

Introduction to chartwork

The first step towards proficiency in navigation to watchkeeping standards is understanding how to interpret a nautical chart. This fundamental knowledge will be the foundation from which all the other skills of the navigator can be built upon. If the chart cannot be understood, then the ship's position cannot be determined and dangers will not be recognised by the watchkeeper.

Even with today's modern satellite technology, there is no substitute for the paper chart. Combined with a magnetic compass and traditional navigational tools, like dividers, parallel rulers, safe coastal navigation by a competent watchkeeper is always possible without the use of modern navigation equipment. Remember that ultimately the ship should be self sufficient in every way. The ability to determine the vessel's position by use of a chart is vital in the event that the vessel's GPS unit should fail.

Many thousands of hours and huge amount of survey work has gone into each chart. Avoid folding the chart if possible and keep them corrected and up to date at all times —this is a statute requirement with regard to the seaworthiness of the ship. Aside from a ready reference chart that may be exposed to the elements, don't use charts that are laminated for watchkeeping purposes — they are slippery under the parallel rulers and impossible to use a pencil on. Laminated charts should not be used for position determination.

Chart interpretation

Projections — how the Earth appears on the chart

There are numerous ways in which the Earth's spherical surface can be projected onto a flat chart and all have some elements of distortion. For navigation at sea, two projections are used: Mercator projection and Gnomonic projection.

Gnomonic projection

The Gnomonic projection is used for ocean navigation. It is commonly used for planning purposes to establish 'great circle routes' which represent the shortest distances between positions, but would show up on the Mercator projection as a curved lines bulging towards the poles.

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Mercator projection

The Mercator projection is used for coastal and inshore navigation, it is an important projection for watchkeepers to be aware of. This method of projection distorts features and landmasses.

- **Lines of longitude** (meridians) run through the north and south poles, and converge with each other as distance increases from the equator — think of the earth being cut into lemon wedges.
- **Lines of latitude** (parallels) travel around the Earth east to west but never meet — think of the earth being cut into a rectangle rather than a sphere.

Both latitude and longitude represent angular distances, with the apex of that angle measured from the geometric centre of the earth, in two dimensions — north/south (latitude) and east/west (longitude). These angular distances are represented on the chart. The scale of latitude runs down either side and the scale of longitude runs across the top and the bottom. With a Mercator chart, meridians of longitude do not converge at the poles.

The charts used for coastal navigation are a much larger scale, however, the same principle applies as they are still in Mercators projection.

Measuring distance

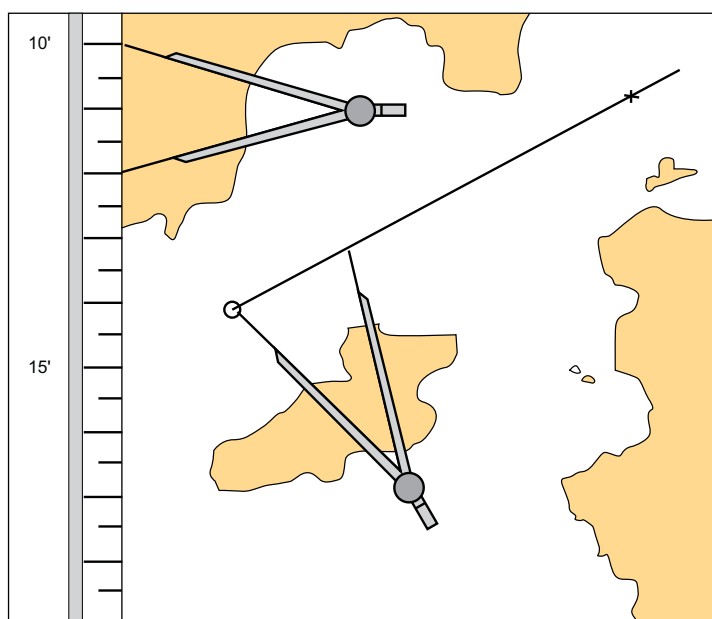
The unit of measurement at sea is the nautical mile and measuring distances on the chart using this unit is simple:

- One degree of arc is further divided into 60 minutes.
- One minute of arc at the Earth's surface is equal to one nautical mile.

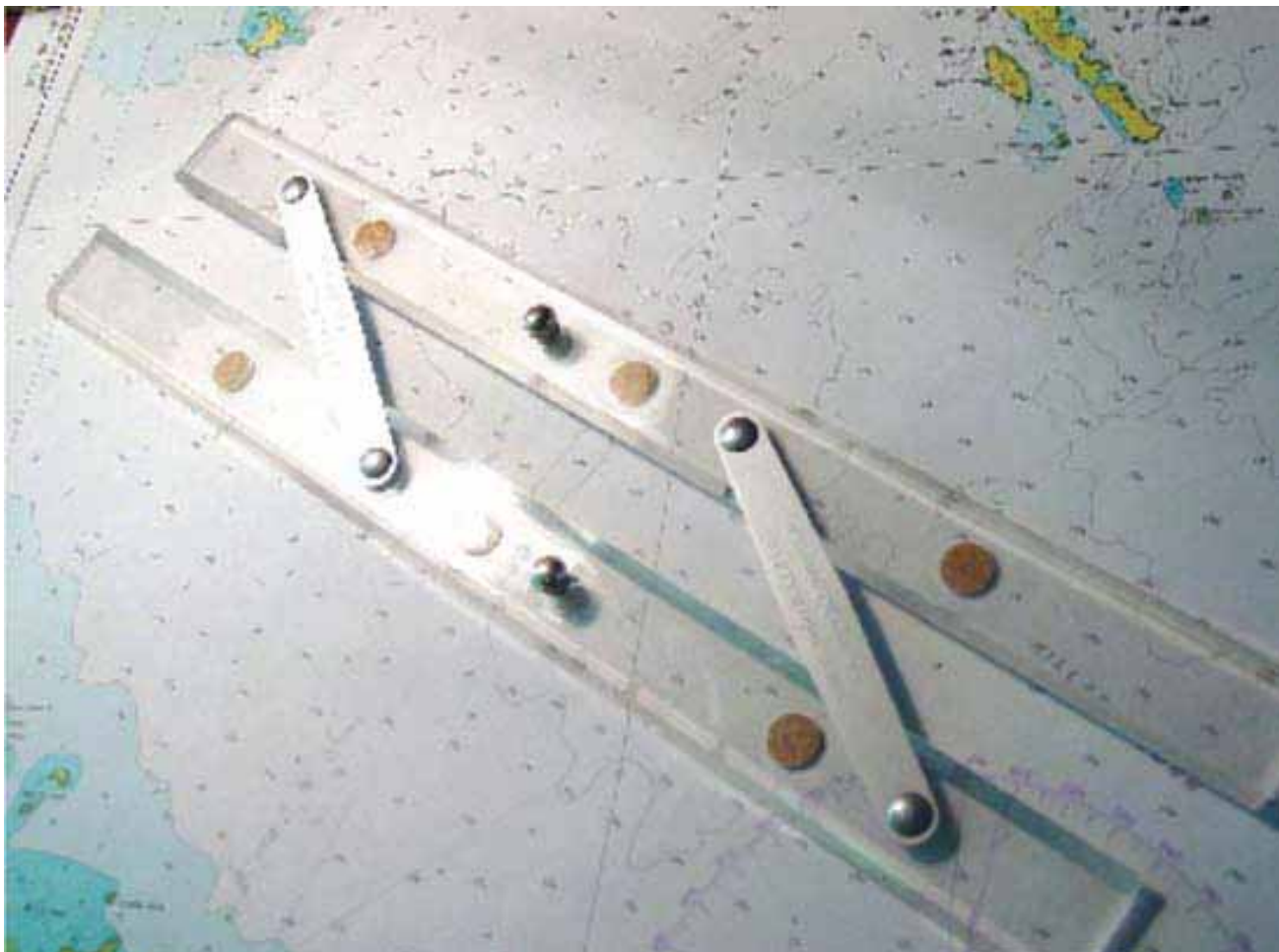
Therefore one degree of arc (measured from the centre of the Earth) is equal to 60 nautical miles.

Dividers

To measure distances on a chart in any direction, use dividers and transfer the distance, or step out the distance, from the latitude scales. This must be done in the vicinity of the passage latitude, since the latitude scales vary slightly down the chart (on a small-scale chart, this variation may be substantial). Read off the minutes in tenths and call them nautical miles. Accuracy should be to the nearest tenth (cable).



Measuring distance



Parallel rules

Primarily used for transferring bearings to or from the 'compass rose' on the chart, parallel rules are also used to read of the scales of latitude and longitude. Some practice is required to become proficient in the use of them, as they are prone to slip on the chart despite the non-slip cork material that is applied to the underside of some types. Even a small slip can result in a very large navigational error.

Practice 'walking' the parallel rules from one side of the chart to the other – see if they meet the opposite side of the chart aligned perfectly with the scale.

Interpreting chart symbols

The symbols shown on official charts, such as those produced by the Australian Hydrographic Service and Maritime Safety Queensland conform to guidelines contained in the publication *Symbols and Abbreviations used on Admiralty Charts* (Chart 5011).

This is produced by the United Kingdom Hydrographic Office and provides an interpretation of the symbols used on navigation charts.

Extracts from AUS5011:

Lights

Light Characters		Light Characters on Light Buoys → IQ		471.2 K21-30a	
	Abbreviation		Class of Light	Illustration	Period shown
	International	National			
10.1	F		Fixed		
10.2	Occulting (total duration of light longer than total duration of darkness)				
	Oc	Ooc	Single-occulting		
	Oc(2) Example	GpOoc(2) Example	Group-occulting		
	Oc(2-3) Example	GpOoc(2-3) Example	Composite group-occulting		
10.3	Isophase (duration of light and darkness equal)				
	Is		Isophase		
10.4	Flashing (total duration of light shorter than total duration of darkness)				
	Fl		Single-flashing		
	Fl(2) Example	GpFl(2) Example	Group-flashing		
	Fl(2-1) Example	GpFl(2-1) Example	Composite group-flashing		
10.5	LR		Long-flashing (flash 2s or longer)		
10.6	Quick (repetition rate of 50 to 79 - usually either 50 or 60 - flashes per minute)				
	Q	Q(F)	Continuous quick		
	Q(3) Example	Q(F)(3) Example	Group quick		
	IQ	IQ(F)	Interrupted quick		
10.7	Very quick (repetition rate of 80 to 159 - usually either 100 or 120 - flashes per minute)				
	VQ	VQ(F)	Continuous very quick		
	VQ(3) Example	VQ(F)(3) Example	Group very quick		
	IVQ	IVQ(F)	Interrupted very quick		
10.8	Ultra quick (repetition rate of 160 or more - usually 240 to 300 - flashes per minute)				
	UQ		Continuous ultra quick		
	IUQ		Interrupted ultra quick		
10.9	M(3) Example		Morse Code		
10.10	FR		Fixed and flashing		
10.11	ALWR Example	ALWR Example	Alternating		

Buoys and beacons

130 IALA Maritime Buoyage System	<i>IALA International Association of Lighthouse Authorities</i>
<p>Where in force, the IALA System applies to all fixed and floating marks except landfall lights, leading lights and marks, sector lights and major floating lights. The standard buoy shapes are cylindrical (can) , conical , spherical , pillar , and spar , but variations may occur, for example: minor light-buoys . In the illustrations below, only the standard buoy shapes are used. In the case of fixed beacons (lit or unlit) only the shape of the topmark is of navigational significance.</p>	
130.1 Lateral marks are generally for well-defined channels. There are two international Buoyage Regions - A and B - where Lateral marks differ.	
<p>Port-hand Marks are red with cylindrical topmarks (if any). Lights are red and have any rhythm except F(2+1)R.</p> <p>Starboard-hand Marks are green with conical topmarks (if any). Lights are green and have any rhythm except F(2+1)G.</p>	<p>Port-hand Marks are green with cylindrical topmarks (if any). Lights are green and have any rhythm except F(2+1)G.</p> <p>Starboard-hand Marks are red with conical topmarks (if any). Lights are red and have any rhythm except F(2+1)R.</p>
<p>A preferred channel buoy may also be a pillar or a spar. All preferred channel marks have three horizontal bands of colour. Where for exceptional reasons an Authority considers that a green colour for buoys is not satisfactory, black may be used.</p>	
130.2	Symbol showing direction of buoyage where not obvious. Symbol showing direction of buoyage where not obvious, on multicoloured charts (red and green circles coloured as appropriate).
130.3 Cardinal Marks indicating navigable water to the named side of the marks. Cardinal marks have the same meaning in Regions A and B.	
<p>UNLIT MARKS</p> <p>Topmark: 2 black cones</p>	<p>LIGHTED MARKS</p> <p>White light</p> <p>The same abbreviations are used for lights on spar buoys and beacons. The periods, 5s, 10s and 15s, may not always be charted.</p>
130.4	Isolated Danger Marks , stationed over dangers with navigable water around them.
<p>Body: black with red horizontal band(s)</p> <p>Topmark: 2 black spheres</p>	<p>White light</p>
130.5	Safe Water Marks , such as mid-channel and landfall marks
<p>Body: red and white vertical stripes</p> <p>Topmark (if any): red sphere</p>	<p>White light</p>
130.6	Special Marks , not primarily to assist navigation but to indicate special features.
<p>Body: (shape optional): yellow</p> <p>Topmark (if any): yellow X</p>	<p>Yellow light</p>

Chart datums

All depths on the chart (called soundings) are measured from the chart datum for depths. Usually, this will be the lowest astronomical tide (LAT) — that is, the lowest tide that could be theoretically predicted to occur under average meteorological conditions.

All heights on the chart are measured from the chart datum for heights. Usually, this will be mean high water springs (MHWS) which is the long-term average of the heights of high water at full and new moon.

All clearances on the chart (such as those under bridges or power cables) are usually measured from highest astronomical tide (HAT), the highest tide that could be theoretically predicted to occur under average meteorological conditions. Additionally, a safety margin is also added to clearances.

The compass rose

Every chart will normally have at least two compass roses that are printed in the colour magenta (because magenta shows up boldly under red light, which is used at night to protect the watchkeeper's night vision). These are used in conjunction with parallel rulers to transfer bearing lines and course lines across to the rose so that they can be given a true angular notation.

For example, if a line is drawn across a body of water on the chart along which the vessel is to travel, this line must be transferred by 'walking' the rule from it across to the nearest compass rose to read off a true bearing. The process is reversed in the case of a compass bearing taken of a landmark.

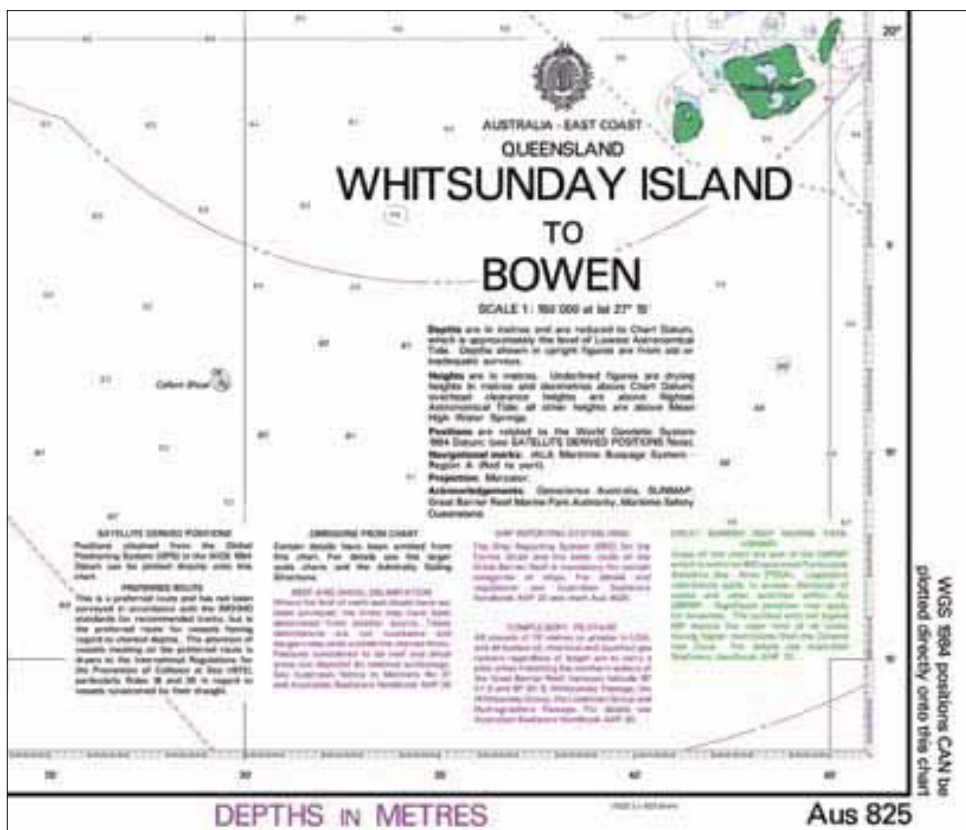


Chart title block

Chart datum can be found in the chart's title block, along with other important information including magnetic anomalies, recommended tracks and marine protected areas. The scale of the chart can also be found here.



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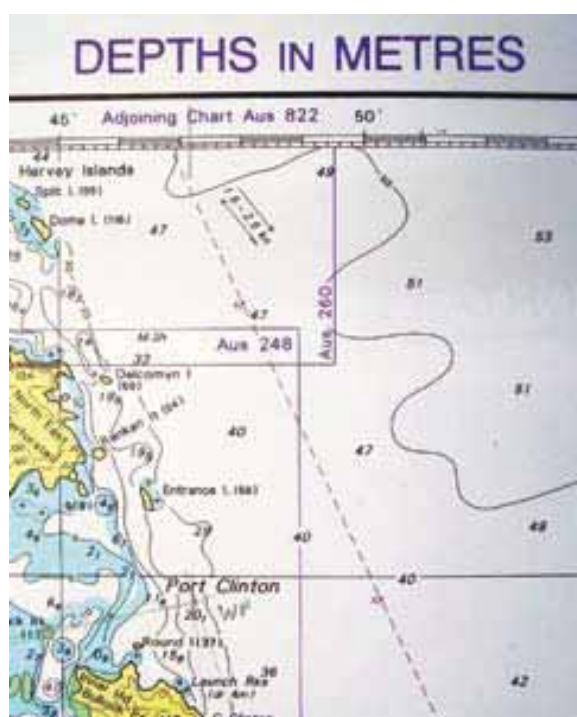
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The compass rose also indicates the variation of the Earth's magnetic field in the area, including how much it is increasing or decreasing each year. This error must be applied, along with any deviation of the compass caused by the influence of the ship itself (particularly those constructed of steel) and is the subject of further study beyond the scope of this publication.

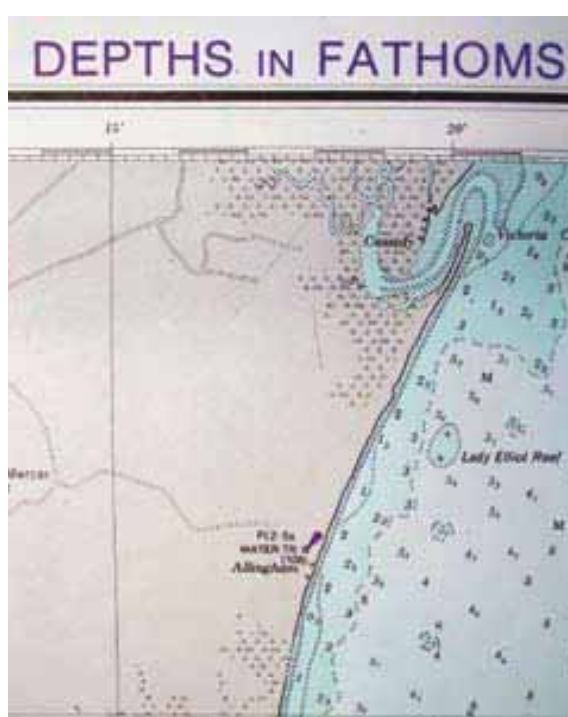
Metric and imperial charts

Although most charts of the Australian coastline are now metric, several older charts are still in use. Care needs to be taken when moving from one chart to another, particularly with regard to depths, as a different unit of measurement may have been used.

As shown below, metric and imperial charts are not only indicated as such on the upper left, and lower right corners of the chart, but also by their colour schemes — land is yellow on metric charts and grey on imperial charts.



Metric chart



Imperial chart.

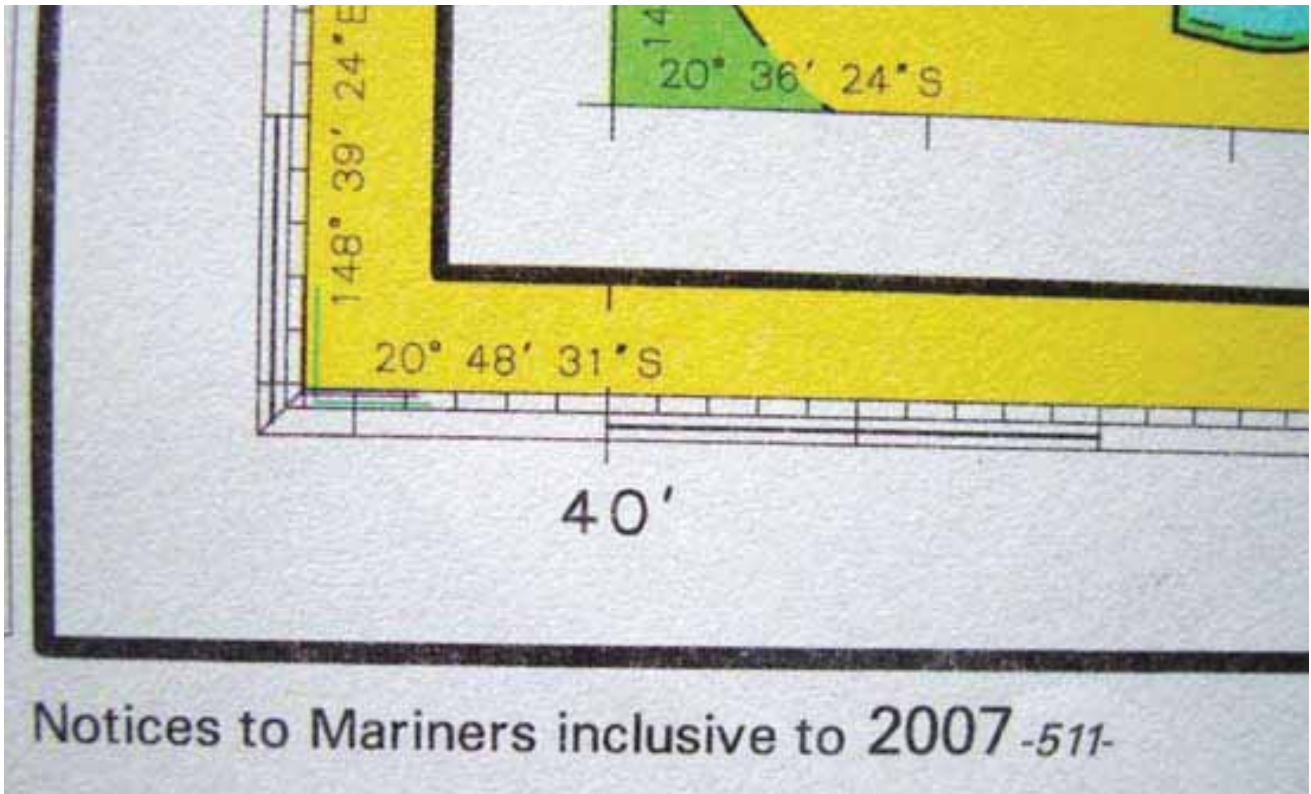
Notices to Mariners

Notices to Mariners are issued by the Australian Hydrographic Service and Maritime Safety Queensland and advise of:

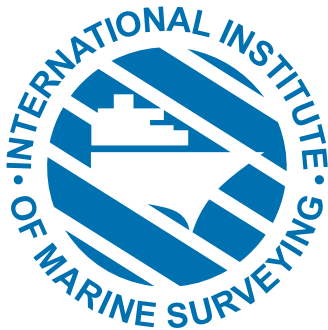
- navigation warnings and hazards (such as aids to navigation that may have been destroyed, missing or unlit)
- changes to the uniform buoyage system (which assists with the correction and updating of marine charts)
- navigation depths (necessary when navigating in channels with depth restrictions)
- any other works that may affect the safe navigation of vessels in Queensland and Australian coastal waters and ports (such as dredging operations and construction works).

The Notices are used to make corrections and changes to charts with the correction year and Notice number listed at the bottom left-hand corner of the chart. Notices are either

temporary or permanent corrections to the chart. Permanent corrections are to be made with a magenta pen and temporary corrections made with a pencil.



This chart has been corrected at the date of purchase to the Notices to Mariners number shown. Further corrections are the duty of the master/navigator.



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