.07	2.79	2.65	2.66	2.87	3.28	3.87
14	Sa	4.60	5.38	6.14	6.81	7.35	7.72	7.91	7.92	7.74	7.40	6.93	6.37	5.78	5.21	4.67	4.19	3.77	3.42	3.15	3.00	2.99	3.16	3.51	4.03
		4.69	5.43	6.17	6.84	7.39	7.81	8.07	8.15	8.07	7.83	7.43	6.92	6.34	5.74	5.15	4.61	4.14	3.72	3.37	3.09	2.90	2.85	2.95	3.22
15	Su	3.67	4.26	4.95	5.66	6.33	6.91	7.35	7.63	7.73	7.67	7.46	7.10	6.64	6.12	5.58	5.06	4.58	4.16	3.80	3.51	3.30	3.20	3.25	3.45
		3.80	4.31	4.92	5.60	6.26	6.87	7.36	7.72	7.91	7.94	7.82	7.56	7.16	6.67	6.13	5.57	5.04	4.55	4.12	3.74	3.43	3.19	3.05	3.03

Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)
 Data computed by POLTIPS-4 software from the UK National Oceanography Centre.

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15. Where can I find out more information about tides?

There are many websites that cover the subject of tides but the reader should be aware of inaccuracies that often exist. If you want to really understand tides, you will need a book written by an authority of tidal science. See Appendix C of this user guide for some recommendations.

Appendix I: Poltips Frequently Asked Questions (FAQ)

Why is Daylight Saving Time not available with equal interval predicted data?

Things can get a little complicated when you have evenly spaced data and the clocks are able to move forwards or backwards in time (effectively changing the time zone midway through a time series of data). When the clocks go forward you end up with a gap in the data. When the clocks go backwards, the same hour gets repeated twice so you have two height values for each time interval within that hour. Either way, your data is no longer evenly spaced. Therefore it does not make sense to allow daylight saving time changes in fixed interval tidal predictions.

When calculating the stats, why does Poltips use a 20 year period from 1997 to 2016 to derive the highest and lowest tides possible?

The tides follow a cycle called the 18.6 year nodal cycle. This means that every 18.6 years you get slightly higher high waters and slightly lower low waters. Whenever calculating tidal statistics it makes sense to always base them on a complete nodal cycle. The peaks years for the nodal cycle were 1997 and 2015/16. Therefore, when computing highest and lowest tidal levels it makes sense to include both of these years to improve the likelihood of identifying the most extreme tides.

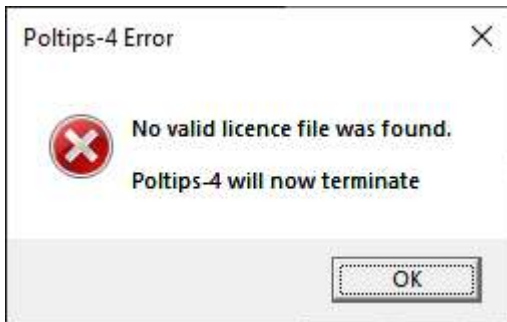
Why do some days only have 3 tides on them instead of 4?

You often hear of there being 2 high waters and 2 low waters every day (a total of 4 turning points each day). However, it is actually not quite right. On average there are 4 turning points every 24 hours, 50 minutes. This is why the times of high water move on by an average of 50 minutes each day.

The result of this is that about every 7 or 8 days, a tide moves past midnight into the following day meaning that you only have 3 turning points on that day.

Appendix J: Troubleshooting

I get the following error message appear



You should have obtained a licence file from the National Oceanography Centre when you purchased the software. Follow the instructions on page 11 to ensure both the software and the licence were properly installed.

I get a report that one of the files is missing

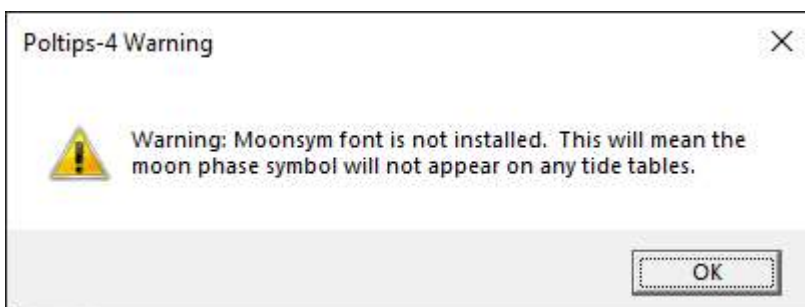
Send an email to products@noc-innovations.com giving details of the error you are getting and we will try and help to sort out the problem.

Moon symbols don't appear on the tide table

Most tide table formats usually have a Moon symbol on the days for which the Moon is at one of the four primary phases:

- full moon shown as: ○
- new moon shown as: ●
- first quarter shown as: ☾
- third quarter shown as: ☽

If these are not showing up or you see the letters A,B,C,D instead, then it probably means the font file was not installed correctly. It is possible you may have received the following message when you first started Poltips:



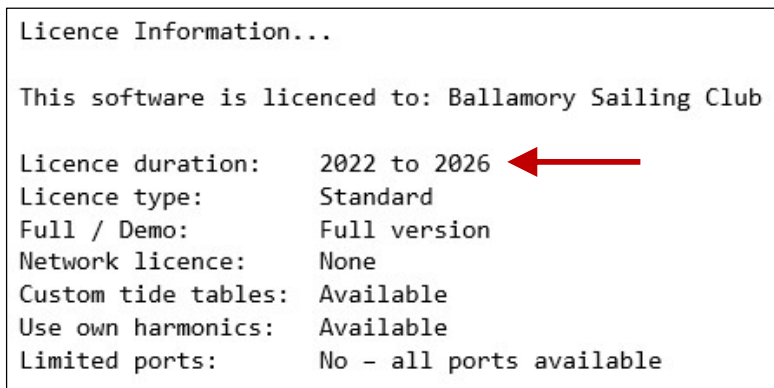
The font file (moonsym.ttf) should be installed when you run the setup.exe program supplied by the NOC. If this has not happened, contact NOC Innovations Ltd (products@noc-innovations.com) and request a copy of the Moon symbol font file.

To manually install a font file on Windows, copy the file into the Windows fonts folder. This will usually be **C:\Windows\Fonts**. This will automatically install the font onto Windows. Then close Poltips completely and restart it. Moon symbols should now appear correctly on the tide tables.

When I try to predict the tides I get a licence error

Check that the period you are computing the tides for is within the licence period purchased. It is possible that your licence has now expired and you will need to contact NOC Innovations (products@noc-innovations.com) to purchase an extension.

The duration of your current licence is shown when you first start Poltips.



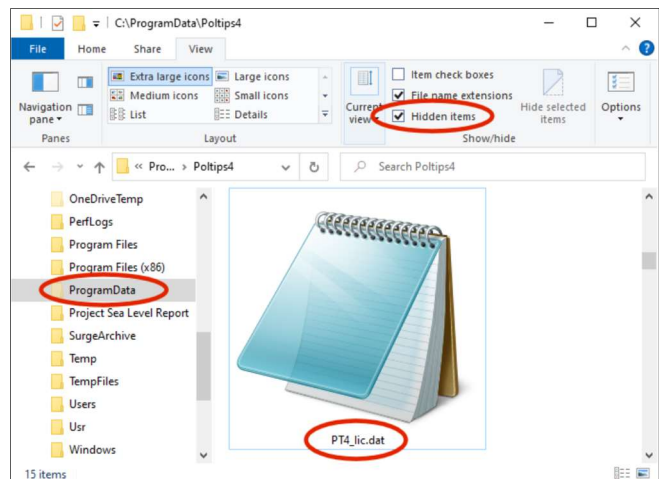
Although you can use the software outside of the licence period, you can only compute the tides for the years specified in the licence.

Where is my licence file and what is it called?

The licence file for Poltips-4 is called **PT4_lic.dat**. If you installed this using the process mentioned on page 11, then the licence file will be found in **C:\ProgramData\Poltips4**.

Why can't see the C:\ProgramData folder?

The folder C:\ProgramData is actually a hidden folder by default in Windows. To see this in Windows File Explorer you will need to 'show hidden items'. Once installed you should never need to touch this file.



Appendix K: Text Layouts for Data

Default Layout

Example of High and Low Waters	Example of Equal Interval Data
01/02/2023 02:09 3.35	01/02/2023 00:00 4.27
01/02/2023 08:07 7.49	01/02/2023 01:00 3.65
01/02/2023 14:51 3.24	01/02/2023 02:00 3.35
01/02/2023 20:36 7.60	01/02/2023 03:00 3.54
02/02/2023 03:14 3.17	01/02/2023 04:00 4.24
02/02/2023 09:09 7.84	01/02/2023 05:00 5.31
02/02/2023 15:54 2.90	01/02/2023 06:00 6.40
02/02/2023 21:33 7.91	01/02/2023 07:00 7.18
...	...

CSV (Comma Separated Values) Layout

Example of High and Low Waters	Example of Equal Interval Data
01/02/2023,02:09,3.35	01/02/2023,00:00,4.27
01/02/2023,08:07,7.49	01/02/2023,01:00,3.65
01/02/2023,14:51,3.24	01/02/2023,02:00,3.35
01/02/2023,20:36,7.60	01/02/2023,03:00,3.54
02/02/2023,03:14,3.17	01/02/2023,04:00,4.24
02/02/2023,09:09,7.84	01/02/2023,05:00,5.31
02/02/2023,15:54,2.90	01/02/2023,06:00,6.40
02/02/2023,21:33,7.91	01/02/2023,07:00,7.18
...	...

CSV (Comma Separated Values) - One Line Per Day Layout

Example of High and Low Waters (showing the letter for Moon phase)
01/02/2023,E,02:09,3.35,08:07,7.49,14:51,3.24,20:36,7.60
02/02/2023,E,03:14,3.17,09:09,7.84,15:54,2.90,21:33,7.91
03/02/2023,E,04:07,2.89,09:57,8.23,16:45,2.55,22:18,8.23
04/02/2023,E,04:50,2.61,10:36,8.56,17:26,2.24,22:56,8.49
05/02/2023,C,05:26,2.35,11:11,8.82,18:02,2.00,23:30,8.68
06/02/2023,E,05:59,2.14,11:43,8.99,18:34,1.83
07/02/2023,E,00:00,8.80,06:30,1.96,12:15,9.08,19:06,1.71
...
Example of Equal Interval Data (showing the letter for Moon phase)
Data interval is 60 minutes, therefore 24 data values per line
01/02/2023,E,4.27,3.65,3.35,3.54,4.24,5.31,6.40,7.18,7.49,7.29,6.62,5.71,4.81,4.02, ...
02/02/2023,E,5.17,4.26,3.55,3.18,3.34,4.07,5.30,6.56,7.46,7.84,7.61,6.82,5.77,4.73, ...
03/02/2023,E,6.15,5.02,4.00,3.24,2.89,3.15,4.11,5.59,6.99,7.92,8.23,7.81,6.78,5.55, ...
04/02/2023,E,7.15,5.88,4.61,3.54,2.82,2.62,3.13,4.47,6.18,7.59,8.42,8.50,7.75,6.45, ...
05/02/2023,C,7.99,6.79,5.36,4.03,3.00,2.42,2.48,3.42,5.16,6.95,8.23,8.80,8.50,7.38, ...
06/02/2023,E,8.56,7.64,6.19,4.69,3.40,2.48,2.14,2.61,4.07,6.06,7.74,8.75,8.95,8.20, ...
07/02/2023,E,8.80,8.31,7.03,5.46,3.99,2.79,2.07,2.07,3.09,5.00,7.00,8.40,9.06,8.79, ...
...

Top 20 Highest And Lowest Tides (option not available for fixed interval data)

Example of High and Low Waters

Top 20 Highest Tides in the predicted period

23/03/2023	12:12	10.09
22/03/2023	11:31	10.05
24/03/2023	12:50	9.91
21/03/2023	10:49	9.78
22/03/2023	23:56	9.71
24/03/2023	00:33	9.62

...

Top 20 Lowest Tides in the predicted period

22/03/2023	18:35	0.34
23/03/2023	19:12	0.42
21/03/2023	17:53	0.53
23/03/2023	06:46	0.62
24/03/2023	07:24	0.73
24/03/2023	19:48	0.76

...

Appendix L: Standard Tide Table Layouts

Format A

LIVERPOOL (GLADSTONE DOCK)											
Time Zone: UTC			Datum: Chart Datum			Year: 2023					
January						February					
	Time	m		Time	m		Time	m		Time	m
1	0042	2.61	16	0503	7.60	1	0209	3.34	16	0111	3.25
Su	0632	7.76	Mo	1138	3.35	We	0807	7.49	Th	0657	7.55
	1310	3.05		1725	7.80		1451	3.24		1348	3.14
	1852	8.11					2036	7.60		1939	7.68
2	0146	2.74	17	0030	3.09	2	0314	3.17	17	0236	2.89
Mo	0738	7.83	Tu	0615	7.62	Th	0909	7.84	Fr	0818	8.00
	1416	2.98		1256	3.31		1554	2.90		1510	2.58
	1957	8.10		1841	7.82		2133	7.91		2057	8.19
3	0246	2.73	18	0148	2.93	3	0407	2.89	18	0345	2.33
Tu	0836	8.04	We	0728	7.86	Fr	0957	8.23	Sa	0924	8.62
	1516	2.81		1416	3.01		1645	2.55		1620	1.88
	2055	8.21		1957	8.06		2218	8.23		2158	8.79
4	0339	2.64	19	0258	2.58	4	0450	2.61	19	0445	1.75
We	0926	8.29	Th	0835	8.28	Sa	1036	8.56	Su	1019	9.25
	1609	2.59		1525	2.53		1726	2.24		1720	1.20
	2145	8.36		2103	8.46		2256	8.49		2250	9.29
5	0424	2.52	20	0359	2.16	5	0526	2.35	20	0539	1.24
Th	1009	8.54	Fr	0933	8.78	Su	1111	8.82	Mo	1108	9.75
	1654	2.40		1627	1.99	○	1802	2.00	●	1812	0.66
	2228	8.52		2203	8.90		2330	8.68		2336	9.62
6	0502	2.41	21	0455	1.75	6	0559	2.14	21	0626	0.88
Fr	1048	8.75	Sa	1027	9.26	Mo	1143	8.99	Tu	1153	10.08
○	1735	2.25	●	1726	1.46		1834	1.83		1858	0.35
	2307	8.63		2257	9.27						
7	0537	2.32	22	0548	1.42	7	0000	8.80	22	0020	9.73
Sa	1123	8.88	Su	1118	9.65	Tu	0630	1.96	We	0709	0.72
	1812	2.16		1821	1.02		1215	9.08		1236	10.18
	2342	8.68		2348	9.52		1906	1.71		1940	0.33
8	0610	2.27	23	0638	1.19	8	0031	8.85	23	0101	9.64
Su	1157	8.94	Mo	1207	9.91	We	0702	1.85	Th	0750	0.80
	1847	2.11		1912	0.73		1245	9.10		1317	10.05
							1936	1.68		2018	0.61
9	0017	8.68	24	0036	9.59	9	0101	8.83	24	0140	9.36
Mo	0642	2.25	Tu	0725	1.11	Th	0735	1.83	Fr	0827	1.11
	1230	8.94		1254	9.99		1315	9.04		1357	9.71
	1920	2.11		1959	0.66		2007	1.75		2054	1.12
10	0050	8.63	25	0123	9.48	10	0132	8.74	25	0218	8.96
Tu	0715	2.27	We	0810	1.21	Fr	0808	1.94	Sa	0903	1.61
	1303	8.87		1340	9.89		1345	8.92		1436	9.20
	1954	2.16		2044	0.84		2038	1.93		2129	1.78
11	0124	8.52	26	0208	9.19	11	0203	8.58	26	0257	8.47
We	0751	2.36	Th	0853	1.49	Sa	0840	2.16	Su	0940	2.22
	1336	8.75		1425	9.60		1415	8.74		1518	8.56
	2028	2.26		2127	1.24		2109	2.19		2204	2.49
12	0158	8.36	27	0253	8.79	12	0239	8.36	27	0340	7.92
Th	0827	2.51	Fr	0936	1.91	Su	0915	2.45	Mo	1024	2.88
	1411	8.57		1511	9.17		1451	8.50		1609	7.86
	2104	2.42		2209	1.79		2145	2.51		2249	3.17
13	0235	8.16	28	0339	8.33	13	0320	8.09	28	0438	7.37
Fr	0905	2.73	Sa	1021	2.42	Mo	0955	2.79	Tu	1126	3.46
	1448	8.37		1600	8.64		1536	8.18		1717	7.24
	2142	2.63		2254	2.39		2229	2.87		2357	3.70
14	0315	7.94	29	0432	7.86	14	0413	7.76			
Sa	0947	2.97	Su	1113	2.92	Tu	1050	3.13			
	1530	8.15		1656	8.08		1638	7.79			
	2227	2.85		2349	2.93		2335	3.20			
15	0404	7.73	30	0535	7.49	15	0527	7.50			
Su	1036	3.20	Mo	1220	3.30	We	1210	3.34			
€	1621	7.95		1805	7.63		1805	7.52			
	2320	3.02	31	0056	3.28						
			Tu	0651	7.34						
				1338	3.42						
				1924	7.46						

Computed and formatted by POLTIPS-4 : the National Oceanography Centre's Tidal Software

Format D

ENGLAND, WEST COAST - LIVERPOOL (GLADSTONE DOCK)											
Time Zone: UTC			53° 27' N, 03° 01' W			Year: 2023					
January				February				March			
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
1	0042	2.61	16	0603	7.80	1	0209	3.34	16	0111	3.25
	0832	7.76		1138	3.35		0807	7.49		0657	7.55
Su	1310	3.05	Mo	1726	7.80	We	1451	3.24	Th	1348	3.14
	1852	8.11					2036	7.60		1939	7.68
2	0146	2.74	17	0030	3.09	2	0314	3.17	17	0236	2.89
	0738	7.83		0615	7.62		0909	7.84		0818	8.00
Mo	1418	2.98	Tu	1256	3.31	Th	1554	2.90	Fr	1510	2.58
	1957	8.10		1841	7.82		2133	7.91		2057	8.19
3	0246	2.73	18	0148	2.93	3	0407	2.89	18	0345	2.33
	0836	8.04		0728	7.86		0957	8.23		0924	8.62
Tu	1516	2.81	We	1416	3.01	Fr	1645	2.55	Sa	1620	1.88
	2055	8.21		1957	8.08		2218	8.23		2158	8.79
4	0339	2.64	19	0258	2.58	4	0450	2.61	19	0445	1.75
	0928	8.29		0835	8.28		1036	8.56		1019	9.25
We	1609	2.59	Th	1525	2.53	Sa	1726	2.24	Su	1720	1.20
	2145	8.36		2103	8.48		2256	8.49		2250	9.29
5	0424	2.52	20	0359	2.18	5	0528	2.35	20	0539	1.24
	1009	8.54		0933	8.78		1111	8.82		1108	9.76
Th	1654	2.40	Fr	1627	1.99	Su	1802	2.00	Mo	1812	0.86
	2228	8.52		2203	8.90		2330	8.68		2336	9.62
6	0502	2.41	21	0455	1.75	6	0559	2.14	21	0626	0.88
	1048	8.75		1027	9.26		1143	8.99		1153	10.08
Fr	1735	2.25	Sa	1726	1.46	Mo	1834	1.83	Tu	1858	0.35
	2307	8.63		2257	9.27						
7	0537	2.32	22	0548	1.42	7	0000	8.80	22	0020	9.73
	1123	8.88		1118	9.65		0630	1.96		0709	0.72
Sa	1812	2.16	Su	1821	1.02	Tu	1215	9.08	We	1236	10.18
	2342	8.88		2348	9.52		1906	1.71		1940	0.33
8	0610	2.27	23	0638	1.19	8	0031	8.85	23	0101	9.64
	1157	8.94		1207	9.91		0702	1.85		0750	0.80
Su	1847	2.11	Mo	1912	0.73	We	1245	9.10	Th	1317	10.05
							1936	1.68		2018	0.61
9	0017	8.68	24	0036	9.59	9	0101	8.83	24	0140	9.36
	0642	2.25		0725	1.11		0735	1.83		0827	1.11
Mo	1230	8.94	Tu	1254	9.99	Th	1315	9.04	Fr	1357	9.71
	1920	2.11		1959	0.66		2007	1.75		2054	1.12
10	0050	8.63	25	0123	9.48	10	0132	8.74	25	0218	8.96
	0715	2.27		0810	1.21		0808	1.94		0903	1.61
Tu	1303	8.87	We	1340	8.89	Fr	1345	8.92	Sa	1436	9.20
	1954	2.16		2044	0.84		2038	1.93		2129	1.78
11	0124	8.52	26	0208	9.19	11	0203	8.58	26	0257	8.47
	0751	2.36		0853	1.49		0840	2.16		0940	2.22
We	1338	8.75	Th	1425	9.60	Sa	1415	8.74	Su	1518	8.56
	2028	2.26		2127	1.24		2109	2.19		2204	2.49
12	0158	8.36	27	0253	8.79	12	0239	8.36	27	0340	7.92
	0827	2.51		0936	1.91		0915	2.45		1024	2.88
Th	1411	8.57	Fr	1511	9.17	Su	1451	8.50	Mo	1609	7.86
	2104	2.42		2209	1.79		2145	2.51		2249	3.17
13	0235	8.16	28	0339	8.33	13	0320	8.09	28	0438	7.37
	0905	2.73		1021	2.42		0955	2.79		1126	3.46
Fr	1448	8.37	Sa	1600	8.64	Mo	1536	8.18	Tu	1717	7.24
	2142	2.63		2254	2.39		2229	2.87		2357	3.70
14	0315	7.94	29	0432	7.86	14	0413	7.76	14	0250	8.29
	0947	2.97		1113	2.92		1050	3.13		0930	2.54
Sa	1530	8.15	Su	1656	8.08	Tu	1638	7.79	Tu	1510	8.19
	2227	2.85		2349	2.93		2335	3.20		2157	2.83
15	0404	7.73	30	0535	7.49	15	0627	7.50	15	0343	7.84
	1036	3.20		1220	3.30		1210	3.34		1024	2.97
Su	1621	7.95	Mo	1805	7.63	We	1805	7.52	We	1815	7.64
	2320	3.02								2303	3.30
31	0056	3.28	31	0056	3.28						
	0651	7.34		0651	7.34						
Tu	1338	3.42	Tu	1338	3.42						
	1924	7.46		1924	7.46						
31	0045	4.10	31	0045	4.10						
	0651	6.92		0651	6.92						
Fr	1352	3.57	Fr	1352	3.57						
	1944	6.97		1944	6.97						

Datum of Predictions: Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)
 Tides computed by POLTIPS-4 software from the UK National Oceanography Centre

Format G

Time Zone: UTC		Tidal Predictions : HIGH WATERS 2023				Units: METRES		
Datum of Predictions = Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)								
Daylight Saving Time Dates for 2023 : 26th March to 29th October (for information only - data not adjusted)								
LIVERPOOL (GLADSTONE DOCK)		LIVERPOOL (GLADSTONE DOCK)		LIVERPOOL (GLADSTONE DOCK)		LIVERPOOL (GLADSTONE DOCK)		
January		February		March		April		
Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	
time	m	time	m	time	m	time	m	
1 Su	06:32 7.76	18:52 8.11	1 We	08:07 7.49	20:36 7.60	1 We	05:59 7.01	18:48 6.96
2 Mo	07:38 7.83	19:57 8.10	2 Th	09:09 7.84	21:33 7.91	2 Th	07:35 7.09	20:18 7.18
3 Tu	08:36 8.04	20:55 8.21	3 Fr	09:57 8.23	22:18 8.23	3 Fr	08:48 7.52	21:18 7.64
4 We	09:26 8.29	21:45 8.36	4 Sa	10:36 8.56	22:56 8.49	4 Sa	09:37 8.02	22:01 8.10
5 Th	10:09 8.54	22:28 8.52	5 Su	11:11 8.82	23:30 8.68	5 Su	10:15 8.46	22:36 8.47
6 Fr	10:48 8.75	23:07 8.63	6 Mo	11:43 8.99		6 Mo	10:49 8.80	23:07 8.75
7 Sa	11:23 8.88	23:42 8.68	7 Tu	00:00 8.80	12:15 9.08	7 Tu	11:20 9.03	23:36 8.94
8 Su	11:57 8.94		8 We	00:31 8.85	12:45 9.10	8 We	11:50 9.18	
9 Mo	00:17 8.68	12:30 8.94	9 Th	01:01 8.83	13:15 9.04	9 Th	00:05 9.05	12:19 9.25
10 Tu	00:50 8.63	13:03 8.87	10 Fr	01:32 8.74	13:45 8.92	10 Fr	00:34 9.08	12:48 9.22
11 We	01:24 8.52	13:36 8.75	11 Sa	02:03 8.58	14:15 8.74	11 Sa	01:04 9.02	13:17 9.12
12 Th	01:58 8.36	14:11 8.57	12 Su	02:39 8.36	14:51 8.50	12 Su	01:35 8.88	13:48 8.93
13 Fr	02:35 8.16	14:48 8.37	13 Mo	03:20 8.09	15:36 8.18	13 Mo	02:09 8.64	14:24 8.63
14 Sa	03:15 7.94	15:30 8.15	14 Tu	04:13 7.76	16:38 7.79	14 Tu	02:50 8.29	15:10 8.19
15 Su	04:04 7.73	16:21 7.95	15 We	05:27 7.50	18:05 7.52	15 We	03:43 7.84	16:15 7.64
16 Mo	05:03 7.60	17:25 7.80	16 Th	06:57 7.55	19:39 7.68	16 Th	05:03 7.43	17:54 7.30
17 Tu	06:15 7.62	18:41 7.82	17 Fr	08:18 8.00	20:57 8.19	17 Fr	06:42 7.46	19:35 7.55
18 We	07:28 7.86	19:57 8.06	18 Sa	09:24 8.62	21:58 8.79	18 Sa	08:07 7.96	20:51 8.18
19 Th	08:35 8.28	21:03 8.46	19 Su	10:19 9.25	22:50 9.29	19 Su	09:12 8.66	21:48 8.83
20 Fr	09:33 8.78	22:03 8.90	20 Mo	11:08 9.75	23:36 9.62	20 Mo	10:04 9.30	22:35 9.32
21 Sa	10:27 9.26	22:57 9.27	21 Tu	11:53 10.08		21 Tu	10:49 9.78	23:17 9.61
22 Su	11:18 9.65	23:48 9.52	22 We	00:20 9.73	12:36 10.18	22 We	11:31 10.05	23:56 9.71
23 Mo		12:07 9.91	23 Th	01:01 9.64	13:17 10.05	23 Th		12:12 10.09
24 Tu	00:36 9.59	12:54 9.99	24 Fr	01:40 9.36	13:57 9.71	24 Fr	00:33 9.62	12:50 9.91
25 We	01:23 9.48	13:40 9.89	25 Sa	02:18 8.96	14:36 9.20	25 Sa	01:09 9.37	13:27 9.54
26 Th	02:08 9.19	14:25 9.60	26 Su	02:57 8.47	15:18 8.56	26 Su	01:43 9.00	14:03 9.01
27 Fr	02:53 8.79	15:11 9.17	27 Mo	03:40 7.92	16:09 7.86	27 Mo	02:19 8.54	14:43 8.38
28 Sa	03:39 8.33	16:00 8.64	28 Tu	04:38 7.37	17:17 7.24	28 Tu	03:00 8.00	15:30 7.69
29 Su	04:32 7.86	16:56 8.08				29 We	03:52 7.42	16:36 7.05
30 Mo	05:35 7.49	18:05 7.63				30 Th	05:10 6.95	18:10 6.74
31 Tu	06:51 7.34	19:24 7.46				31 Fr	06:51 6.92	19:44 6.97

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LIVERPOOL (GLADSTONE DOCK)

Time Zone: UTC 53° 27' N, 03° 01' W Year: 2023

January

Time	m	Time	m	Time	m	Time	m
1	0042 2.61	9	0017 8.68	17	0030 3.09	25	0123 9.48
	0632 7.76		0642 2.25		0615 7.62		0810 1.21
Su	1310 3.05	Mo	1230 8.94	Tu	1256 3.31	We	1340 9.89
	1852 8.11		1920 2.11		1841 7.82		2044 0.84
2	0146 2.74	10	0050 8.63	18	0148 2.93	26	0208 9.19
	0738 7.83		0715 2.27		0728 7.86		0853 1.49
Mo	1416 2.98	Tu	1303 8.87	We	1416 3.01	Th	1425 9.60
	1957 8.10		1954 2.16		1957 8.06		2127 1.24
3	0246 2.73	11	0124 8.52	19	0258 2.58	27	0253 8.79
	0836 8.04		0751 2.36		0835 8.28		0936 1.91
Tu	1516 2.81	We	1336 8.75	Th	1525 2.53	Fr	1511 9.17
	2055 8.21		2028 2.26		2103 8.46		2209 1.79
4	0339 2.64	12	0158 8.36	20	0359 2.16	28	0339 8.33
	0926 8.29		0827 2.51		0933 8.78		1021 2.42
We	1609 2.59	Th	1411 8.57	Fr	1627 1.99	Sa	1600 8.64
	2145 8.36		2104 2.42		2203 8.90	☾	2254 2.39
5	0424 2.52	13	0235 8.16	21	0455 1.75	29	0432 7.86
	1009 8.54		0905 2.73		1027 9.26		1113 2.92
Th	1654 2.40	Fr	1448 8.37	Sa	1726 1.46	Su	1656 8.08
	2228 8.52		2142 2.63	●	2257 9.27		2349 2.93
6	0502 2.41	14	0315 7.94	22	0548 1.42	30	0535 7.49
	1048 8.75		0947 2.97		1118 9.65		1220 3.30
Fr	1735 2.25	Sa	1530 8.15	Su	1821 1.02	Mo	1805 7.63
○	2307 8.63		2227 2.85		2348 9.52		
7	0537 2.32	15	0404 7.73	23	0638 1.19	31	0056 3.28
	1123 8.88		1036 3.20		1207 9.91		0651 7.34
Sa	1812 2.16	Su	1621 7.95	Mo	1912 0.73	Tu	1338 3.42
	2342 8.68	☾	2320 3.02				1924 7.46
8	0610 2.27	16	0503 7.60	24	0036 9.59		
	1157 8.94		1138 3.35		0725 1.11		
Su	1847 2.11	Mo	1725 7.80	Tu	1254 9.99		
					1959 0.66		

Datum of Predictions: Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)
 Tides computed by POLTIPS-4 software from the UK National Oceanography Centre

Format I

Tide Table Window -- Ensure printer is set to landscape orientation for this format

ENGLAND, WEST COAST - LIVERPOOL (GLADSTONE DOCK)

TIME ZONE: UTC Lat 53° 27' N Long 03° 01' W UNITS: METRES

JANUARY 2023

	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
1 Su	2.79	2.85	3.28	4.51	5.91	7.04	7.87	7.80	7.11	6.15	5.12	4.19	3.44	3.06	3.30	4.25	5.64	6.98	7.85	8.10	7.69	6.75	5.62	4.54
2 Mo	3.80	2.93	2.76	3.30	4.46	5.87	7.03	7.71	7.79	7.24	6.28	5.22	4.25	3.44	3.00	3.18	4.08	5.49	6.87	7.79	8.10	7.73	6.79	5.64
3 Tu	4.54	3.59	2.92	2.75	3.29	4.51	6.00	7.21	7.91	7.98	7.36	6.31	5.19	4.14	3.29	2.83	3.01	3.98	5.51	6.96	7.90	8.20	7.77	6.75
4 We	5.54	4.39	3.42	2.78	2.68	3.36	4.76	6.35	7.57	8.23	8.17	7.38	6.19	4.97	3.87	3.02	2.60	2.90	4.06	5.75	7.23	8.14	8.34	7.74
5 Th	6.57	5.27	4.07	3.12	2.57	2.67	3.60	5.23	6.88	8.04	8.54	8.24	7.22	5.89	4.59	3.49	2.69	2.40	2.94	4.39	6.20	7.64	8.42	8.39
6 Fr	7.55	6.22	4.84	3.64	2.77	2.41	2.80	4.08	5.90	7.49	8.49	8.73	8.12	6.88	5.42	4.12	3.07	2.38	2.33	3.21	4.95	6.78	8.09	8.62
7 Sa	8.28	7.17	5.71	4.32	3.18	2.47	2.38	3.15	4.78	6.66	8.08	8.81	8.71	7.76	6.32	4.88	3.61	2.67	2.17	2.45	3.74	5.68	7.40	8.45
8 Su	8.64	7.94	6.61	5.11	3.77	2.76	2.28	2.57	3.76	5.63	7.39	8.55	8.94	8.45	7.21	5.69	4.29	3.14	2.34	2.13	2.83	4.49	6.45	7.94
9 Mo	8.64	8.44	7.41	5.95	4.49	3.26	2.45	2.29	3.00	4.57	6.49	8.00	8.82	8.83	7.97	6.54	5.04	3.75	2.74	2.16	2.31	3.46	5.35	7.15
10 Tu	8.31	8.61	8.02	6.75	5.28	3.93	2.87	2.30	2.52	3.65	5.45	7.22	8.42	8.87	8.49	7.33	5.84	4.45	3.30	2.46	2.16	2.73	4.25	6.15
11 We	7.67	8.45	8.35	7.44	6.06	4.67	3.49	2.63	2.37	2.97	4.43	6.26	7.75	8.60	8.69	7.97	6.65	5.21	3.97	2.98	2.34	2.38	3.35	5.04
12 Th	6.78	7.96	8.36	7.91	6.80	5.44	4.20	3.21	2.59	2.64	3.58	5.19	6.87	8.05	8.66	8.32	7.36	6.01	4.69	3.62	2.81	2.42	2.80	4.02
13 Fr	5.71	7.18	8.02	8.08	7.39	6.21	4.96	3.90	3.10	2.73	3.07	4.21	5.80	7.24	8.14	8.35	7.66	6.78	5.49	4.33	3.43	2.79	2.66	3.28
14 Sa	4.80	6.14	7.35	7.91	7.74	6.93	5.78	4.67	3.77	3.15	2.99	3.51	4.69	6.17	7.39	8.07	8.07	7.43	6.34	5.15	4.14	3.37	2.90	2.95
15 Su	3.67	4.95	6.33	7.35	7.73	7.46	6.64	5.58	4.58	3.80	3.30	3.25	3.80	4.92	6.26	7.36	7.91	7.82	7.16	6.13	5.04	4.12	3.43	3.05
16 Mo	3.15	3.83	5.02	6.32	7.26	7.80	7.34	6.59	5.61	4.67	3.92	3.45	3.39	3.85	4.68	6.14	7.22	7.75	7.71	7.13	6.17	5.12	4.23	3.54
17 Tu	3.14	3.15	3.73	4.89	6.20	7.17	7.60	7.45	6.78	5.62	4.55	4.05	3.50	3.32	3.83	4.57	5.69	7.04	7.69	7.79	7.32	6.40	5.34	4.38
18 We	3.61	3.09	2.94	3.44	4.84	6.08	7.20	7.79	7.77	7.13	6.11	5.03	4.09	3.40	3.03	3.20	4.14	5.59	6.93	7.78	8.08	7.68	6.74	5.58
19 Th	4.48	3.56	2.88	2.58	3.06	4.41	6.07	7.41	8.16	8.21	7.53	6.39	5.10	3.99	3.13	2.90	2.66	3.89	5.35	6.97	8.04	8.46	8.10	7.05
20 Fr	5.72	4.48	3.37	2.53	2.16	2.72	4.30	6.28	7.79	8.64	8.89	7.86	6.47	5.02	3.74	2.74	2.08	2.14	3.31	5.29	7.18	8.42	8.90	8.48
21 Sa	7.23	5.72	4.29	3.07	2.13	1.76	2.48	4.39	6.85	8.29	9.15	9.10	8.05	6.42	4.80	3.41	2.30	1.56	1.66	3.09	5.44	7.53	8.83	9.27
22 Su	8.67	7.22	5.56	4.02	2.71	1.74	1.44	2.43	4.73	7.17	8.81	9.60	9.36	8.04	6.24	4.52	3.05	1.87	1.09	1.33	3.13	5.78	7.92	9.18
23 Mo	9.49	8.66	7.03	5.29	3.68	2.35	1.41	1.28	2.83	5.25	7.71	9.25	9.90	9.41	7.85	5.96	4.21	2.72	1.49	0.76	1.27	3.46	6.23	8.26
24 Tu	9.39	9.49	8.41	6.69	4.94	3.35	2.06	1.22	1.36	3.10	5.87	8.16	9.54	9.99	9.22	7.50	5.62	3.91	2.44	1.23	0.66	1.56	4.03	6.67
25 We	8.48	9.39	9.24	7.97	6.25	4.56	3.06	1.87	1.23	1.72	3.77	6.44	8.48	9.64	9.82	8.80	7.04	5.25	3.64	2.24	1.16	0.90	2.17	4.66
26 Th	7.02	8.54	9.19	8.76	7.41	5.78	4.21	2.86	1.86	1.60	2.34	4.49	6.88	8.61	9.51	9.41	8.24	6.55	4.89	3.42	2.18	1.36	1.46	2.97
27 Fr	5.27	7.23	8.43	8.79	8.17	6.84	5.35	3.96	2.82	2.06	2.00	3.06	5.08	7.11	8.52	9.15	8.83	7.63	6.09	4.61	3.34	2.33	1.80	2.20
28 Sa	3.72	5.67	7.25	8.15	8.28	7.59	6.38	5.07	3.89	2.98	2.46	2.60	3.69	5.42	7.09	8.23	8.64	8.21	7.11	5.76	4.49	3.44	2.67	2.39
29 Su	2.91	4.24	5.82	7.08	7.77	7.78	7.16	6.13	5.01	4.03	3.31	2.93	3.13	4.08	5.46	6.83	7.78	8.08	7.69	6.78	5.65	4.58	3.71	3.11
30 Mo	2.94	3.40	4.46	5.73	6.79	7.39	7.44	6.96	6.13	5.18	4.33	3.69	3.33	3.43	4.13	5.24	6.42	7.30	7.63	7.40	6.69	5.75	4.82	4.04
31 Tu	3.49	3.28	3.80	4.42	5.50	6.51	7.16	7.34	7.03	6.34	5.47	4.65	3.97	3.51	3.45	3.94	4.88	6.02	6.95	7.42	7.37	6.83	5.97	5.07

Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)
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