Competency Unit Module MARH013

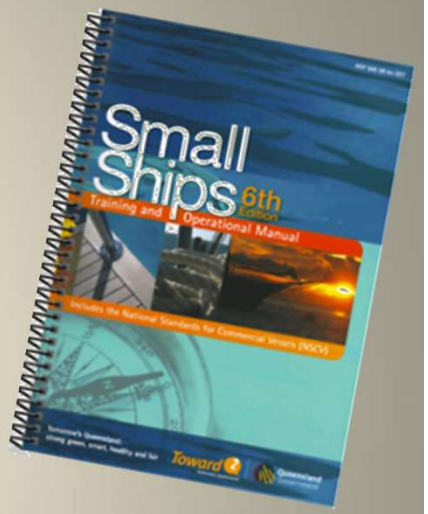
Plan and navigate a passage for a vessel up to 12 metres

Module Syllabus

- Interpretation of Navigational Charts and Publications
- True Course Plotting and Distance/Time/Speed Calculations
- Planning and Plotting Safe Courses
- Magnetic and Gyro Compass, with Error, Variation and Deviation
- Positions and Position Fixing
- Compass Error by Transit Bearing
- Tides and Tide Calculations
- Electronic Aids to Navigation
- Meteorology

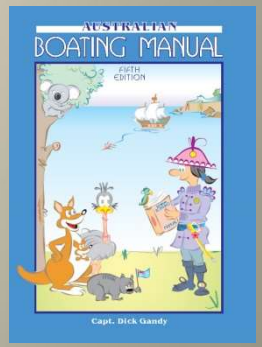
Plan and Navigate a Passage

Recommended Study Reference



Small Ships Training and Operational Manual – Edition 6
Maritime Safety Queensland
Section C: Safe Navigation
Chapters 10 thru 14

Australian Boating Manual
Capt. Dick Gandy
Chapter 17 - Navigation
Chapters 14 thru 16 – Electronic Equipment
Chapter 20 - Meteorology

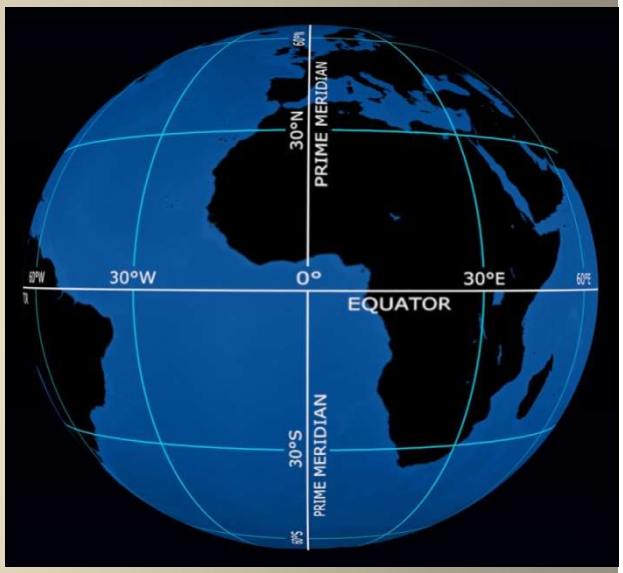


Online Resources

Interpretation of Navigational Charts and Publications

Defining Positions

- To define an EXACT position on the Earth's surface, it is necessary to have 2 sets of Co-ordinates, based on Grid Lines *(similar to street directory)*

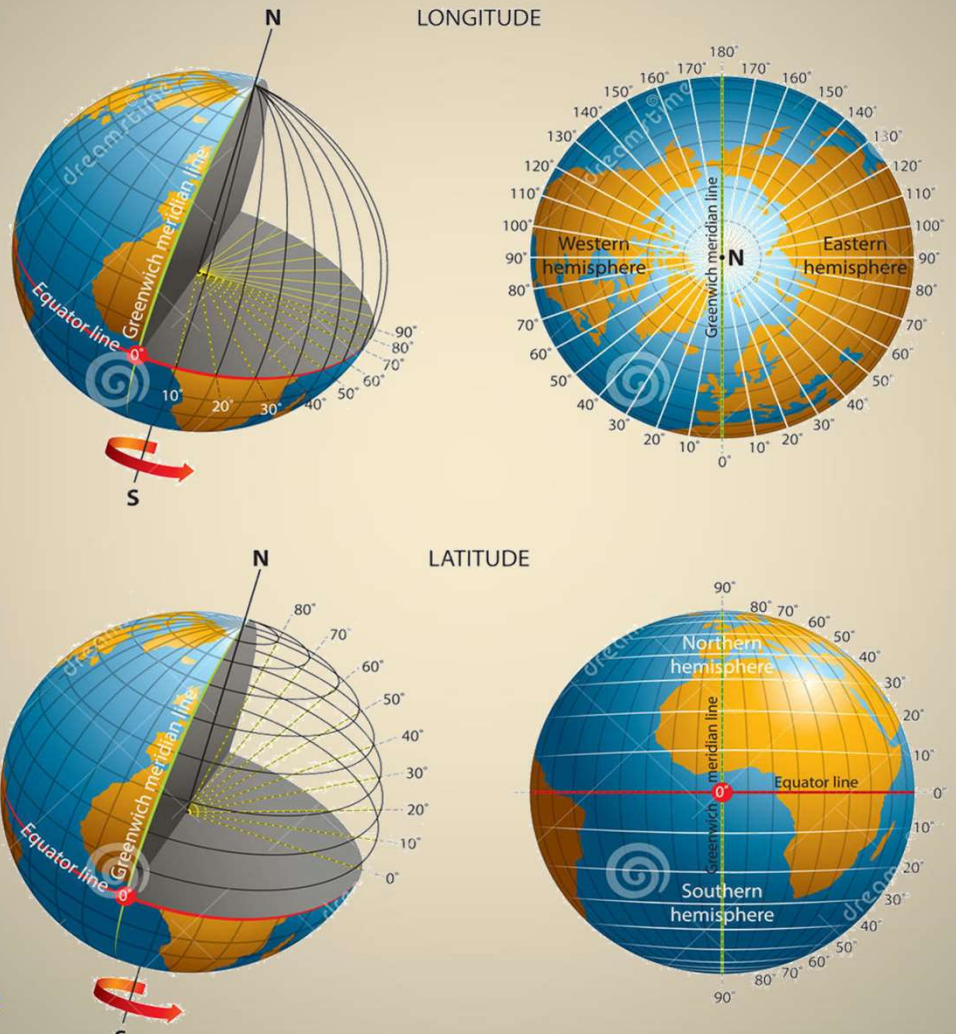


- The Co-ordinates used are
  - **LATITUDE** and **LONGITUDE**

- Note: Position may also be expressed in relation to a known Geographical position

  Eg: 15 miles East of Burnett Head Lighthouse

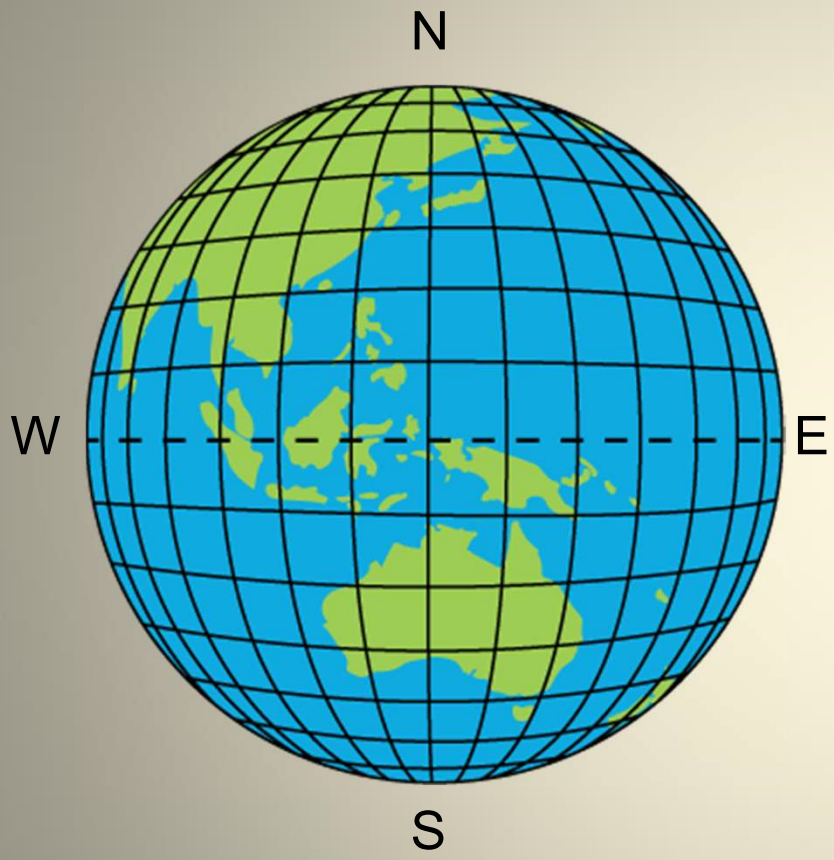
Latitude and Longitude

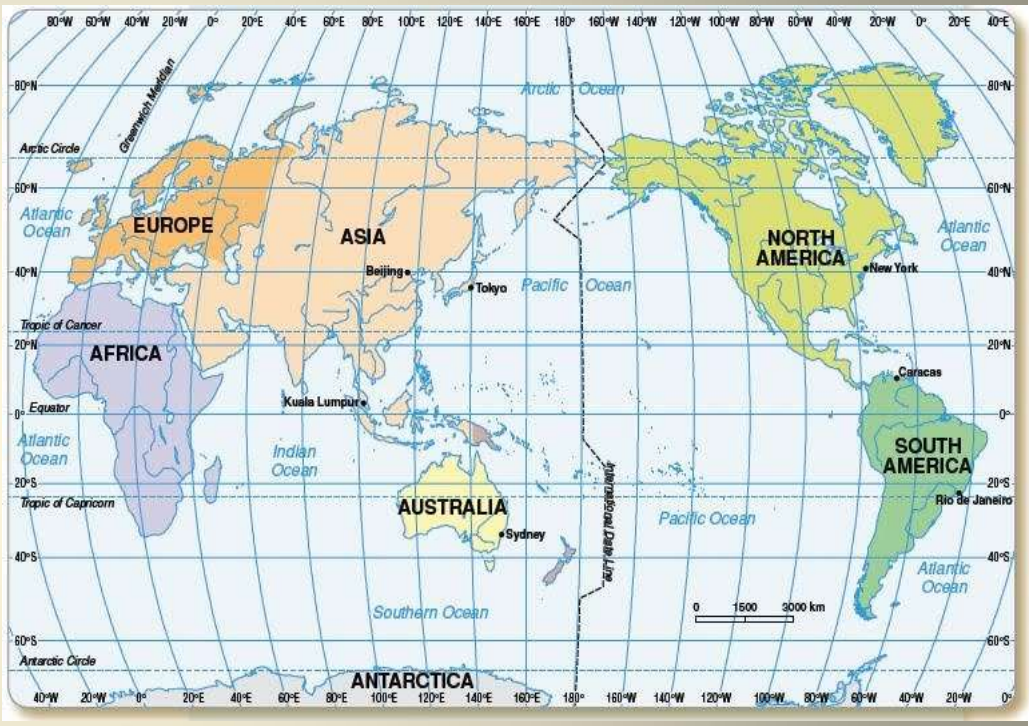


Parallels of Latitude
North south and always stated first

Meridians of Longitude
East West stated second

Mercator Chart

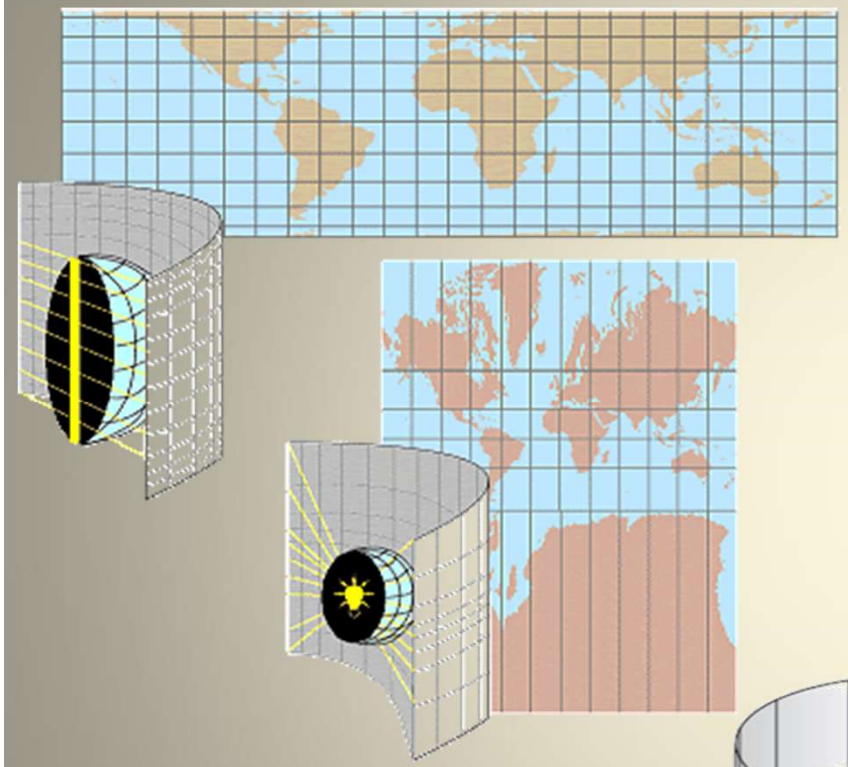


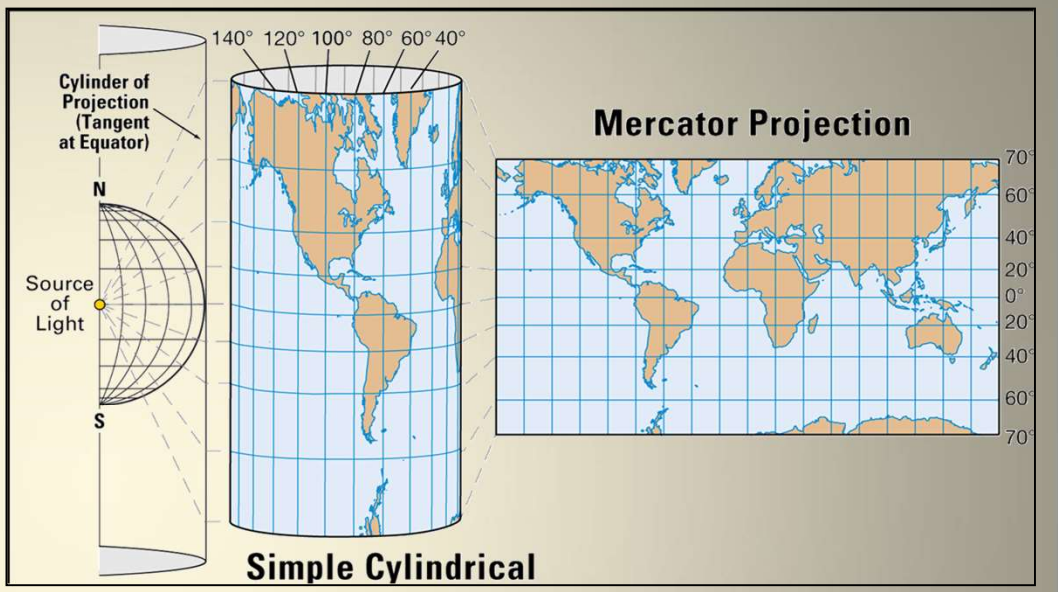


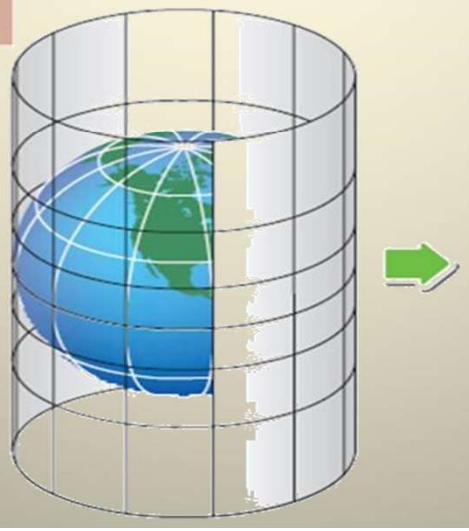
From this ⬆.....to this ⬆

HOW?

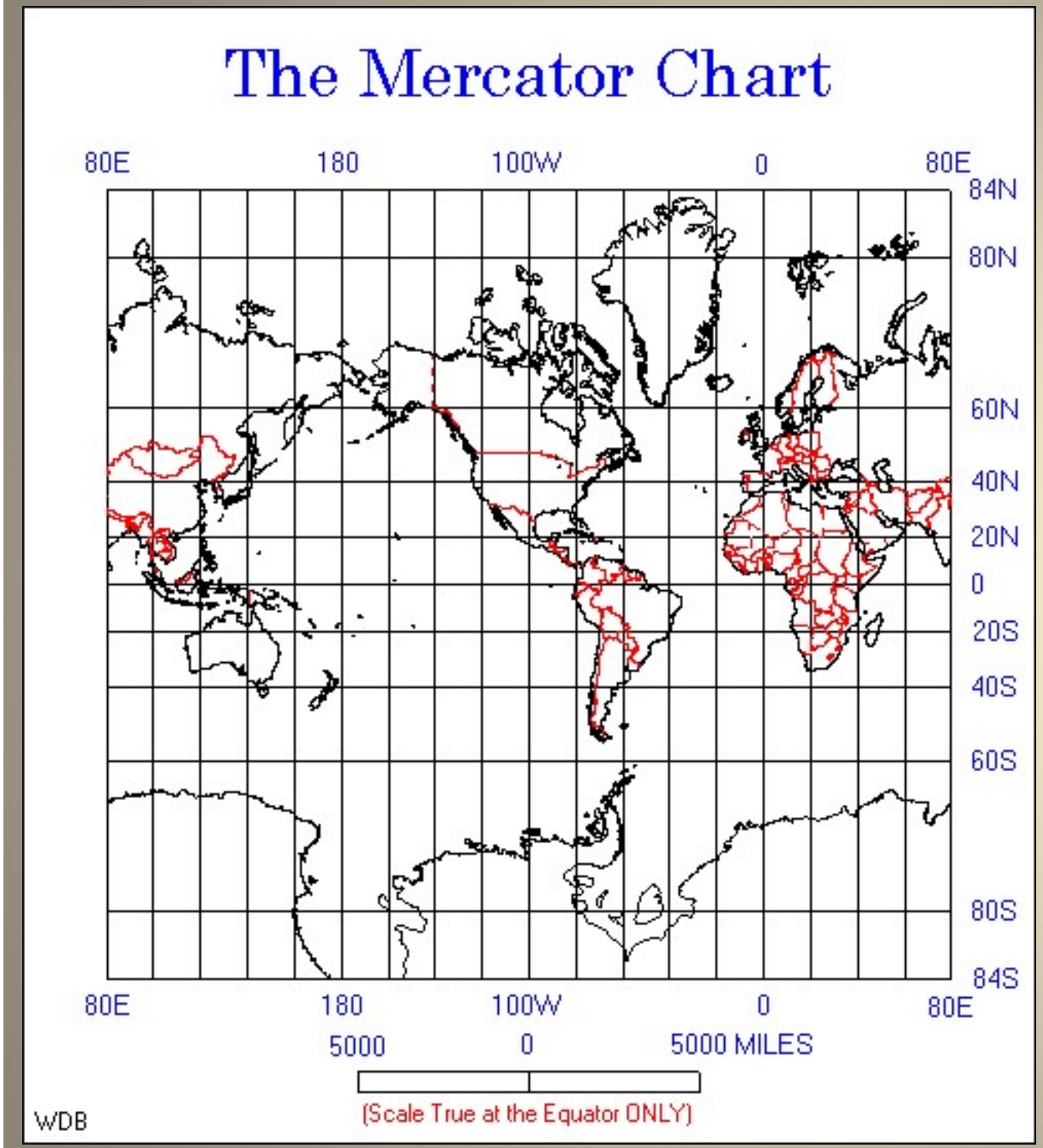
Charts




140° 120° 100° 80° 60° 40°
Cylinder of Projection (Tangent at Equator)
N
Source of Light
S
Simple Cylindrical
Mercator Projection
70°
60°
40°
20°
0°
20°
40°
60°
70°




GREENLAND
SOUTH AMERICA



Spacings between Parallels of Latitude increase proportionally with distance the further North or South from the Equator

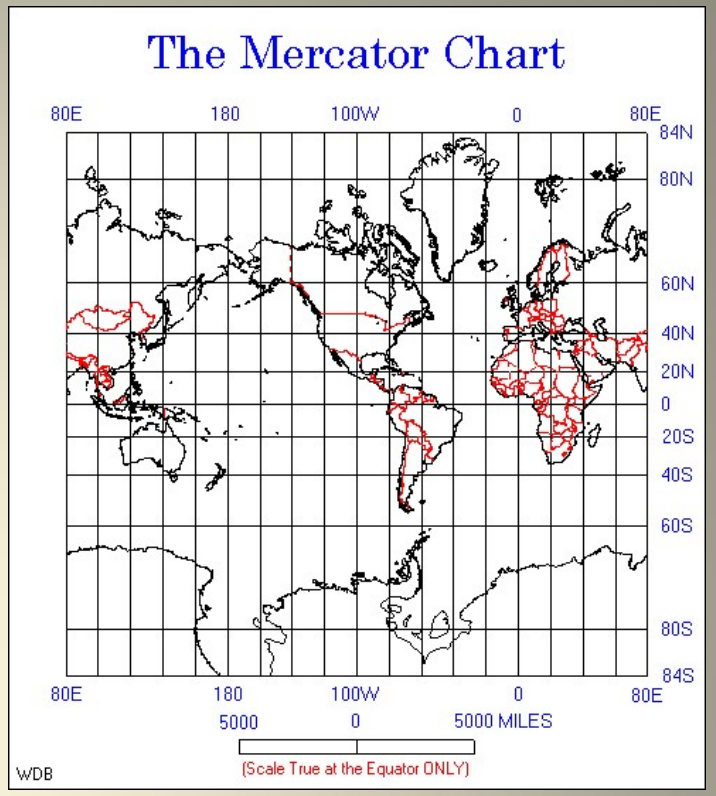
←Here the Parallels of Latitude are shown for every 20°

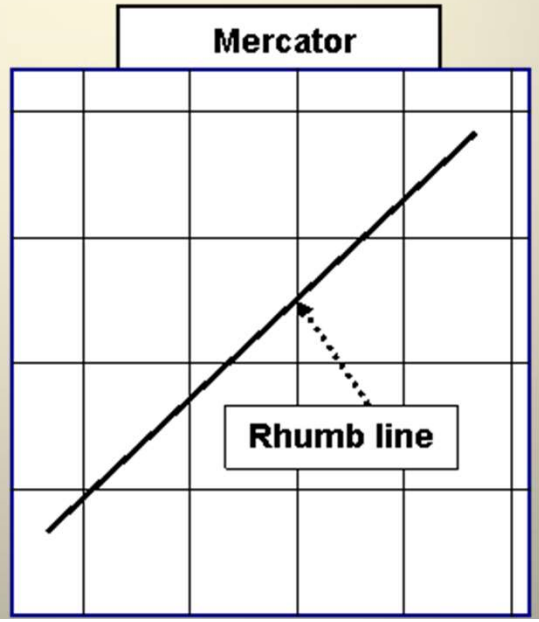
Even though the spacings increase, the number of degrees (20°) stays the same between the Parallels of Latitude

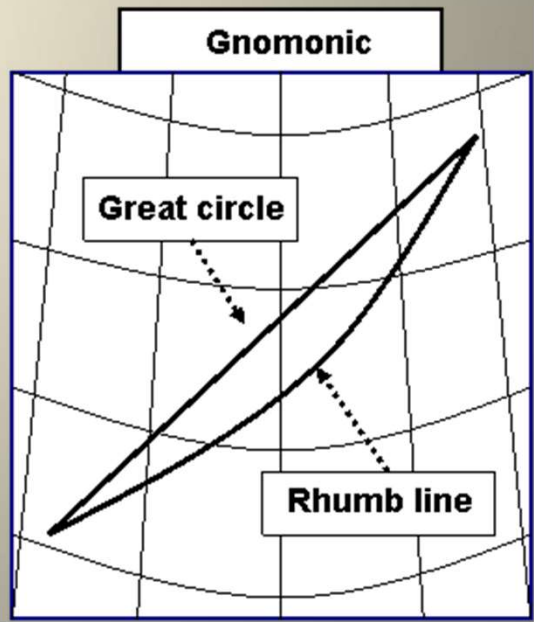
On a MERCATOR Chart:

- Coastlines retain same shape as on the earth's sphere
- Lines of Latitude & Longitude are East/West and North/South respectively i.e. cut at right angles
- A straight line drawn on a chart between any 2 points gives the distance and direction between them
- The straight line is called a **RHUMB Line**, even though the shortest distance is a **GREAT CIRCLE**

(Rhumb lines are used for Coastal Navigation where distances between 2 points are usually less than 600 N.M







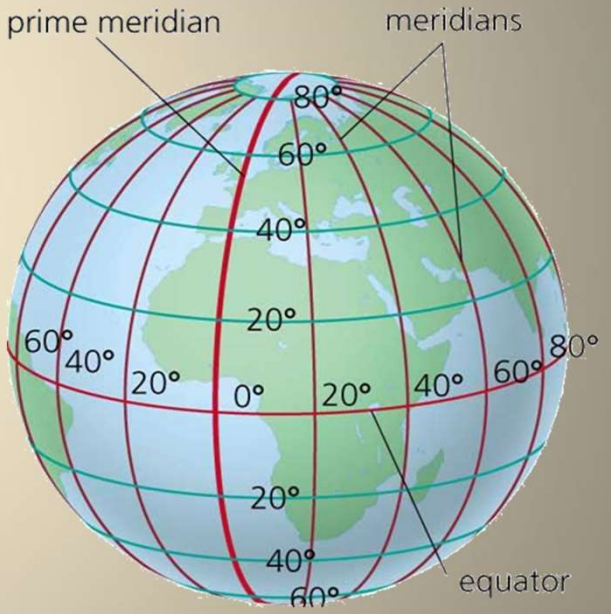
Latitude & Longitude

For navigation, Co-ordinates are described in:

- Degrees (°), Minutes (‘) and Decimals of a Minute (0.0’)

✓ Lat: 34°50.697’S D. M. Decimals

✓ Long: 138°29.949’E



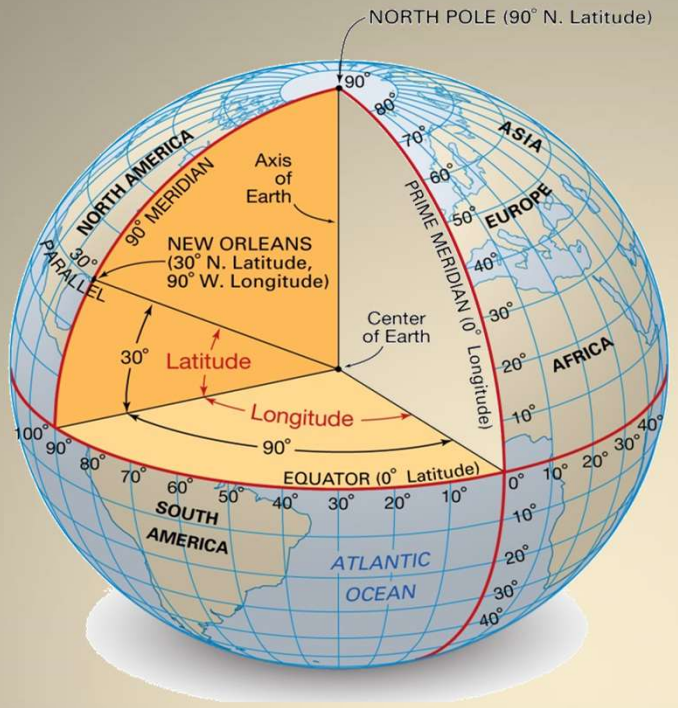
OR

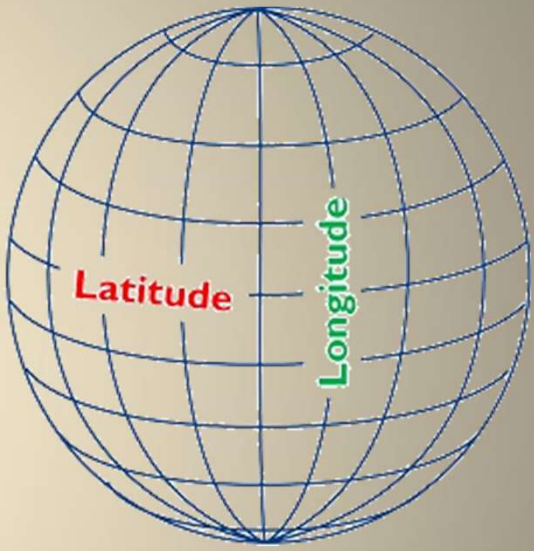
- Degrees (°), Minutes (’), Seconds (”)
  (60’ = 1°) (60” = 1’)

✓ Lat: 34° 50’ 42”S D. M. Seconds

✓ Long: 138° 29’ 57”E

Don’t Get It Wrong Ensure You Are Using The Right Denominations When Plotting From GPS To Paper Charts, Big Errors





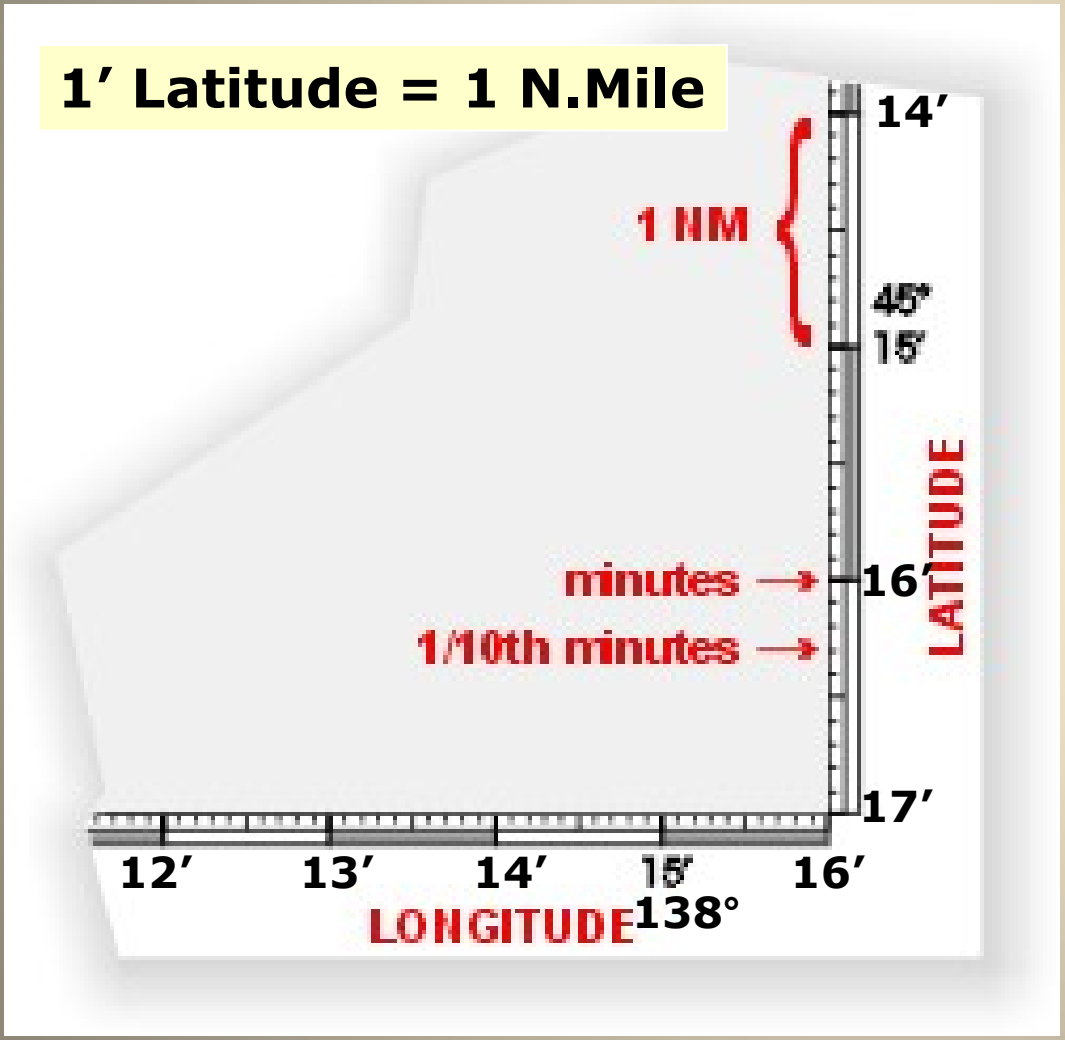
- The distance between any 2 **Parallels of Latitude** is consistent around the globe
- Distance is always measured on the LATITUDE scale

1' (minute) of Latitude = 1 Nautical Mile

1 Nautical Mile = 1852 meters

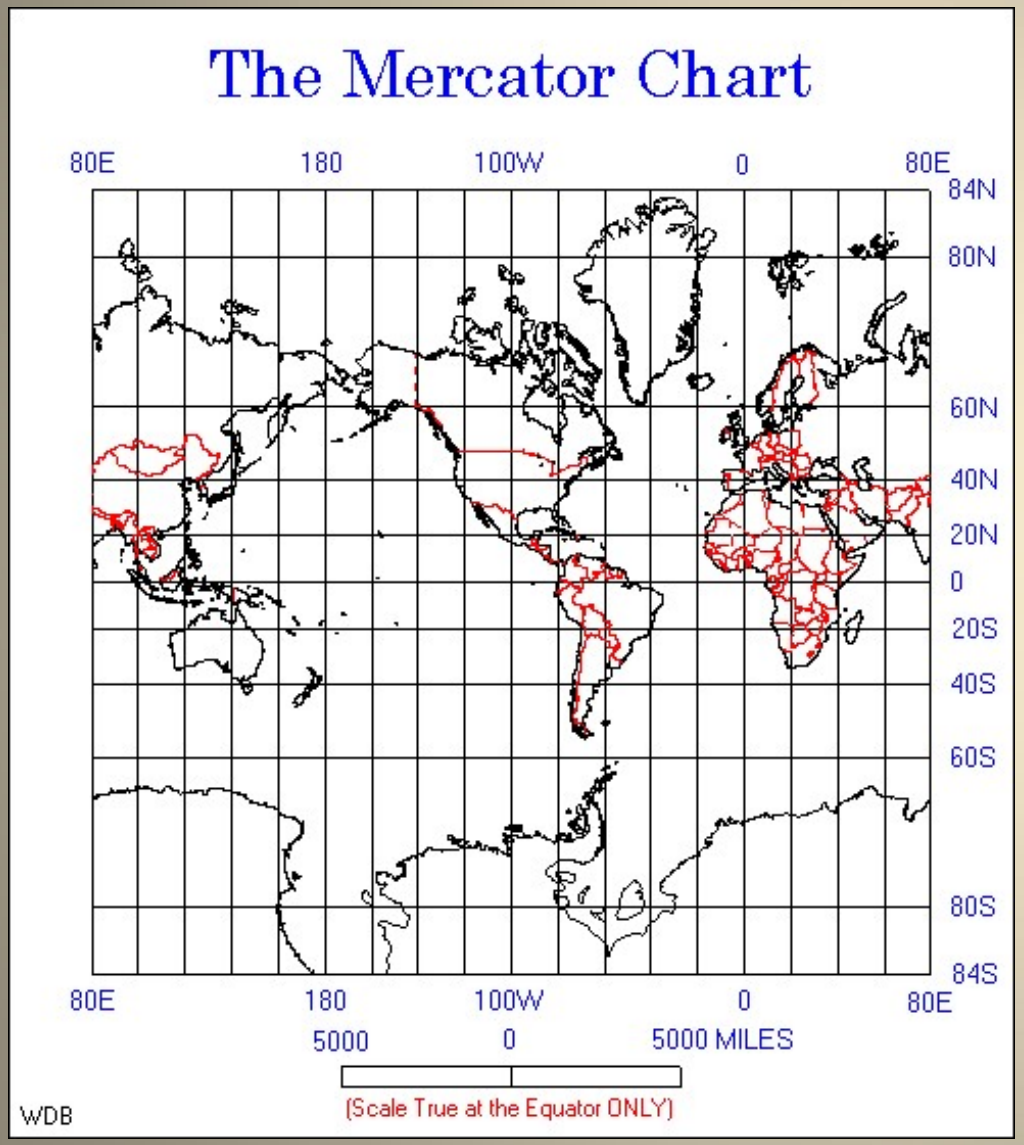
- The distance between any 2 **Meridians of Longitude** is **not** consistent around the globe

Measuring Distance

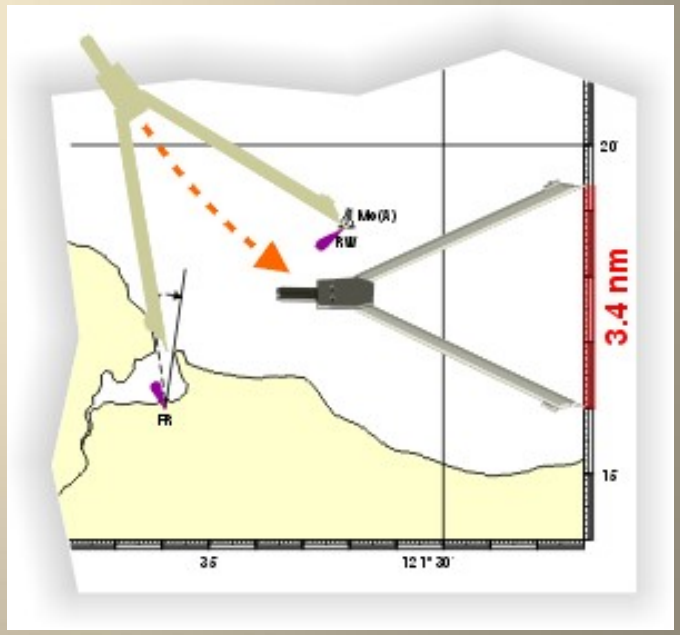


"Minutes" are divided into smaller increments, depending on chart scale size (e.g., 0.1', 0.2' or 0.5')

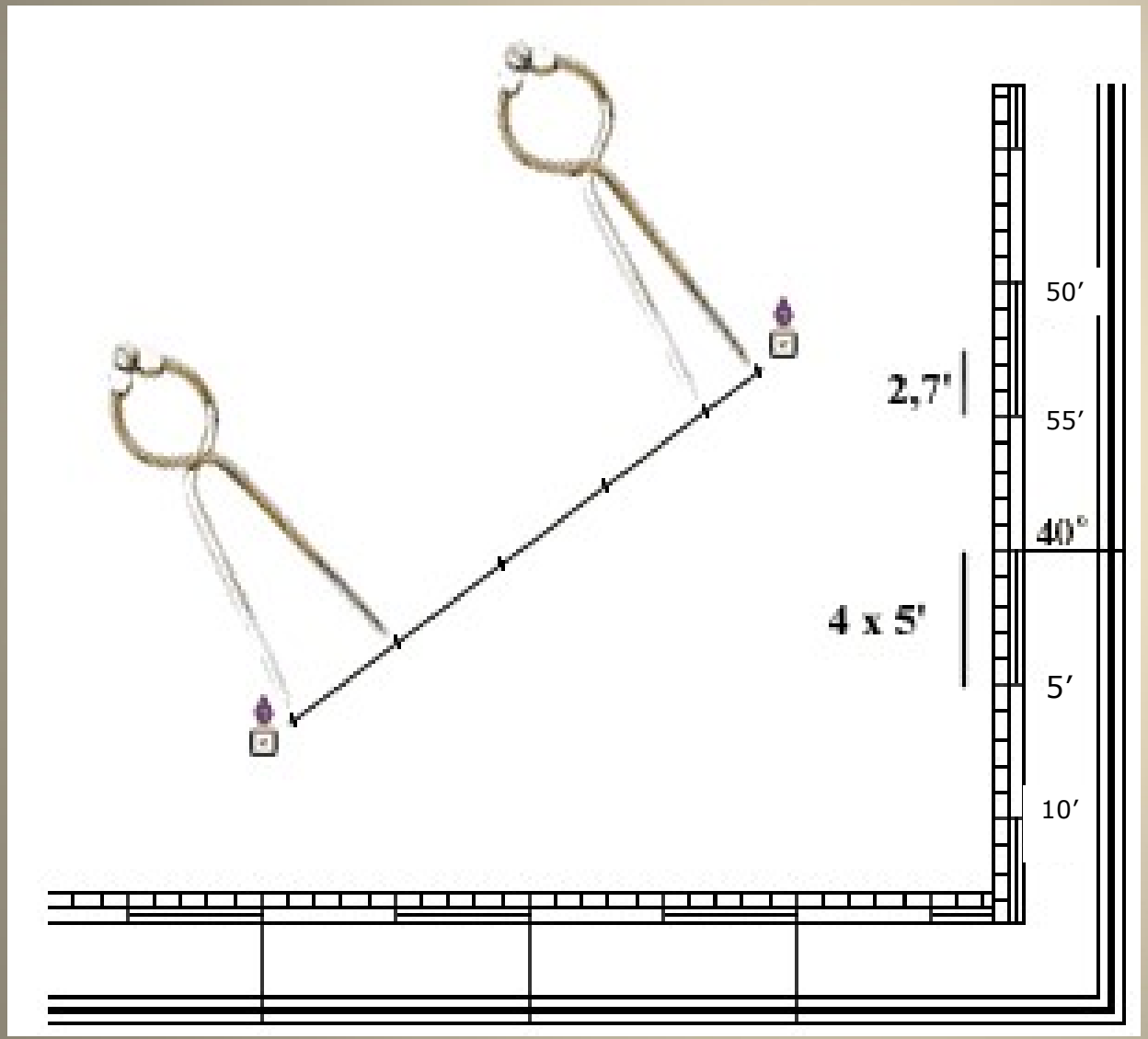
Measuring Distance



Always measure distance on Latitude scale <u>adjacent</u> to area of interest



Measuring Distance



For long distances, set dividers to smaller manageable lengths

Measuring Distance

EXERCISES

(Class based)

Class Exercise

Exercise Sheet #1

- ***Measure the distance in nautical miles in a direct line***
  - ***Exercise 1 (all 3 questions)***

CHART CATEGORIES

World Charts

Smallest scale, used for Ocean Routes, Ocean Currents, and to show Magnetic Variation

Ocean Charts

Typically 1:10,000,000 covering large areas, with basic detail of shoreline & topography – used for planning & position fixing on long ocean passages

General Charts

Typically 1:1,000,000 - used for Coastal Navigation Off-shore. Greater detail.

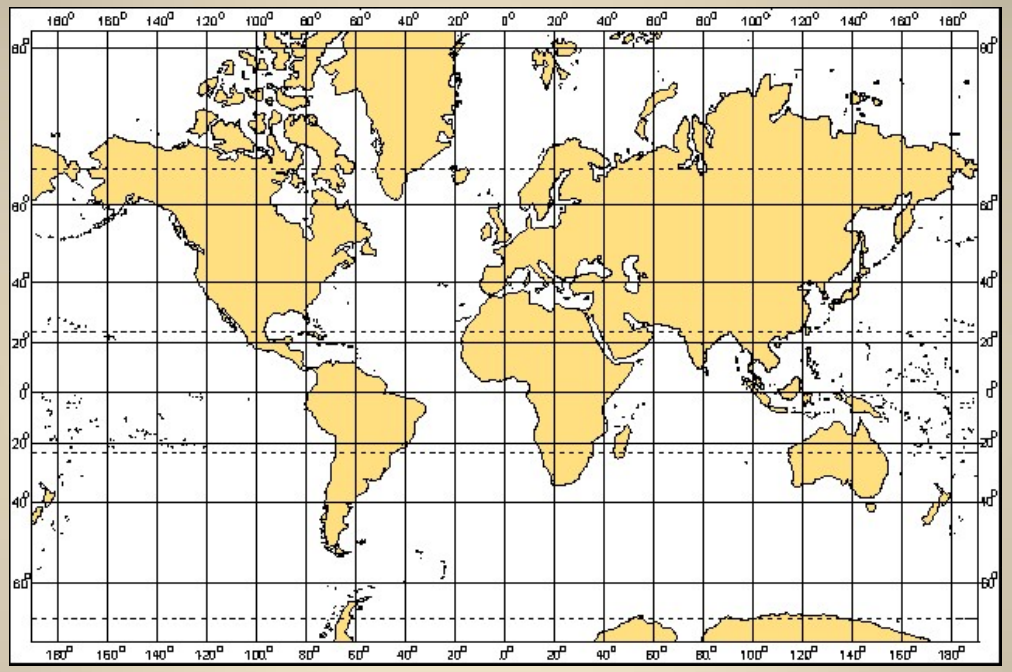
Coastal Charts

Typically 1:150,000 – used for Inshore Navigation – greater detail.

Plan Charts

Large scale (1:75,000 or 1:37,500) – great detail.

Charts And Features



Top of chart is direction of True North

Chart ID Number

- Number prefixed by:

AUS 342	Australian
NZ 123	New Zealand
BA 135	British Admiralty
INT 154	International

Chart ID Number

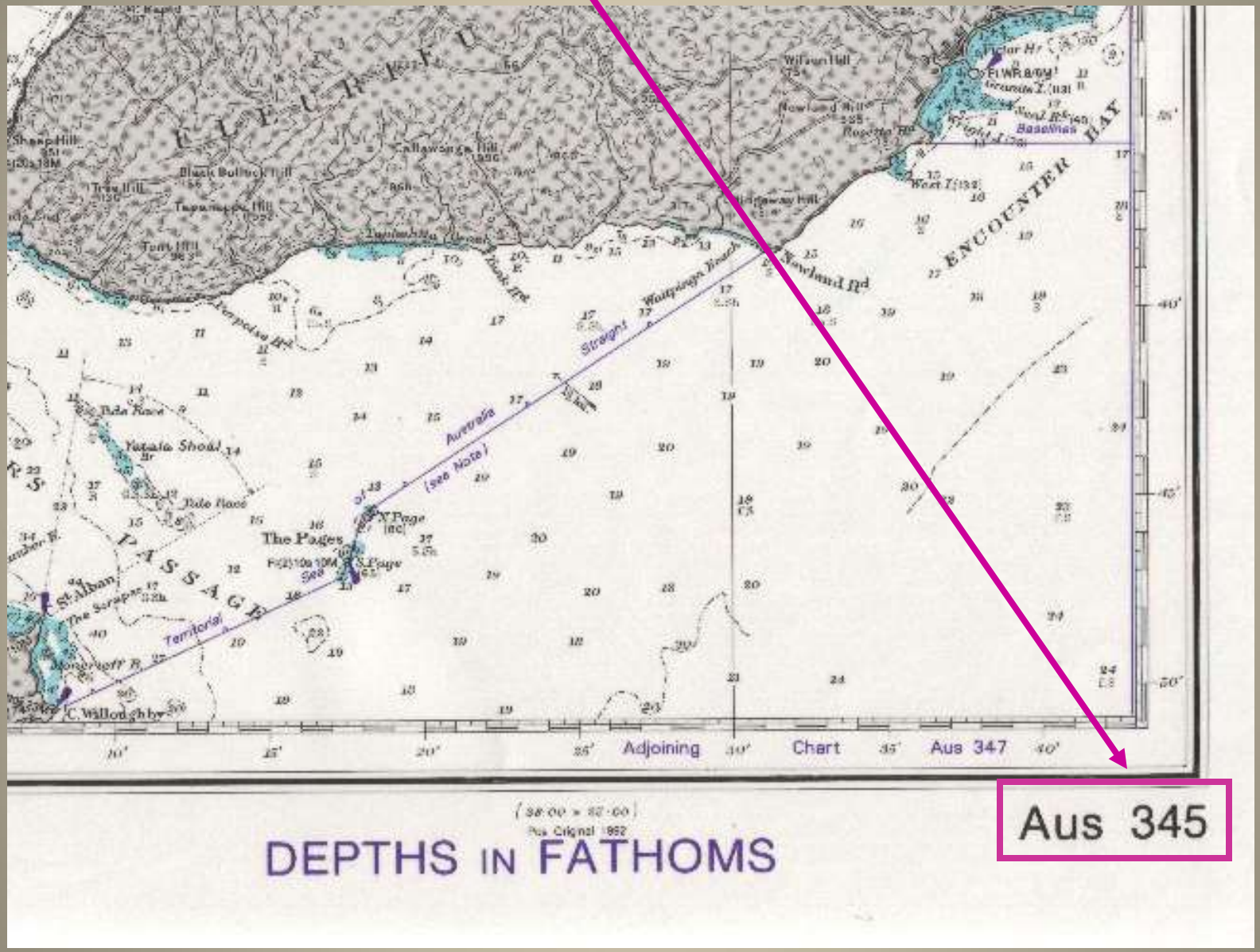
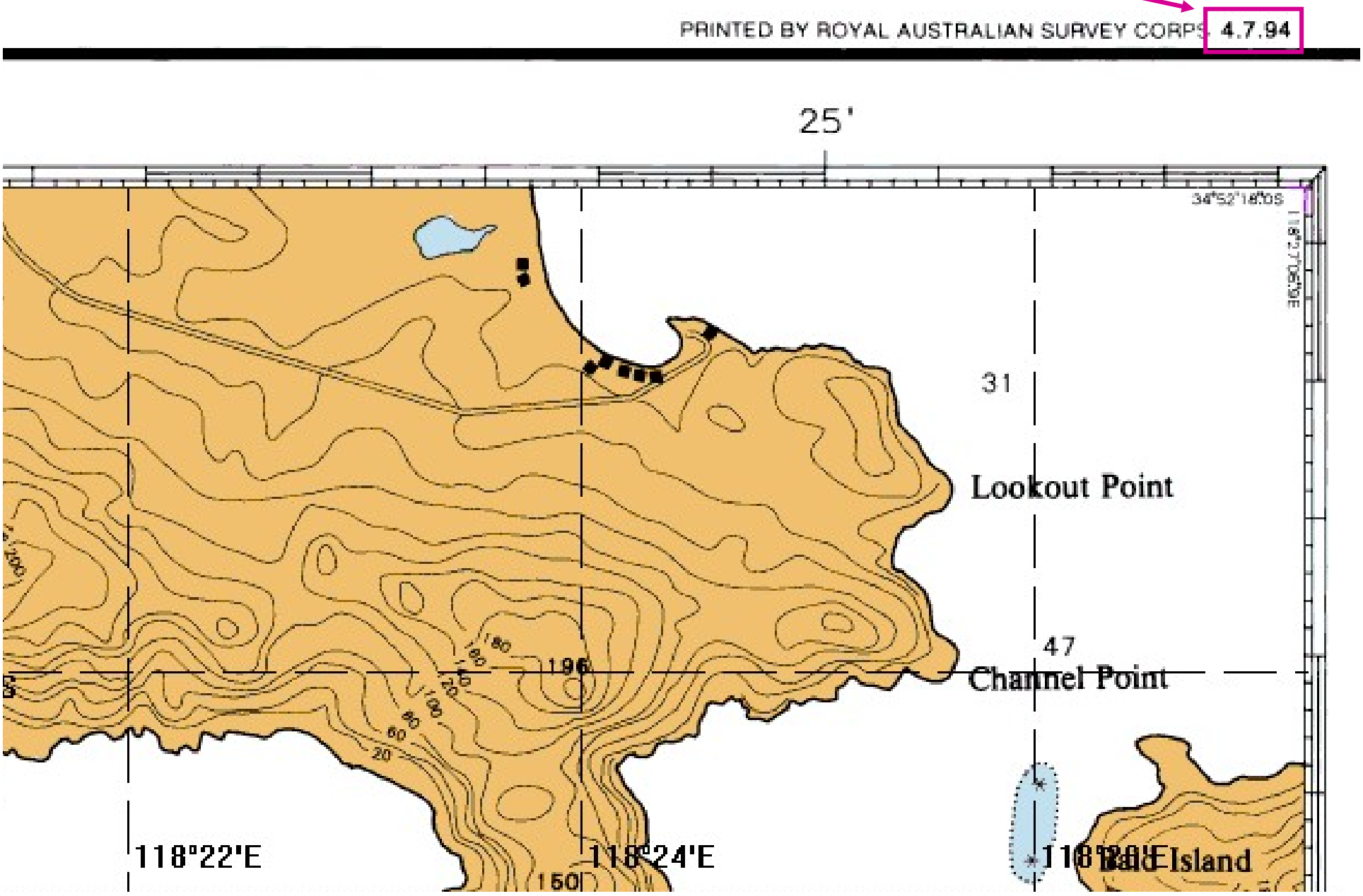
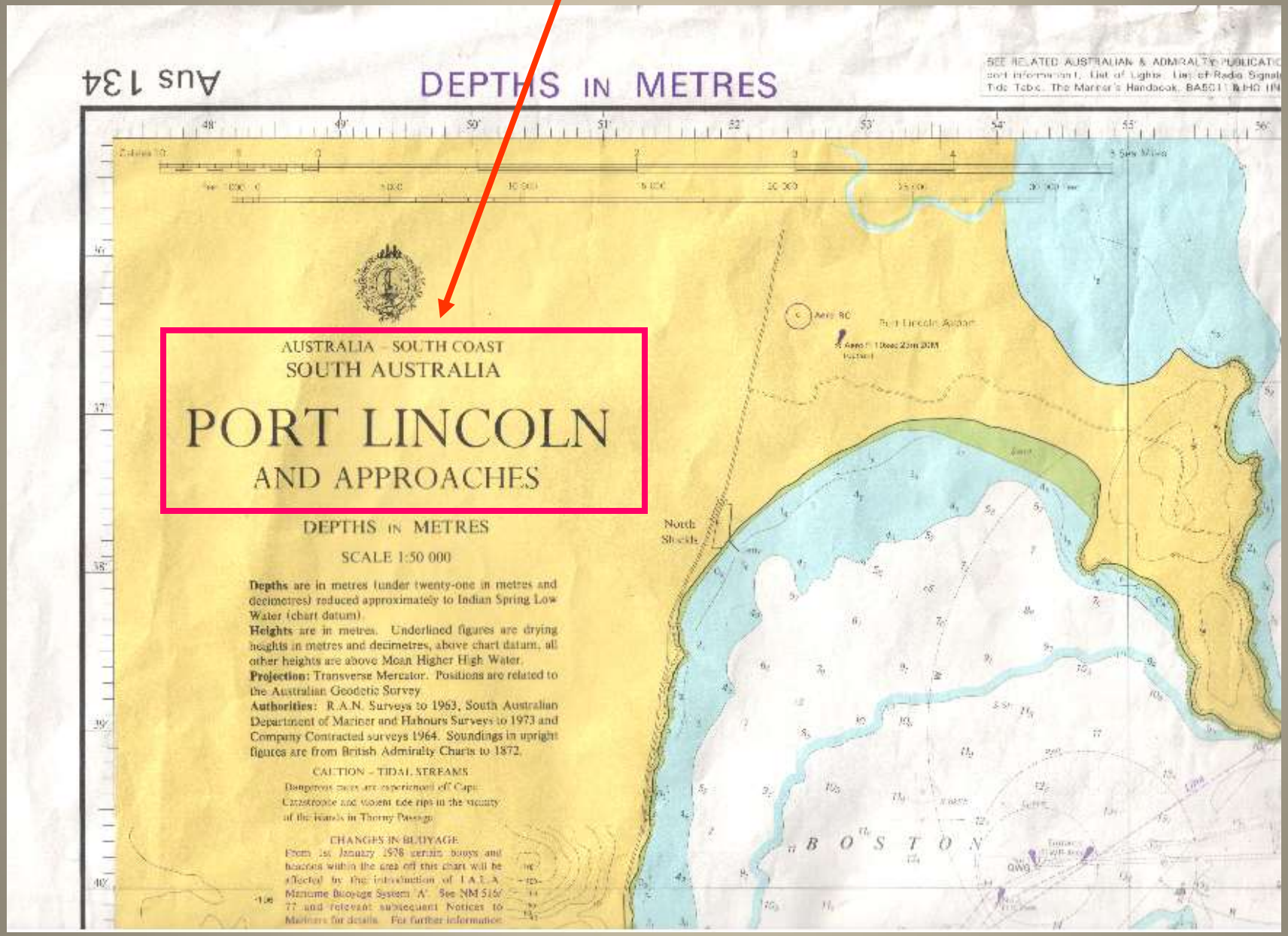


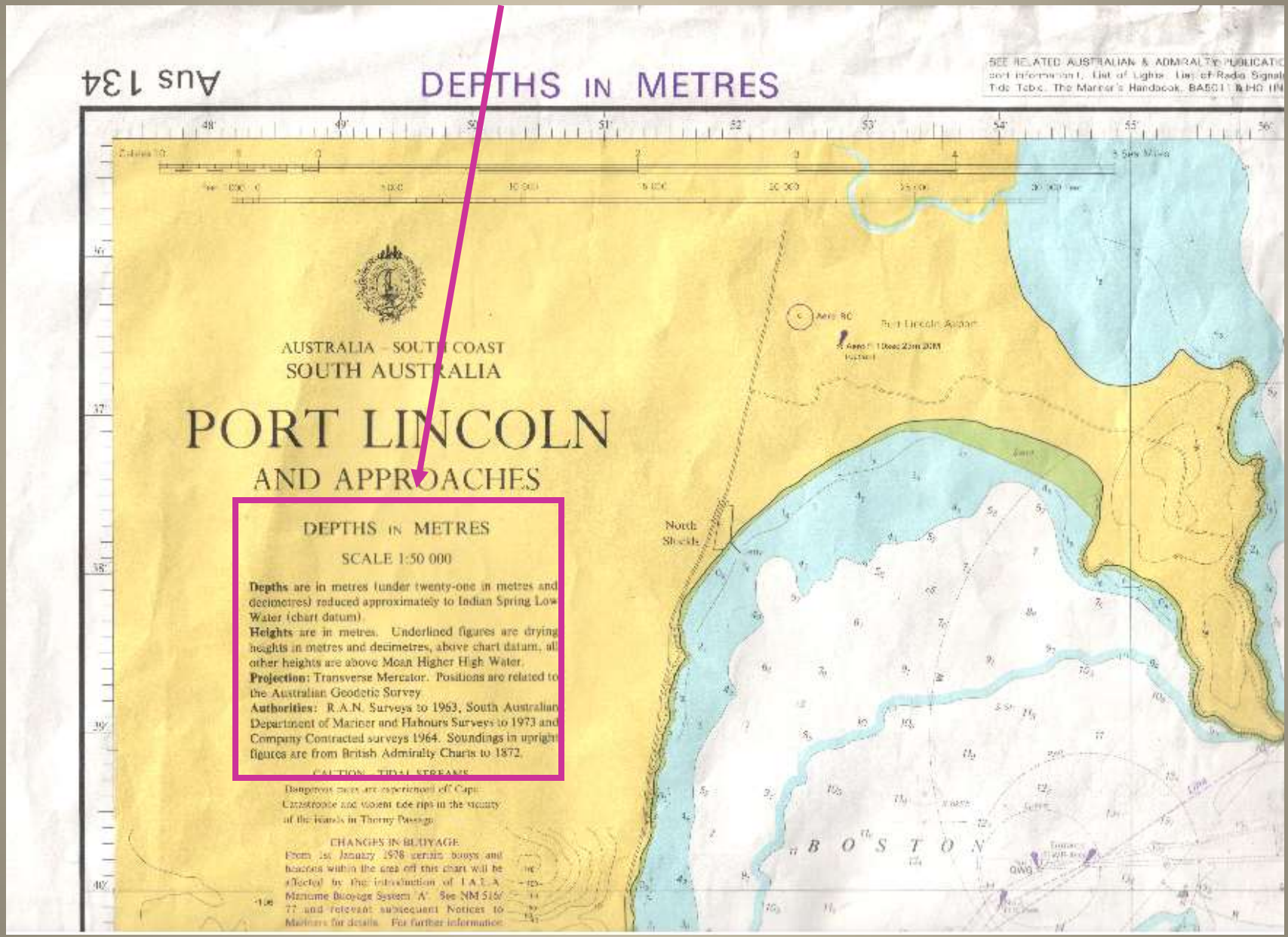
Chart Print Date



Title


Aus 134
DEPTHS IN METRES
AUSTRALIA – SOUTH COAST
SOUTH AUSTRALIA
PORT LINCOLN
AND APPROACHES
DEPTHS IN METRES
SCALE 1:50 000
Depths are in metres (under twenty-one in metres and decimetres) reduced approximately to Indian Spring Low Water (chart datum).
Heights are in metres. Underlined figures are drying heights in metres and decimetres, above chart datum, all other heights are above Mean Higher High Water.
Projection: Transverse Mercator. Positions are related to the Australian Geodetic Survey.
Authorities: R.A.N. Surveys to 1963, South Australian Department of Mariner and Harbours Surveys to 1973 and Company Contracted surveys 1964. Soundings in upright figures are from British Admiralty Charts to 1872.
CAUTION – TIDAL STREAMS
CHANGES IN BUOYAGE
North Shoals
BOSTON

Title Info


Aus 134
DEPTHS IN METRES
AUSTRALIA – SOUTH COAST
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SCALE 1:50 000
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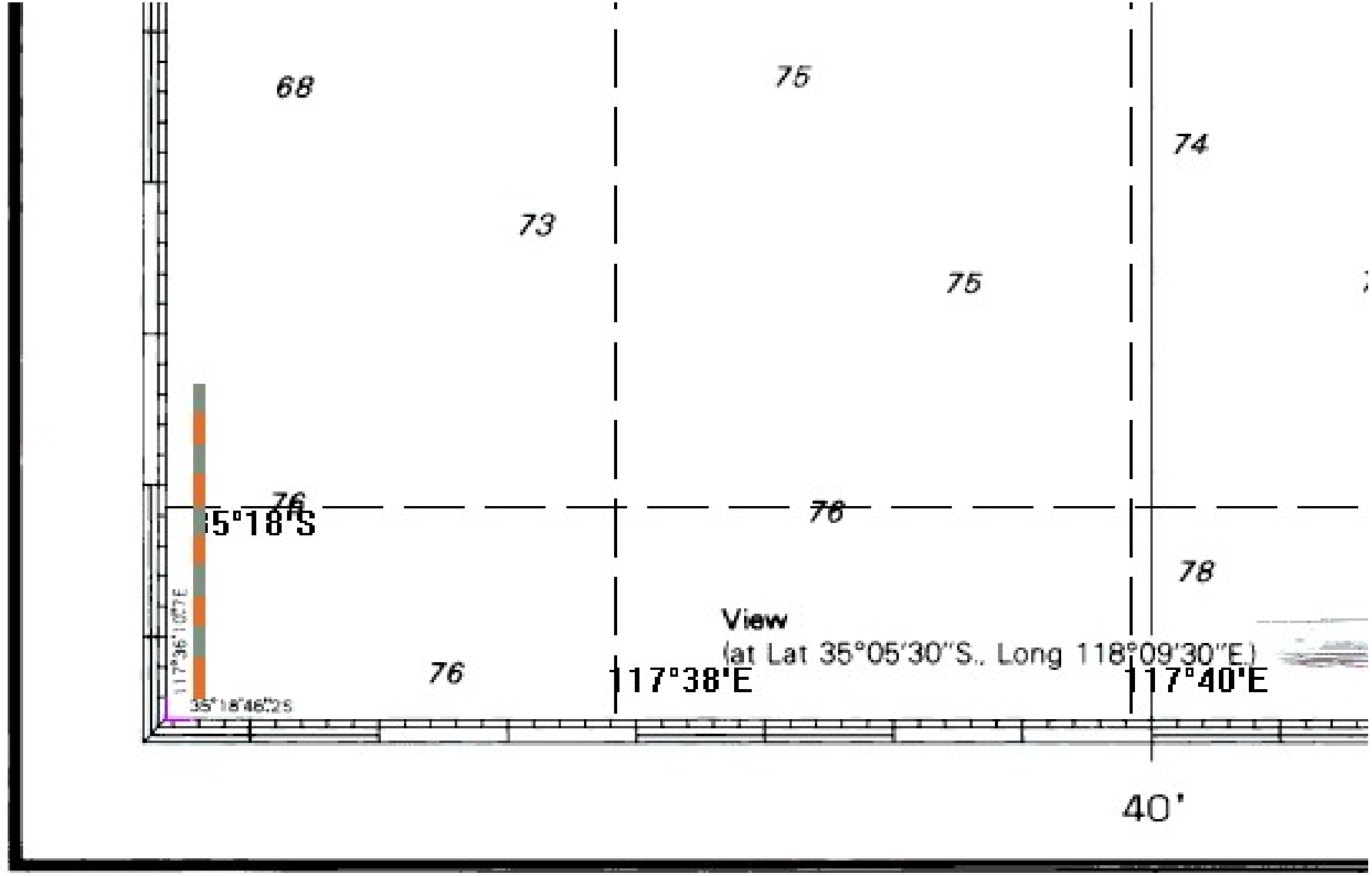
Authorities: R.A.N. Surveys to 1953, South Australian Department of Mariner and Habours Surveys to 1973 and Company Contracted surveys 1964. Soundings in upright figures are from British Admiralty Charts to 1872.
CHANGES IN BUOYAGE
North Shoals
B O S T O N

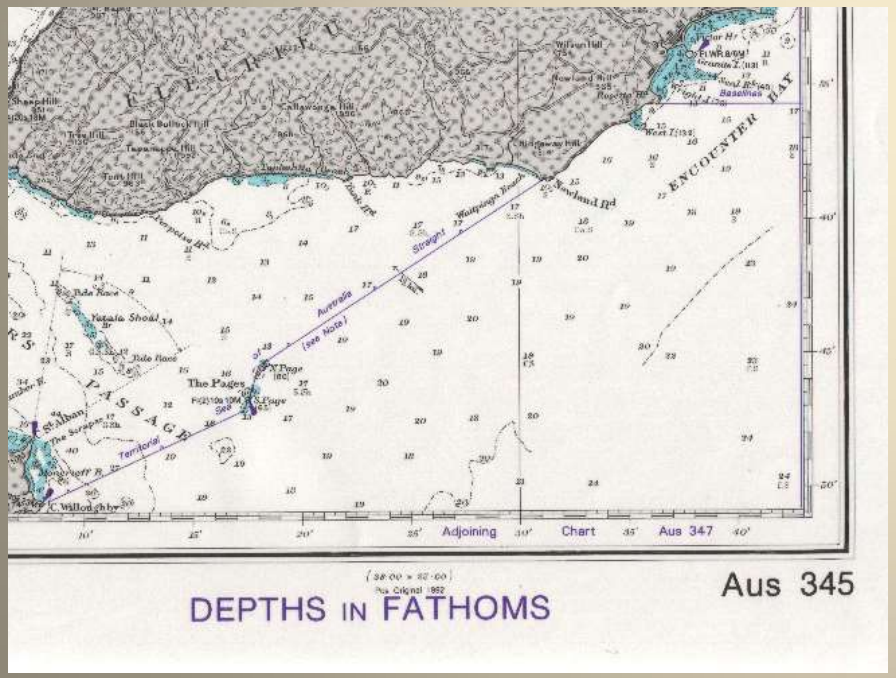


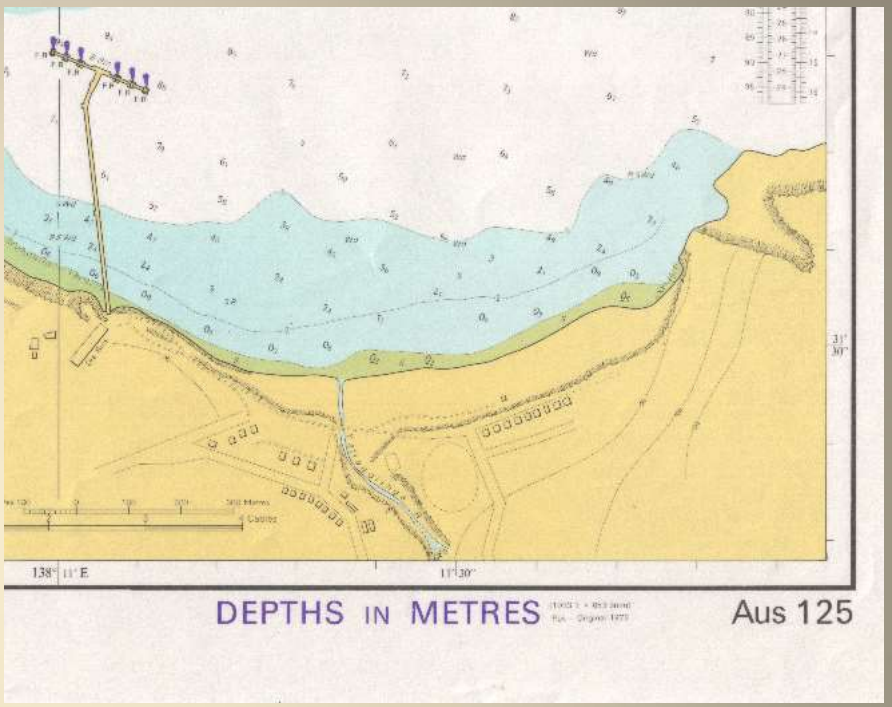
Notices to Mariners inclusive to 1994 -156- 234- 270- [1.7] –1996– 323

CORRECTIONS n

Depths

<u>METRIC CHART</u> ➔
Under 21 Metres, depths shown in Metres and Decimetres
e.g. **10_7 = *10.7 Metres***





➔**<u>FATHOMS CHART</u>**
Under 11 Fathoms, depths shown in Fathoms and Feet
e.g. **8_5** = ***8 Fathoms 5 feet***
(1 Fathom = 6 feet)

Satellite Derived Positions

SATELLITE – DERIVED POSITIONS

Positions obtained from satellite navigation systems are normally referred to WGS 72 Datum; such positions should be moved 0.09 minutes SOUTHWARD and 0.07 minutes WESTWARD to agree with this chart.

To accompany Australian Notice to Mariners 123/2002

SATELLITE DERIVED POSITIONS

Positions obtained from the Global Positioning System (GPS) in the WGS 1984 Datum must be moved 0.09 minutes SOUTHWARD and 0.06 minutes WESTWARD to agree with this chart.

Note for chart Aus 836

To accompany Australian Notice to Mariners 36/2002

SATELLITE DERIVED POSITIONS

Positions obtained from the Global Positioning System (GPS) in the WGS 1984 Datum can be plotted directly onto this chart.

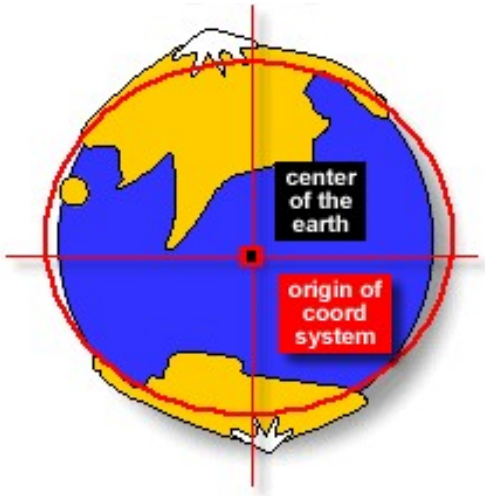
Note for chart Aus 342

A little about CHART DATUMS

GPS positions relate to the American **WGS 1984** system

WGS 1984 *is based on a particular mathematical shape which represents the centre of the Earth. GPS satellites relate positions to this* ***DATUM***

WGS 1984

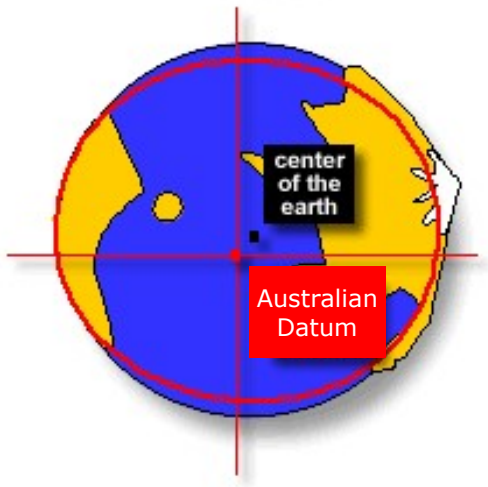


←American Chart Datum (GPS System)

Australian Chart Datum (red)

→

AGD 66
AGD 84



A little about CHART DATUMS

The World Geodetic System (WGS) is a standard for use in cartography, geodesy, and satellite navigation including GPS. It comprises a standard coordinate system for the Earth, a standard spheroidal reference surface (the datum or reference ellipsoid) for raw altitude data, and a gravitational equipotential surface (the geoid) that defines the nominal sea level.

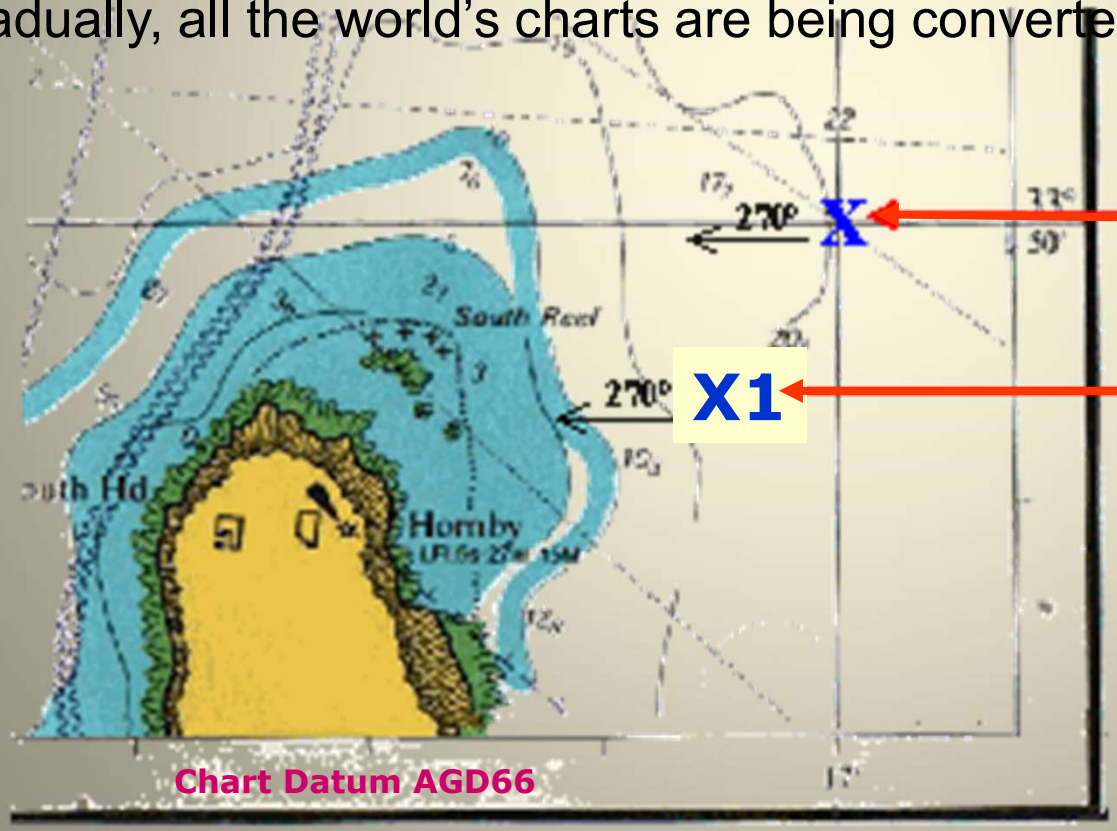
The latest revision is WGS 84 (also known as WGS 1984, EPSG:4326), established in 1984 and last revised in 2004.[1] Earlier schemes included WGS 72, WGS 66, and WGS 60. WGS 84 is the reference coordinate system used by the Global Positioning System

Example – Using the wrong Datum

Your Australian Datum Chart (AGD66) will show your WGS84 GPS position at "X", and safely heading West into harbour.

However, the corrected WGS position (which agrees with the Australian Datum) places you at "X1", <u>HEADING FOR THE ROCKS!</u>

Make sure the GPS datum agrees with your chart
(Gradually, all the world's charts are being converted to WGS 1984)



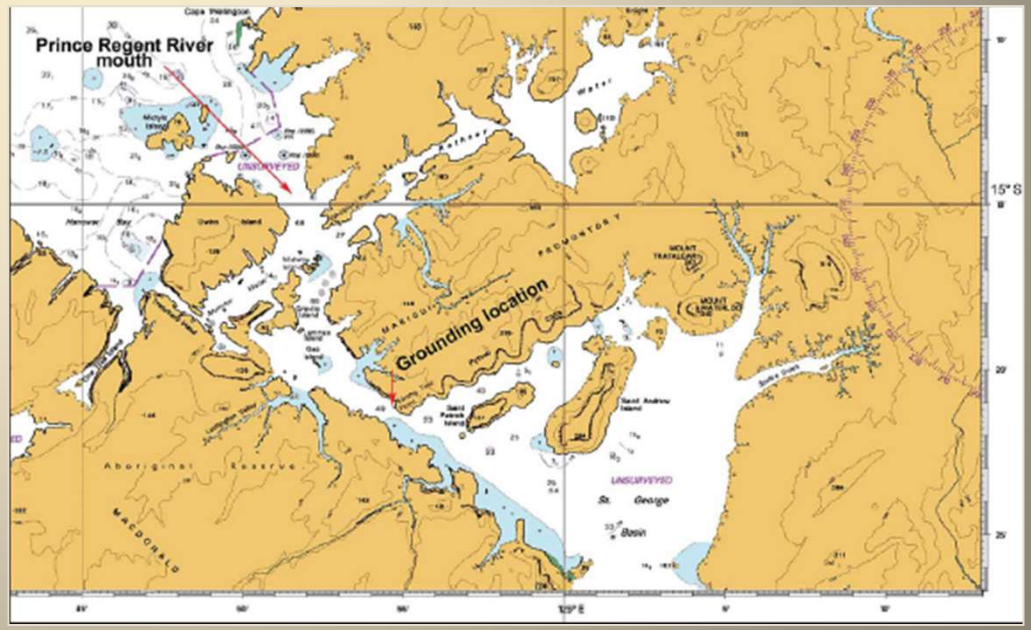
...your GPS lat. and long. indicates you are here. . . .

...but after applying the datum correction you find you are actually here!

What happens when you get it wrong

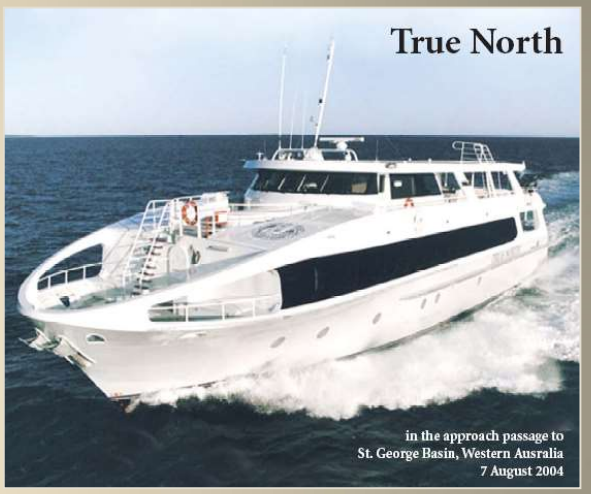
CASE STUDY

Grounding of “True North” in the approach passage to St George Basin, Western Australia on 7th August, 2004.



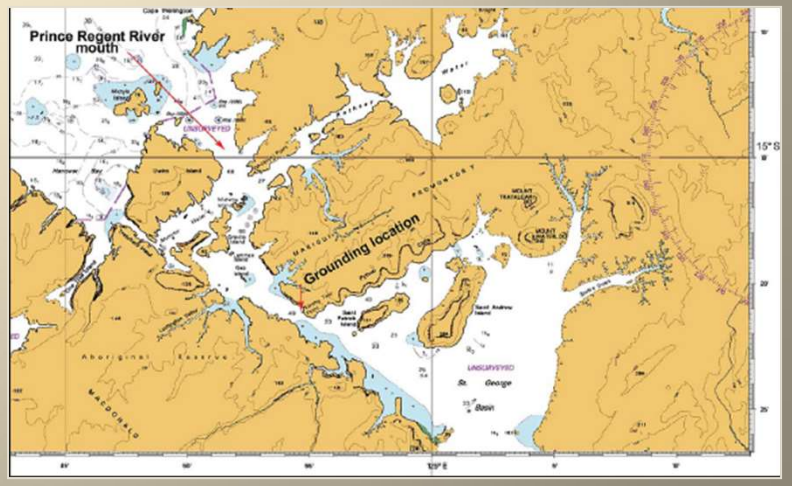
Vessel Particulars

Vessel Length: 34.56 metres
Vessel Class: Passenger
Persons on Board: 38
Persons on Watch: 1 (Master)
Navigation Mode: Automatic, Electronic Chart with GPS interface



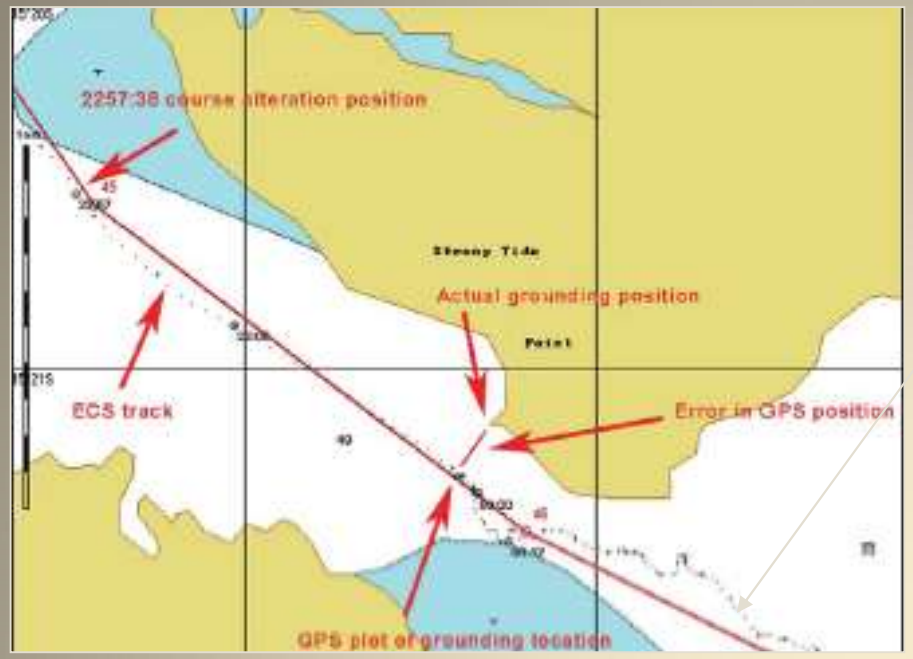
Incident Particulars

Date of Grounding: 7th August,2004
Time of Grounding: 2304 hours
Speed at Grounding: 14.5 knots

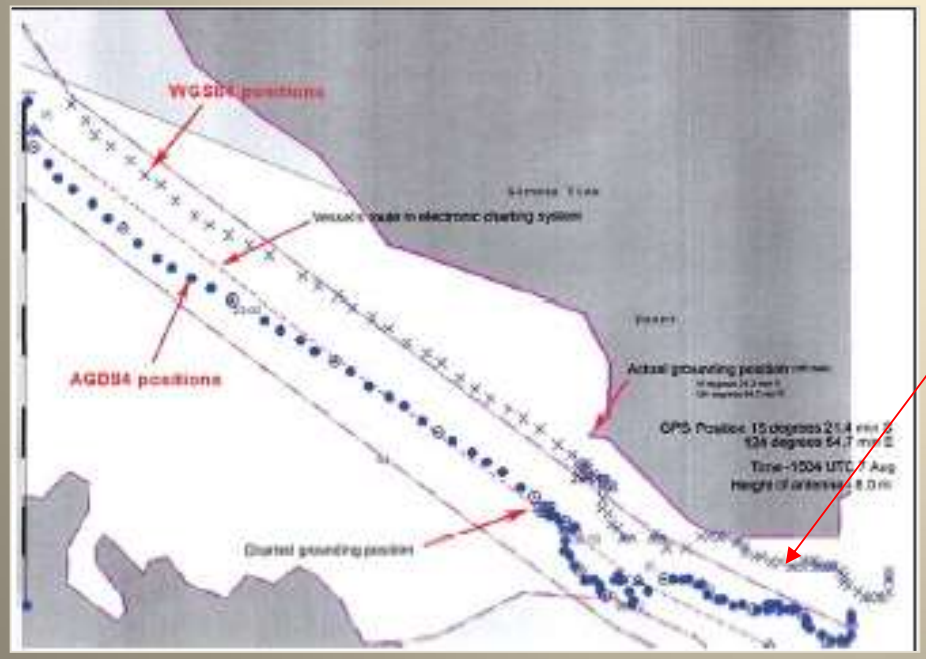


Navigational Equipment

Radar: On
GPS: On
ECS: On
E/Sounder: Off
Sonar: Off



Master of “True North” thought he was on this track (according to GPS Plotter)



This was the actual track of “True North” prior to grounding

FINDINGS OF MARINE SAFETY INVESTIGATION

- Too much reliance was placed on the accuracy of GPS positions, and the GPS positions plotted on the vessel's Electronic Chart System were not adequately checked by other navigational means

- A proper lookout was not maintained by visual, radar and other means to ensure the vessel remained in safe water

- At the time of the grounding, it is probable that the master was suffering from some effects of fatigue as a result of his work routine……

FINDINGS OF MARINE SAFETY INVESTIGATION

GPS derived positions plotted on the ECS differed from the vessel's true position, possibly caused by:

- GPS system inaccuracy;
- Geodetic datum ambiguity;
- The ECS operating on a common user personal computer which allowed possible corruption of the ECS operating system;
- A change in the GPS receiver parameters;
- Loose wiring or connection in the on-board systems;
- A combination of the above

Roebuck Bay

- Australia Border Control's patrol boat Roebuck Bay ran into Henry's Reef in the Great Barrier Reef in September 2017.
- An investigation is finding faults with the new electronic chart system which had problems "storing" the amendments to the route through the Reef before the boat collided with the reef after midnight.
- This new electronic chart system has been mandatory for all large vessels making their way through the Great Barrier Reef since July 2018.
- The Australian Transport Safety Bureau has a more detailed report ready by "first quarter 2019".

ns / Other Info

Sources: R.A.N. surveys to 1980 and Public Works Department W.A. plans to 1982. Soundings shown in upright figures are from early Admiralty surveys.

SATELLITE-DERIVED POSITIONS

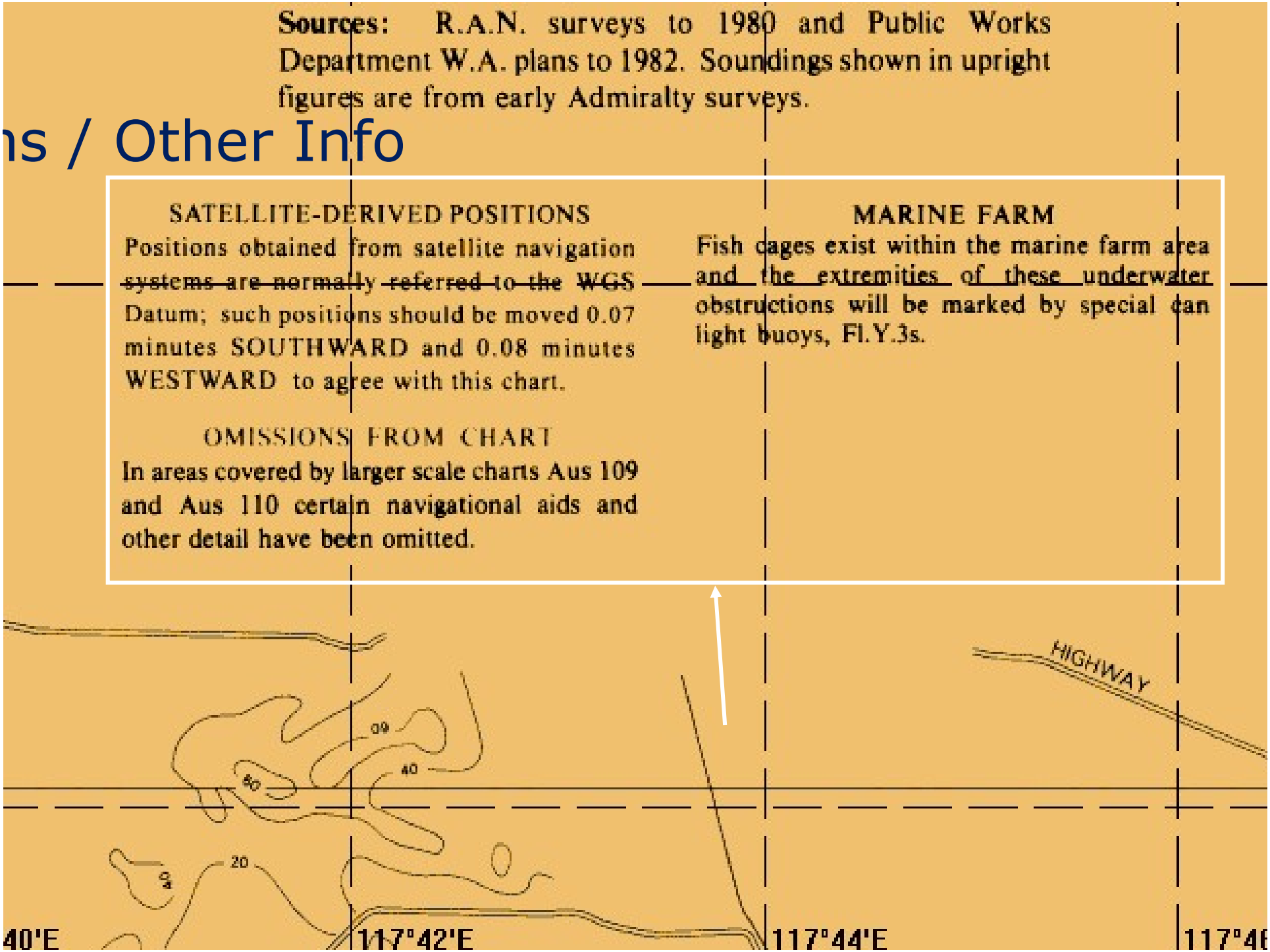
Positions obtained from satellite navigation systems are normally referred to the WGS Datum; such positions should be moved 0.07 minutes SOUTHWARD and 0.08 minutes WESTWARD to agree with this chart.

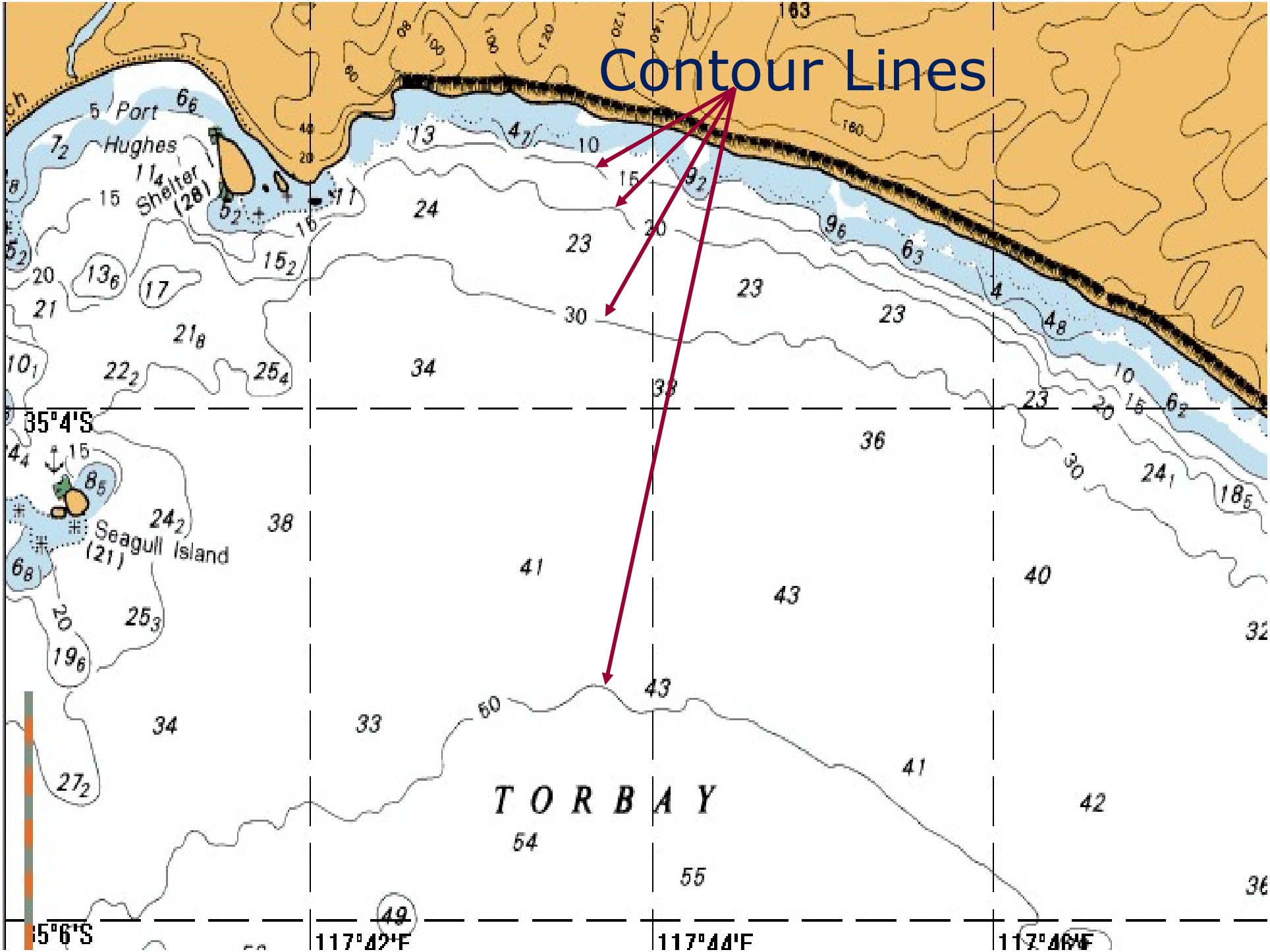
OMISSIONS FROM CHART

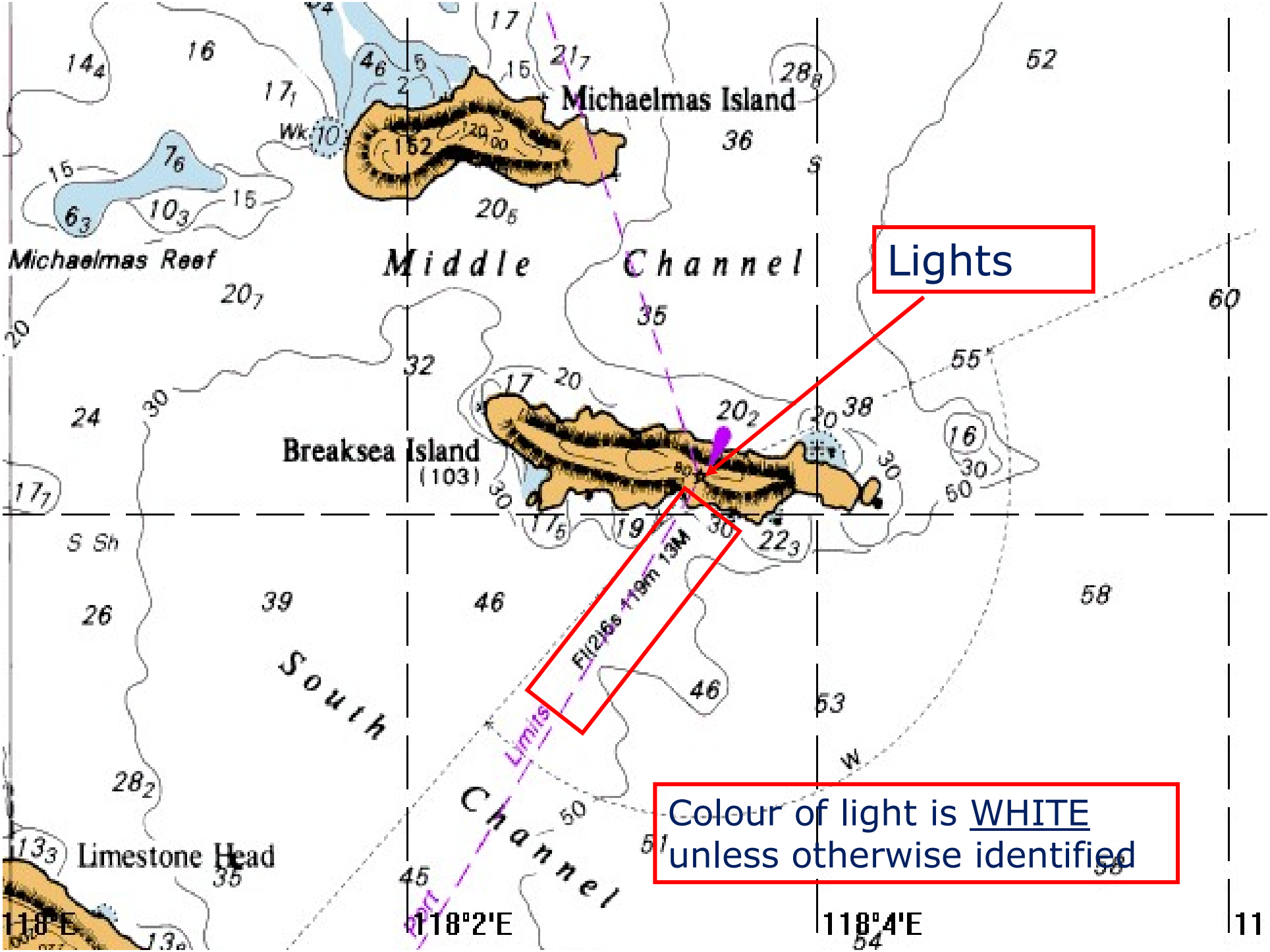
In areas covered by larger scale charts Aus 109 and Aus 110 certain navigational aids and other detail have been omitted.

MARINE FARM

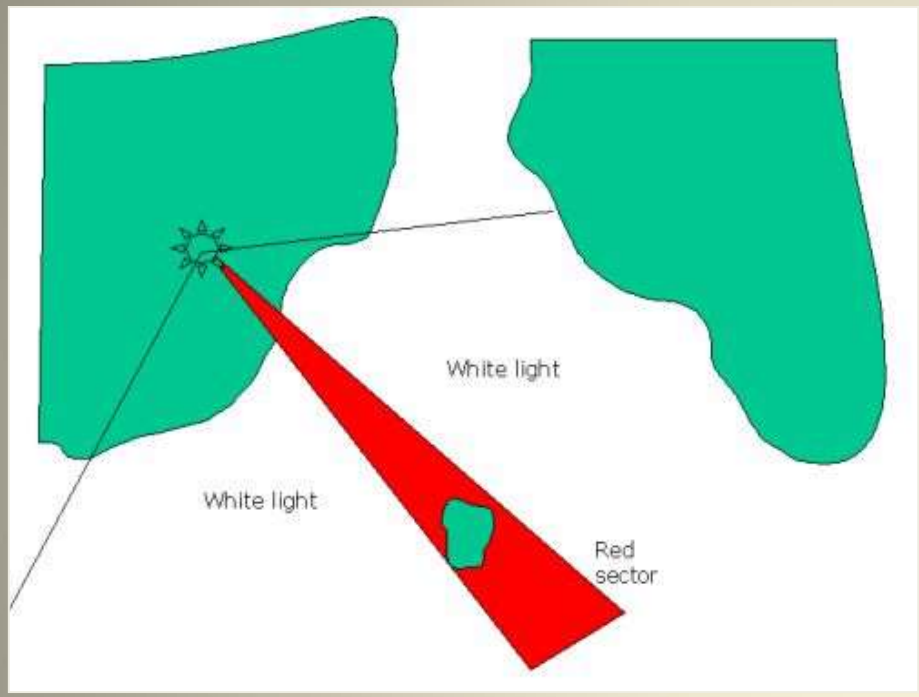
Fish cages exist within the marine farm area and the extremities of these underwater obstructions will be marked by special can light buoys, Fl.Y.3s.

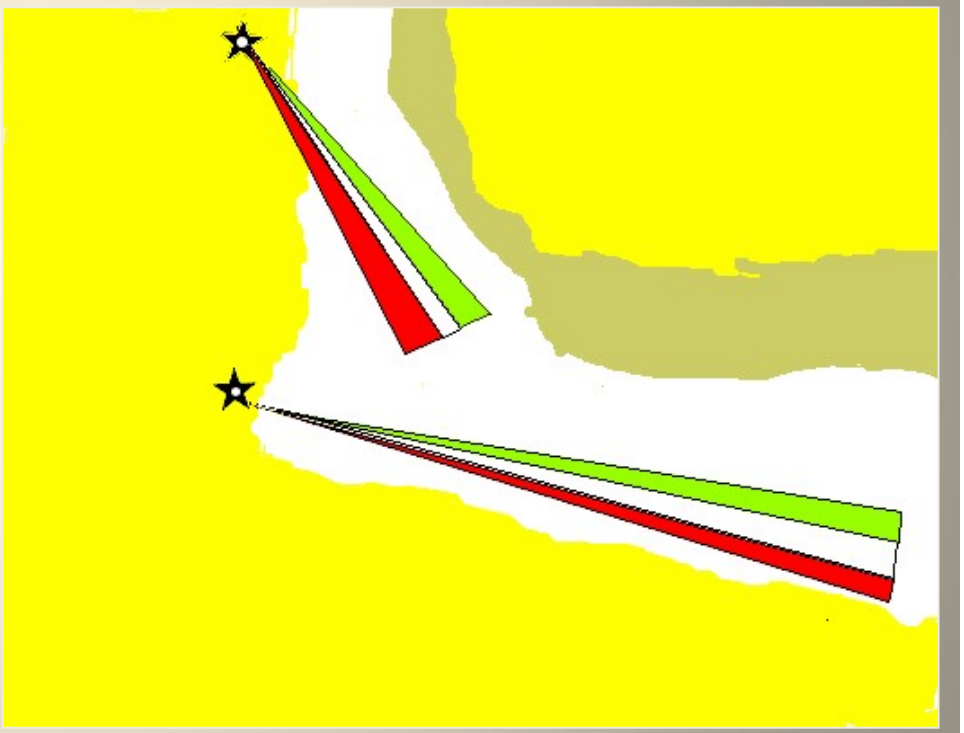



Contour Lines
Port Hughes
Shelter (28)
Seagull Island (21)
TORBAY
35°4'S
35°6'S
117°42'E
117°44'E

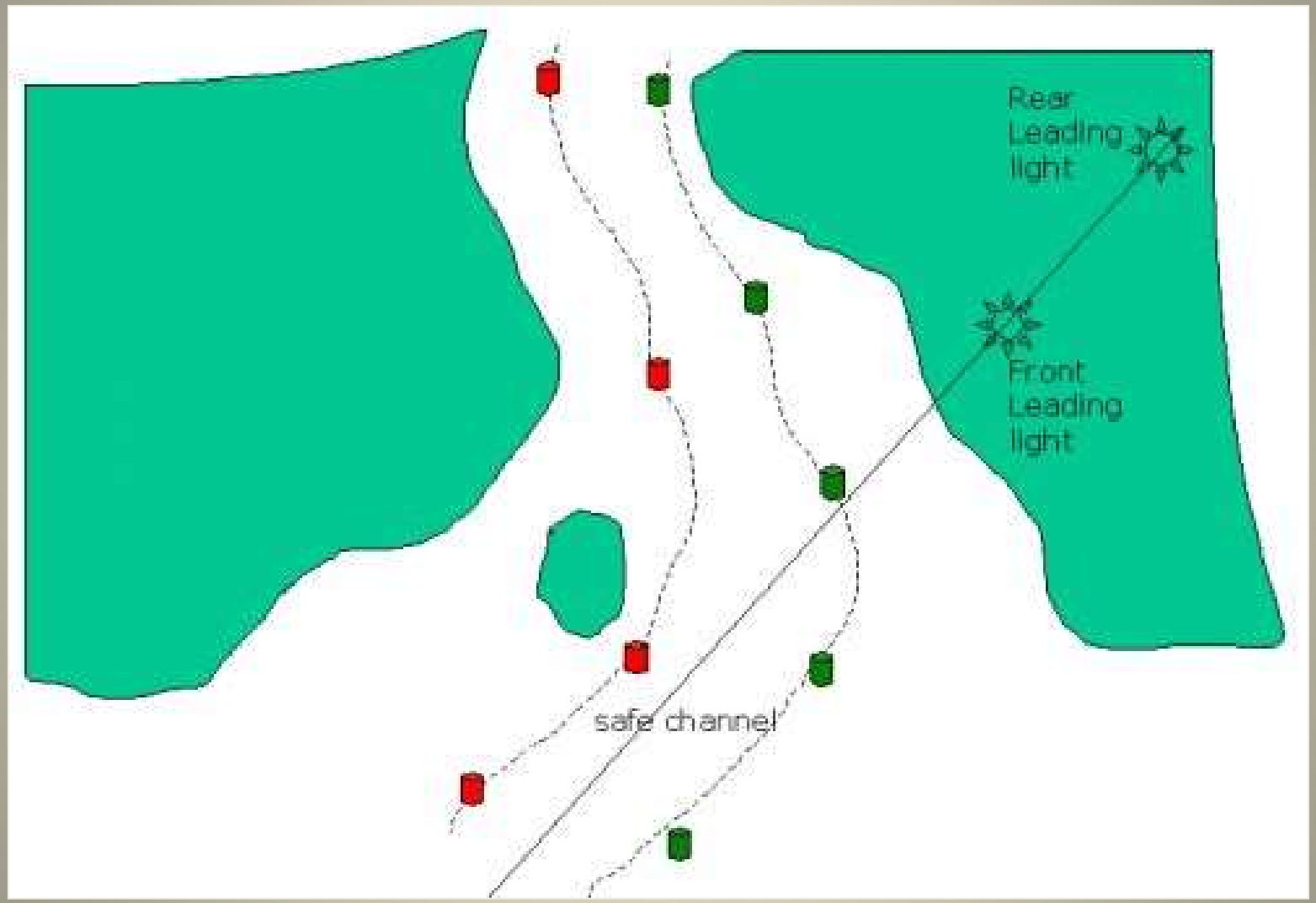

Michaelmas Island
Michaelmas Reef
Middle Channel
Breaksea Island
(103)
South Channel
Limestone Head
Lights
Colour of light is WHITE
unless otherwise identified
118°2'E
118°4'E

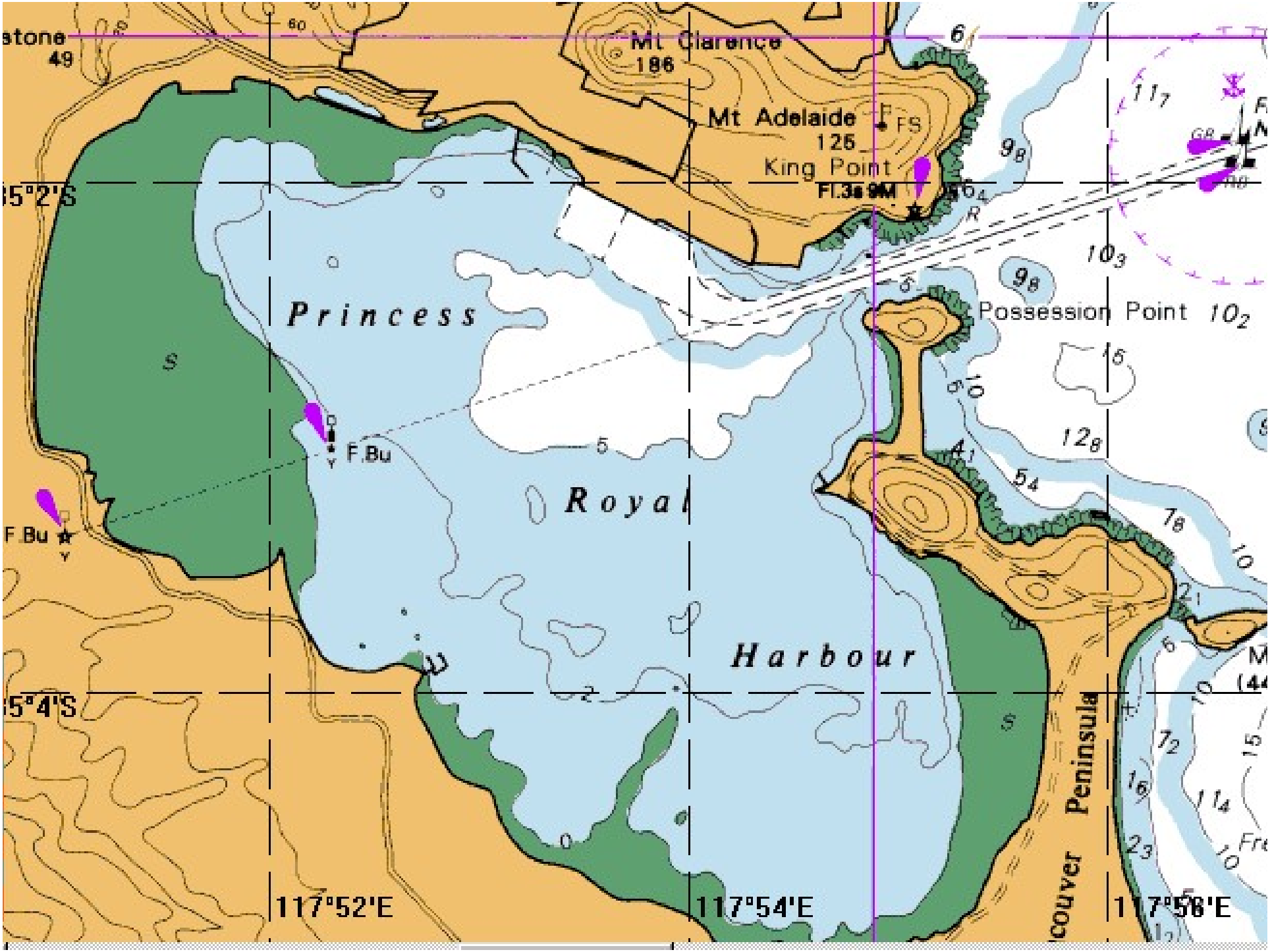
Lights - Sectors



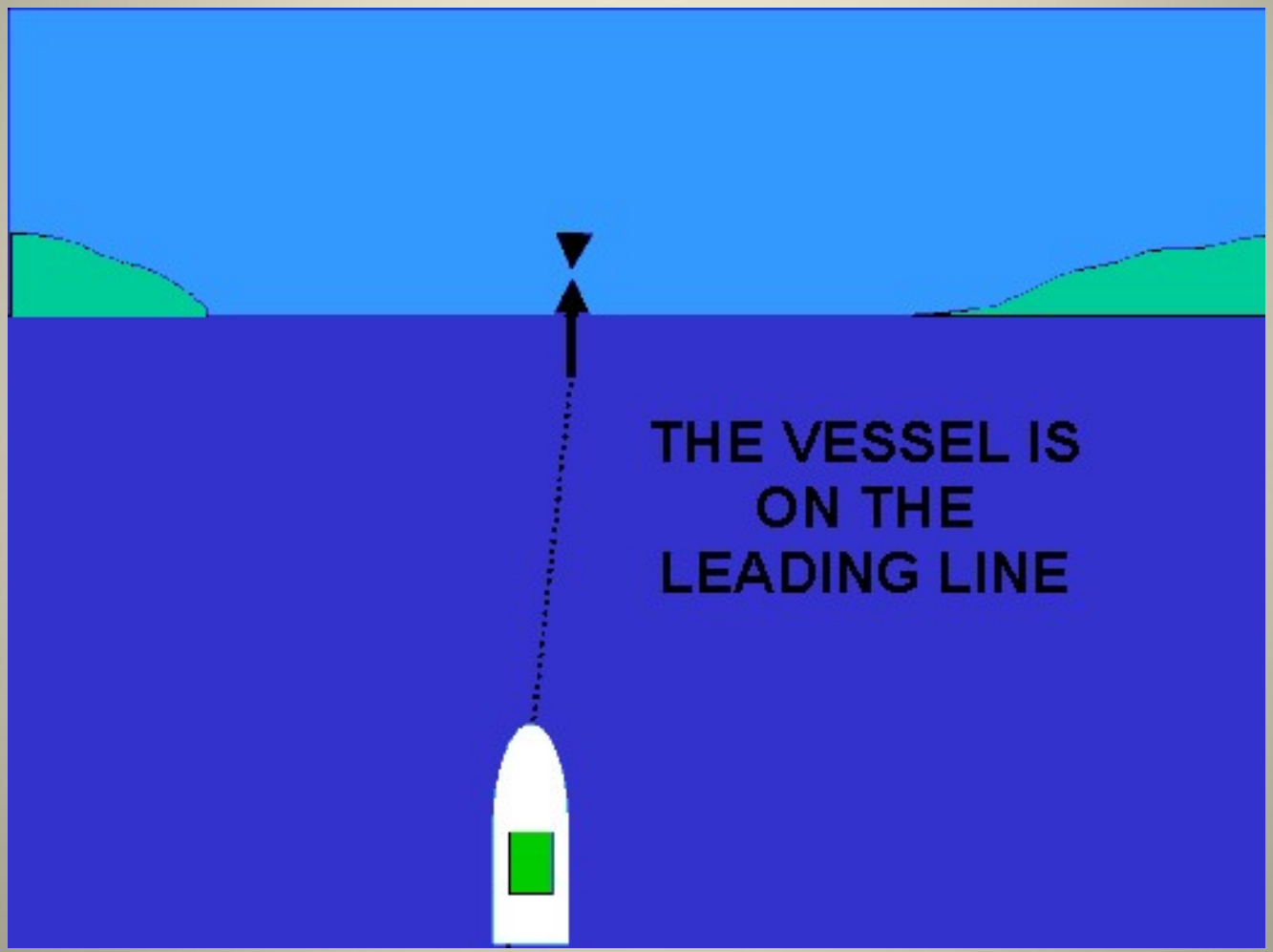


Leading Lights

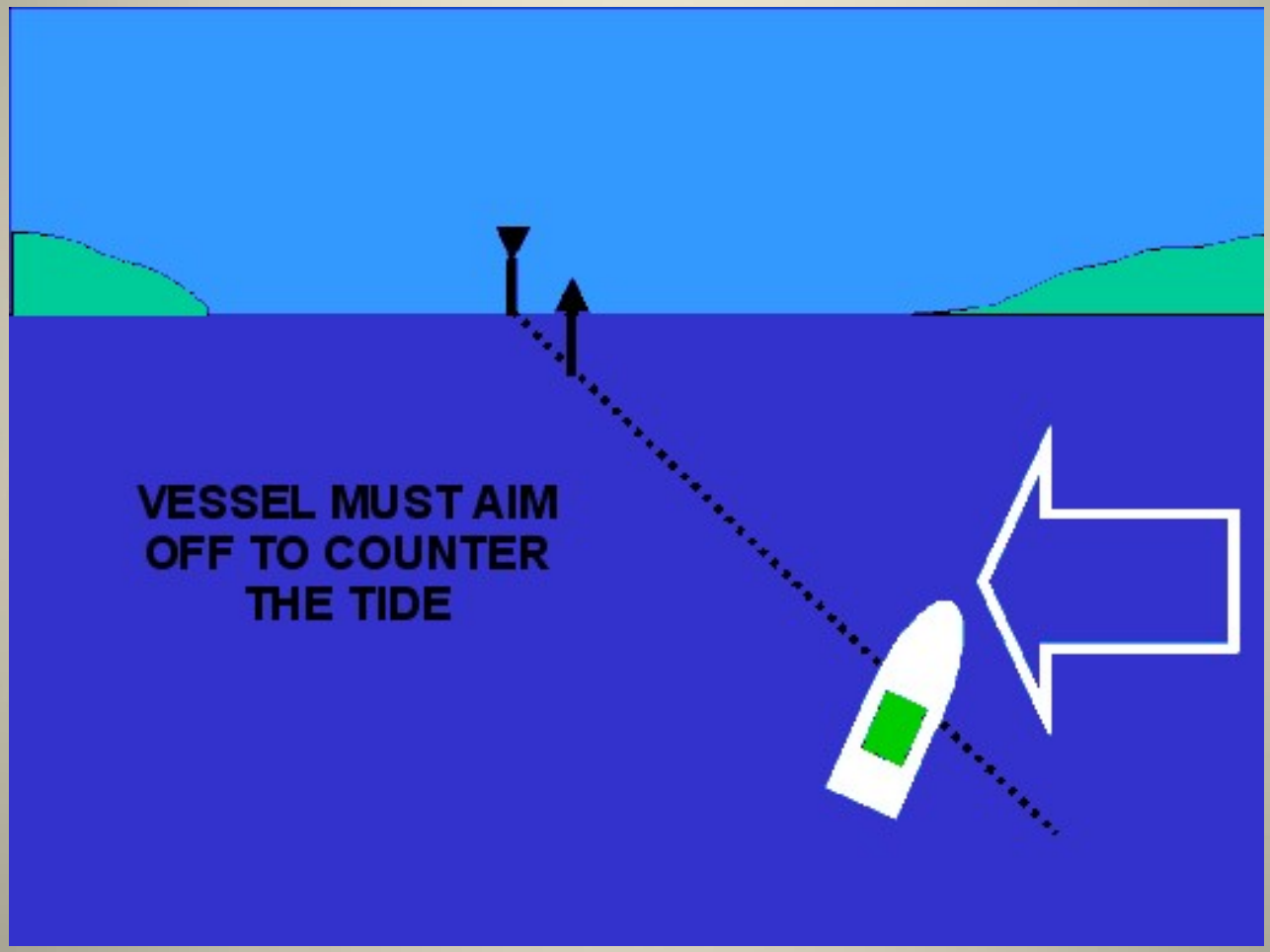



Mt Clarence
186
Mt Adelaide
125
King Point
Fl.3s 9M
Possession Point
Princess
Royal
Harbour
F.Bu
F.Bu
Peninsula
117°52'E
117°54'E
117°56'E

Leading Marks



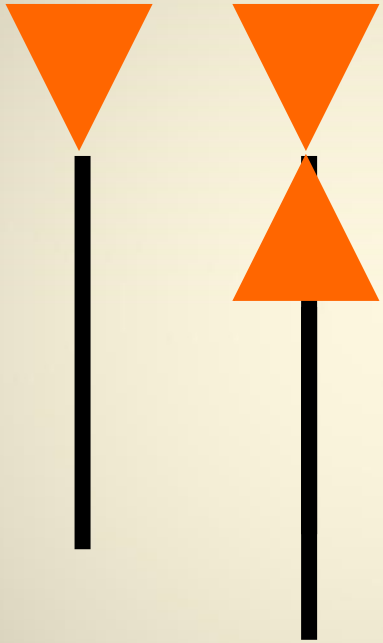
Leading Marks



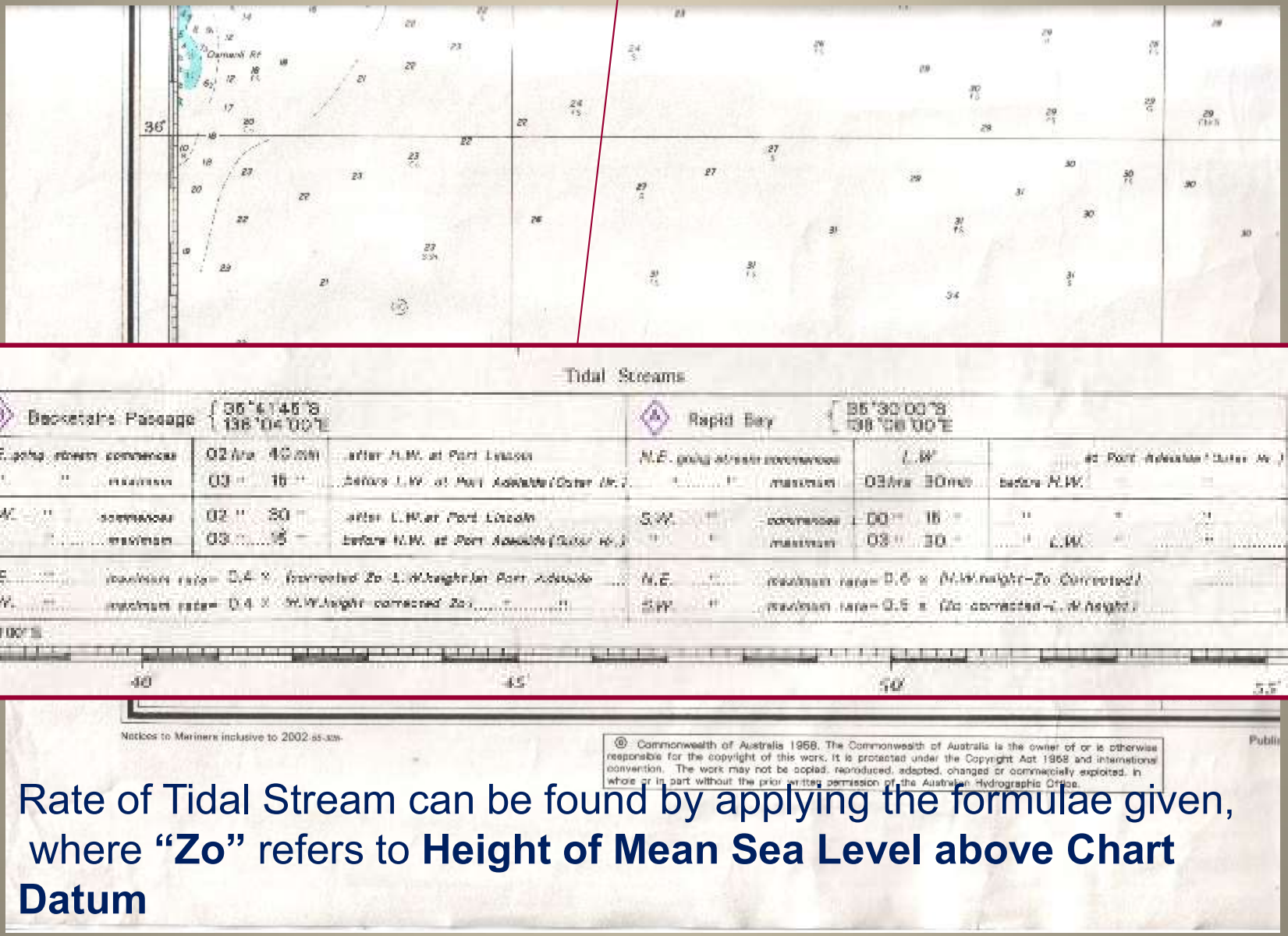
“Off the Leads” – Vessel too far to Port

“On the Leads” – Vessel on correct track

“Off the Leads” – Vessel too far to Starboard



Tidal Stream information



Tidal Streams

Beckerlaire Passage 35°41'45"S 136°04'00"E

S.E. going stream commences	02 hrs 40 mins	after H.W. at Port Lincoln	
" " maximum	03 " 16 "	before L.W. at Port Adelaide (Outer Hr.)	
N.W. " commences	02 " 30 "	after L.W. at Port Lincoln	
" " maximum	03 " 16 "	before H.W. at Port Adelaide (Outer Hr.)	

S.E. maximum rate = 0.4 × (corrected Zo + L.W. height at Port Adelaide)

N.W. maximum rate = 0.4 × (H.W. height corrected Zo) ... "

Rapid Bay 35°32'00"S 138°08'00"E

N.E. going stream commences	L.W.	at Port Adelaide (Outer Hr.)	
" " maximum	03 hrs 30 mins	before H.W.	
S.W. " commences	00 " 15 "	" " "	
" " maximum	03 " 30 "	" L.W. "	

N.E. maximum rate = 0.6 × (H.W. height − Zo Corrected)

S.W. " = 0.5 × (Zo corrected − L.W. height)

Notices to Mariners inclusive to 2002/35-328

Rate of Tidal Stream can be found by applying the formulae given, where **"Zo"** refers to **Height of Mean Sea Level above Chart Datum**

TIDAL STREAMS

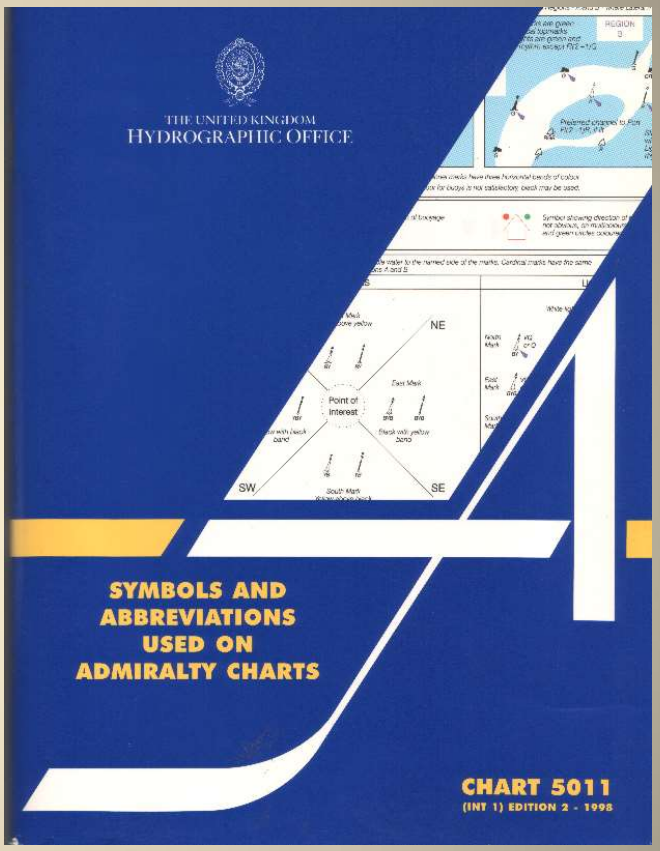
Aus 345

Aus 345

Direction and Rate shown on Chart

Symbols & Abbreviations

Chart 5011



A reference to Symbols and Abbreviations found on British Admiralty and International Charts

Chart 5011 – information

Topography

- Landmarks, Ports
- Natural/Cultural features
- Topographic Terms

Hydrography

- Tides, Currents
- Depths
- Nature of seabed
- Rocks, Wrecks, Obstructions
- Offshore installations
- Tracks, Routes
- Areas, Limits
- Hydrographic Terms

Aids & Services

- Lights
- Buoys, Beacons
- Fog Signals
- Radar, Radio, Electronic Position Fixing systems
- Services
- Small Craft facilities

Alphabetical Indexes

- Index of Abbreviations

General

- Chart Number, Title Marginal notes
- Positions, Distances, Directions, Compass

Chart 5011

General information in "INTRODUCTION"

Depths

- The position of a sounding is the centre of the area covered by the figures

Drying Heights

- Underlined figures on rocks and banks which uncover due to tidal movement, indicate heights **above chart datum**

Heights

- Including overhead clearances, are given **above Mean High Water Springs**

Bearings

- Given from seaward, referred to the True Compass

Publications Used For Navigation

- Sailing Directions (Pilots)
- Admiralty List of Lights
- Tide Tables (Australian National Tide Tables, or locally published Tide Tables)
- Australian Notices to Mariners
- Australian Seafarers Handbook
- Beacon to Beacon
- Reef Vessel Traffic Services

Australian Notices to Mariners

Published Fortnightly by Australian Hydrographic Service
www.hydro.gov.au

Contain corrections for:

- Charts
- Sailing Directions (Pilots)
- List of Lights
- Admiralty List of Radio Signals
- Navigational Warnings

http://www.hydro.gov.au/n2m/about-notices.htm#updates

Australian Notices to Mariners are the authority for correcting Australian Charts

AUSTRALIAN NOTICES TO MARINERS

Notices 358 - 387

Published fortnightly by the Australian Hydrographic Service

B. J. KAFER,
Hydrographer of Australia

SECTIONS.

The substance of these notices should be inserted on the charts affected.

Bearings are referred to the true compass and are reckoned clockwise from 000° (North) to 359°; those relating to lights are given as seen by an observer from seaward. Positions quoted in permanent notices relate to the horizontal datum for the chart(s). When preliminary or temporary notices affect multiple charts, positions will be provided in relation to only one horizontal datum and that datum will be specified. When the multiple charts do not have a common horizontal datum, mariners will be required to adjust the position(s) for those charts not on the specified datum. The range quoted for a light is its nominal range. Depths are with reference to the chart datum of each chart. Heights are above mean high water springs or mean higher high water, as appropriate.

The capital letter (P) or (T) after *the number* of *any notice denotes a preliminary or temporary notice respectively, which are contained separately at the end* of *the permanent notices. A star (*) adjacent to the number* of *a notice indicates that the notice is based on original information.*

Mariners are particularly requested to notify the AUSTRALIAN HYDROGRAPHIC SERVICE, Locked Bag 8801 South Coast Mail Centre, NSW 2521 (Fax 02-4221 8599, e-mail Hydro.NTM@defence.gov.au or, alternatively by filling in and submitting the Hydrographic Notes forms located on the web site – www.hydro.gov.au), immediately on the discovery of new dangers or suspected dangers to navigation. For changes or defects in aids to navigation notify AusSAR (Fax 02-6230 6868 or email rccaus@amsa.gov.au).

Copies of these notices can be obtained from the AUSTRALIAN HYDROGRAPHIC OFFICE, 8 Station Street, Wollongong, and Agents for the sale of charts and hydrographic publications.

Australian Notices to Mariners

Notice number

195* SOUTH AUSTRALIA - Middle Bank - Racon established.

Former Notice - 715(P)/2001 is cancelled

List of Lights Vol K/2002 -- 1930.00

AMSA ATH 2002/08 (02/1299), Auscoast 068/02 (02/1357). *(AH99/37)*

Aus 344 [*80/2002*]

Insert *Racon (M),* at light 33º 43'.9 S 137º 29'.7 E

Aus 444 [*166/2002*]

Insert *Racon (M),* at light 33º 43'.9 S 137º 29'.7 E

Aus 777 [*531/2001*]

Insert *Racon (M),* at light beacon 33º 43'.9 S 137º 29'.6 E

Aus 778 [*80/2002*]

Insert *Racon (M),* at light beacon 33º 44'.0 S 137º 29'.7 E

"*" = based on original information
"P" = Preliminary notice
"T" = Temporary notice

To accompany Australian Notice to Mariners 768/2002

MARINE FARMS

Marine farms, which may be floating or fixed structures, and their associated moorings should be avoided. The farms are generally marked by buoys or beacons, which may be lit.

Note for chart Aus 777

To accompany Australian Notice to Mariners 54/2002

ROCK LOBSTER AND
GIANT CRAB FISHERY

During the period 1 October to 31 May, extensive lobster and giant crab fishing takes place inshore of the 500m isobath off the coast of South Australia. Mariners are cautioned that surface floats associated with the activity may be encountered.

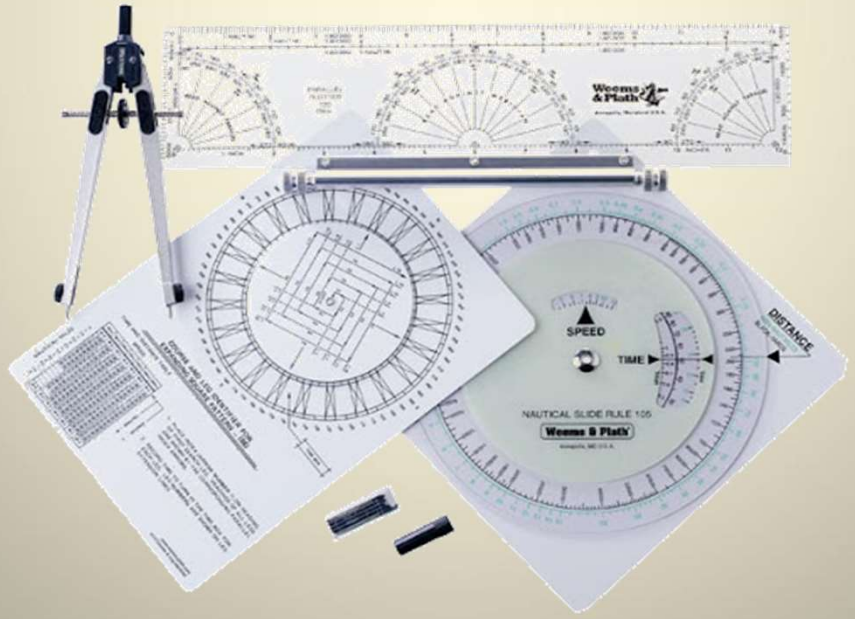
Note for chart Aus 345

Exercises

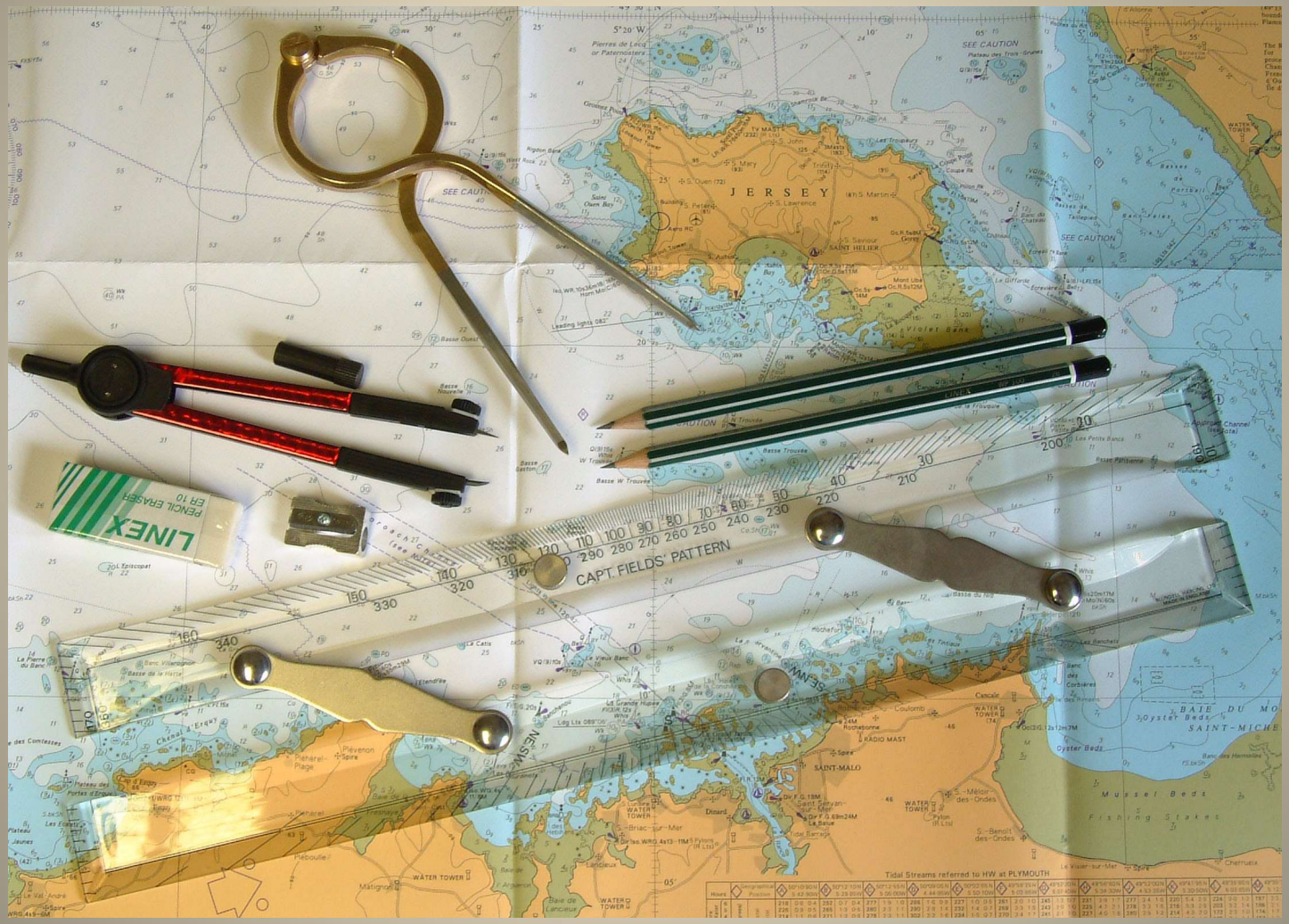
Please go to library and download the latest notice to mariners for Bundaberg/Hervey bay region

www.publications.qld.gov.au/dataset/brisbane-notices-to-mariners

True Course Plotting and Distance, Time, Speed Calculations

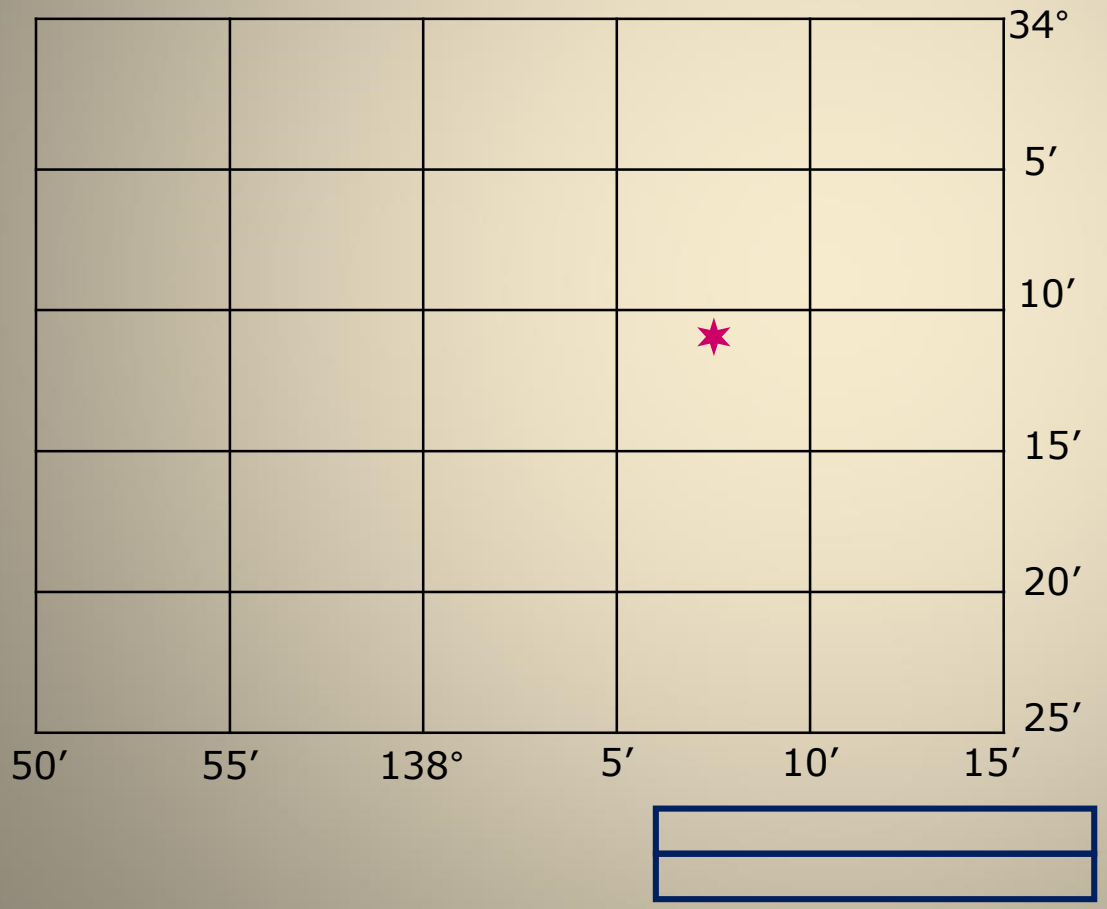


Navigation Equipment



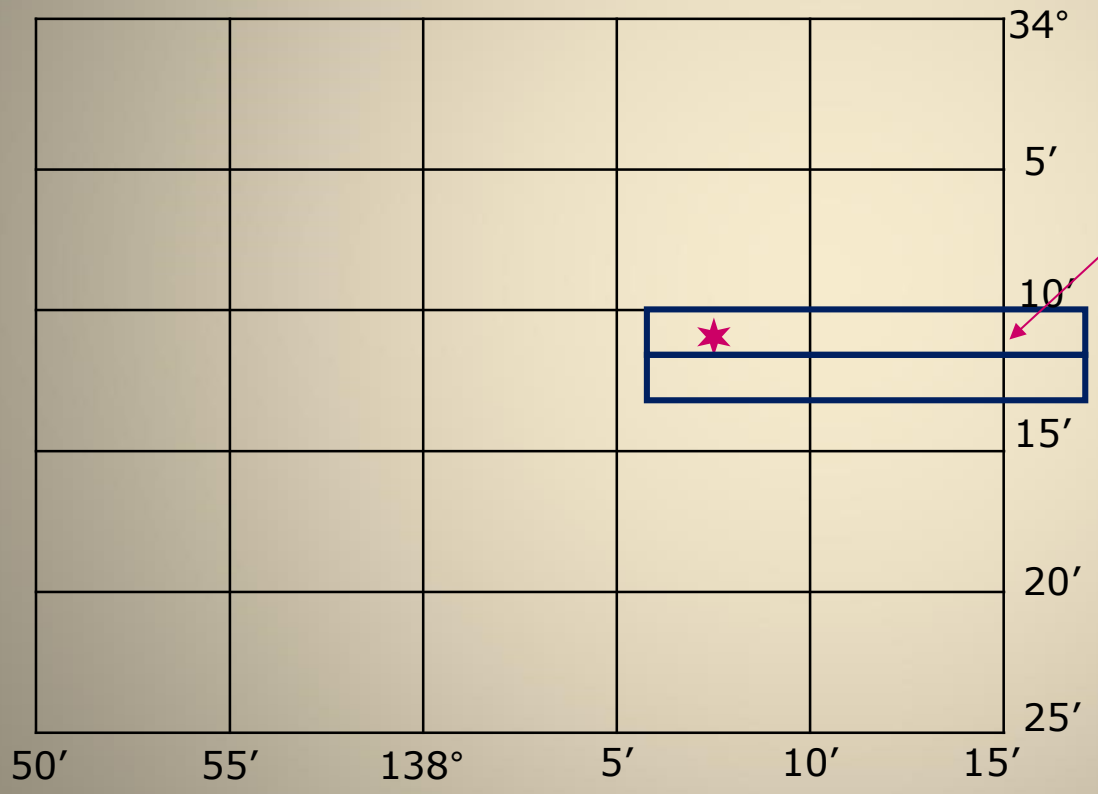
To find the Latitude of a position:

1. Place edge of Parallel Rule against nearest East-West grid line
   (ensure one end of Parallel Rule is over Latitude scale)



To find the Latitude of a position:

2. “Walk” Parallel Rule (up or down) until one edge cuts through centre of position, keeping rule parallel to grid line



3. Read off the Latitude on the Latitude scale
34°11.000’S

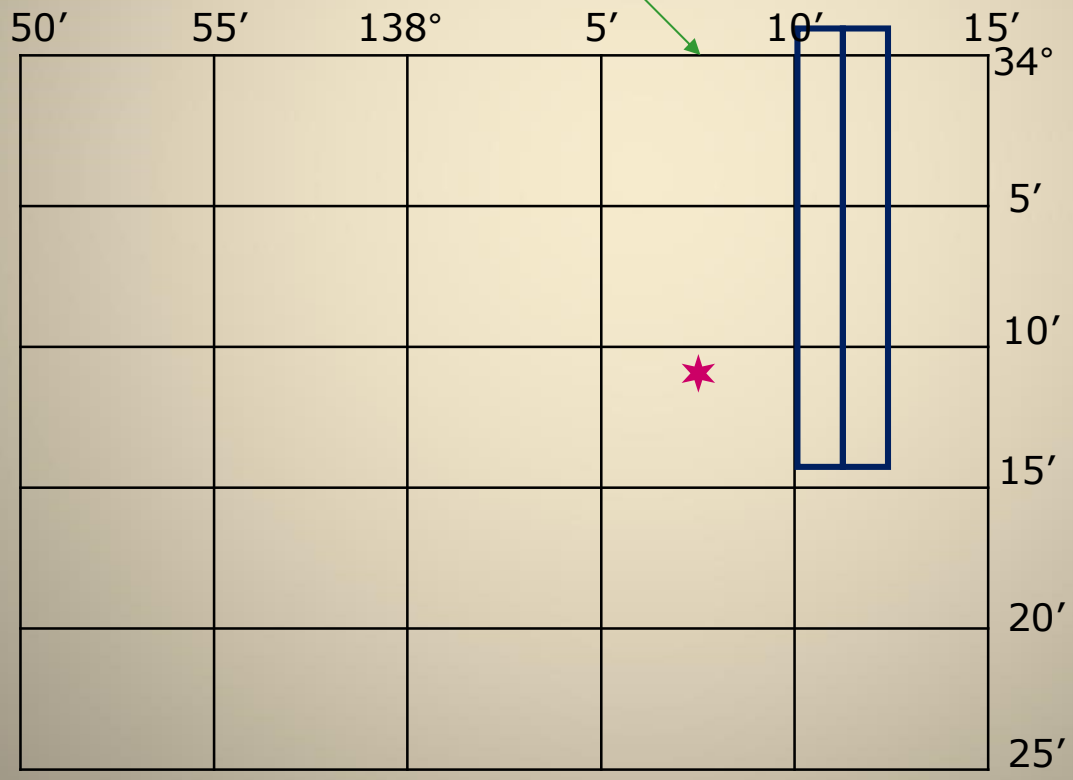
To find the Longitude of a position:

1. Place edge of Parallel Rule against nearest North-South grid line

2. “Walk” Parallel Rule across until one edge of rule cuts through centre of position, keeping rule parallel to grid line

3. Read off the Longitude on the Longitude scale

138°07.500’E



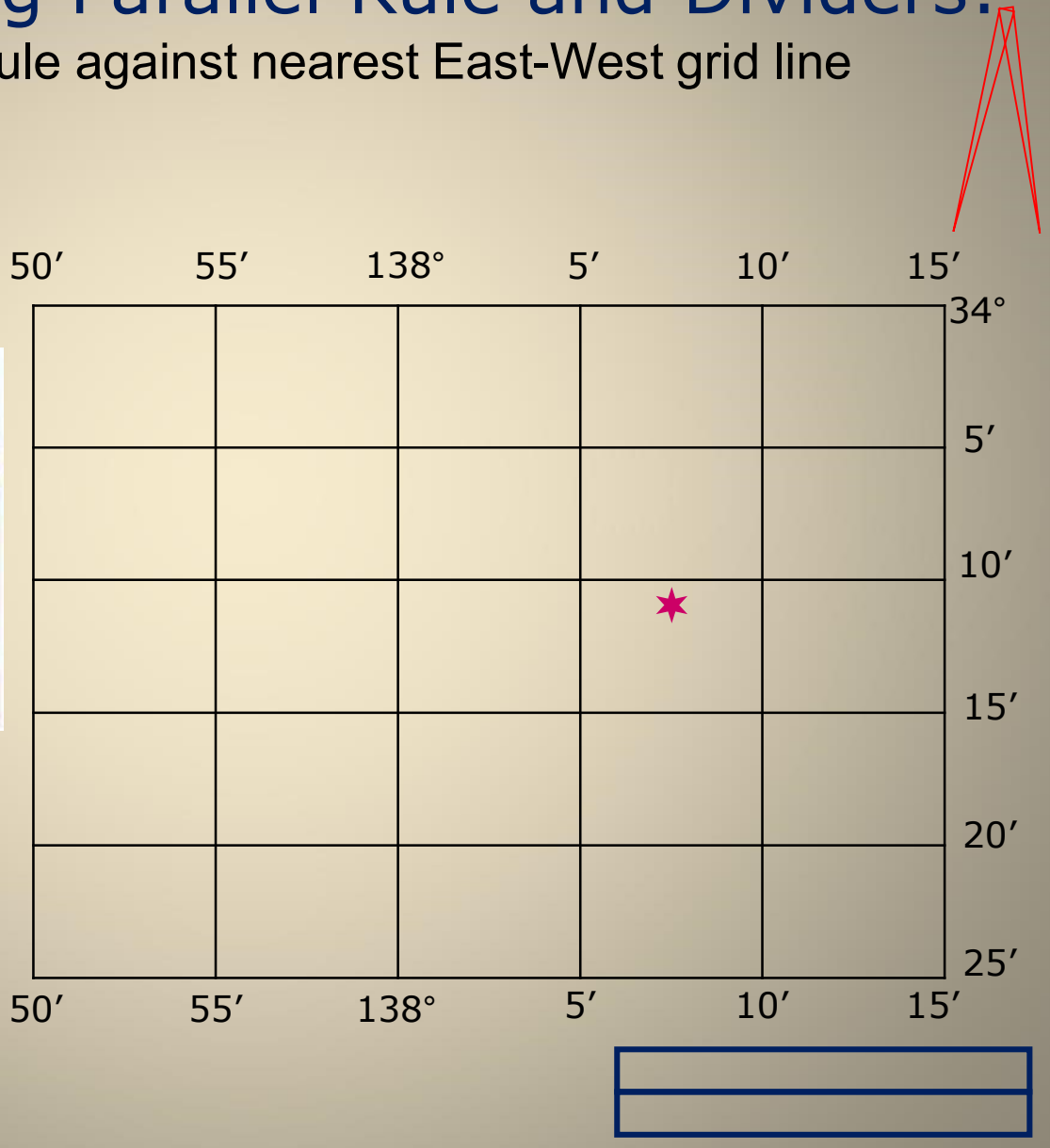
Exercises

Find Longitude

(Class based)

To find the Latitude and Longitude of a position using Parallel Rule and Dividers:

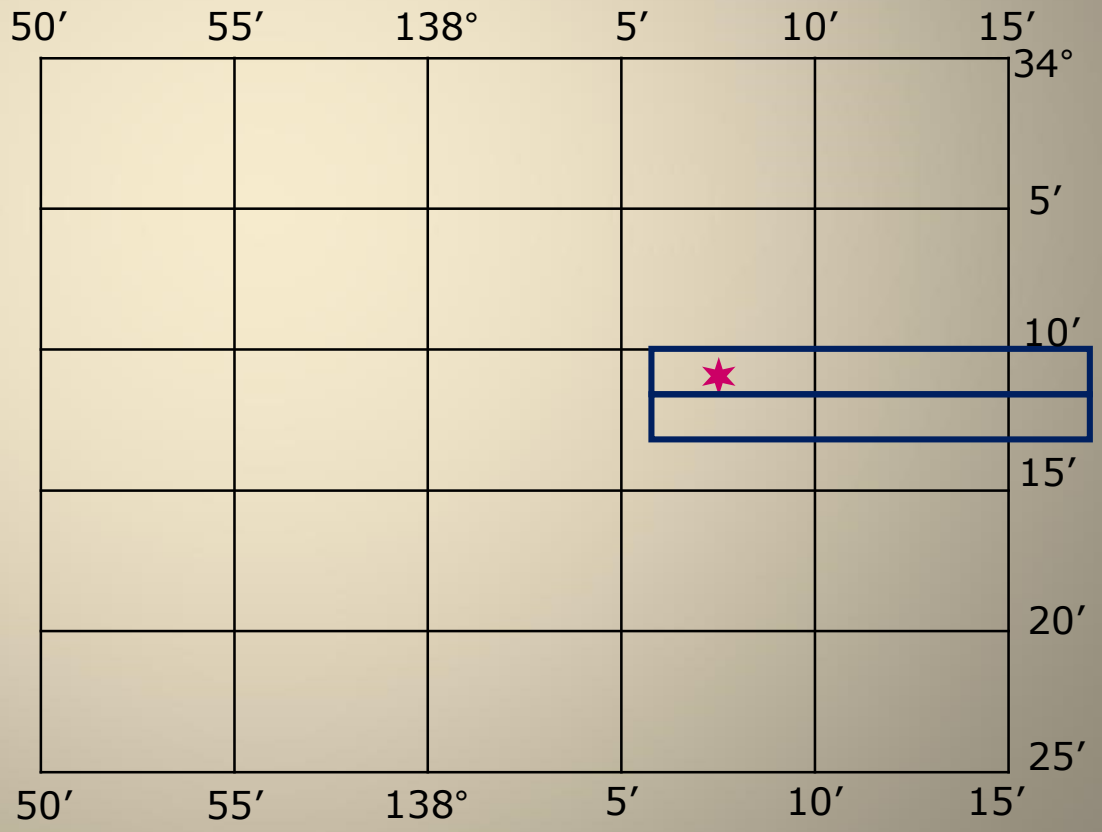
1. Place edge of parallel rule against nearest East-West grid line



To find the Latitude and Longitude of a position using Parallel Rule and Dividers:

2. “Walk” rule (up or down) until one edge cuts through centre of position, keeping rule parallel to grid line

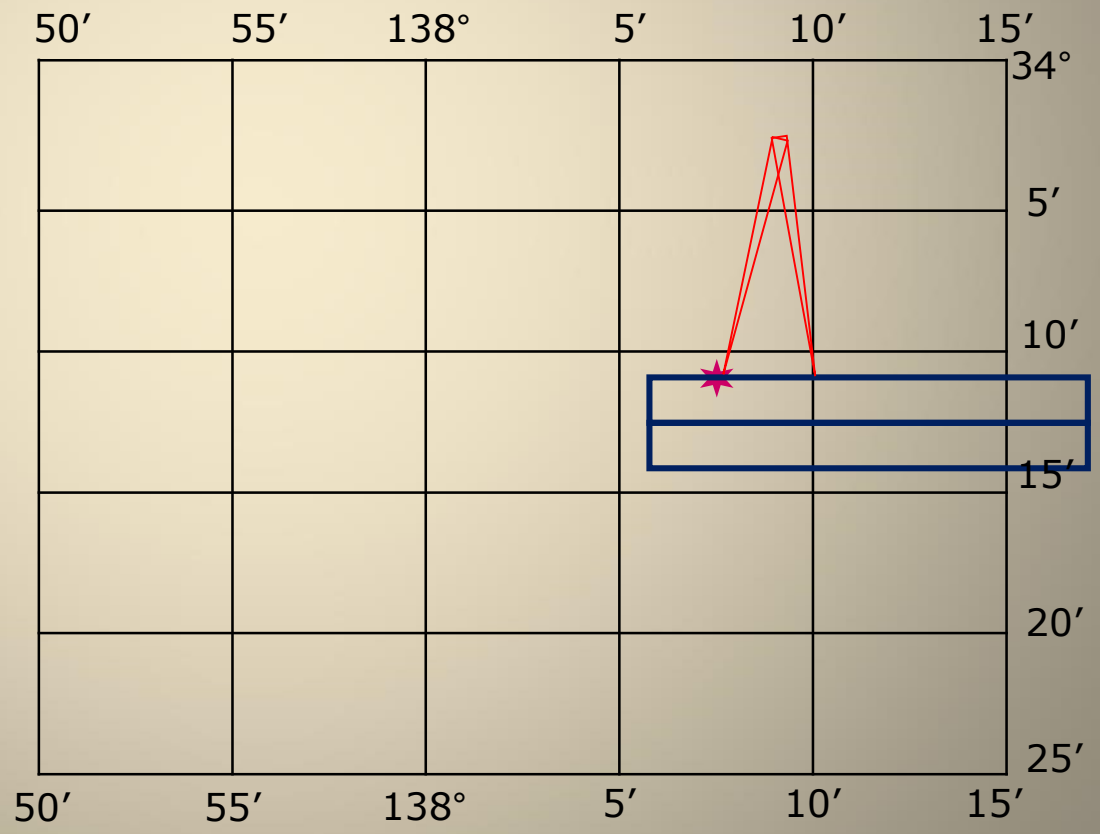
3. Place Dividers with one end on nearest Meridian of Longitude, and other end on Position



To find the Latitude and Longitude of a position using Parallel Rule and Dividers:

4. Move Dividers along Meridian of Longitude to top (or bottom) of Longitude scale

<u>Position</u>
34°11.000'S
138°07.500'E



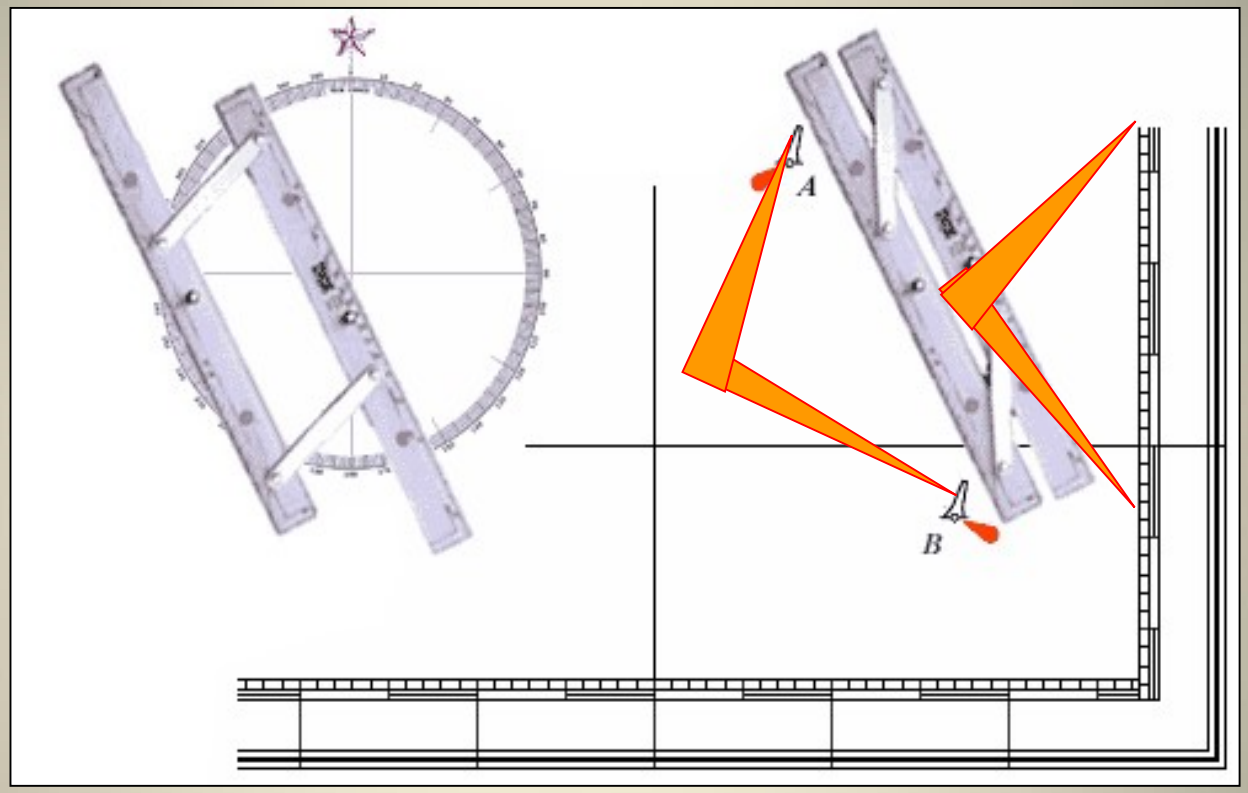
Now Plot Latitude/Longitude

Class Exercise

Exercise Sheet #1

- Find the geographical position of the following
  - Exercise 2 (all 10 questions)

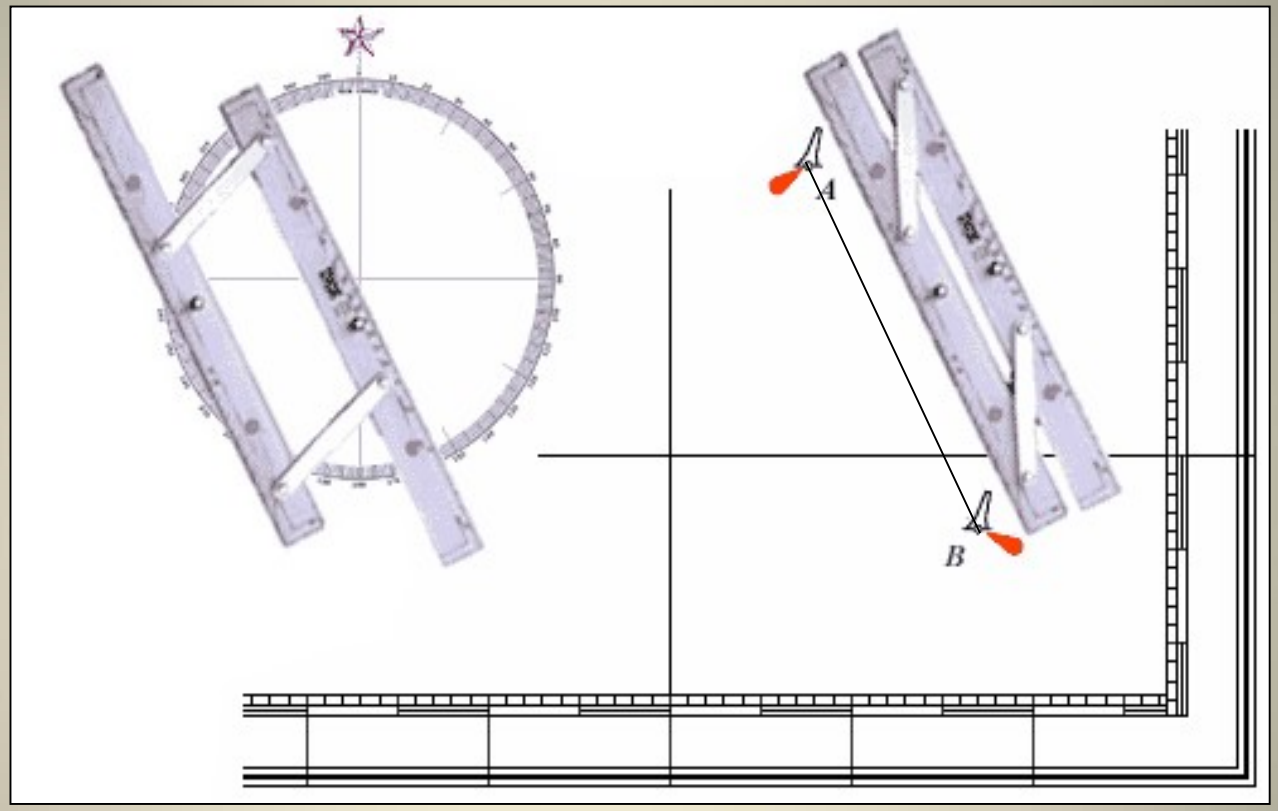
Defining Position by Bearing and Distance



Open up Dividers until the points are on the 2 places in question (A & B)

Move Dividers to side of chart for distance measurement

Defining Position by Bearing and Distance

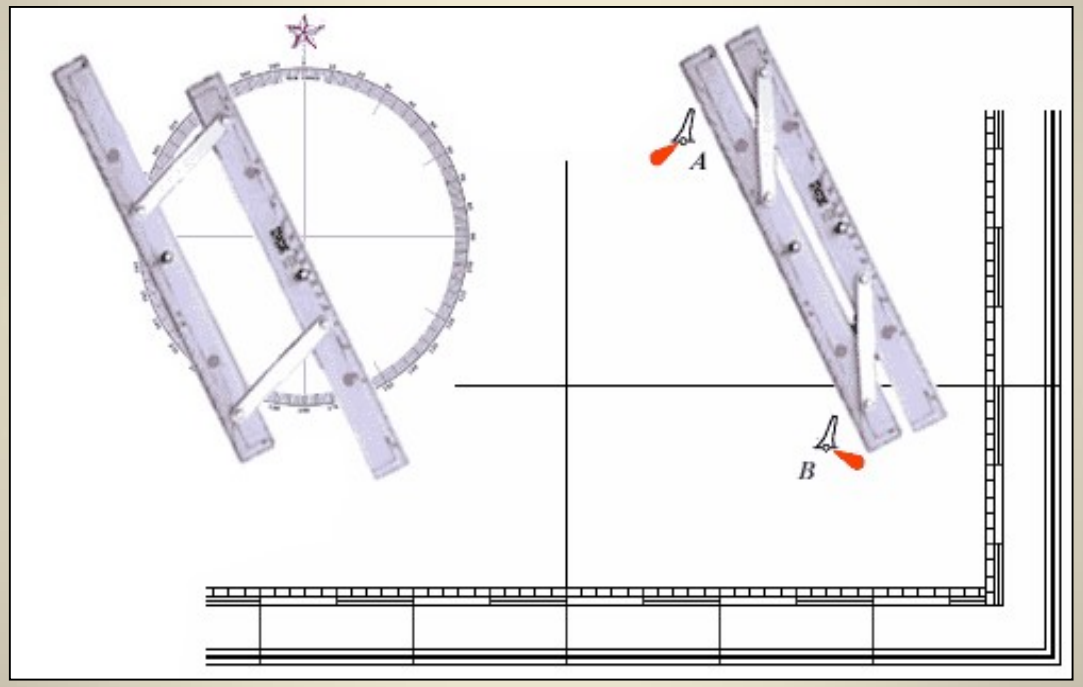


Place Parallel Rule against A & B and draw a line between the two

Move Parallel Rule to centre of nearest Compass Rose and read off the True Direction (or Bearing) from one object to the other

Defining Position by Bearing and Distance

It is now an easy step to lay off a course and measure the distance between two points



A **Course** is the intended horizontal direction of travel through the water

Make sure you read the **correct direction**, and **not the reciprocal**

Finding Distance & Course
Class Exercise

Exercise Sheet #1

- What is the direction from:
- Draw a line from Coppersmith Rk etc
- Find the direction and distance from first to second positions
  - All remaining questions

Days, Hours, Minutes
Adding & Subtracting

Time Calculations

Exercise

A vessel left ‘E’ at 0912, and after steaming for 3 hours 36 minutes she arrived at ‘F’.
At what time did she arrive?

Ans:

	H	M
Depart	09	12
Arrive	+ 03	36
=	**12**	**48**

Time Calculations

Exercise

A vessel left ‘G’ on 5th December at 2330. She arrived at ‘H’ 3 hours and 47 minutes later. What was her time of arrival?

Ans:

		D	H	M
Depart Dec		5	23	30
Time	+		1 03 1 47	
		6	~~27~~	~~77~~
			03	17

Arrive Dec 6, 0317

Speed, Distance & Time Calculations

Speed, Distance & Time Calculations

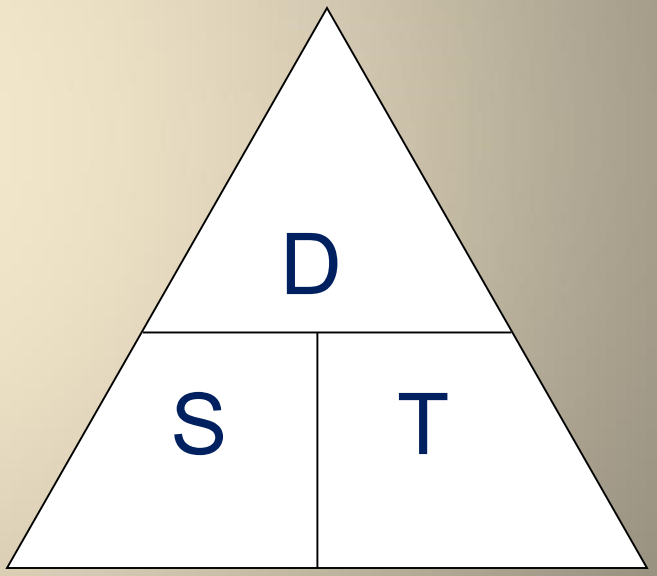
Many problems in navigation require an ability to apply Speed, Distance and Time values, e.g. ETA at a particular port

You need to know the following formulae:

Time = $\frac{\text{Distance}}{\text{Speed}}$

Speed = $\frac{\text{Distance}}{\text{Time}}$

Distance = Speed X Time



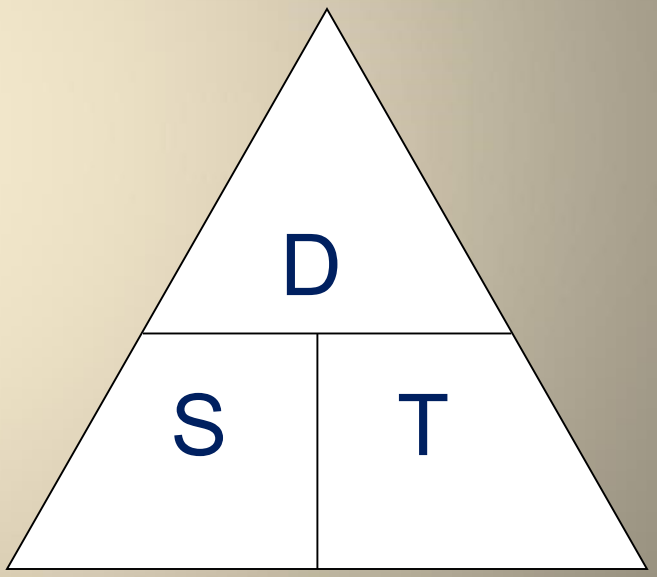
Speed, Distance & Time Calculations

Put another way;

Distance = Speed x Time

Speed = Distance ÷ Time

Time = Distance ÷ Speed



Speed, Distance & Time Calculations

Working with minutes and decimals

To go from minutes to decimal (÷ 60)

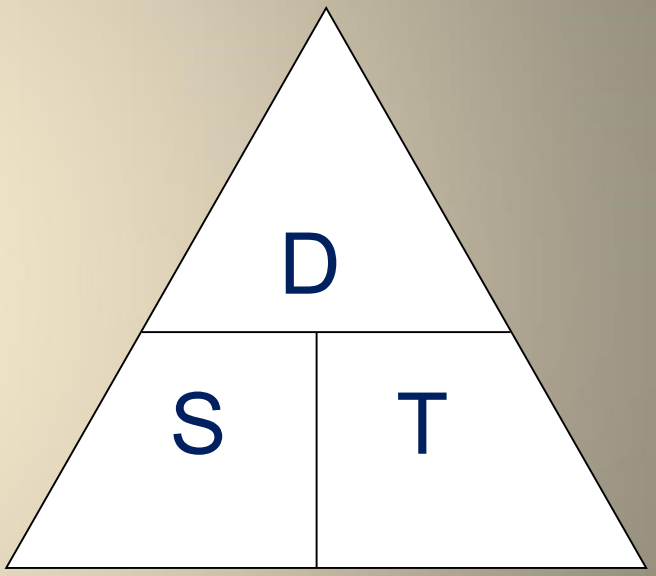
Example,

54 minutes

54 ÷ 60 = 0.9 (or 0.9 of an hour)

So,

1hr:54min = 1.9 Hours



Exercise 1

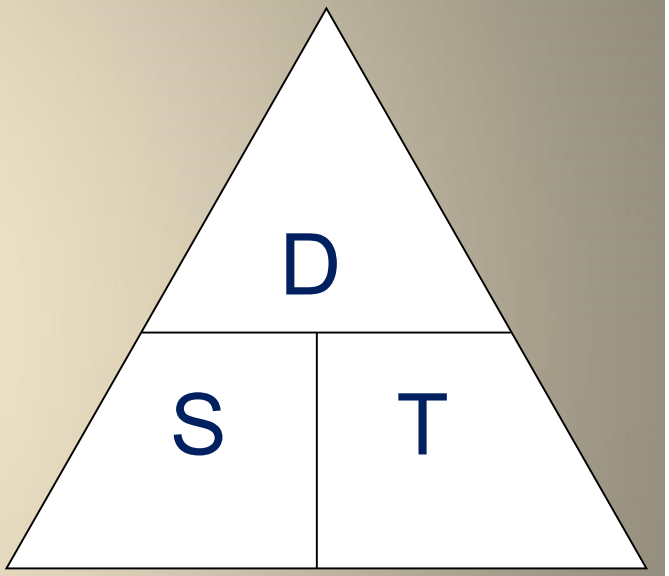
A ship has just completed a voyage of 373 miles and took one day, six hours and 30 minutes. What speed did she average?

1Day = 24 hrs plus 6 hours = 30 hours plus 30 minutes (30÷60 = .5)

30H:30M = 30.5 hours

Speed, Distance & Time Calculations

Working with minutes and decimals



To go from decimal to minutes (x 60)

Example,

0.27 hours

0.27 x 60 = 16.2 (or 16 minutes)

So,

1.27 hours = 1hr:16min

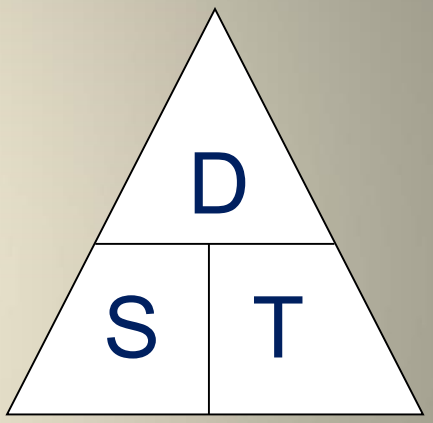
Exercise 2

A boat went from Fremantle to a point of Rottnest, a distance of 17 miles in 1.**7 hours**. What is the boats average speed?

Speed, Distance & Time Calculations

Exercise 3

A vessel left ‘A’ and after steaming 28 miles in 4 hours, she reached ‘B’.
What was her average speed?



Ans:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

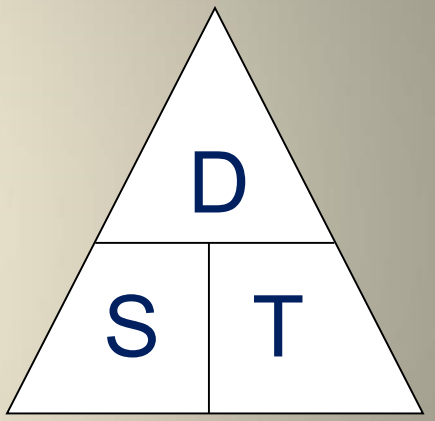
$$= \frac{28}{4}$$

= **7 Knots**

Speed, Distance & Time Calculations

Exercise 4

At 0830 hours a vessel departs ‘A’ for position ‘B’, a distance of 28 miles.
Cruising speed is 7 knots.
What is the ETA at ‘B’?



Ans:

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$= \frac{28}{7}$$

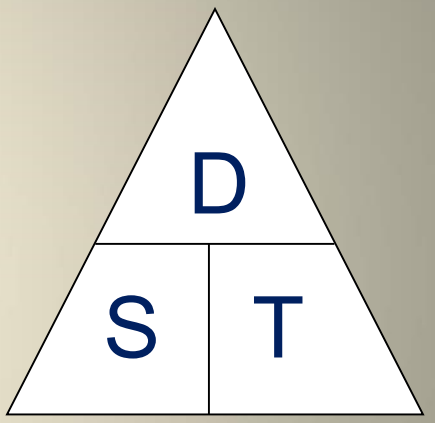
= **4 Hours**

Departure time	=	08 30
Time of voyage	=	+04 00
ETA	=	**12 30 Hrs**

Speed, Distance & Time Calculations

Exercise 5

A vessel left ‘C’ at 1930 hours and arrived at ‘D’ at 2100 hours.
Find the distance if she steamed at 8 knots.



Ans:

Distance = Speed X Time

= 8 X (2100-1930)

= 8 X 1.5

= **12 miles**

	H	M
	20	60
	~~21~~	00
	-19	30
=	1	30

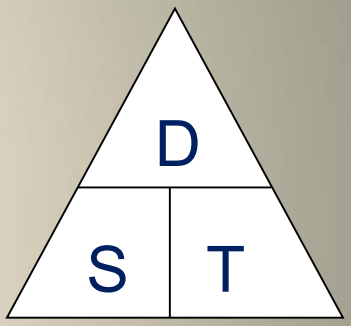
= **1.5 hrs**

Speed, Distance & Time Calculations

Exercise 6

A vessel left 'J' on 3rd January at 2245 and arrived at 'K' on 4th January at 0315. Distance travelled was 45 miles.

What was the average speed?



Ans: Speed = $\frac{\text{Distance}}{\text{Time}}$

= $\frac{45}{\text{Time } \textit{(4th Jan 0315 - 3rd Jan 2245)}}$

= $\frac{45}{4.5}$

= 10 Knots

Time:	D	H	M
		24 } 26	
	3	02 }	60 } 75
Jan	~~4~~	~~03~~	15 }
- Jan	3	22	45
=	0	**04**	**30**
=		**4.5 Hours**	

Speed, Distance & Time Calculations

Class Exercise

Exercise Sheet #2

- Distance, Speed and Time Problems
  - All 15 questions

(AFA Time/Dist/Speed EXERCISES 'A' & 'B')

Planning and Plotting Safe Courses

Passage Planning

Checklist

- Charts – to cover all areas/intended areas of operation
- Notice for mariners for area of passage
- Update the charts to be used
- Books and publications
- Calculate distance of passage
- Calculate passage time

Passage Planning

Checklist

- Calculate fuel requirement and reserves
- Calculate food and victuals required for passage
- Identify safe havens along route and emergency ports
- Navigational Dangers – check depth and safe distance to pass
  - Eg, During Day safe distance = 1nm
  - During Night, safe distance = 2nm
- Note which part of your track will be covered in Daylight, and which part in Darkness.
- Work out how you will cover the watches and
  - account for fatigue management and crew
  - experience to do watches

Passage Planning

Checklist

- Weather - obtain forecast for area of operation – identify sources where weather information may be obtained from
- Set maximum weather parameters (wind speed/sea conditions) for voyage

Passage Planning

Checklist

- Tidal Streams – ascertain from chart – consider best approach (state of tide) with impending weather
- Never pass a Light without checking its period & characteristics
- Do not rely on Light Buoys alone – they may not be lit
  - Buoys may also have shifted
  - When passing between islands, use features of one island only for position fixing (may have been separately surveyed)
  - Use clearly defined points for Bearings (i.e., avoid low points of land)

Passage Planning

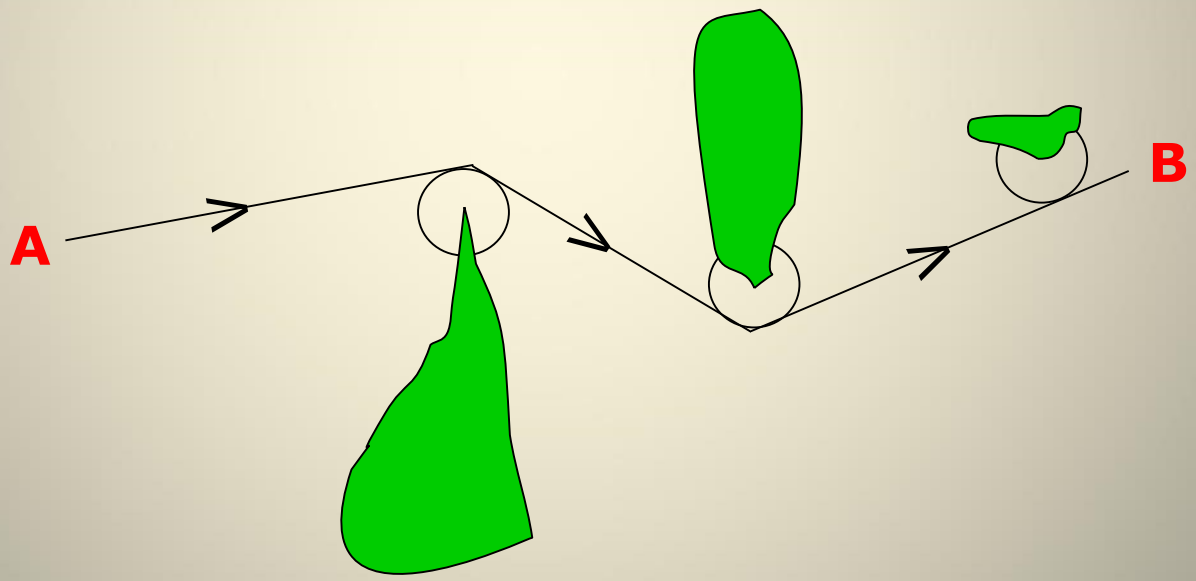
Checklist

- Take account of traffic density and manouevrability of larger vessels
- Consult chart Zone of Confidence or Reliability Diagram
- Transfer positions from one chart to another by Bearing and Distance, then verify by checking Latitude and Longitude (in case chart scales are different)
- Where possible, select Waypoints that are easily conspicuous
- For position fixing, always select objects close to your vessel in preference to distant objects
  - In narrow waters, allow plenty of room rounding points of land, shoals, buoys etc.
  - Check state (strength) of tidal stream before passing objects

Plotting Safe Courses

1 Select a safe distance, and draw arcs around all the hazards adjacent to your intended track

2 Join the circles, around the dangers, to make your safe course



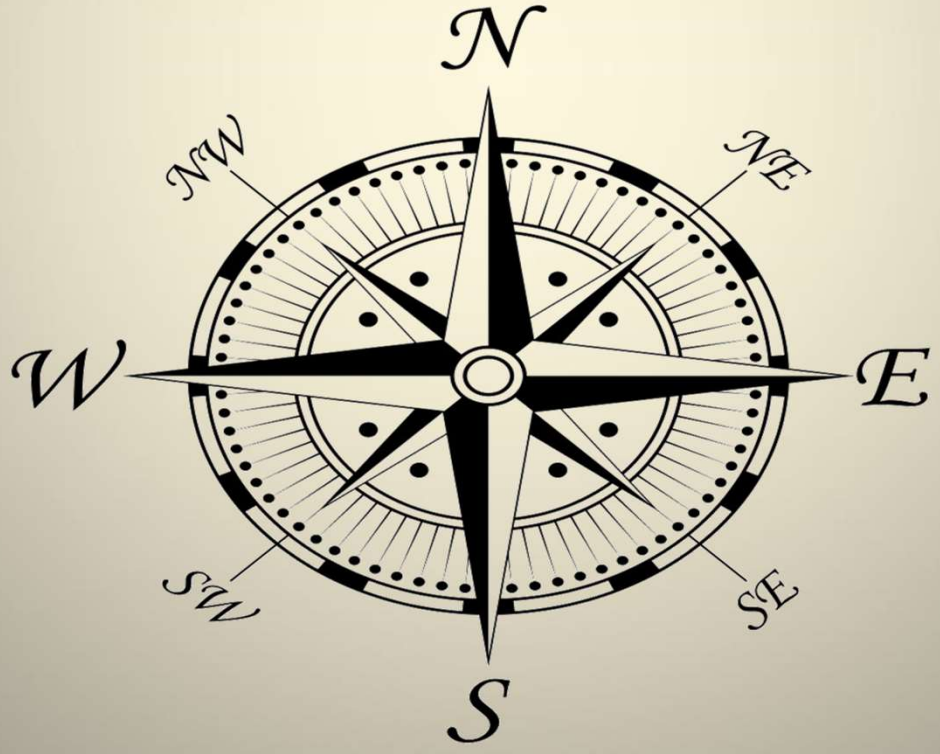
Don’t cut it to fine allow some sea room for errors

EXERCISES

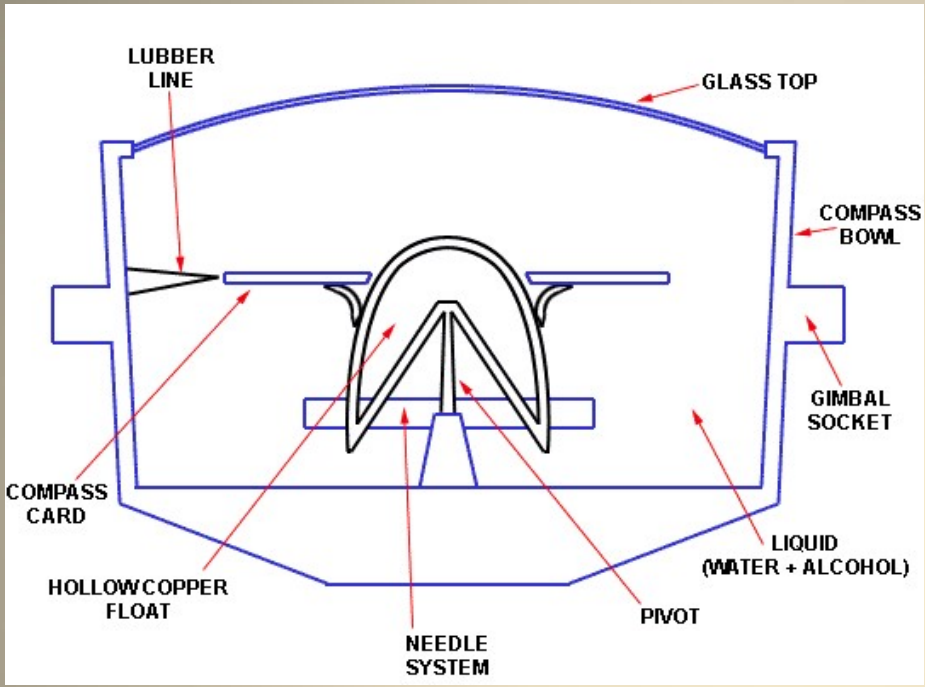
You have a passage plan to complete as part of your assignment.

Let’s take a moment to look at this and discuss.

Magnetic and Gyro Compass, with Error, Variation And Deviation



Magnetic Compass



- Simple and reliable
- Filled with liquid – to dampen card's movement
- Liquid is mixture of Distilled Water & Alcohol
- Magnets attached to underside of compass card
- Lubber line at forward end – indicates vessel's head
- Compass bowl suspended in gimbals

Magnetic Compass

Fitting

- On fore & aft line of vessel
- Visible from helm

Care & Maintenance

- Clean & free from salt/grease
- Gimbals lightly oiled
- Away from direct sunlight
- Remove air bubbles
- Detect pivot wear (in port)
- Maintain deviation card, swing

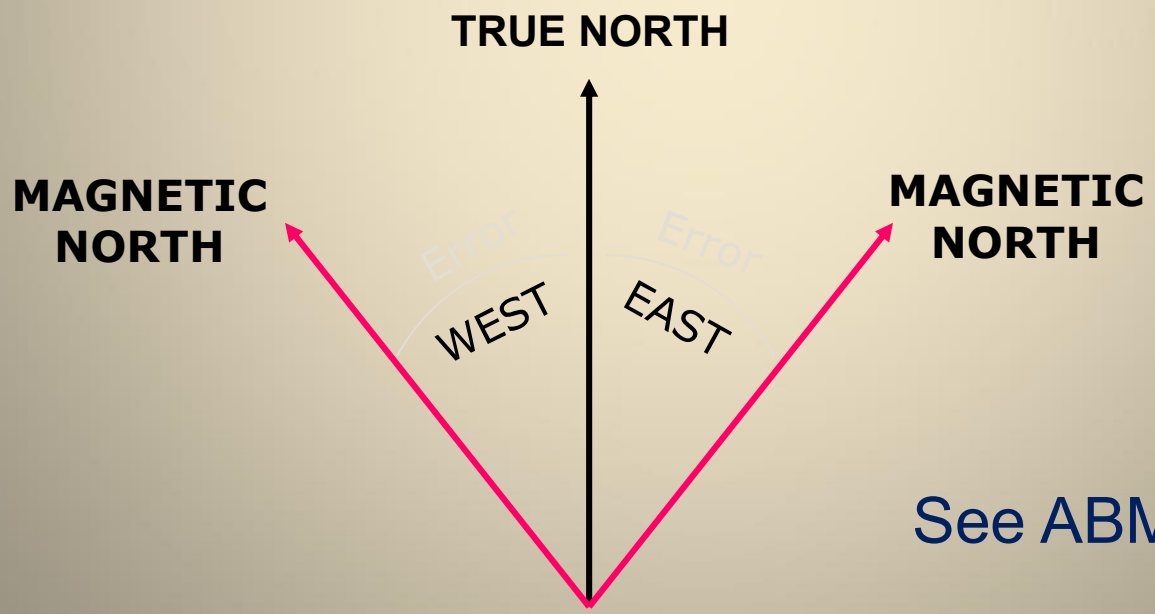
Do Not Place

- Metal objects near compass
- Electrical appliances (radio) near compass
- Electronic equipment near compass – check safe distance
- Any new electrical wiring near compass

Magnetic Variation

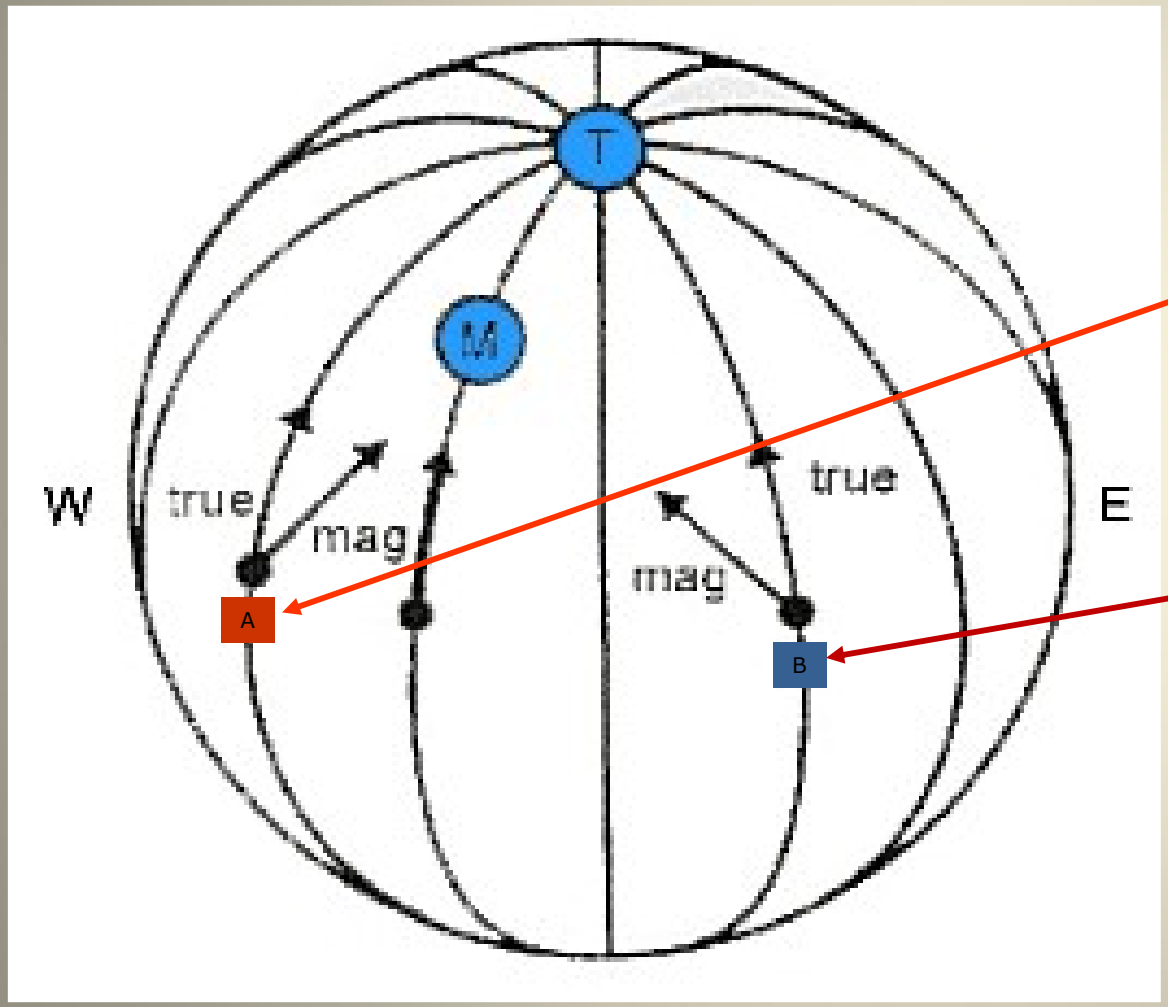
- Angular difference between **Magnetic North** and **True North**

- Variation can be West or East found on chart



See ABM Page 449

Magnetic Variation



Variation at ‘A’
= East or West ?

Variation at ‘B’
= East or West?

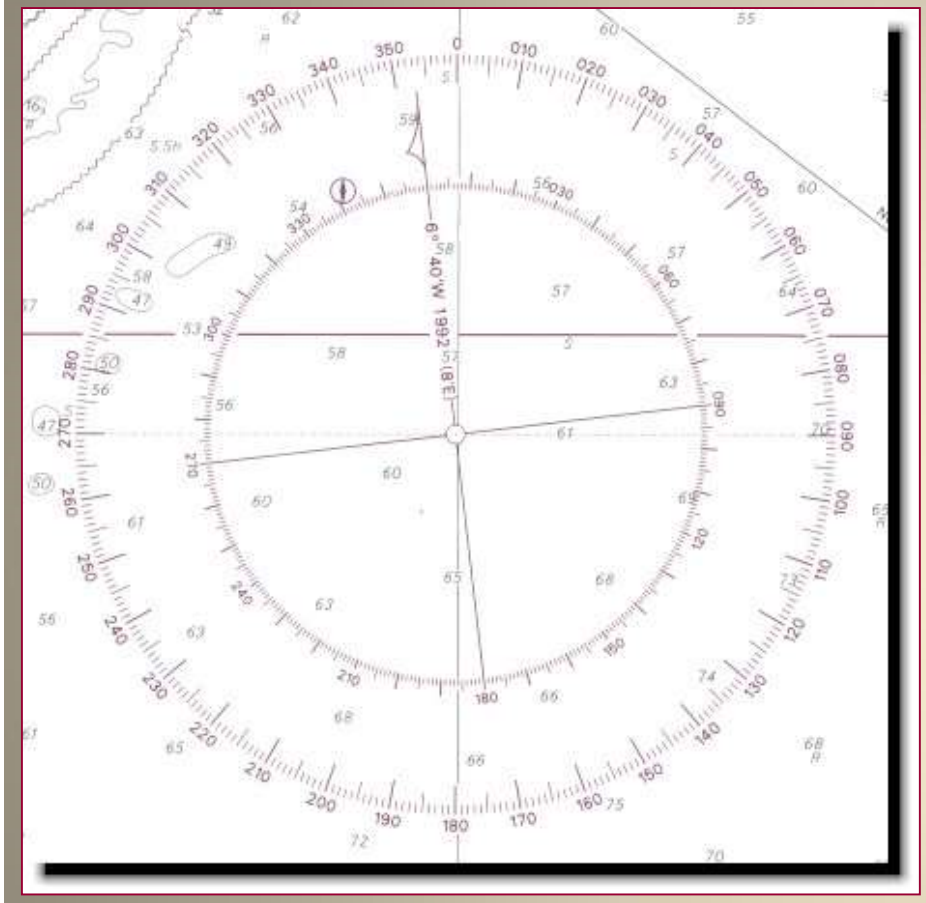
Magnetic Variation

EXERCISE

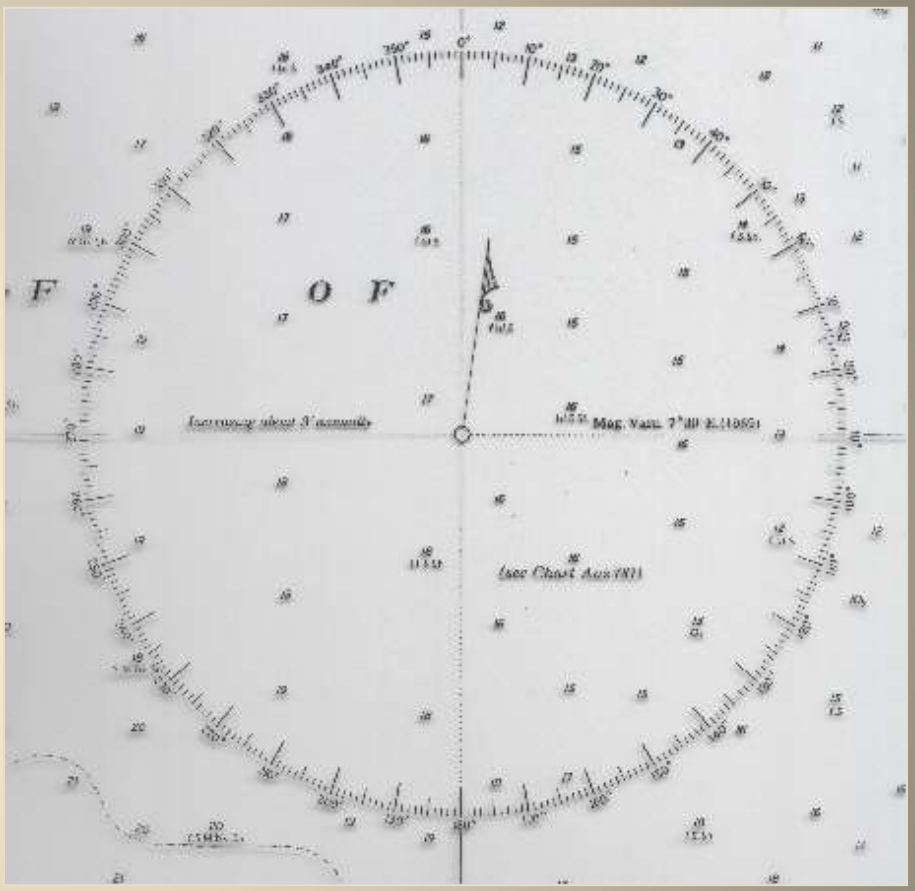
Look at the Chart in front of you and calculate the Magnetic Variation from compass rose for this current year.

Is there any difference in Variation between different Compass roses on the same chart?

Magnetic Variation



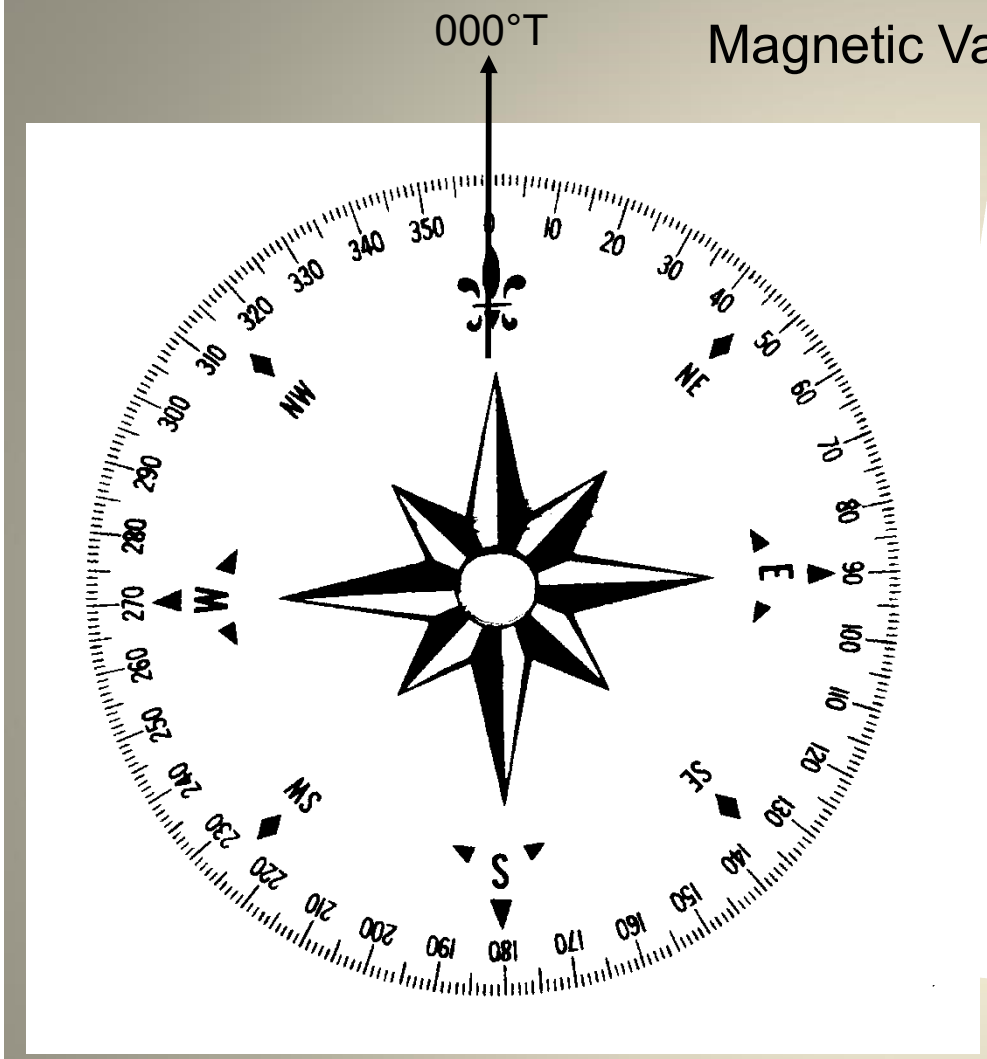
Variation WEST



Variation EAST

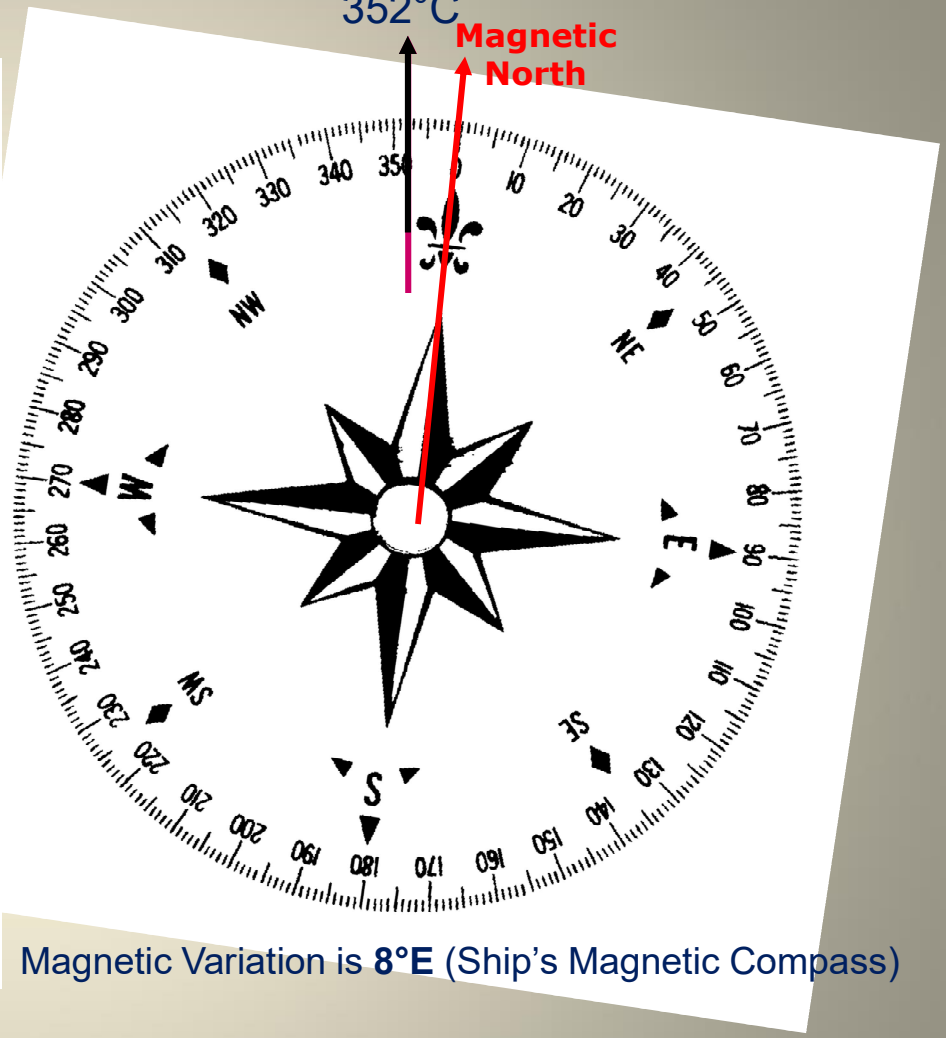
Compass Rose indicates direction and value of Variation for a particular year

Exercise
Magnetic Variation



Compass Rose on Chart

Course required to be steered is **000°T (360°T)**

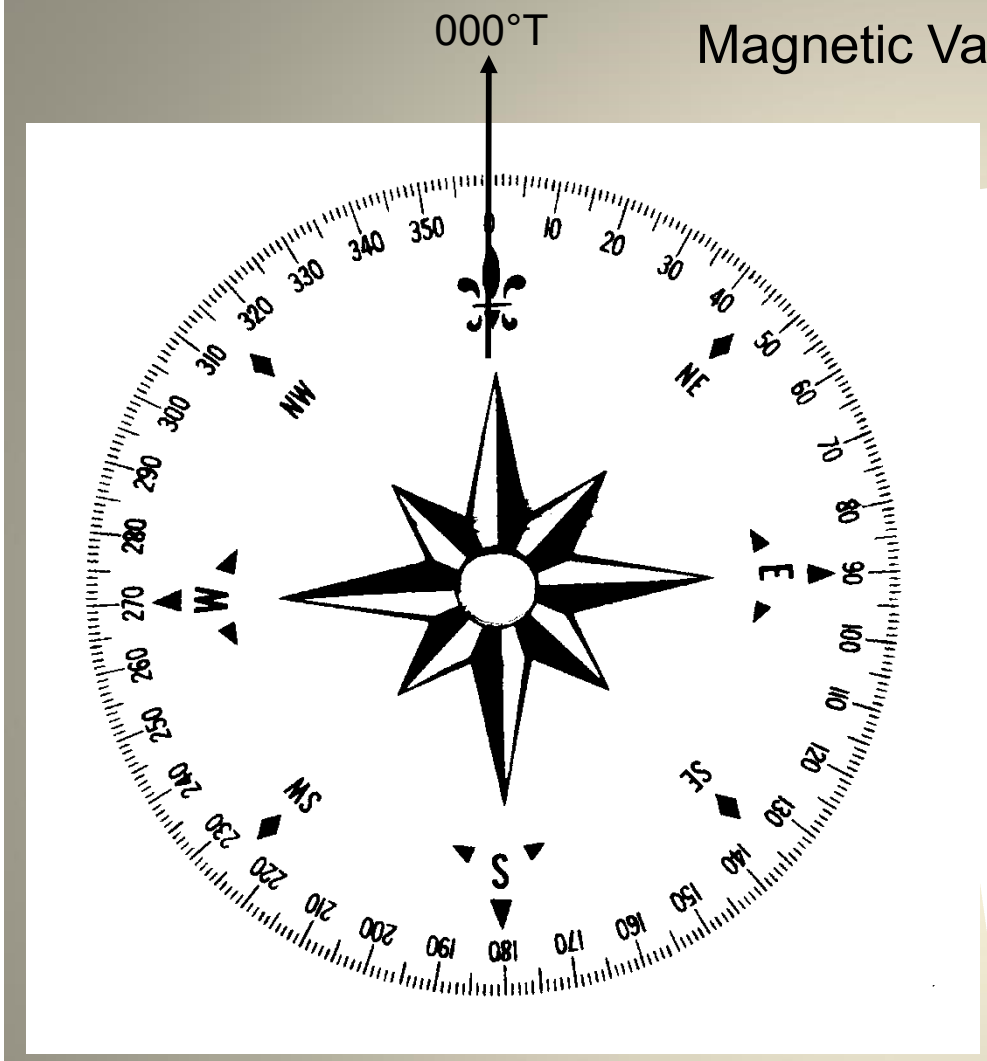


Magnetic Variation is **8°E** (Ship's Magnetic Compass)

What **Compass Course** should be steered to maintain **000°T**?

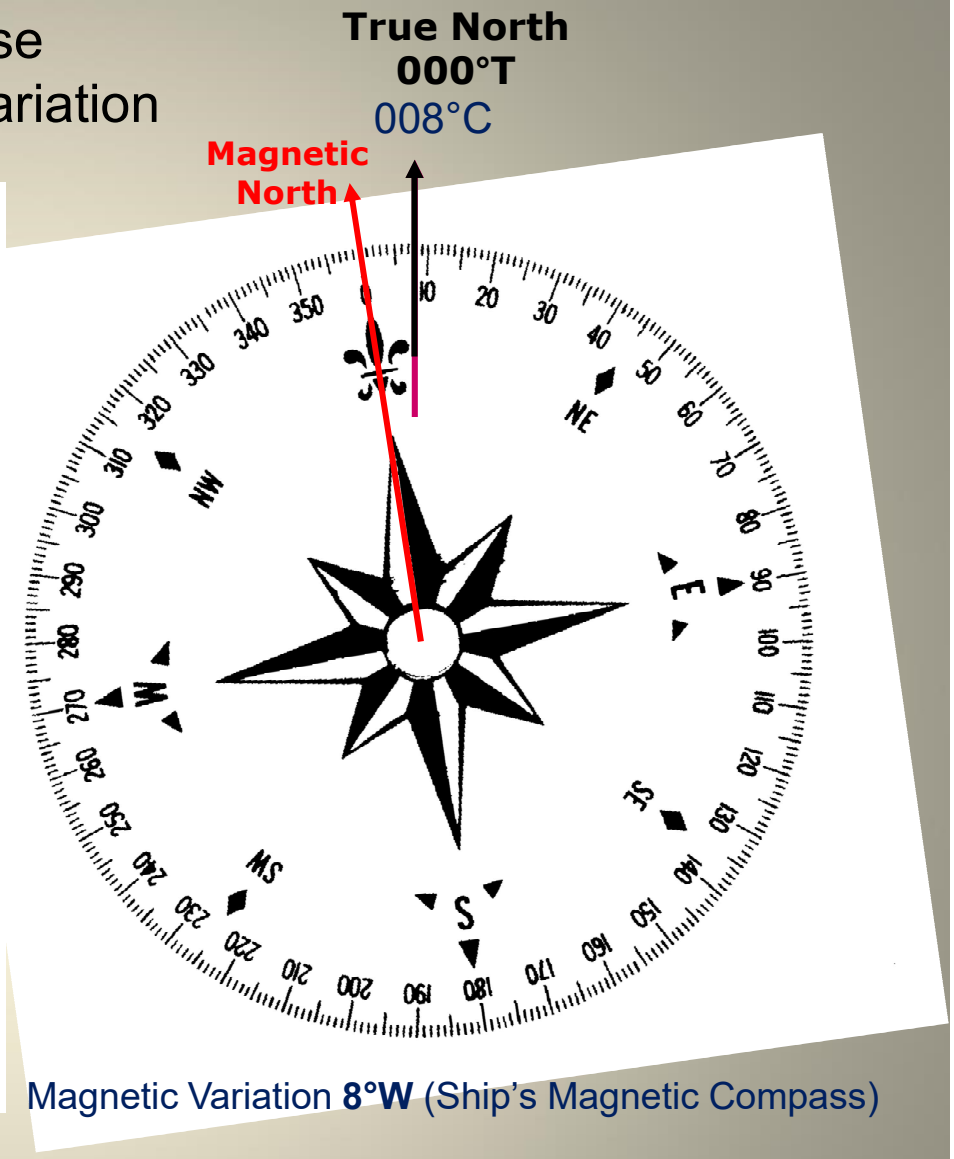
Ans. = 352°C

Exercise
Magnetic Variation



Compass Rose on Chart

Course required to be steered is **000°T (360°T)**

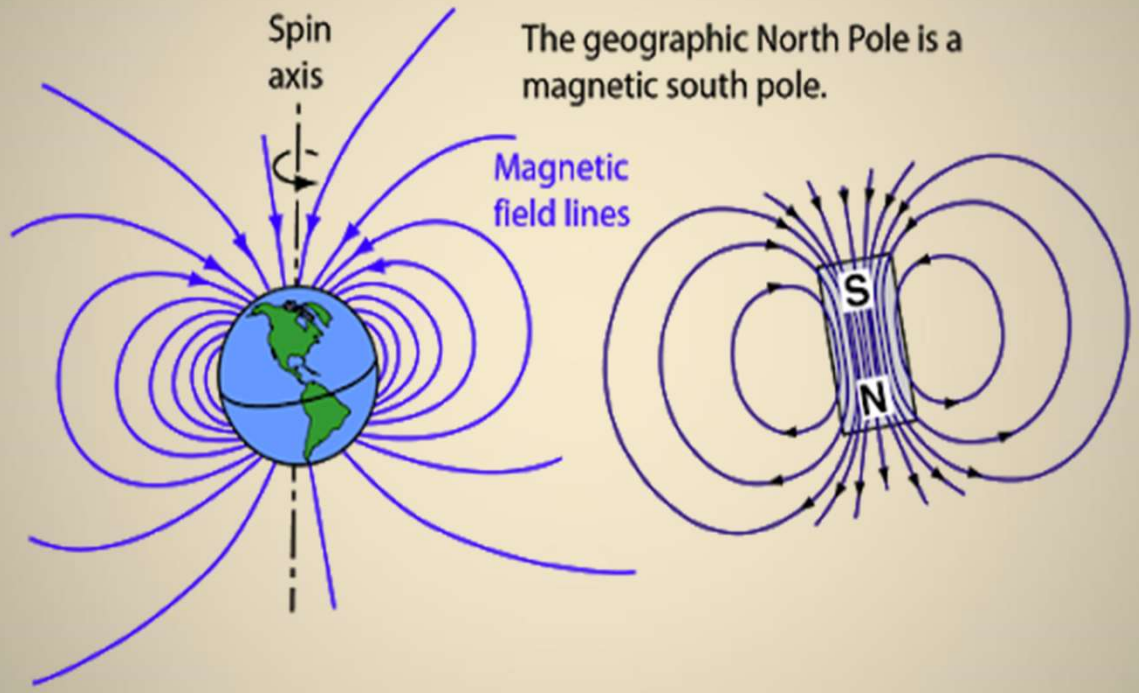


Magnetic Variation **8°W** (Ship's Magnetic Compass)

What **Compass Course** should be steered to maintain **000°T**?

Ans. = 008°C

Magnetic Deviation

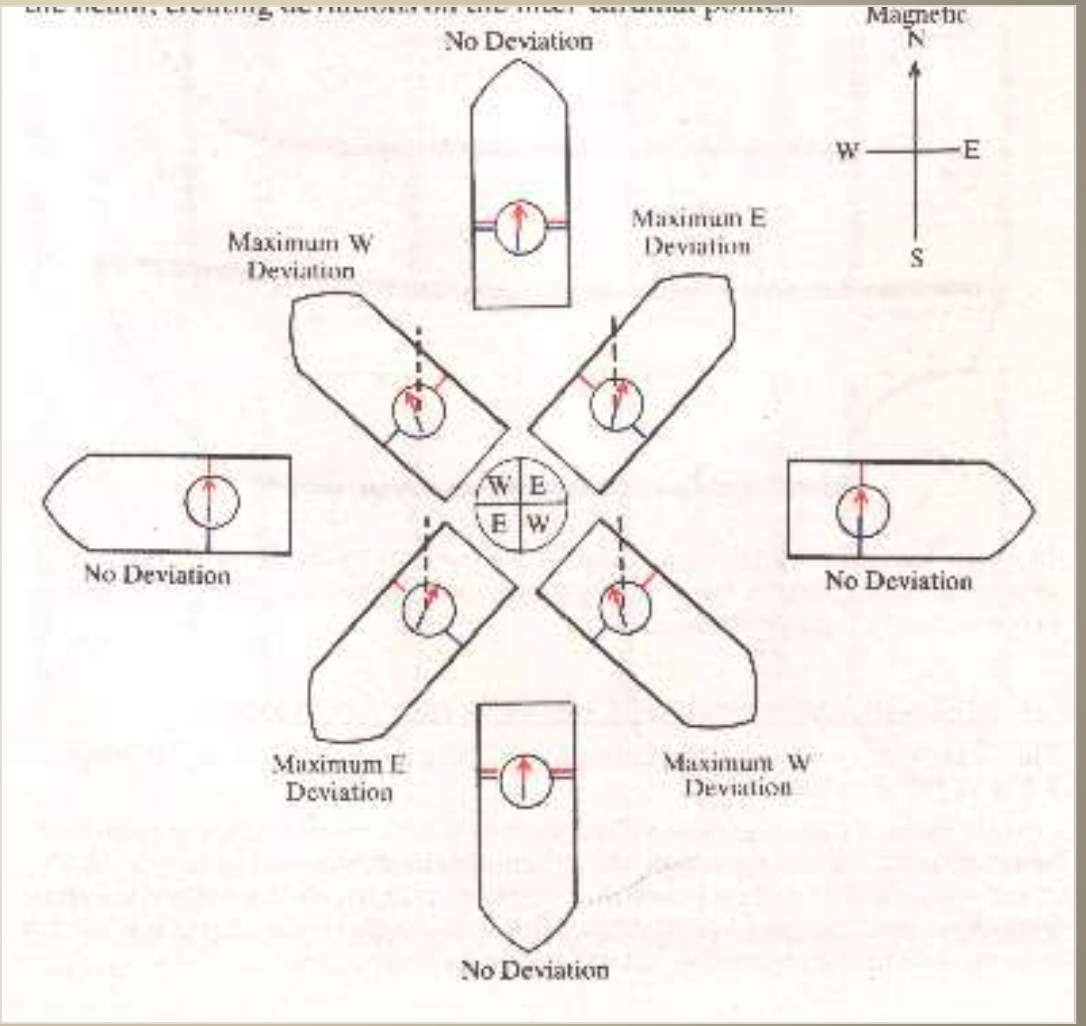


Affect on Ship's magnetic compass due to Ship's own magnetic fields

Magnetic Deviation

Affect on Ship's magnetic Compass due to Ship's own magnetic fields

(Note: Deviation changes as vessel alters heading)



Magnetic Deviation

- Amount of Deviation is reduced by a Compass Adjuster every 3 years
- Deviation for any heading is obtained from the Deviation Card
- DO NOT place any magnetic objects near compass

Deviation Card

COMPASS DEVIATION CARD 1A

Ship's head by compass	Deviation	Ship's head by compass	Deviation
000°	2°W	180°	2°E
010°	3°W	190°	2°E
020°	3°W	200°	1°E
030°	4°W	210°	1°E
040°	4°W	220°	1°E
050°	4°W	230°	2°E
060°	3°W	240°	2°E
070°	3°W	250°	2°E
080°	2°W	260°	3°E
090°	1°W	270°	2°E
100°	0	280°	2°E
110°	1°E	290°	1°E
120°	2°E	300°	0
130°	3°E	310°	1°W
140°	3°E	320°	1°W
150°	3°E	330°	2°W
160°	2°E	340°	2°W
170°	2°E	350°	2°W

COMPASS DEVIATION CARD 1A

Ship's head by compass	Deviation	Ship's head by compass	Deviation
000°	2°W	180°	2°E
010°	3°W	190°	2°E
020°	3°W	200°	1°E
030°	4°W	210°	1°E
040°	4°W	220°	1°E
050°	4°W	230°	2°E
060°	3°W	240°	2°E
070°	3°W	250°	2°E
080°	2°W	260°	3°E
090°	1°W	270°	2°E
100°	0	280°	2°E
110°	1°E	290°	1°E
120°	2°E	300°	0
130°	3°E	310°	1°W
140°	3°E	320°	1°W
150°	3°E	330°	2°W
160°	2°E	340°	2°W
170°	2°E	350°	2°W

Exercise

How To Use Deviation Card

Compass Error

Combination of:

- VARIATION (from Chart)
- DEVIATION (from Deviation Card)

Compass Error

The combined difference between TRUE and Compass course/bearing

When VARIATION & DEVIATION are the same (i.e., EAST or WEST), add the values together.

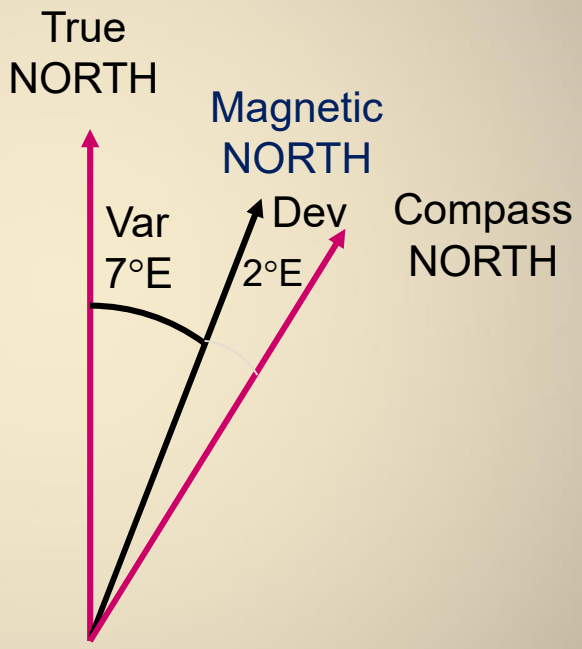
- Variation 7°E
  Deviation 2°E
  C/E = 9°E

- Variation 4°W
  Deviation 3°W
  C/E = 7°W

Compass Error

Variation		7°E
Deviation		2°E
C/E	=	9°E

In this case the vessel's Compass will indicate COMPASS North as being 9° to the East of TRUE North



Compass Error

When VARIATION & DEVIATION are opposite values, (E and W):

Subtract the Lower number from the Higher number

Use the VALUE of the Higher number

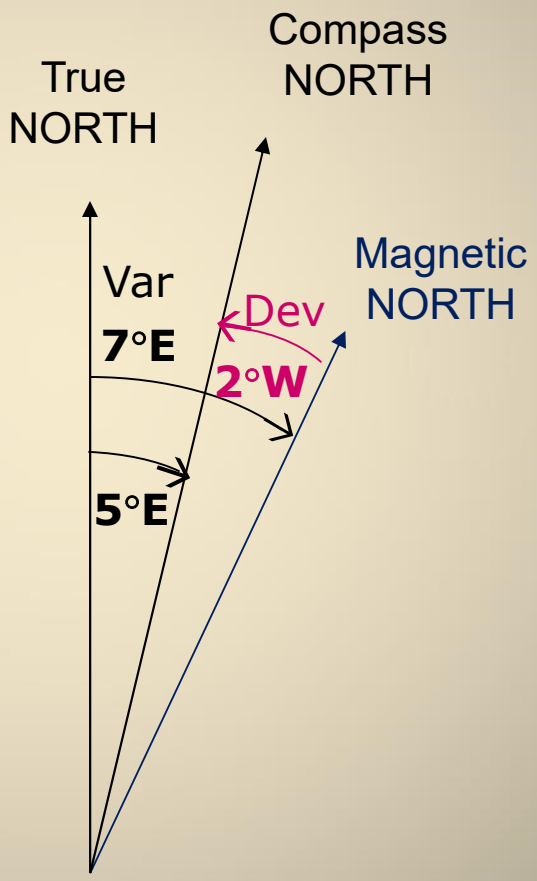
- Variation 7°E
  Deviation 2°W
  C/E = 5°E

- Variation 3°E
  Deviation 4°W
  C/E = 1°W

Compass Error

Variation		7°E
Deviation		2°W
C/E	=	5°E

In this case the vessel's Compass will indicate COMPASS North as being 5° to the East of TRUE North



Compass Error

Important to be sure, lets review

Variation	8°E	Variation and Deviation are opposites (E & W)
Deviation	2°W	Use larger value and subtract smaller value
C/E = 6°E		Error is still East

Variation	8°E	Variation and Deviation are both E
Deviation	3°E	Add values together
C/E = 11°E		Error is East

Variation	8°E
Deviation	0°
C/E = 8°E	

Variation	13°E	The compass is deflected 13°E
Deviation	7°W	The compass is deflected 7°W
C/E = 6°E		The resultant deflection is 6°E

Compass Error

Important to be sure, lets review

A transit bearing on chart AUS252 gave a total compass error of 1°W. What is the Deviation on the vessels heading?

Variation	8½°E	As printed on chart rose
Deviation	??	
C/E =	1°W	

Compass Error

Important to be sure, lets review

A transit bearing on chart AUS252 gave a total compass error of 1°W. What is the Deviation on the vessels heading?

Variation	8½°E	As printed on chart rose
Deviation	??	
C/E =	1°W	

Answer

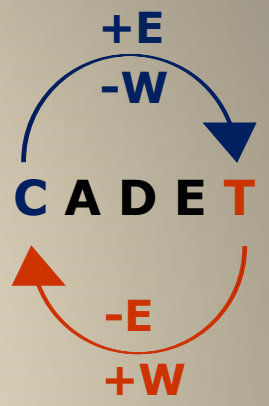
Variation	8½°E	
Deviation	**9½°W**	The Deviation must be 9½°W to give the Total Error of 1°W
C/E =	1°W	

Applying Compass Error

To convert a **True course** to a **Compass course**:

Compass **LEAST -** Error **EAST**

Compass **BEST -** Error **WEST**



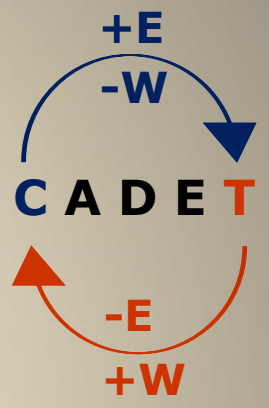
T	True	067°T	
V	Variation	- 7°E	(Refer to Chart Compass Rose, e.g. 7°E)
M	Magnetic	060°M	
D	Deviation	+ 3°W	(Refer to Deviation Card **1A**)
C	Compass	063°C	

Applying Compass Error

To convert a **Compass course** to a **True course**:

Compass **LEAST -** Error **EAST**

Compass **BEST -** Error **WEST**



C	Compass	063°C
D	Deviation	- 3°W
M	Magnetic	060°M
V	Variation	+ 7°E
T	True	067°T

(Refer to Deviation Card **1A)**

Error = 4°E

(Refer to chart Compass Rose, e.g. **7°E**)

Remember

When converting a **Compass bearing** to a **True bearing**:

Apply **Deviation** for the **SHIP'S HEAD** when taking each bearing

CADET : Compass Add East to get True

Exercises
(Use Deviation Card 1A, Variation 8°E)

(1) Ship heading **080° C**
Bearing of Lighthouse is **145° C.**
What is True Bearing of Lighthouse?

Ans: 151° T

V = 8°E
D = 2°W
C/E = 6°E

(2) Ship heading **260° C**
Bearing of Mt Lofty is **355° C.**
What is True Bearing of Mt Lofty?

Ans: 006° T

V = 8°E
D = 3°E
C/E = 11°E

(3) Ship heading **100° C**
Bearing of Snapper Point is **000° C.**
What is true Bearing of Snapper Point?

Ans: 008° T

V = 8°E
D = 0°
C/E = 8°E

EXERCISES

True to Compass

Exercise sheet #3 – All questions

Compass to True

Exercise sheet #4 – All questions

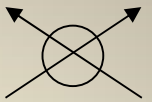
Compass True, True Compass

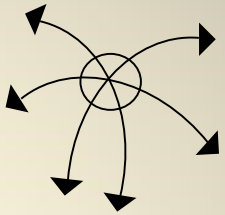
Exercise sheet #5 – All questions

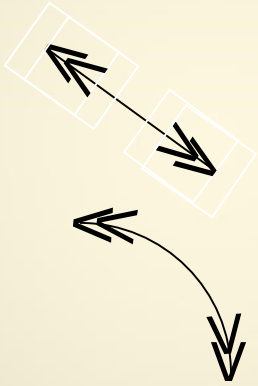
Positions and Position Fixing

Chartwork Conventions And Symbols

Position Line

Bearings 

Ranges 

Transferred Position Line 

Course 

Track 

Set & Drift 

Positioning

DR (Dead Reckoning Position) + (*time)*

Found by using **True Course steered** and **Distance Travelled** through the water.

Takes no account of current or tidal movement, nor the effect of wind on the vessel's track.

EP (Estimated Position)  (*time)*

Found by adjusting the **DR** position after taking into account the effects of **Wind (Leeway)** and **Current/Tidal stream (Set & Drift)**

FIX (Positive Position)  *(time)*

A **KNOWN** position obtained by the intersection of 2 or more position lines

Fixing Position At Sea

- Cross Bearings (Compass)
- Ranges (Radar)
- Bearing/Range
- GPS
- Bearing and Depth Contour
- Running Fix

TAKING A COMPASS BEARING

Don’t use deviation card on hand bearing compass

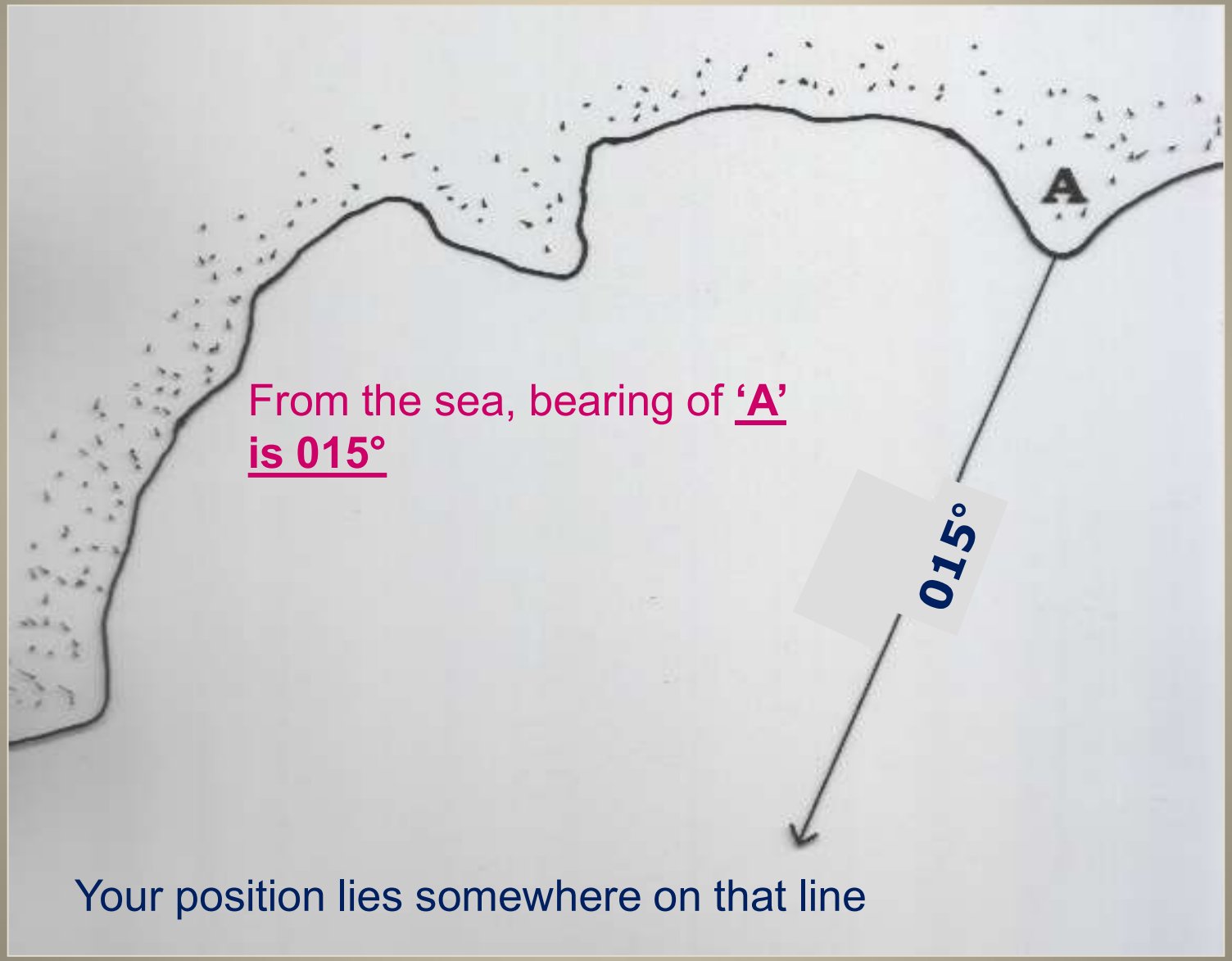
Hand bearing compass – just apply variation, not deviation

Taking A Compass Bearing Using An Azimuth Ring

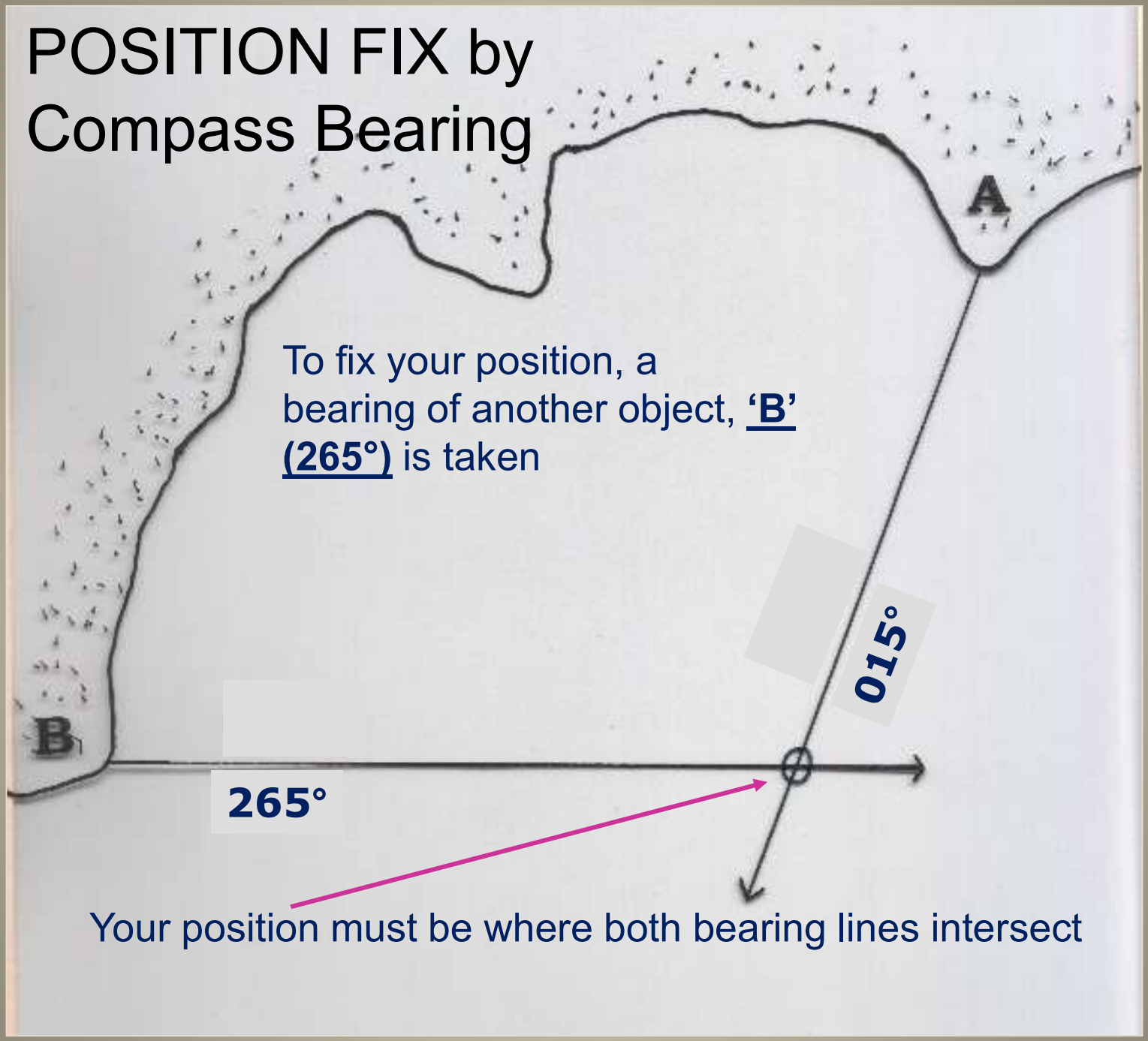
Use deviation card

Be aware of prism errors (arrow UP reading should agree with arrow DOWN reading) – otherwise make allowance.

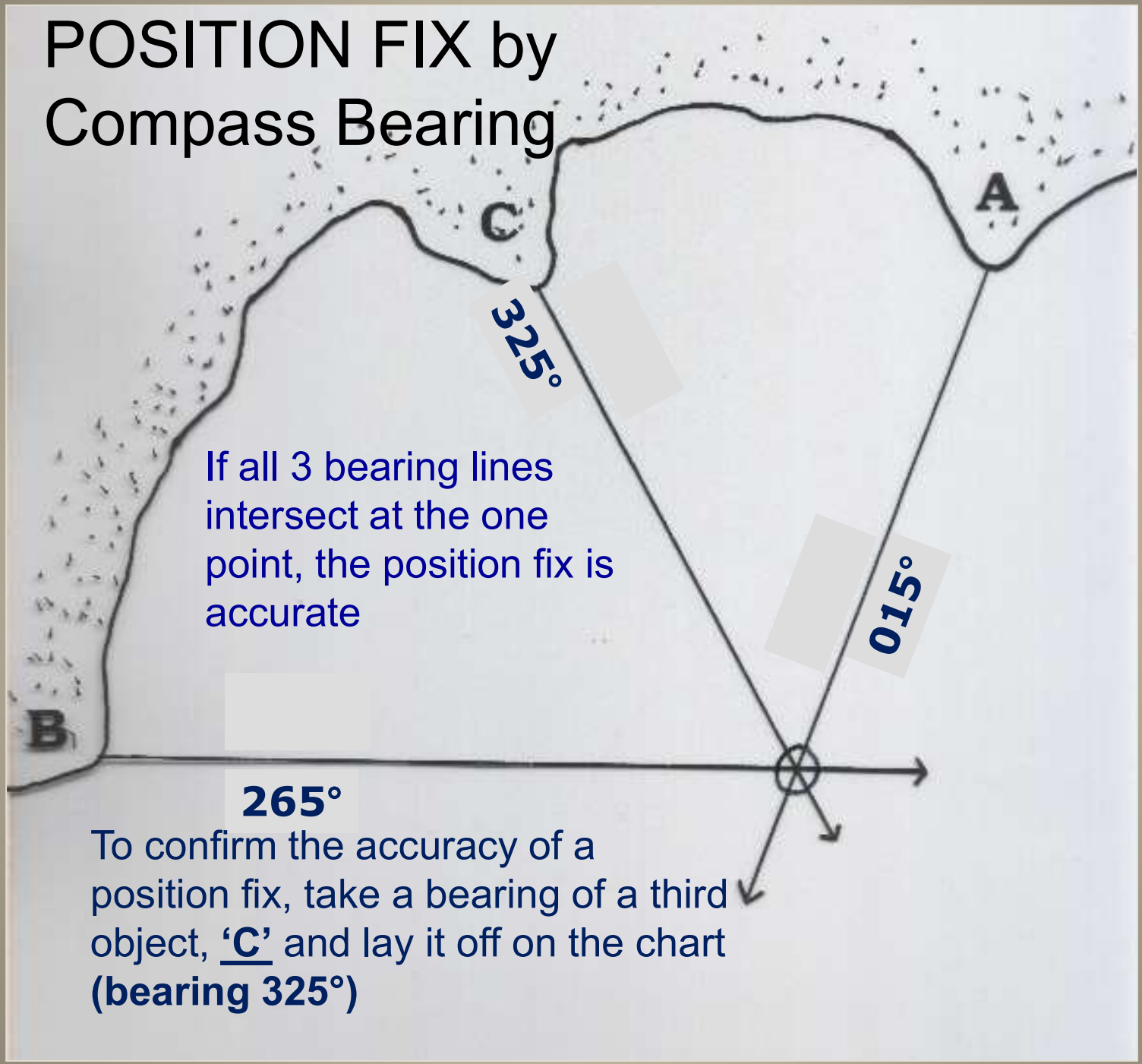
POSITION FIX by Compass Bearing



POSITION FIX by Compass Bearing



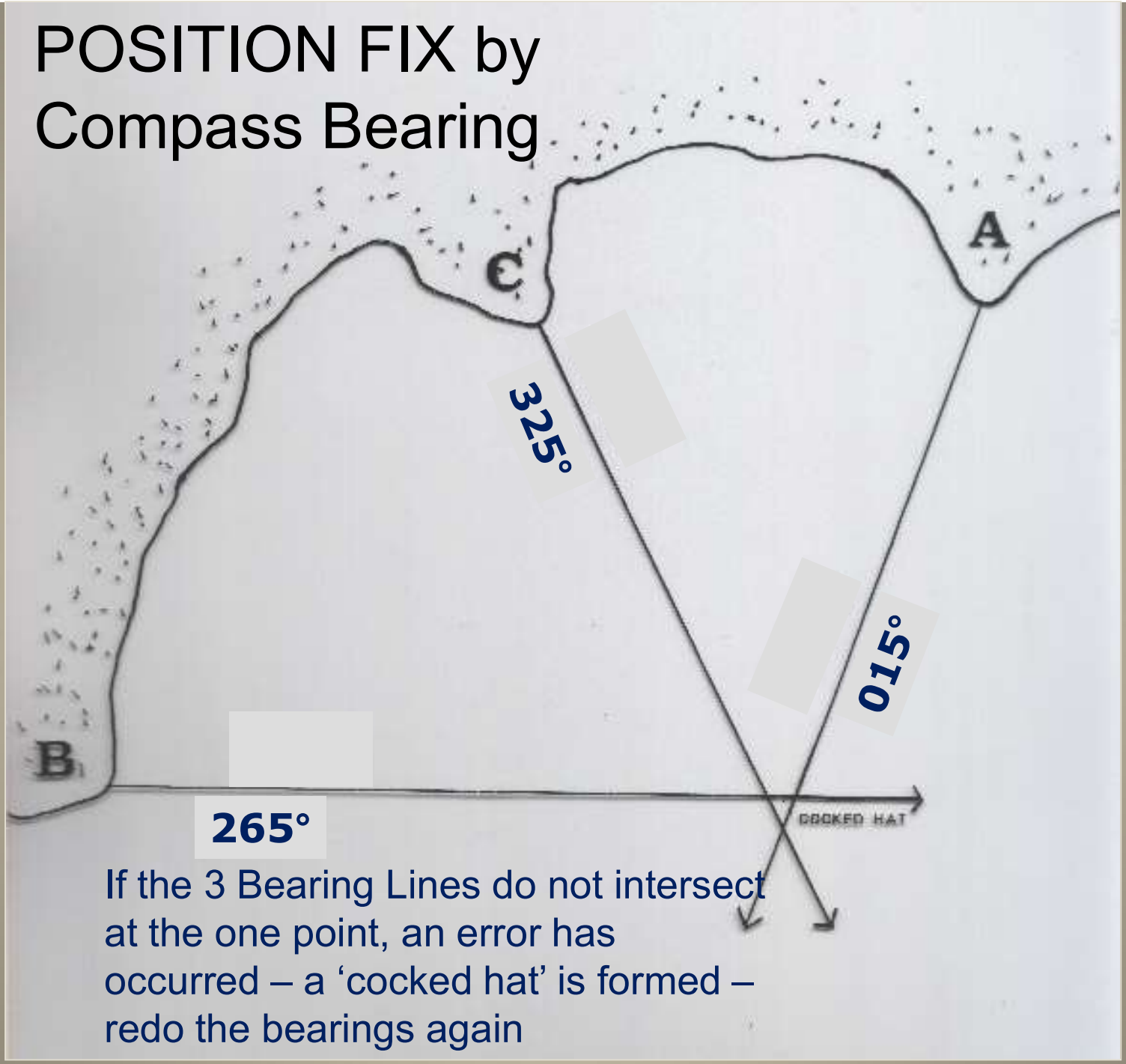
POSITION FIX by Compass Bearing



If all 3 bearing lines intersect at the one point, the position fix is accurate

To confirm the accuracy of a position fix, take a bearing of a third object, **'C'** and lay it off on the chart **(bearing 325°)**

POSITION FIX by Compass Bearing



If the 3 Bearing Lines do not intersect at the one point, an error has occurred – a ‘cocked hat’ is formed – redo the bearings again

POSITION FIX by Compass Bearing

Class Exercise

Exercise Sheet #6

- **Position fix by compass bearings (hand held)**
  - **Question 6**

POSITION FIX by Radar Range

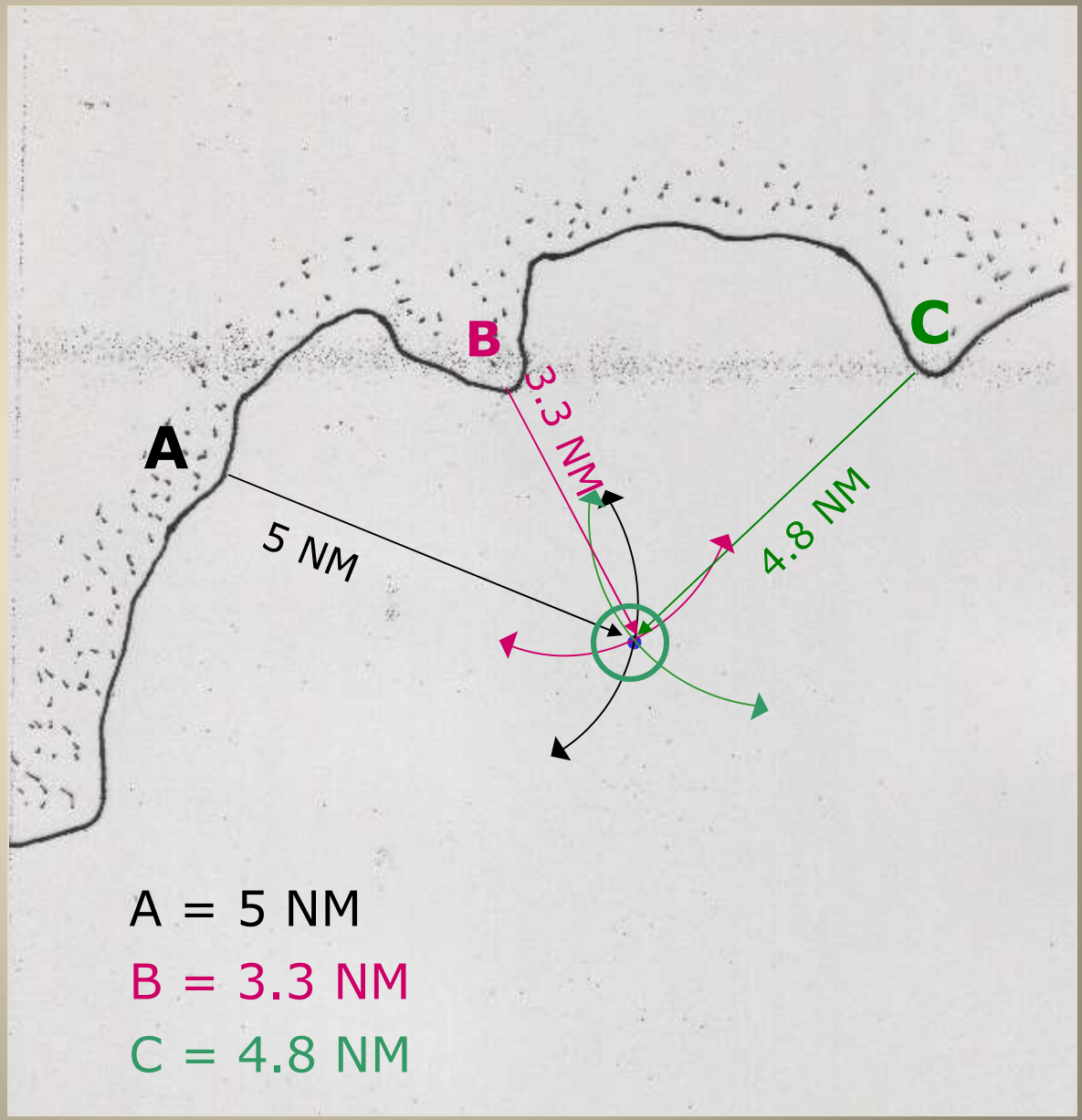
Identify features on chart

Measure distance to each feature by Radar

To fix position on Chart, lay off Radar Ranges obtained from features observed

If arcs drawn from each feature intersect in the one spot, a good fix has been obtained

If result is a cocked hat, re-check ranges obtained and re-plot



POSITION FIX by Radar Range

EXERCISES

(Class based)

POSITION FIX by Compass Bearing and Range

- Identify feature on chart (B)
- Take Compass Bearing of (B) and measure distance by Radar
- From (B) draw line in direction of reciprocal bearing
- From (B) draw arc at radar distance to 'cut' Bearing line

Your position is where the measured radar distance 'cuts' the line of bearing

POSITION FIX by Bearing and Range

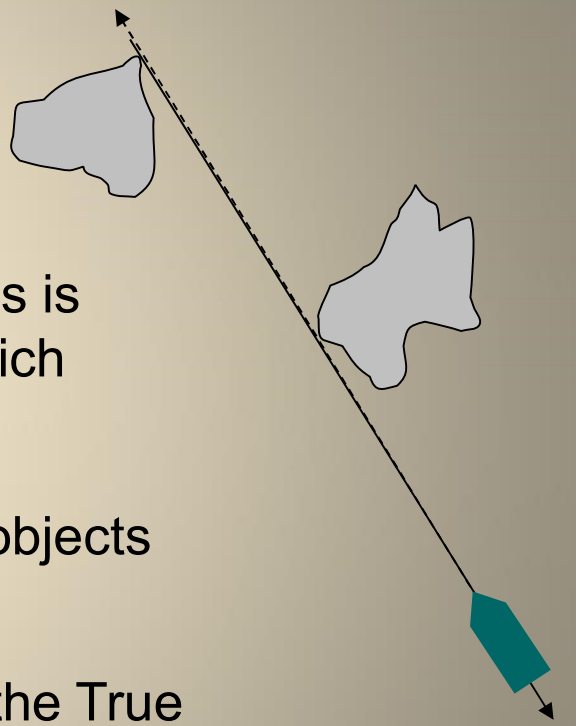
Class Exercise

Exercise Sheet #6

- ***Position fix Bearing & Range***
  - ***Question 7 (3 questions)***

Compass Error By Transit Bearing

How to check DEVIATION at Sea



1. Position your vessel where 2 objects are seen in "transit" *(i.e., in line with one another)*, and identify these on a chart

2. Draw a line on the chart joining these "transits" – this is the **True Bearing** of the transits from your position, which lies somewhere on this line

3. At the same time, take a **Compass bearing** of the objects in "transit"

4. The difference between the Compass Bearing and the True Bearing on the chart is the **Compass Error**

5. **Compass Error** is a combination of **Variation** and **Deviation** – find the Variation from the chart, and the Deviation can then be calculated

How to check DEVIATION at Sea

Example:

True Bearing of Transits	=	173°T
Compass Brg of Transits	=	169°C
C/E	=	4°(E or W)?

4°E

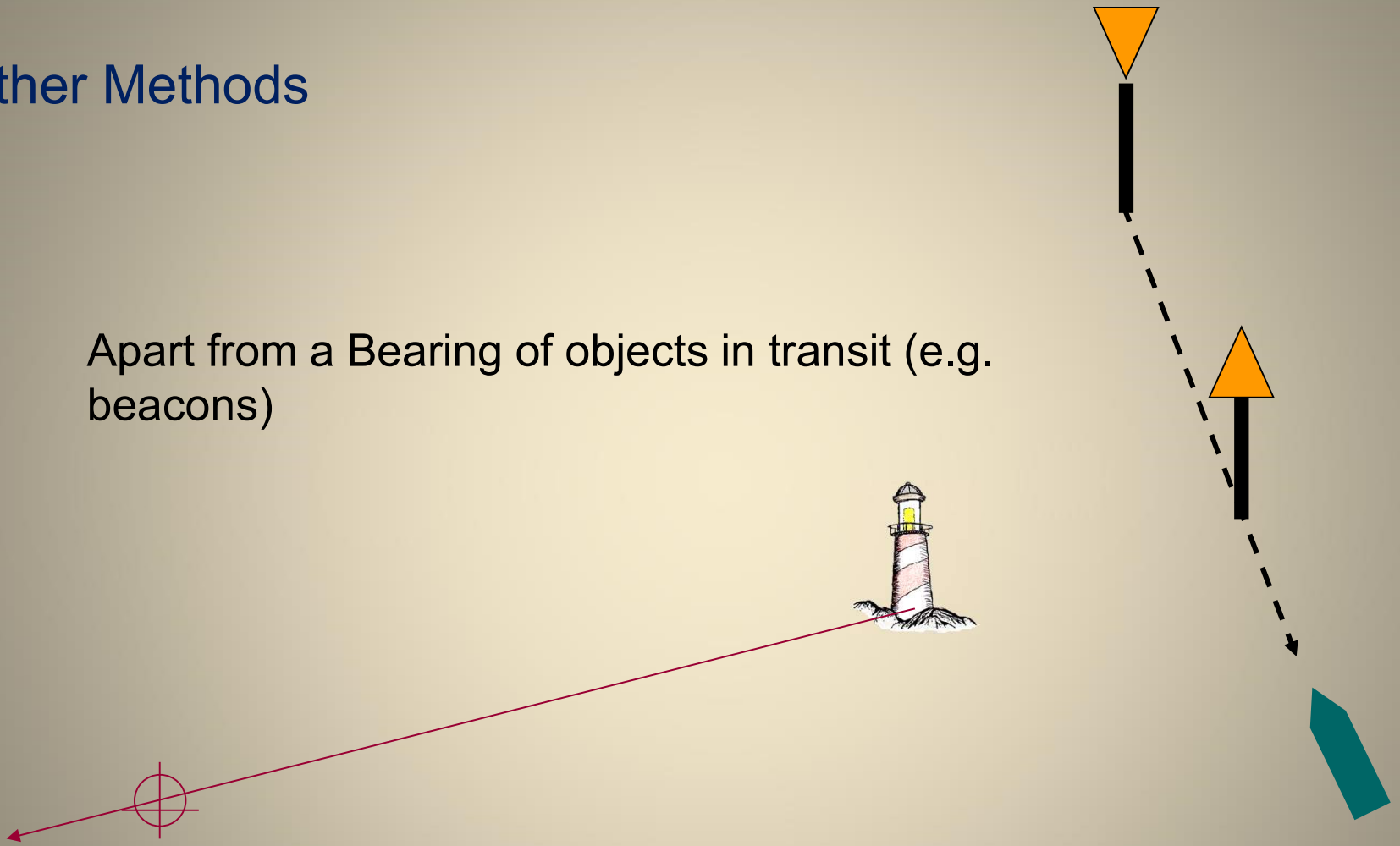
C/Error is a combination of Variation and Deviation

Variation	=	7°E (from Chart)
Deviation	=	3°W
C/E	=	4°E

Checking Deviation

Other Methods

Apart from a Bearing of objects in transit (e.g. beacons)



Bearing of any object from an accurate Position Fix

Checking Deviation

Class Exercise

Exercise Sheet #7

- Checking Deviation
  - Question 10

Study Note

At this stage, you should be comfortable working through the following scenarios.

- Using a hand bearing compass *{consider this}* you can use three chart reference points to determine your position. You should then be able to plot your position on a chart. From that:
  - Define what your current Latitude and Longitude is.
  - From there, be able to lay out a true course to a new position.
  - Be able to calculate the compass course your vessel needs to steer.
  - Calculate your ETA to a new position given a speed.
  - Be able to calculate compass error and deviation using leads and compass comparisons.

Study Note

At this stage, you should be comfortable working through the following scenarios.

- Be able to write (and plot) a passage plan for a short voyage which shows detail on the various passage legs, giving some thought to the following:
  - Way point latitude and longitudes
  - True and compass course information
  - Estimated time of each leg
  - Total distance to travel
  - Any navigation hazards on course and aids to navigation
  - Your destination
  - Duration of voyage and fuel required *{remember reserve}*

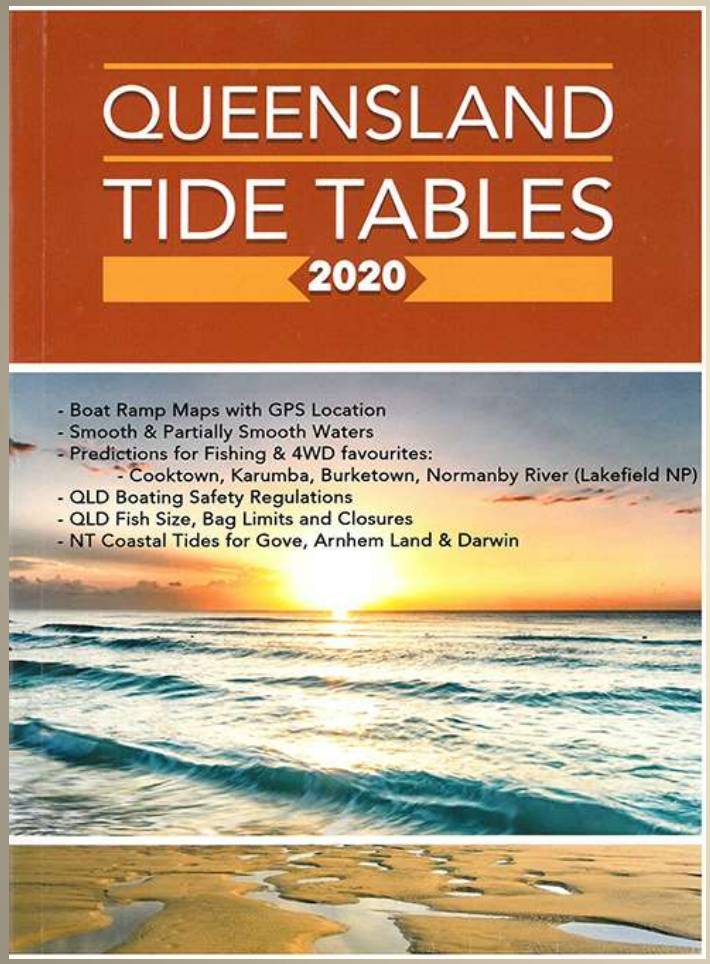
Study Note

At this stage, you should be comfortable working through the following scenarios.

- Be able to fix a position using radar ranges of charted reference points and to then plot this position on a chart. Then:
  - Plot a new course to a new position.
  - Determine the compass course your vessel needs to steer to the new position.
  - Identify targets you could use on a chart to help you fix your position on a chart, using different fixing methods such as hand held compass and radar fixes.
  - Determine charted depths at various positions.

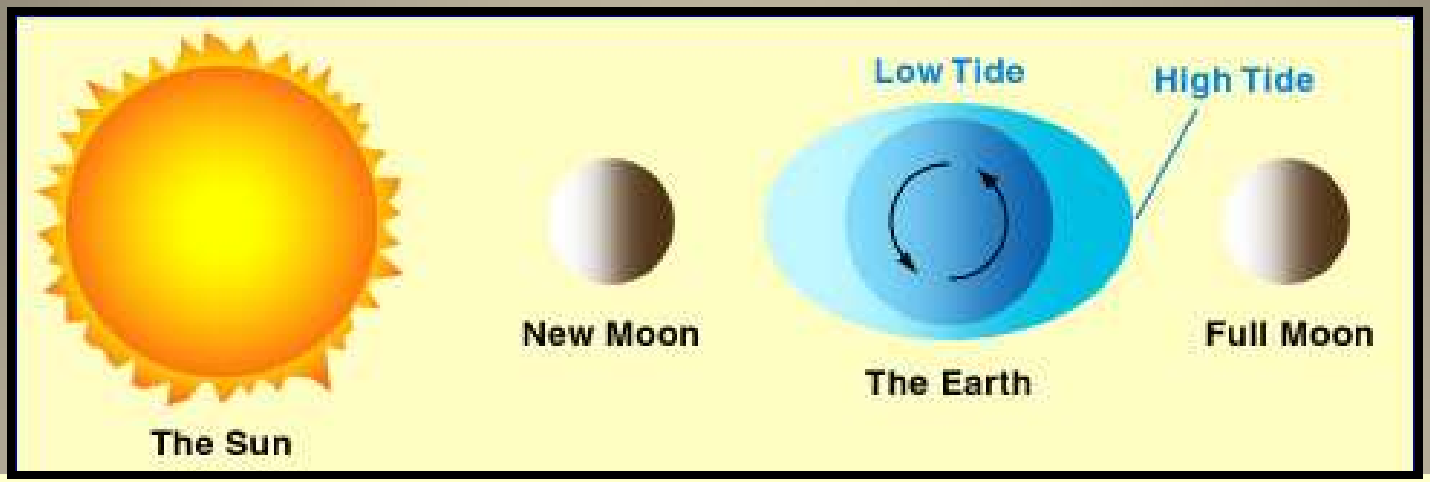
Tides And Tide Calculations

Tides



What causes tides?

How do we predict tide heights and times?



Spring Tides

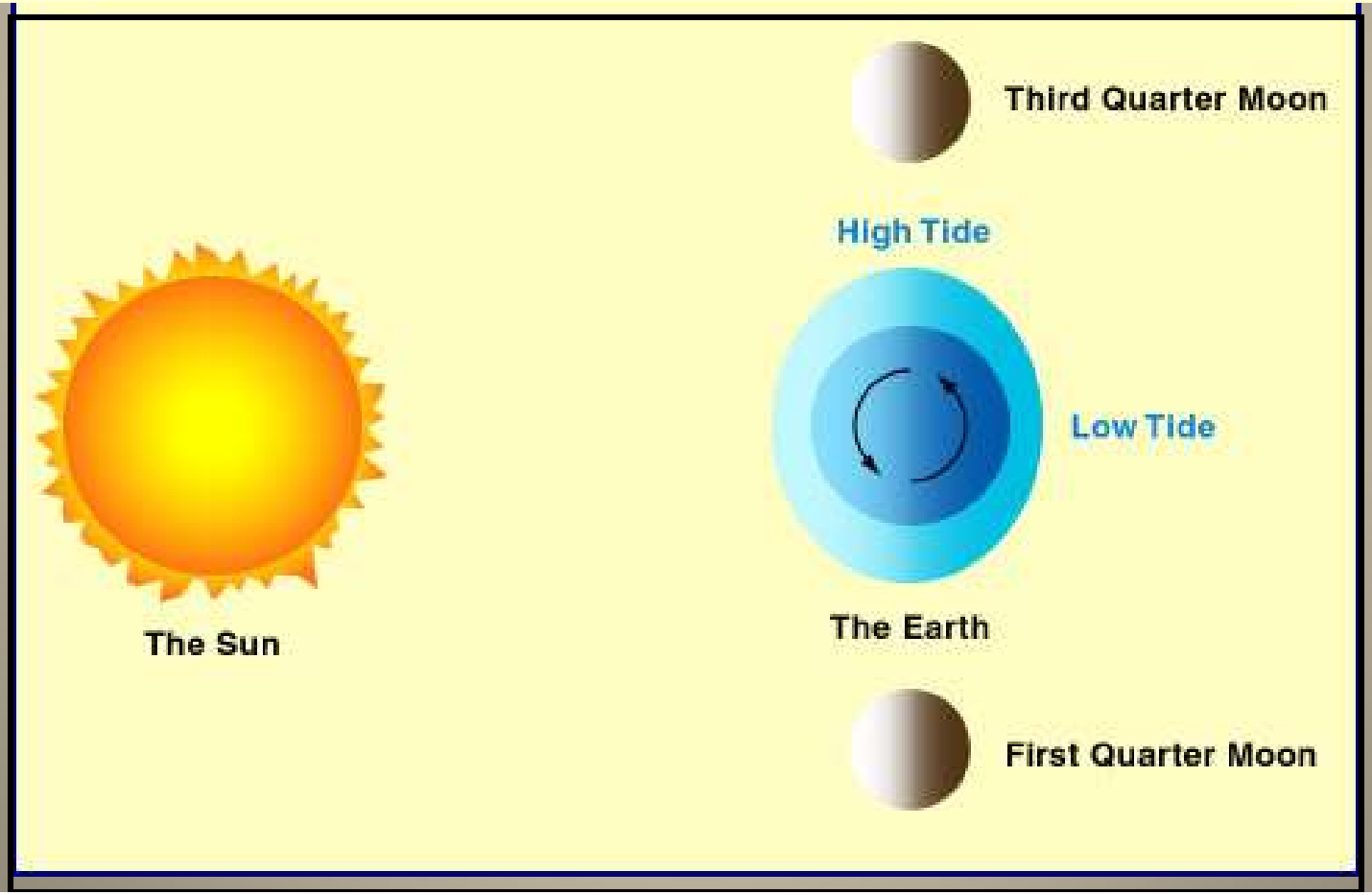
Higher High Tides

Lower Low Tides

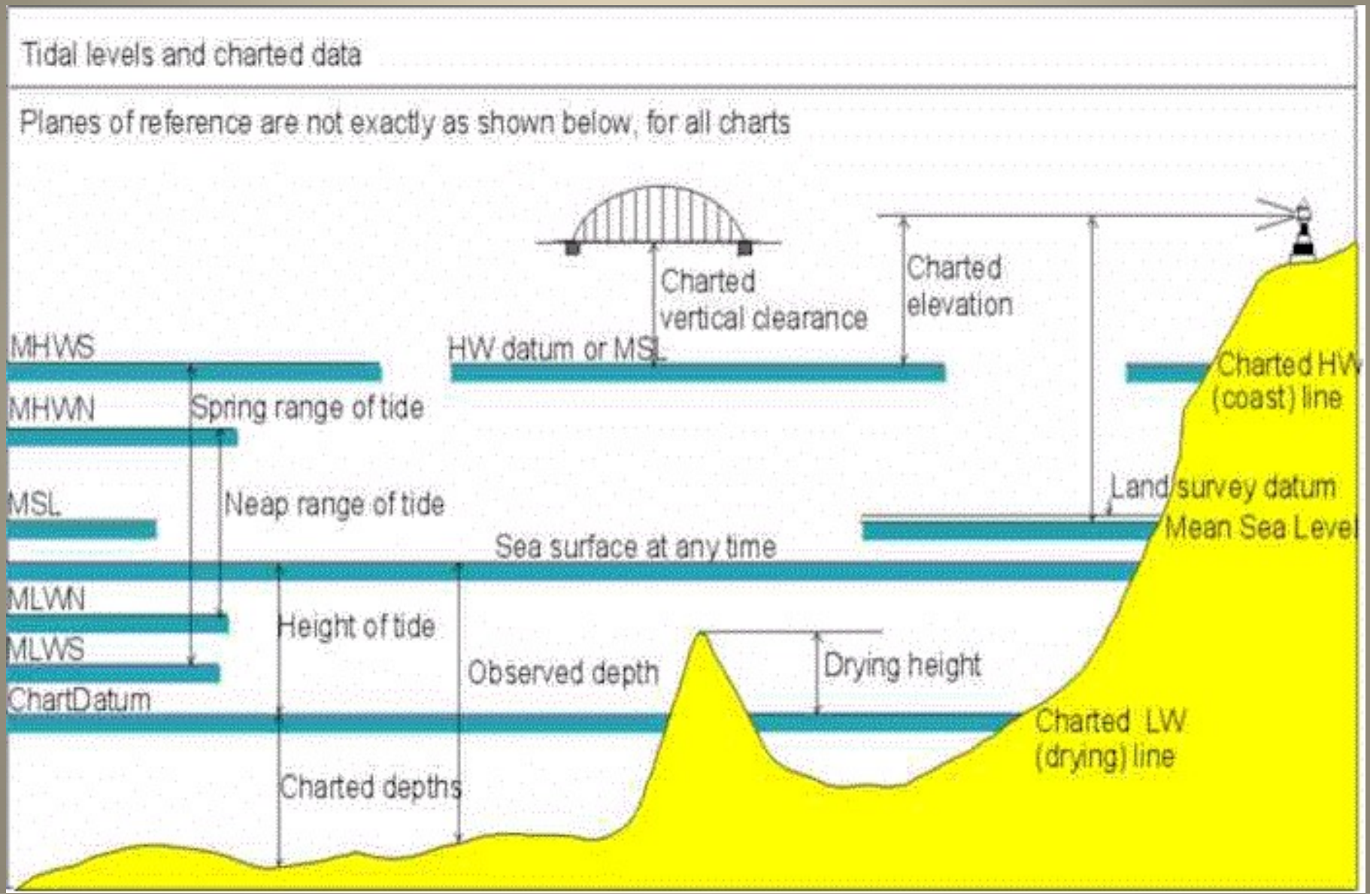
Neap Tides

Lower High Tides

Higher Low Tides



Tide Levels And Chart Data



Tide info for Standard Ports *(as per local Tide Book)*

WADDY POINT (FRASER ISLAND) – QUEENSLAND

2020

LAT 24° 58' S LONG 153° 21' E

Times and Heights of High and Low Waters

Local Time

MAY

	Time	m		Time	m
1 FR ◑	0207 0924 1514 2017	1.82 0.83 1.32 0.90	**16** SA	0333 1031 1646 2204	1.75 0.81 1.47 1.02
2 SA	0317 1019 1622 2149	1.86 0.70 1.44 0.81	**17** SU	0426 1109 1729 2302	1.71 0.74 1.56 0.95
3 SU	0417 1104 1716 2254	1.92 0.57 1.59 0.70	**18** MO	0511 1140 1805 2346	1.68 0.68 1.65 0.88
4 MO	0510 1143 1802 2347	1.97 0.47 1.75 0.60	**19** TU	0550 1205 1838	1.65 0.62 1.74
5 TU	0558 1219 1845	1.98 0.39 1.91	**20** WE	0022 0625 1227 1909	0.82 1.61 0.57 1.83
6 WE	0036 0643 1254 1928	0.53 1.94 0.35 2.05	**21** TH	0059 0657 1253 1939	0.78 1.57 0.54 1.92
7 TH ○	0125 0729 1330 2013	0.52 1.88 0.36 2.17	**22** FR	0137 0731 1322 2011	0.76 1.53 0.52 1.99
8 FR	0218 0817 1409 2059	0.56 1.77 0.42 2.23	**23** SA ●	0219 0807 1354 2046	0.75 1.50 0.53 2.04
9 SA	0317 0905 1448 2147	0.63 1.65 0.52 2.24	**24** SU	0304 0846 1427 2124	0.76 1.46 0.57 2.06
10 SU	0420 0954 1528 2236	0.72 1.53 0.65 2.19	**25** MO	0352 0928 1502 2205	0.78 1.42 0.64 2.04
11 MO	0524 1046 1610 2327	0.81 1.42 0.78 2.10	**26** TU	0444 1016 1543 2251	0.81 1.36 0.72 1.99
12 TU	0628 1146 1701	0.87 1.34 0.90	**27** WE	0539 1111 1628 2341	0.84 1.31 0.80 1.92
13 WE	0024 0733 1306 1808	1.99 0.91 1.31 0.99	**28** TH	0639 1219 1725	0.85 1.28 0.87
14 TH	0127 0841 1433 1922	1.89 0.91 1.33 1.05	**29** FR	0041 0744 1340 1837	1.87 0.83 1.29 0.91
15 FR ◐	0232 0943 1549 2042	1.81 0.87 1.39 1.06	**30** SA ◑	0147 0848 1458 2001	1.84 0.77 1.36 0.90
			31 SU	0251 0944 1605 2126	1.83 0.69 1.48 0.86

JUNE

	Time	m		Time	m
1 MO	0351 1031 1701 2237	1.82 0.60 1.64 0.79	**16** TU	0431 1100 1741 2330	1.54 0.69 1.64 0.95
2 TU	0447 1111 1748 2336	1.79 0.53 1.80 0.72	**17** WE	0517 1129 1818	1.49 0.64 1.73
3 WE	0538 1149 1833	1.75 0.47 1.95	**18** TH	0017 0559 1157 1851	0.90 1.44 0.59 1.82
4 TH	0031 0627 1227 1917	0.67 1.70 0.44 2.09	**19** FR	0058 0638 1228 1923	0.85 1.40 0.56 1.91
5 FR	0126 0716 1307 2003	0.64 1.64 0.44 2.20	**20** SA	0139 0716 1302 1956	0.80 1.38 0.54 1.98
6 SA ○	0223 0806 1350 2049	0.64 1.58 0.49 2.25	**21** SU ●	0222 0754 1337 2033	0.76 1.38 0.53 2.04
7 SU	0321 0858 1434 2137	0.66 1.51 0.57 2.24	**22** MO	0306 0837 1416 2113	0.73 1.38 0.55 2.07
8 MO	0418 0947 1517 2225	0.71 1.45 0.67 2.17	**23** TU	0352 0924 1458 2157	0.70 1.38 0.58 2.07
9 TU	0511 1037 1600 2311	0.77 1.39 0.77 2.06	**24** WE	0440 1016 1544 2245	0.70 1.37 0.65 2.04
10 WE	0602 1127 1647 2358	0.83 1.35 0.87 1.95	**25** TH	0529 1111 1634 2336	0.71 1.34 0.72 1.97
11 TH	0652 1227 1741	0.88 1.32 0.95	**26** FR	0620 1212 1729	0.73 1.33 0.80
12 FR	0048 0747 1339 1843	1.84 0.89 1.32 1.01	**27** SA	0029 0713 1321 1833	1.90 0.74 1.34 0.86
13 SA ◐	0144 0847 1458 1953	1.74 0.87 1.36 1.04	**28** SU ◑	0125 0810 1437 1949	1.81 0.73 1.41 0.91
14 SU	0242 0942 1605 2116	1.66 0.82 1.44 1.04	**29** MO	0226 0907 1549 2117	1.73 0.70 1.52 0.92
15 MO	0339 1025 1658 2233	1.60 0.75 1.53 1.00	**30** TU	0329 0959 1649 2237	1.64 0.66 1.66 0.89

JULY

	Time	m		Time	m
1 WE	0431 1046 1741 2346	1.57 0.62 1.81 0.83	**16** TH	0443 1053 1756	1.32 0.68 1.70
2 TH	0530 1129 1828	1.51 0.58 1.95	**17** FR	0019 0538 1132 1834	0.92 1.28 0.63 1.79
3 FR	0045 0625 1213 1913	0.77 1.47 0.54 2.07	**18** SA	0102 0626 1210 1909	0.84 1.26 0.58 1.88
4 SA	0139 0718 1258 1958	0.71 1.46 0.53 2.15	**19** SU	0140 0710 1250 1943	0.76 1.28 0.54 1.96
5 SU ○	0229 0809 1344 2045	0.66 1.45 0.53 2.19	**20** MO	0218 0751 1329 2020	0.69 1.31 0.50 2.03
6 MO	0318 0858 1430 2131	0.65 1.45 0.57 2.16	**21** TU ●	0258 0833 1410 2100	0.62 1.36 0.47 2.09
7 TU	0405 0944 1513 2214	0.67 1.43 0.64 2.09	**22** WE	0338 0917 1454 2144	0.57 1.40 0.48 2.10
8 WE	0449 1025 1552 2254	0.72 1.40 0.72 1.98	**23** TH	0420 1005 1540 2230	0.55 1.43 0.53 2.07
9 TH	0531 1103 1630 2332	0.78 1.36 0.80 1.87	**24** FR	0503 1056 1629 2317	0.57 1.43 0.61 1.98
10 FR	0611 1146 1714	0.82 1.34 0.88	**25** SA	0548 1151 1723	0.61 1.43 0.72
11 SA	0011 0654 1243 1808	1.77 0.84 1.33 0.95	**26** SU	0007 0636 1254 1828	1.86 0.65 1.45 0.83
12 SU	0056 0744 1357 1913	1.66 0.84 1.35 1.01	**27** MO ◑	0059 0728 1412 1949	1.72 0.69 1.50 0.92
13 MO ◐	0148 0838 1514 2036	1.56 0.81 1.41 1.05	**28** TU	0201 0826 1531 2130	1.57 0.71 1.59 0.95
14 TU	0246 0929 1621 2213	1.46 0.77 1.50 1.04	**29** WE	0313 0928 1638 2300	1.45 0.72 1.72 0.91
15 WE	0345 1013 1713 2325	1.38 0.73 1.60 0.99	**30** TH	0428 1028 1734	1.36 0.70 1.84
			31 FR	0009 0538 1120 1824	0.83 1.33 0.66 1.94

AUGUST

	Time	m		Time	m
1 SA	0100 0636 1209 1908	0.75 1.34 0.61 2.02	**16** SU	0043 0615 1152 1840	0.75 1.21 0.58 1.87
2 SU	0142 0725 1254 1951	0.68 1.38 0.56 2.08	**17** MO	0118 0659 1235 1917	0.64 1.27 0.49 1.97
3 MO	0220 0808 1338 2032	0.62 1.42 0.53 2.09	**18** TU	0154 0738 1316 1954	0.54 1.35 0.42 2.05
4 TU ○	0258 0848 1420 2112	0.60 1.45 0.54 2.06	**19** WE ●	0229 0816 1356 2034	0.46 1.43 0.37 2.10
5 WE	0338 0926 1457 2150	0.61 1.45 0.58 1.98	**20** TH	0305 0858 1439 2117	0.41 1.51 0.37 2.10
6 TH	0414 0959 1531 2223	0.65 1.44 0.65 1.88	**21** FR	0343 0943 1524 2201	0.39 1.57 0.43 2.04
7 FR	0449 1032 1604 2254	0.70 1.42 0.73 1.77	**22** SA	0422 1030 1614 2247	0.43 1.60 0.54 1.91
8 SA	0522 1108 1644 2328	0.75 1.40 0.81 1.67	**23** SU	0504 1122 1712 2335	0.49 1.61 0.68 1.74
9 SU	0558 1155 1734	0.77 1.40 0.91	**24** MO	0548 1223 1825	0.57 1.62 0.82
10 MO	0005 0638 1254 1840	1.55 0.79 1.40 0.99	**25** TU	0028 0639 1339 2000	1.56 0.66 1.64 0.90
11 TU	0048 0723 1410 2006	1.43 0.80 1.42 1.05	**26** WE ◑	0136 0739 1502 2145	1.40 0.73 1.70 0.90
12 WE ◐	0142 0815 1526 2159	1.32 0.79 1.48 1.04	**27** TH	0304 0854 1615 2309	1.29 0.77 1.78 0.83
13 TH	0251 0912 1629 2316	1.23 0.77 1.56 0.96	**28** FR	0432 1011 1716	1.25 0.76 1.86
14 FR	0405 1011 1720	1.18 0.73 1.66	**29** SA	0007 0543 1112 1806	0.75 1.28 0.71 1.92
15 SA	0005 0517 1104 1802	0.87 1.18 0.66 1.76	**30** SU	0047 0633 1200 1849	0.67 1.34 0.64 1.95
			31 MO	0118 0713 1243 1927	0.61 1.40 0.57 1.97

Datum of Predictions is Lowest Astronomical Tide

Times are in local standard time (Time Zone UTC +10:00)

Moon Phase Symbols ● New Moon ◑ First Quarter ○ Full Moon ◐ Last Quarter

Times expressed in 24 Hour clock

PORTS	Time difference		Ratio of Rises
	High Water	Low Water	
	Hr min	Hr min	
Secondary Ports Referred to Port Adelaide			
Ardrossan	-00 02	-00 03	1.22
Brighton	-00 03	-00 02	0.95
Port Noarlunga	-00 09	-00 11	0.81
* Port Wakefield	-00 07	-00 19	1.40
Rapid Bay	-00 04	-00 05	0.70
Second Valley	-00 05	-00 08	0.64

STANDARD AND S

TIDAL DATA

PORTS	TIME DIFFERENCE		RATIO OF RISES
	HIGH WATER	LOW WATER	
	H m	H m	
STANDARD PORTS	-	-	-
Port Adelaide - Outer Harbor	-	-	-
Victor Harbor	-	-	-
Port Giles	-	-	-
Wallaroo	-	-	-
Port Pirie	-	-	-
Whyalla	-	-	-
Port Lincoln	-	-	-
Thevenard	-	-	-
SECONDARY PORTS			
REFERRED TO OUTER HARBOR			
Ardrossan	- 00 02	- 00 03	1.22
Brighton	- 00 03	- 00 02	0.95
Port Noarlunga	- 00 09	- 00 11	0.81
*Port Wakefield	- 00 07	- 00 19	1.40
Rapid Bay	- 00 04	- 00 05	0.70
Second Valley	- 00 05	- 00 08	0.64
REFERRED TO PORT GILES			
Edithburgh	- 00 03	- 00 03	0.95
Emu Bay	- 00 10	- 00 10	0.60
Kingscote	- 00 05	- 00 05	0.63
Port Vincent	- 00 01	- 00 01	1.15
REFERRED TO VICTOR HARBOR			
Beachport	- 00 25	- 00 25	0.95
Kingston	- 00 05	- 00 05	1.00
Port MacDonnell	+ 00 01	+ 00 01	0.86
Robe	- 00 14	- 00 14	0.85

Tide calculations for Secondary Ports – refer to Tide Tables

Exercise

Find Times and Heights of High water and Low water at Port Wakefield on July 18th, 1997

July 18, 1997

Secondary Port: Port Wakefield

Standard Port: Port Adelaide (Outer Harbor)

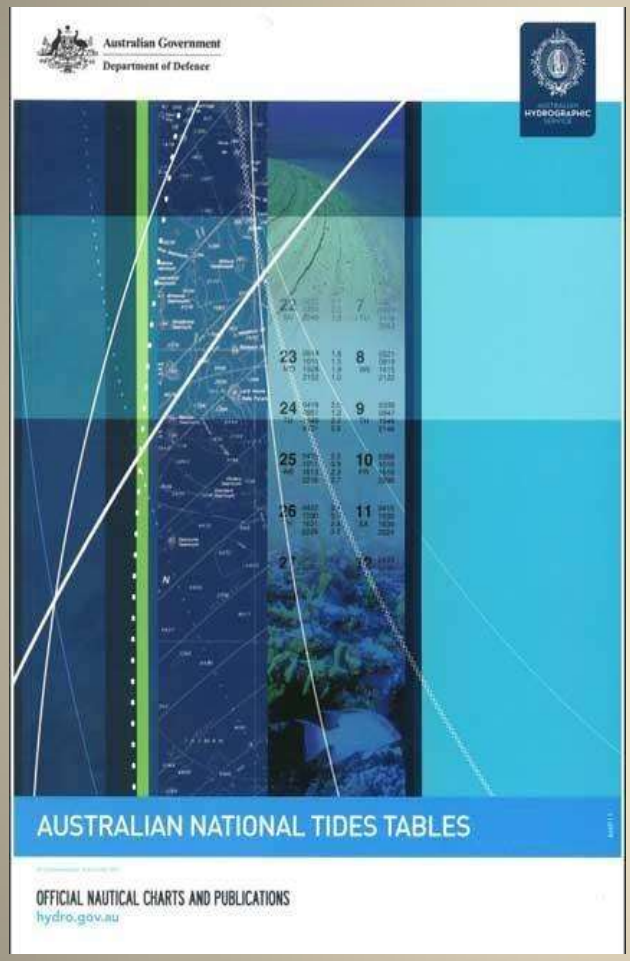
Times:

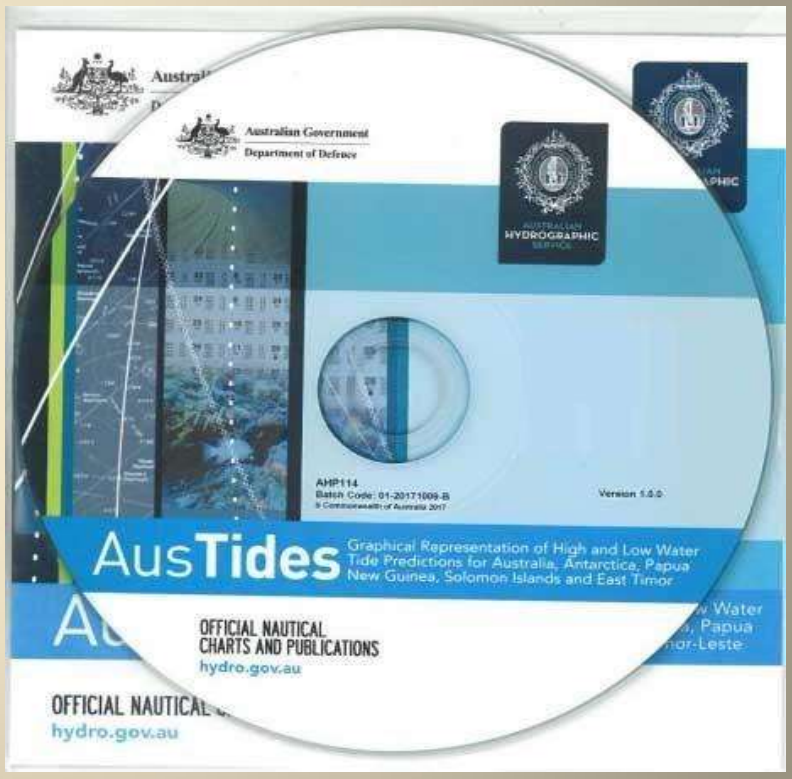
	HW	LW	HW	LW
Pt Adel	0412	0920	1546	2242
Pt W	- 0007	-0019	- 0007	- 0019
=	**0405**	**0901**	**1539**	**2223**

Heights:

	HW	LW	HW	LW
Pt Adel	1.93	1.24	2.67	0.69
Pt W	x 1.40	x 1.40	x 1.40	x 1.40
=	**2.70**	**1.74**	**3.74**	**0.97**

Where else can tidal information be sourced from?

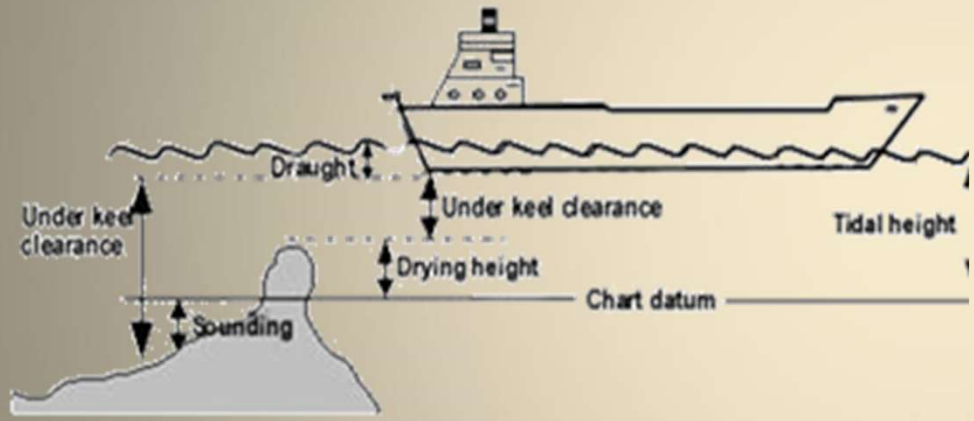


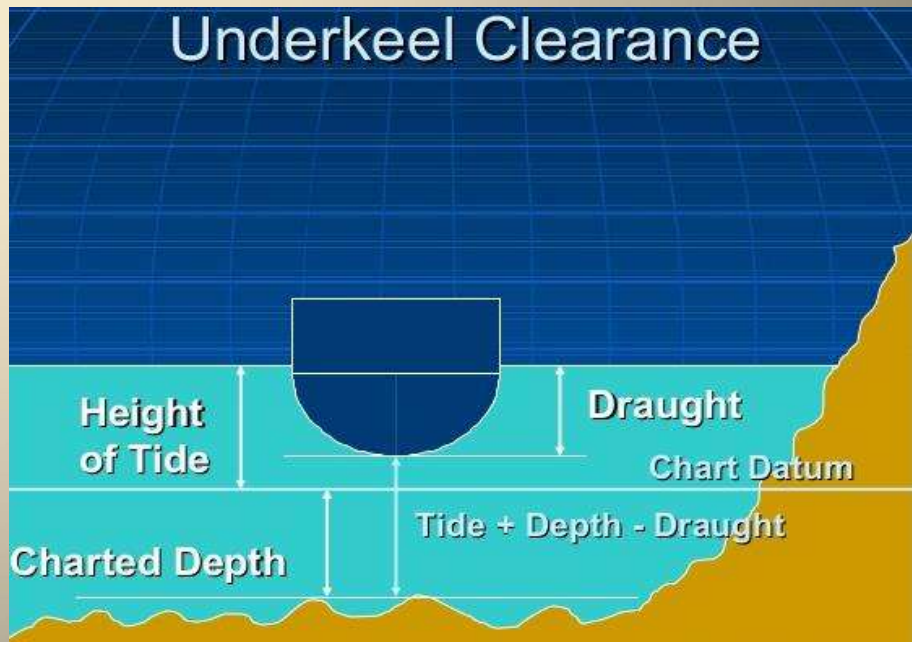


The ANTT contains information for over 500 ports in Australia, Papua New Guinea, Solomon Islands, Antarctica and East Timor.

Under Keel Clearance

Under Keel Clearance = (height of tide + Sounding) – Vessel Draught





Under Keel Clearance

Class Exercise

Exercise Sheet #10

- Tides
  - Lets work through Q1 together
  - Then complete the remaining 5 questions

QUESTION 3

Queensland Government

Tide Calculations

1. Find the required Locality in the Semidiurnal Tidal Planes
2. Date: 05/07/15
3. Standard Port: MOOLOOLAH HARBOUR Secondary Port: INDIJFAIL

Tide	Time	Height
L	1706	0.74
H	2353	2.84

Time Difference	Ratio	Constant
H.W +026	0.98	- 0.63
L.W. +055		

3. Calculate Secondary Port Tide Times (+ or -)
4. Calculate tide heights (multiply by ratio, and + or – constant)
5. Secondary Port:

Tide	Time	Height
L	1801	0.09 ← (0.0952)
H	0019	2.15 ← (2.1532)

0.74 x 0.98 - 0.63

2.84 x 0.98 - 0.63

6. Calculate tidal range -

H.W.	2.15
L.W.	0.09
Range	2.06 ← 2.15 - 0.09

7. Your vessel requires -

Draught	5.1
UKC	0.5
Total	5.7 ← 5.2 + 0.5

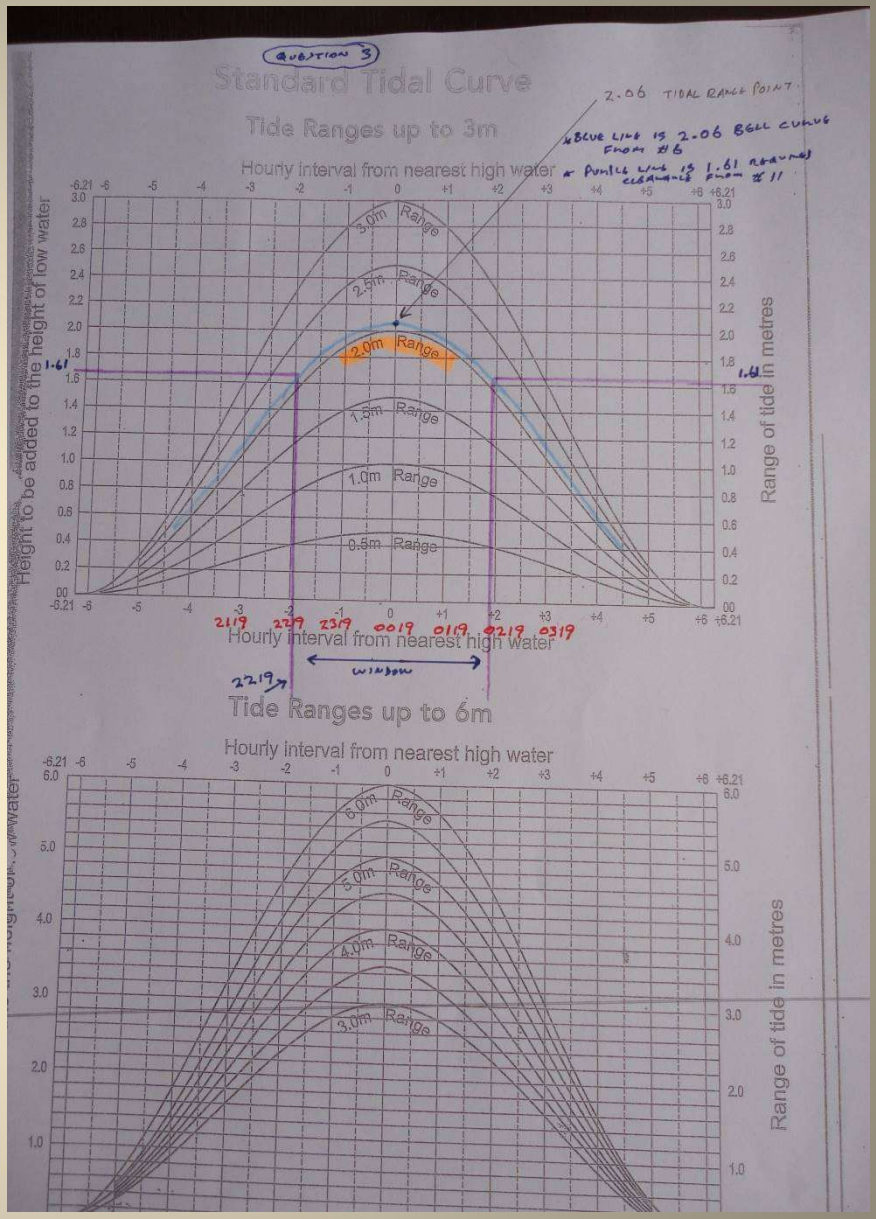
8. You have at L.W. -

Sounding	4.0
L.W.	0.09
Total	4.09 ← 4.0 + 0.09

9. Refer to "Bell Curves" for calculation
10. All calculations should be taken as before or after H.W.
11. Therefore you require:

Total #7	5.7
- Total #8	4.09
Required	1.61 ← 5.7 - 4.09

Earliest Time = 2219



QUESTION 3

Queensland Government

Tide Calculations

1. Find the required Locality in the Semidiurnal Tidal Planes
2. Date: 31/07/15
3. Standard Port: BRISBANE BAR Secondary Port: RABY BAY (CANALS ENTRANCE)

Tide	Time	Height
L	0339	0.38
H	0909	1.97

Time Difference	Ratio	Constant
H.W +002 L.W. +002	1.03	+ 0.03

3. Calculate Secondary Port Tide Times (+ or -)
4. Calculate tide heights (multiply by ratio, and + or – constant)
5. Secondary Port:

Tide	Time	Height	
L	0341	0.42	(0.4214)
H	0911	2.06	(2.0597)

6. Calculate tidal range -

H.W.	2.06
L.W.	0.42
Range	1.64

(SEE #2 on BELL CURVE)

7. Your vessel requires -

Draught	4.3 M
UKC	0.2 M
Total	4.5 M

8. You have at L.W. -

Sounding	3.0 M
L.W.	0.42
Total	3.42

9. Refer to "Bell Curves" for calculation
10. All calculations should be taken as before or after H.W.
11. Therefore you require:

Total #7	4.5 M
- Total #8	3.42 M
Required	1.08 M

Earliest Time =

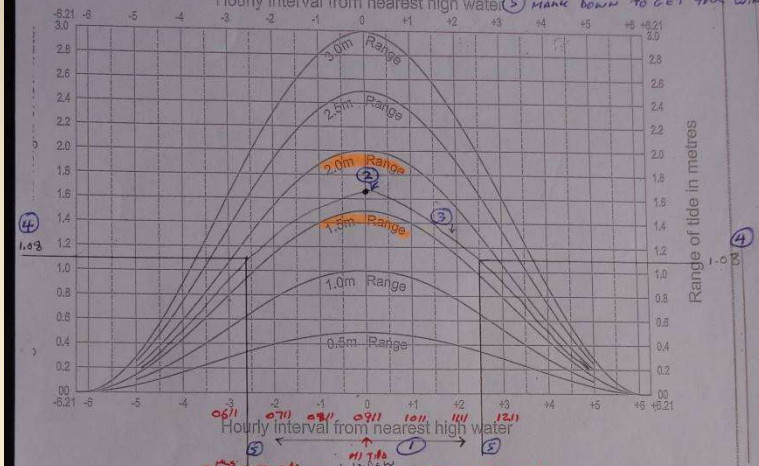
(2) IS RANGE AS SHOWN IN TIDAL TABLE (1) MARK IN YOUR HOURS OF HIGH TIDE HI TIDE = 0 - THEN MARK OF HOURS

QUESTION 5

Standard Tidal Curve

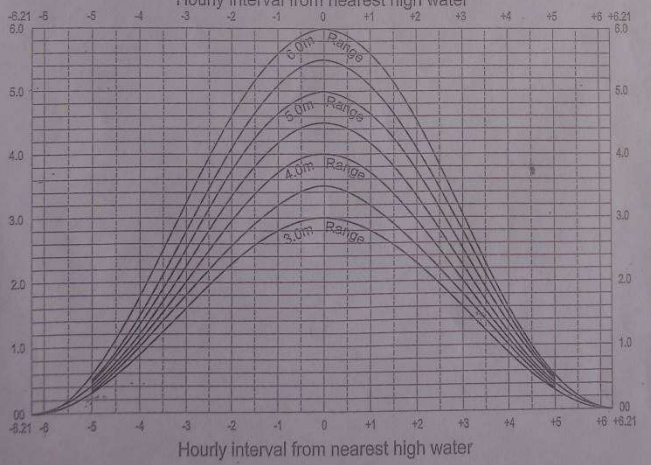
(3) ON THE '0' HEIGHT LINE, PUT A MARK ON THE TIDAL RANGE POINT
(3) DRAW IN A BELL CURVE FROM THAT POINT
(4) MARK IN YOUR REQUIRED CLEARANCE DEPTH (1.08)
(5) MARK DOWN TO GET YOUR WINDOW

Tide Ranges up to 3m

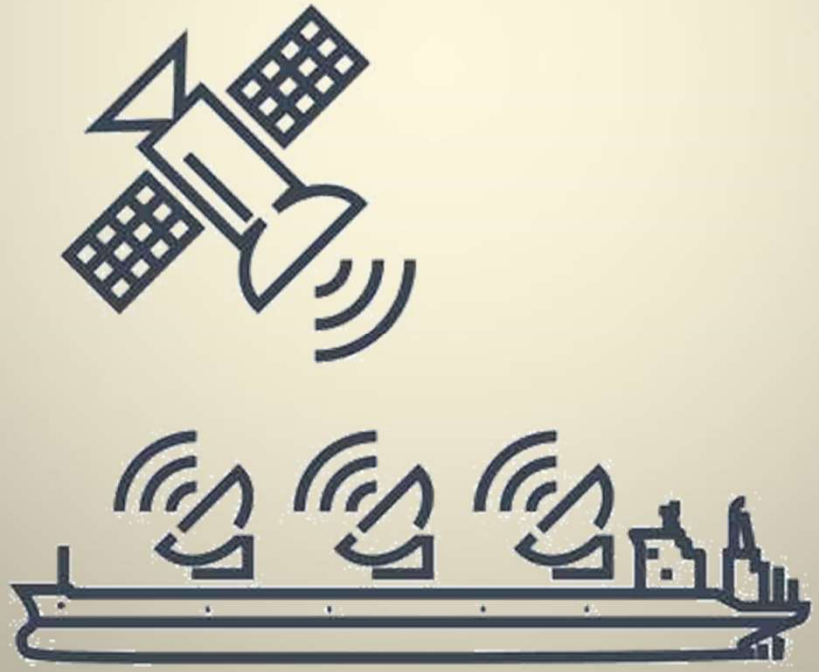


THIS LINE @ 0640

Tide Ranges up to 6m



Electronic Aids To Navigation




FURUNO GPS NAVIGATOR
3D 30-APR-97 06:02:43
47°37.104' N
122°26.060' W
SPD: 1.0kt
CSE: 321°

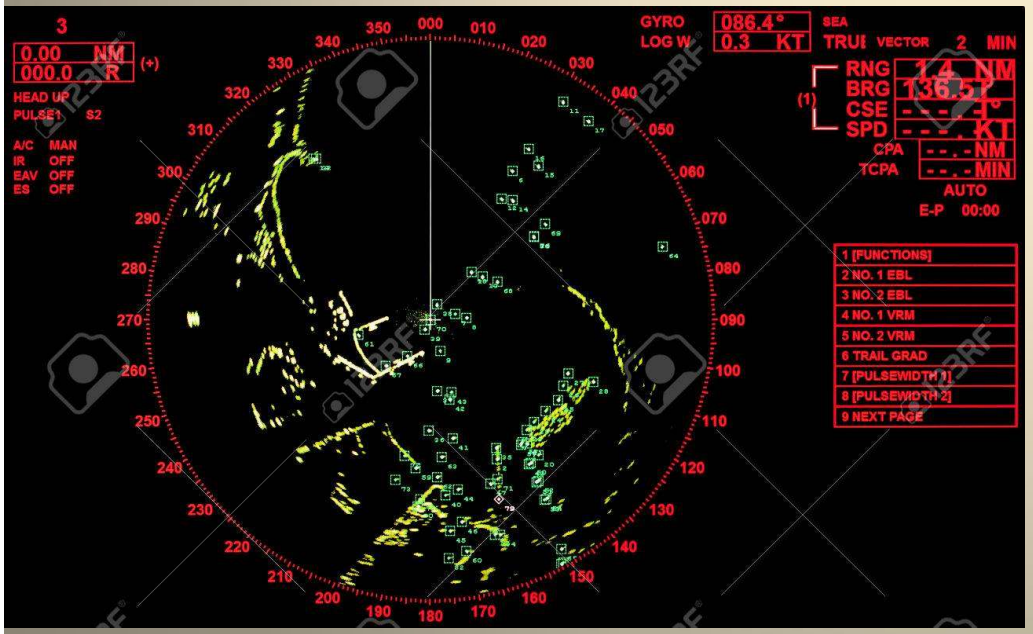

FURUNO
AUTO
19.0
12.5


Raymarine
REEL THING
CHART
SONAR - HIGH
SIDEVISION
3D SONAR
CHART/DASHBOARD
RADAR
DASHBOARD
My Data
MOB
Alarms
Settings

Radar

Used For

Collision avoidance
Position fixing
Finding Ranges/Bearings
(Radar Ranges more accurate than Radar Bearings)

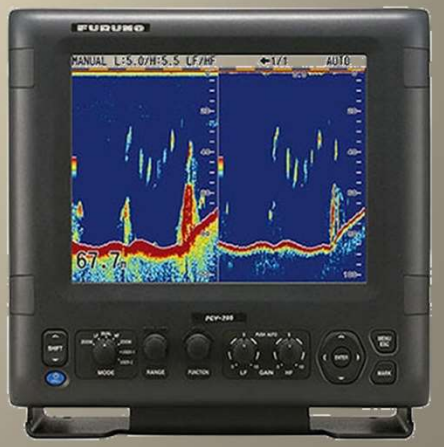


←Your “EYES” at night

Echo Sounders

Display screens are either colour or monochrome

Many units can display Split Screens, Bottom Lock Expansion, Marks and other operator options (Shallow/Depth alarms, Fish Alarms…)



Auto Pilot

All watchkeepers must know how to Engage & Disengage the Auto Pilot (“Stand-by” switch)

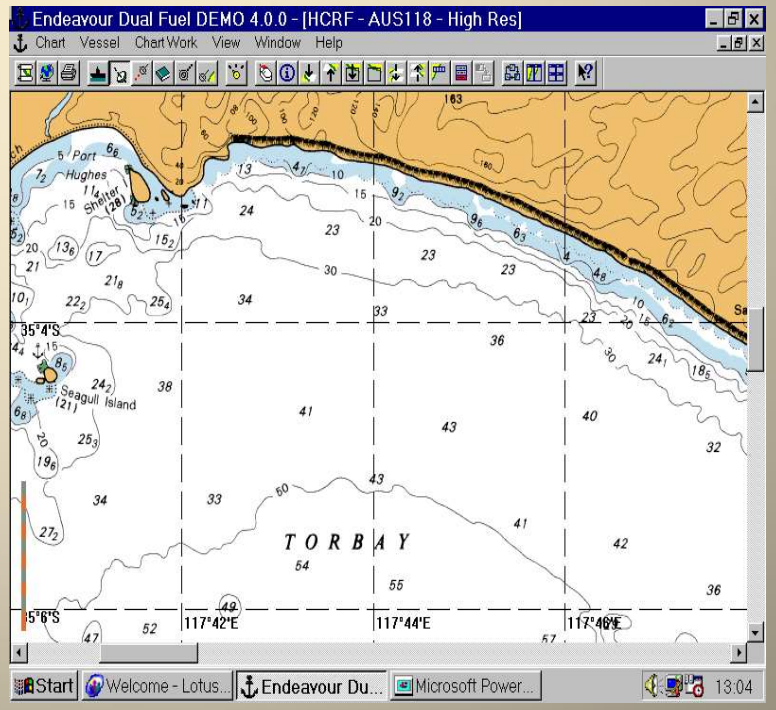
GPS - Plotter

GPS - How does it work?

How accurate is it?

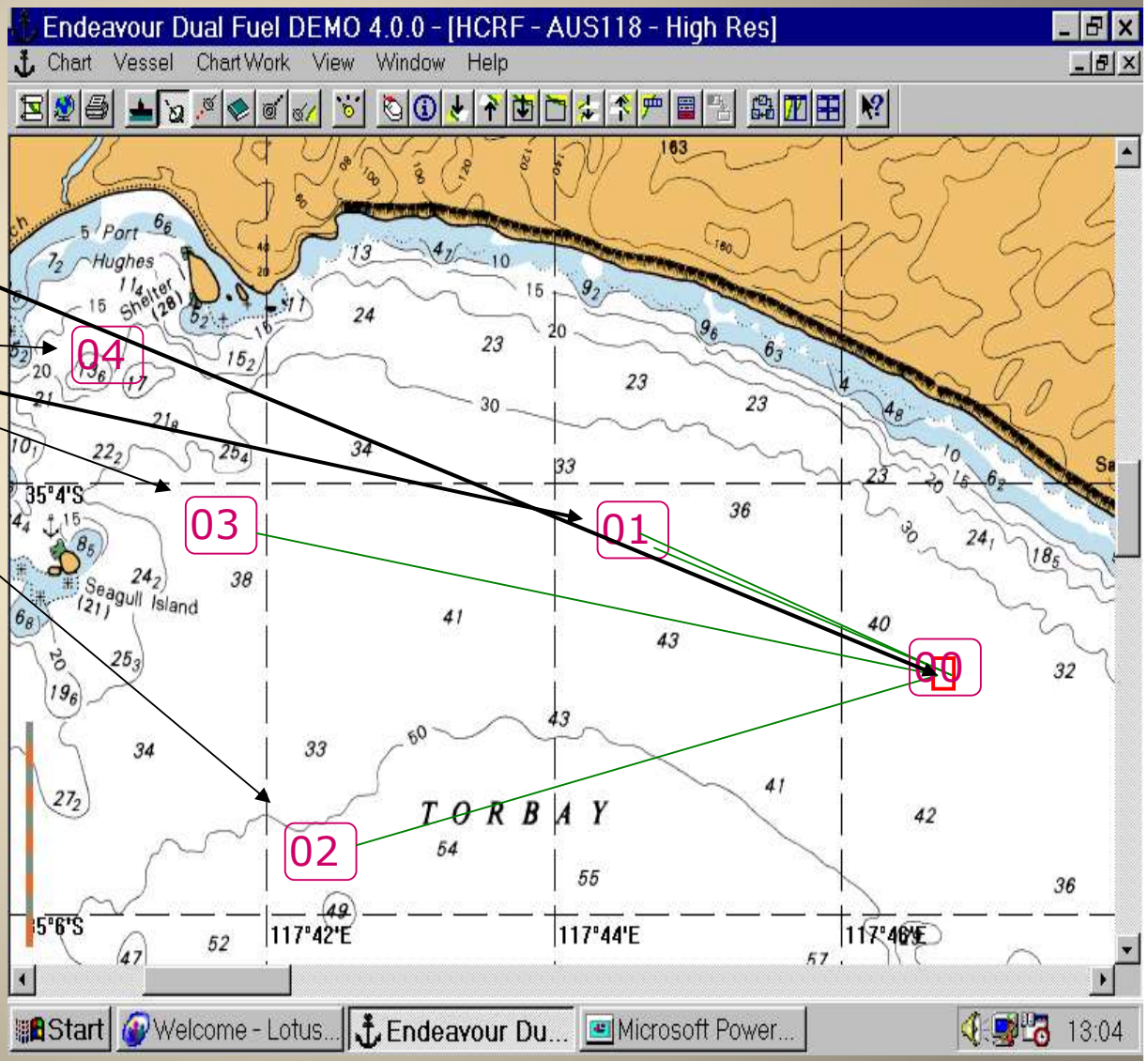
Waypoint Navigation

- "WAYPOINTS" – Co-ordinates in Latitude & Longitude
- Commonly used to indicate point where a "Change of Course" is to be made when planning a safe passage
- May also be used to mark other points of interest (e.g. fishing spots)



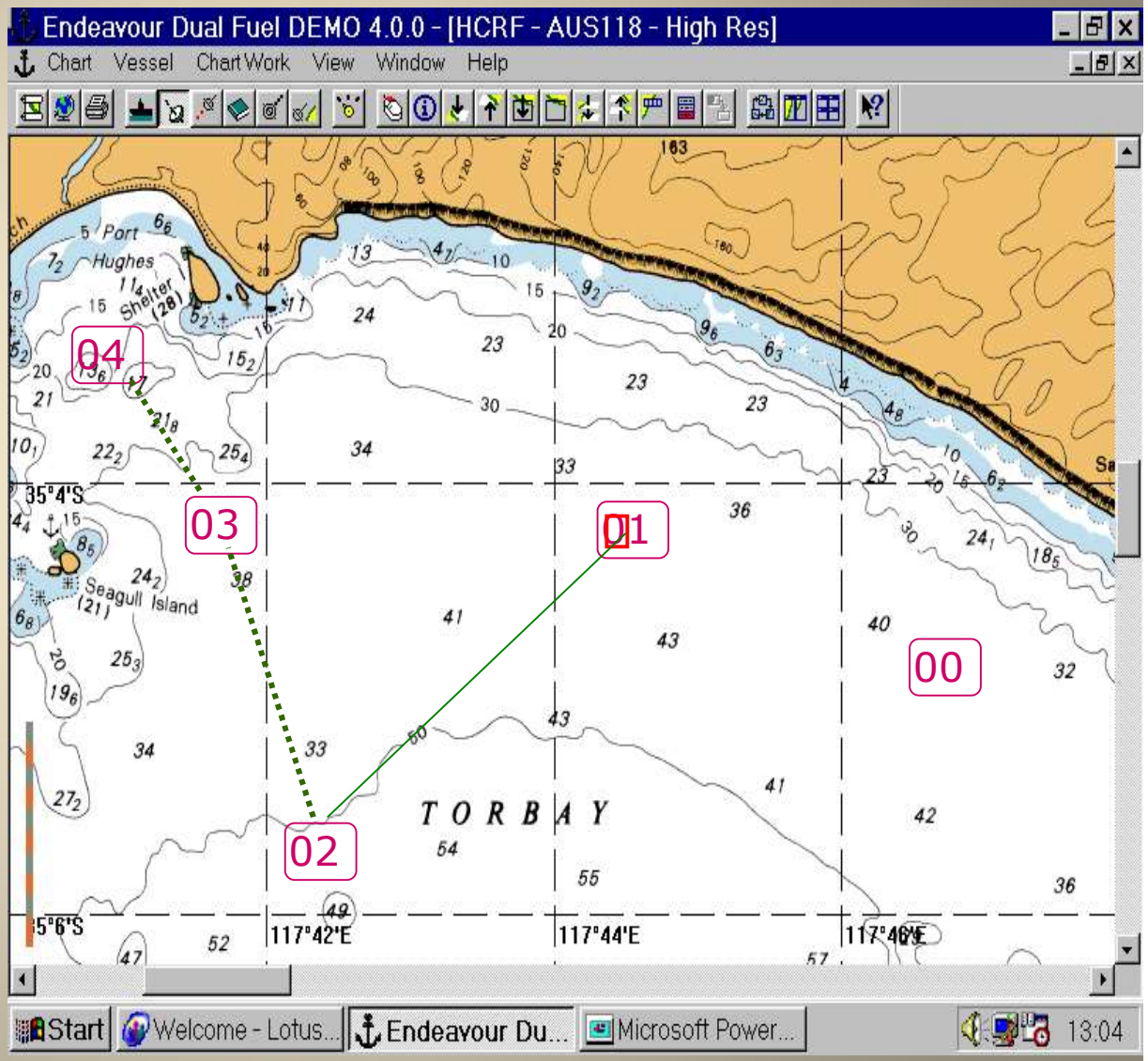
Electronic Navigation

- Vessel position is constantly indicated on chart
- Waypoints may be entered where appropriate
- Any Waypoint may be selected as a “Go to” destination
- When navigating keep your vessel on the Waypoint track



Electronic Navigation

- When you arrive at Waypoint, select next Waypoint destination
- A Waypoint Route can also be selected where future tracks will be shown
- Alter course and navigate to selected Waypoint
- Alarm zones may be set around Waypoints to warn when your vessel is a set distance away

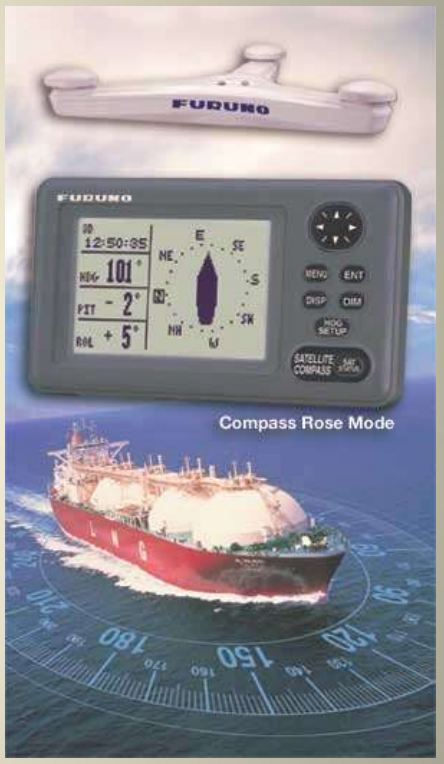


Gyro Compass

- Minimal Error
- Seeks True North
- Repeaters placed anywhere on vessel
- Excellent for taking True Bearings

Satellite Compass

- Extremely accurate
- Cheaper and not as bulky as a Gyro Compass
- Does not rely on earth's magnetic field
- Not affected by metallic objects
- No moving parts to maintain



Study Note

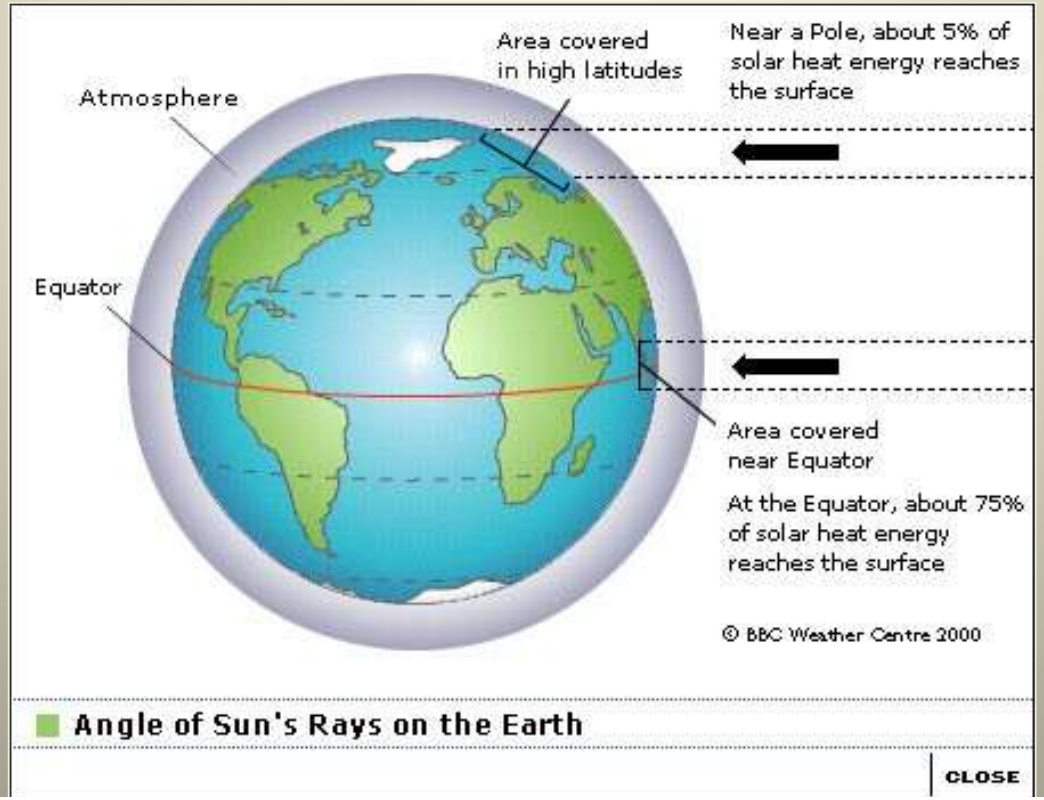
- You should be able to list a number of errors that may affect navigation equipment, in particular GPS
- Describe various checks you could make to cross check the accuracy of navigation equipment.
- What you could do to ensure the accuracy of GPS fixes.

Meteorology

Meteorology

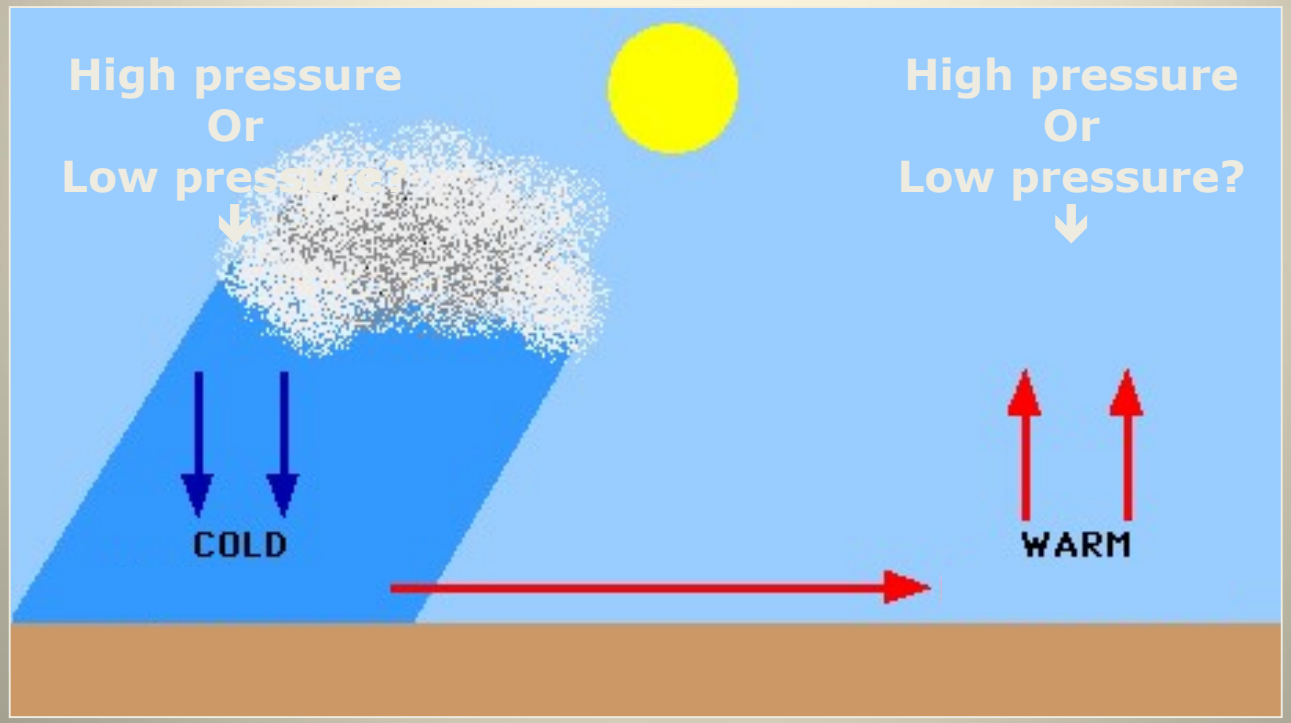
What causes weather?

Weather is caused by the circulation of the Atmosphere, which is caused by the unequal heating of the earth's surface by the sun.

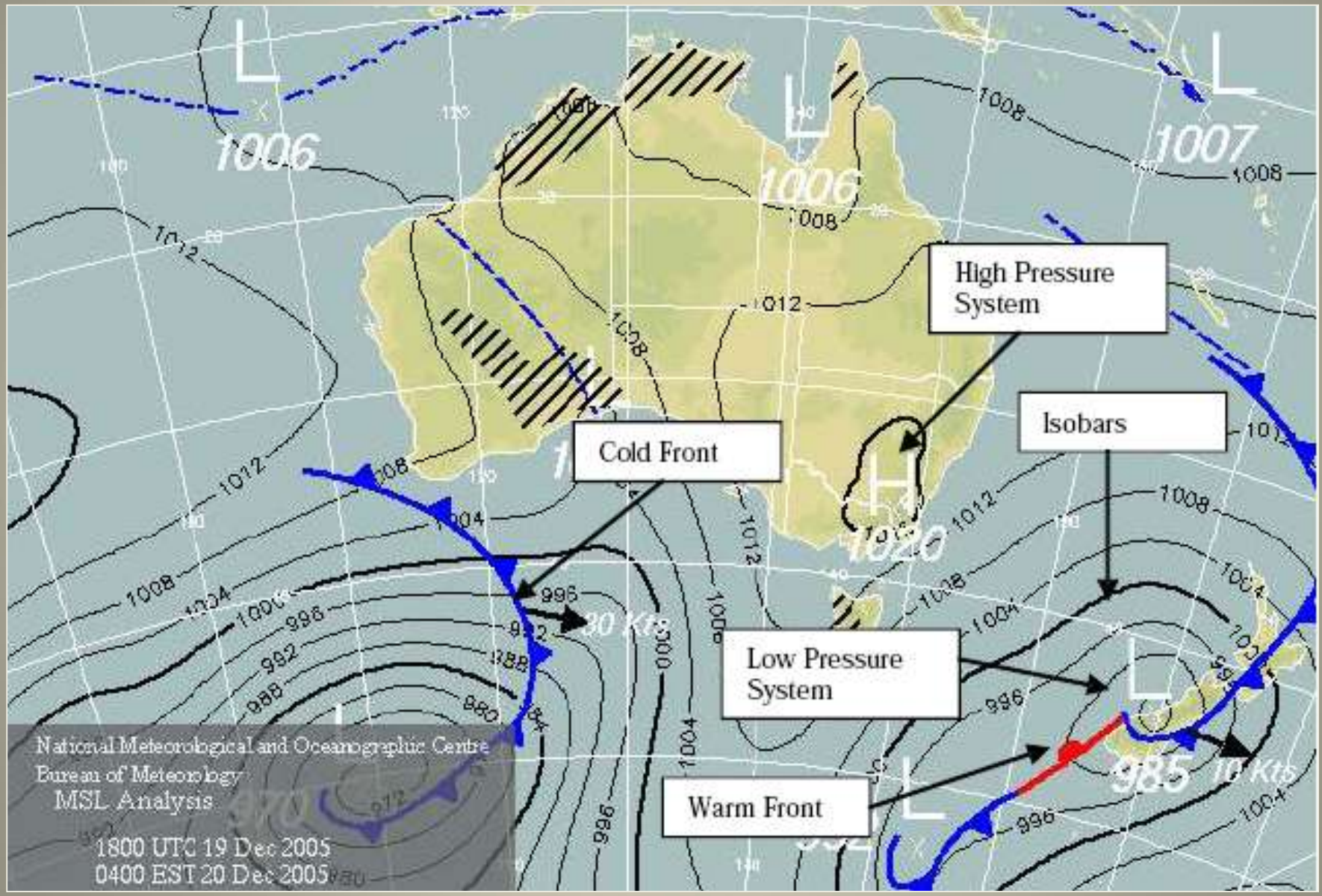


Pressure systems

Unequal heating of the earth's surface by the sun



Typical Weather Map – Synoptic Chart

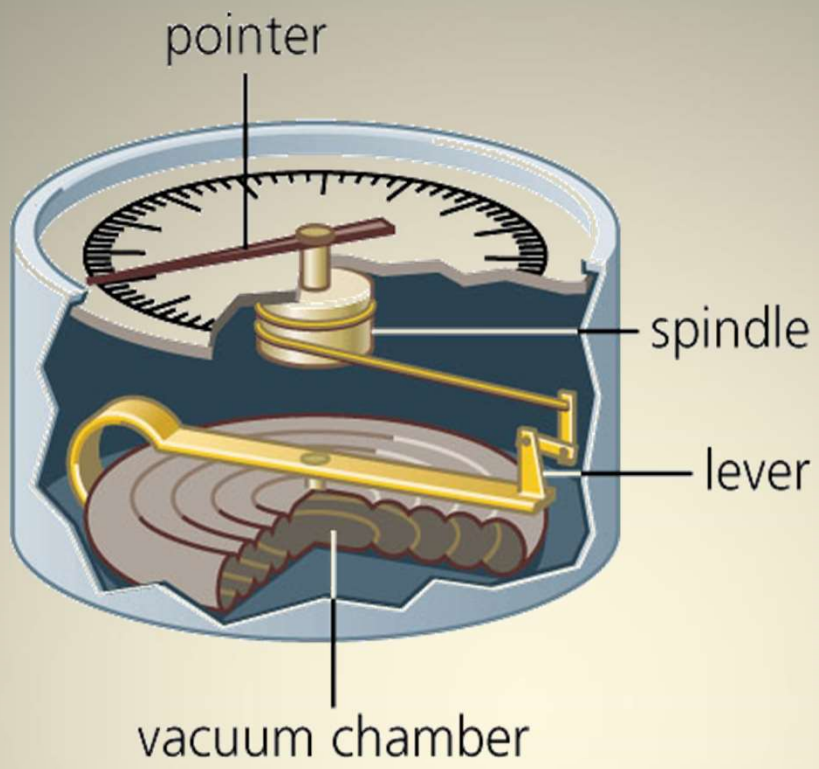


<u>Atmospheric Pressure</u> – The force exerted by the atmosphere on each unit of area, or **the "weight" of air.**

- The unit used is the **hectopascal.**
- 1 hectopascal = 100 Newtons per square metre.
- 1 millibar = 1 hectopascal
- Average atmospheric pressure = 1013 hectopascals

The Aneroid Barometer

and how to use it.



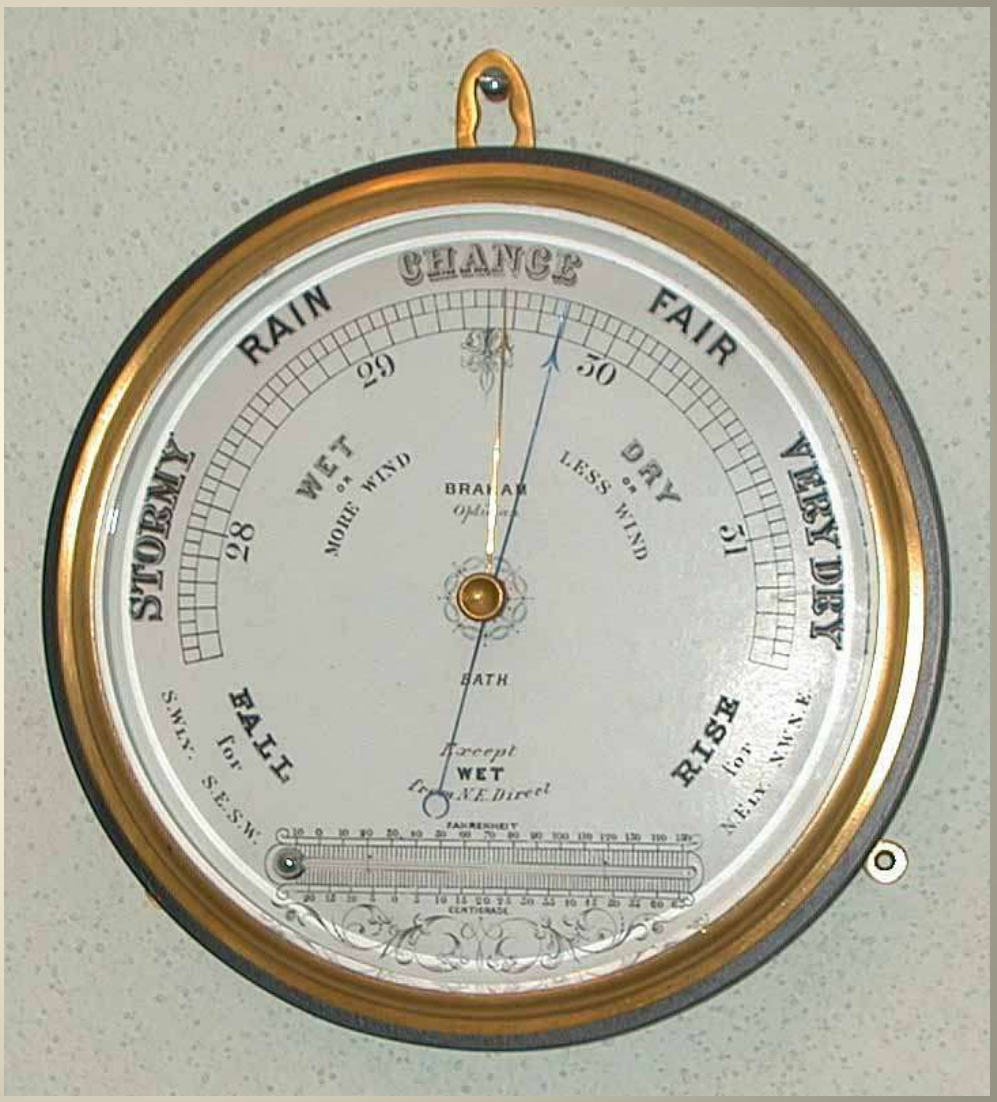
The aneroid barometer consists of a closed sealed capsule (vacuum chamber) with flexible sides. Any change in air pressure creates movement of the capsule sides

Levers magnify these changes, causing a pointer to move on a read-out dial

Reading The Barometer

Tap glass lightly

- Move “Set Pointer” to sit over pressure indicator
- Approx 2 hours later tap glass lightly to check position of pressure indicator
- Note rate and amount of rise or fall in air pressure since previous check
- This will indicate whether a High or Low pressure system is approaching, and associated wind strength

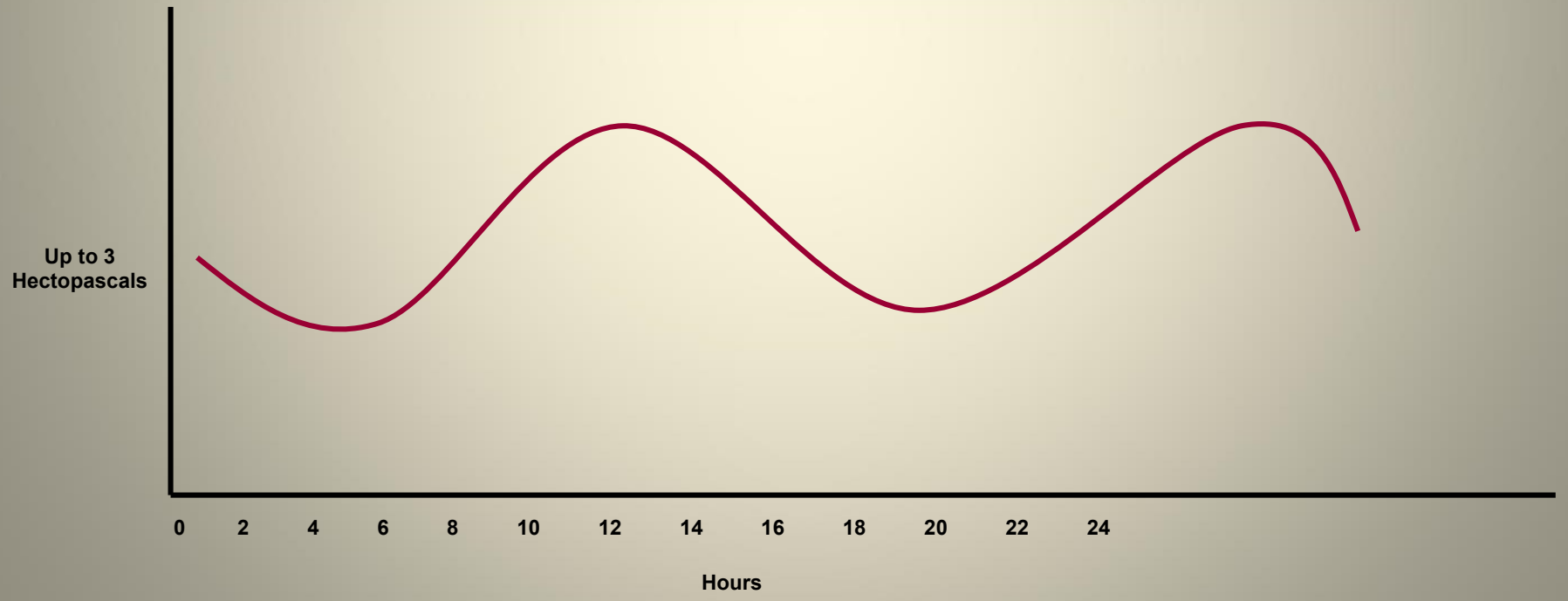


Diurnal Variation
(twice daily)

- A daily atmospheric “tide”
- Diurnal variation approx 3 hPa
- Lower at 0400 hrs & 1600 hrs
- Higher at 1000 hrs & 2200 hrs

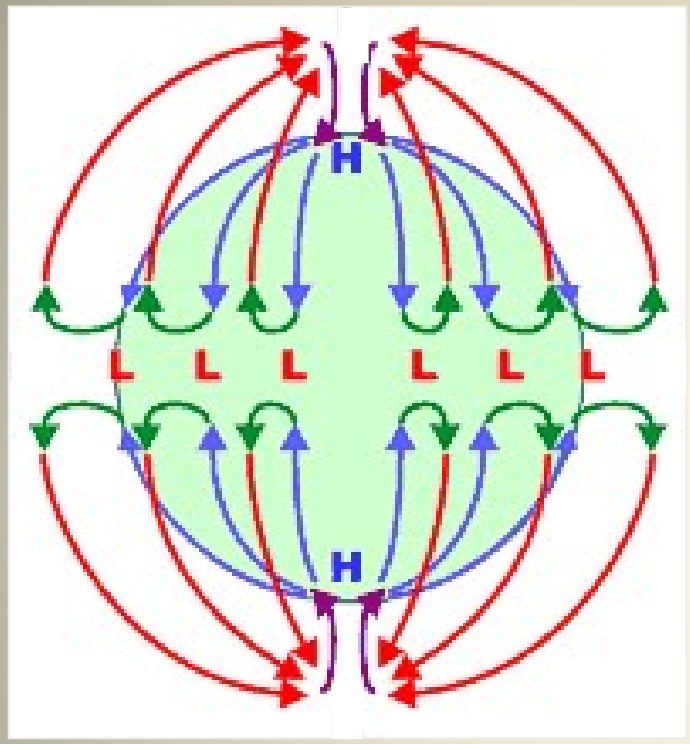
Diurnal Variation
(twice daily)

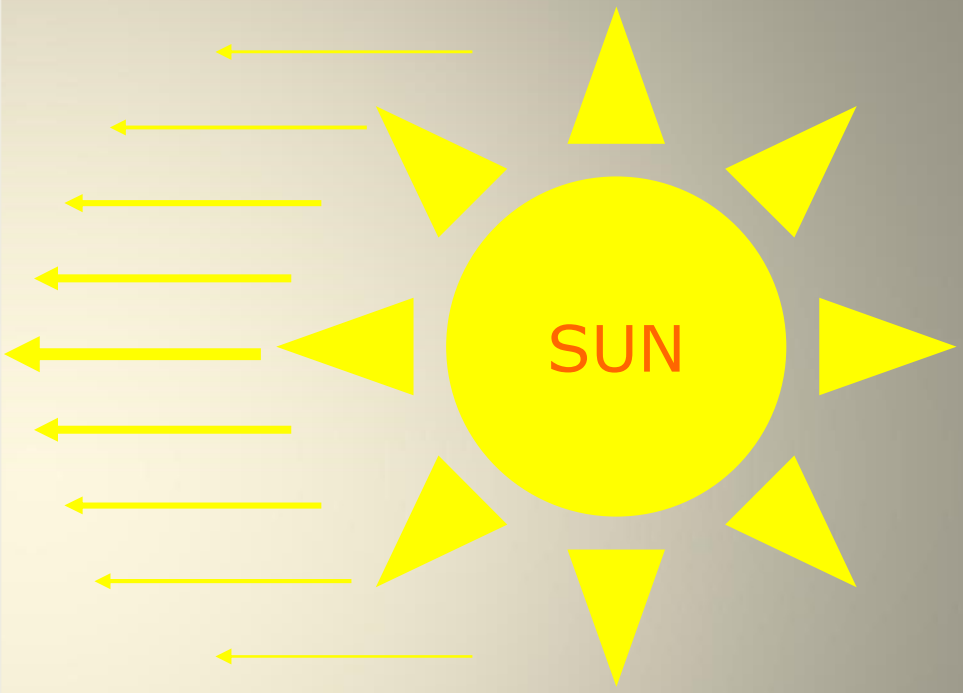
- Lower at 0400 hrs & 1600 hrs
- Higher at 1000 hrs & 2200 hrs



Low and High Pressure systems

If the Earth did not rotate……..



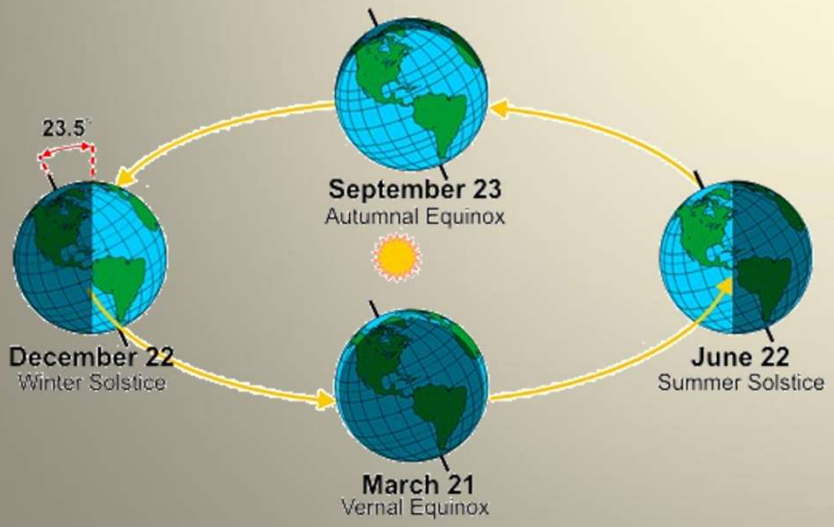


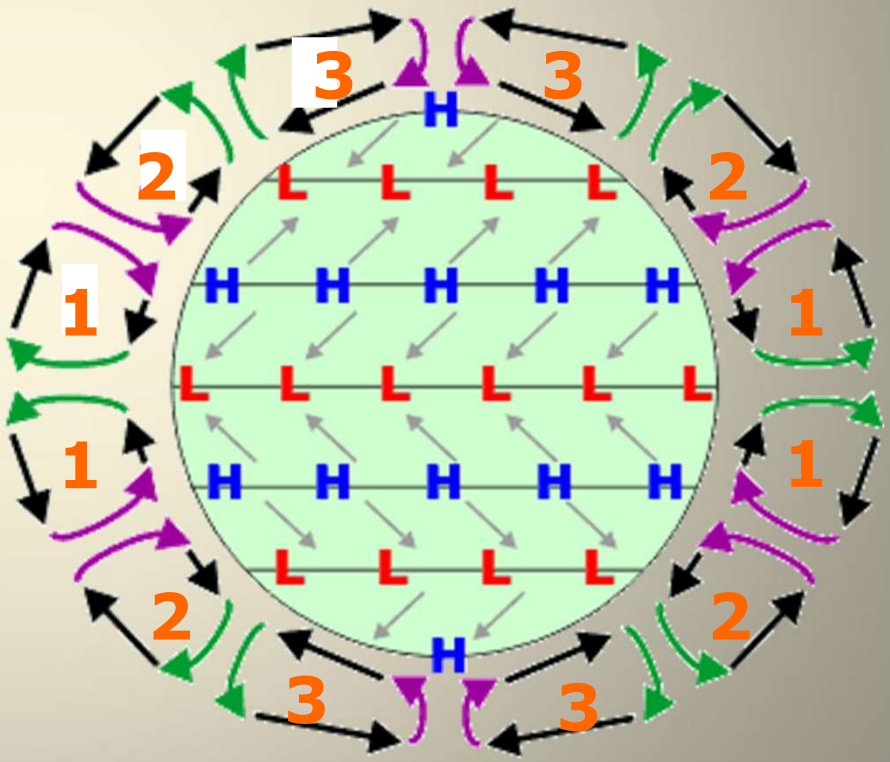
……one large area of High pressure would be at each of the poles with a large belt of Low pressure around the equator

Because :

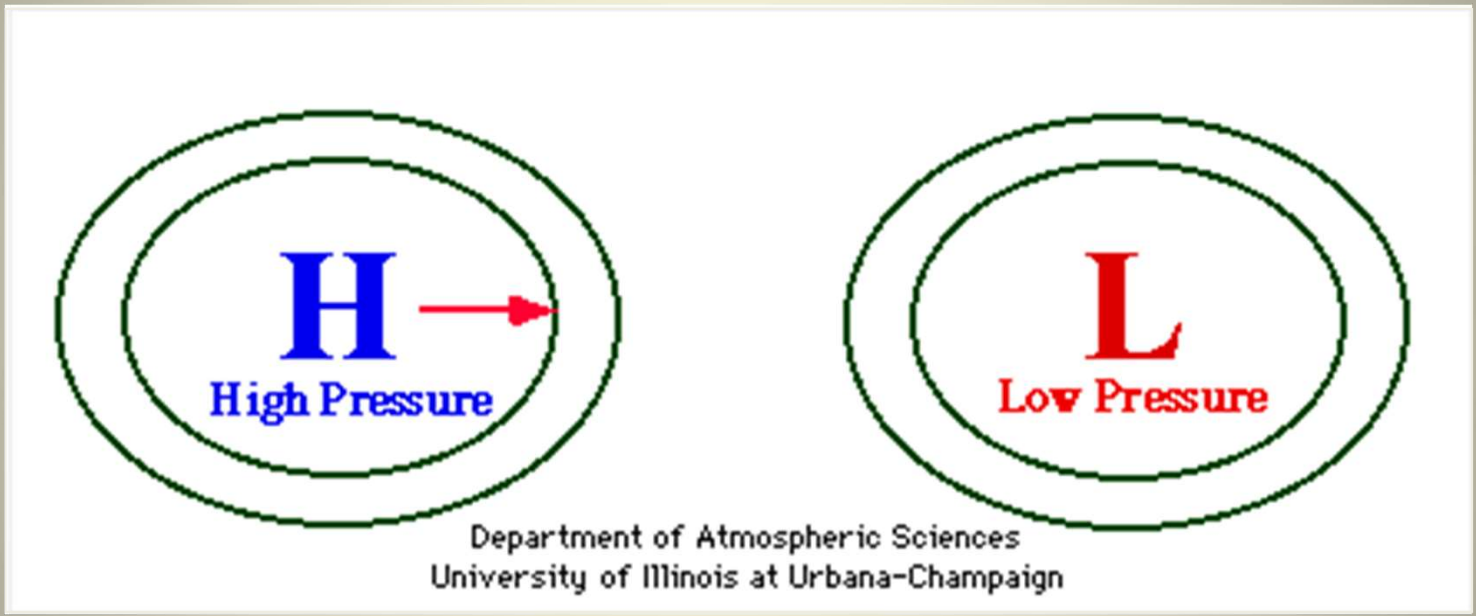
- The Earth rotates,
- Its Axis is tilted,
- It consists of Land and Water

There are 3 air circulations in each hemisphere……

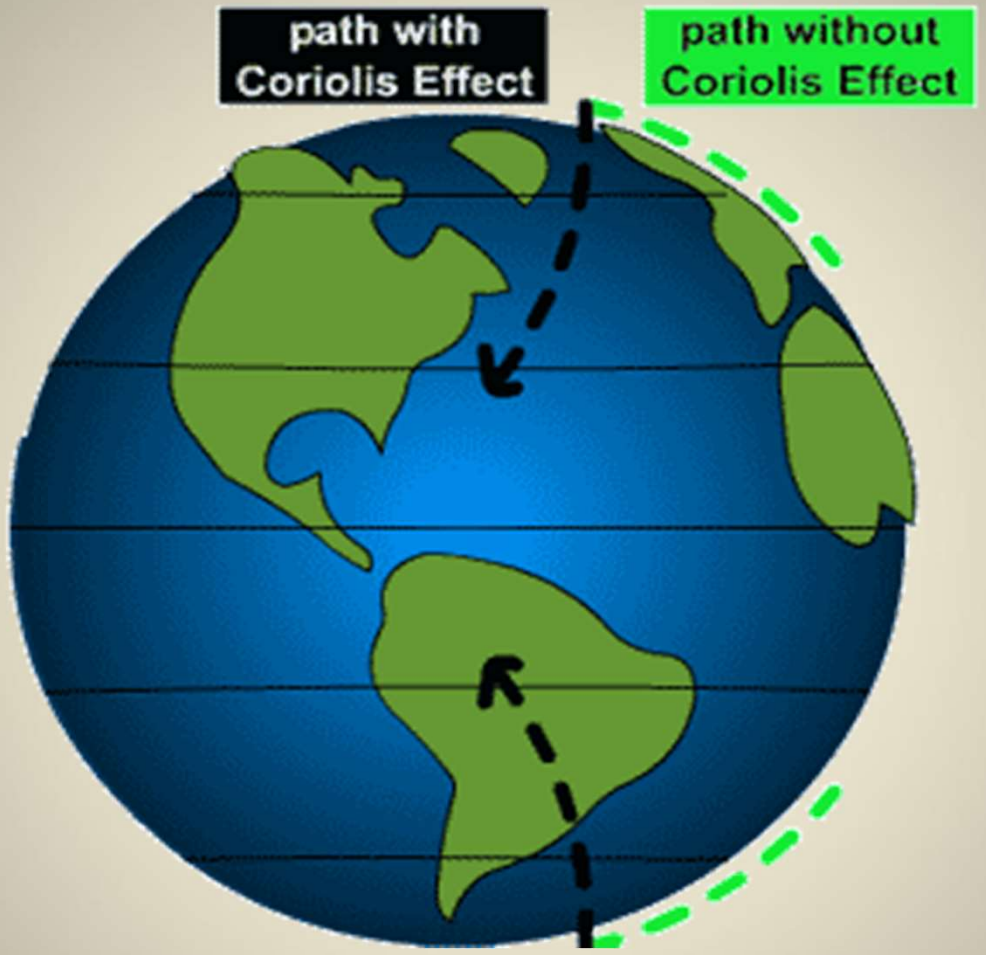




In the absence of other forces, air moves from a High pressure to a Low pressure



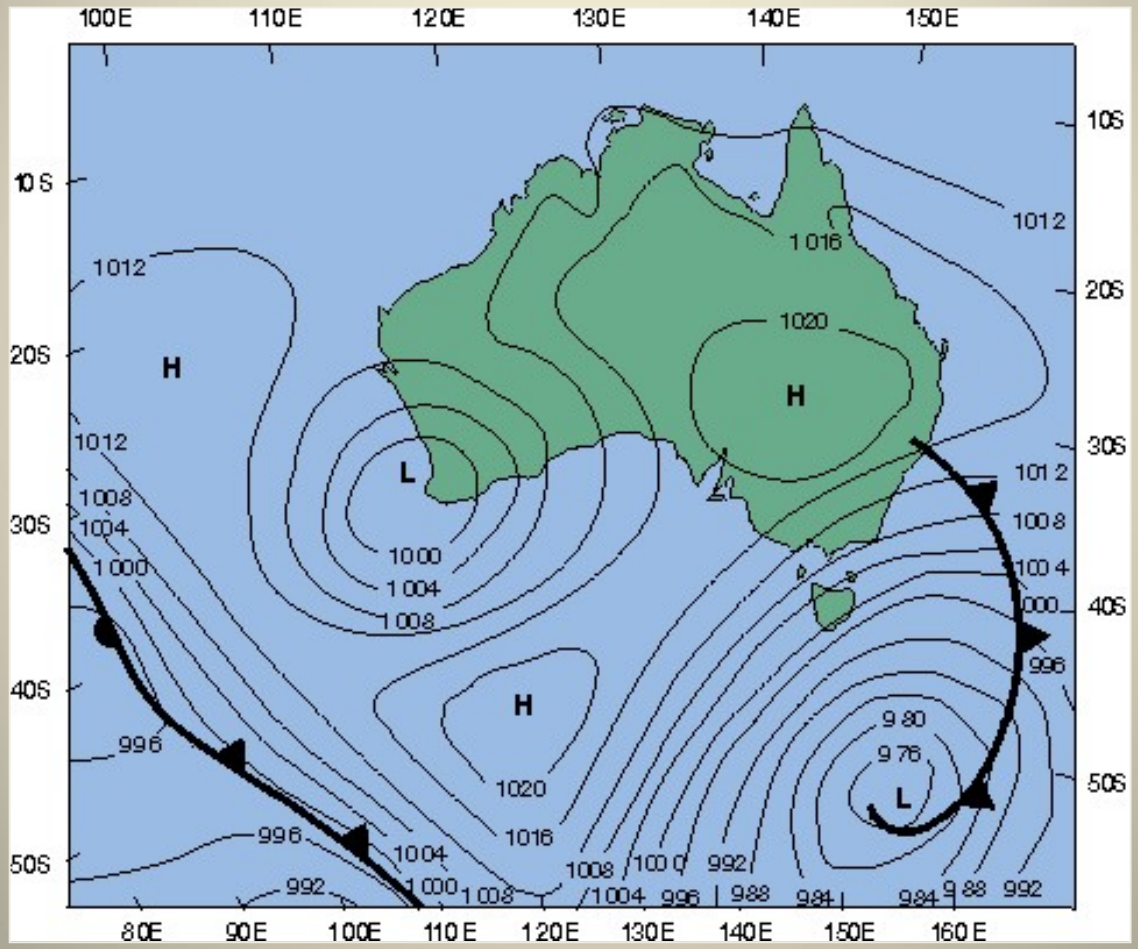
Coriolis Effect



In the **Southern Hemisphere**, air moving from a **High** to a **Low** pressure is deflected to the **left** by the **Coriolis** effect

General Weather Terms

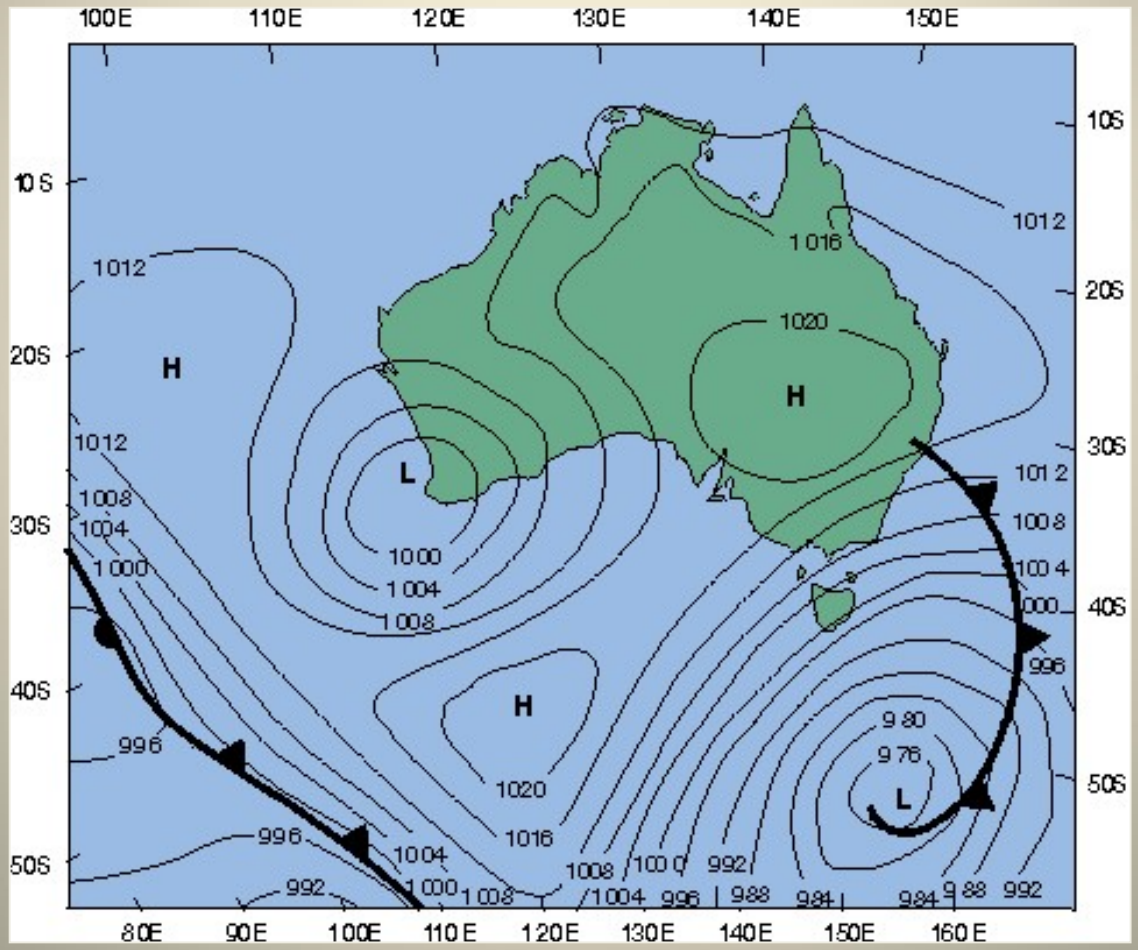
Isobars – lines on a weather map joining places of equal atmospheric pressure



Synoptic Chart

General Weather Terms

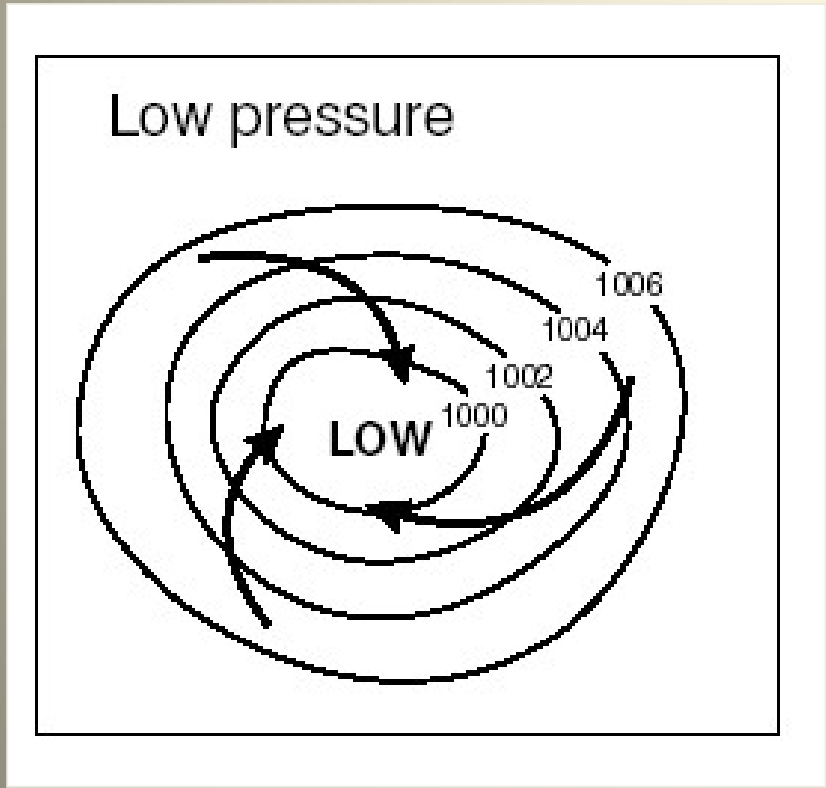
<u>Low, Depression or Cyclone</u> – An area of low pressure within a closed system of isobars

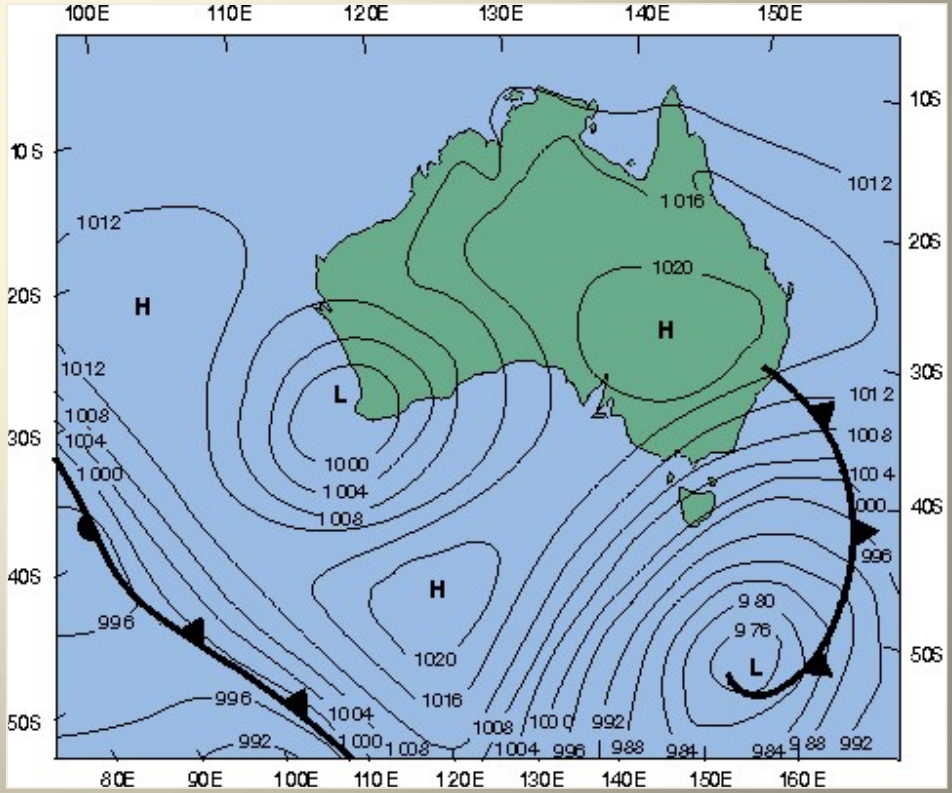


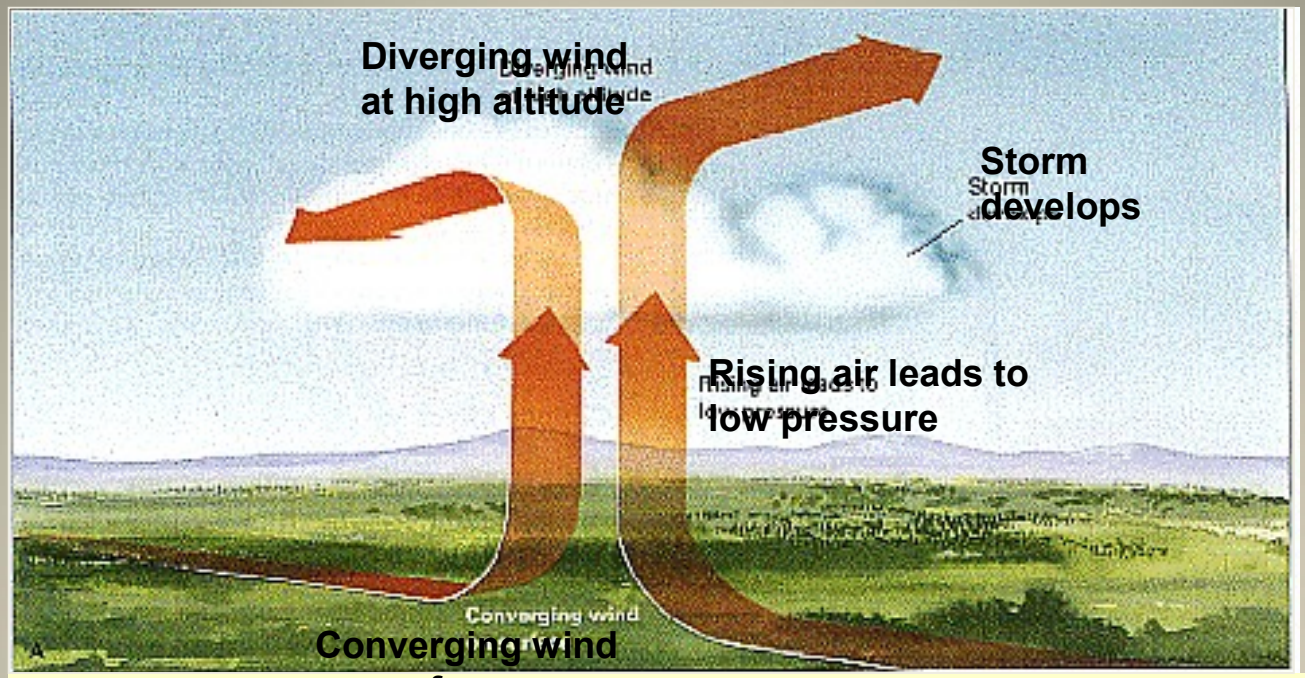
Low Pressure System

"Region of rising air"

- Lowest pressure in centre
- Winds circulate clockwise *(Southern Hemisphere)*
- Usually associated with bad weather





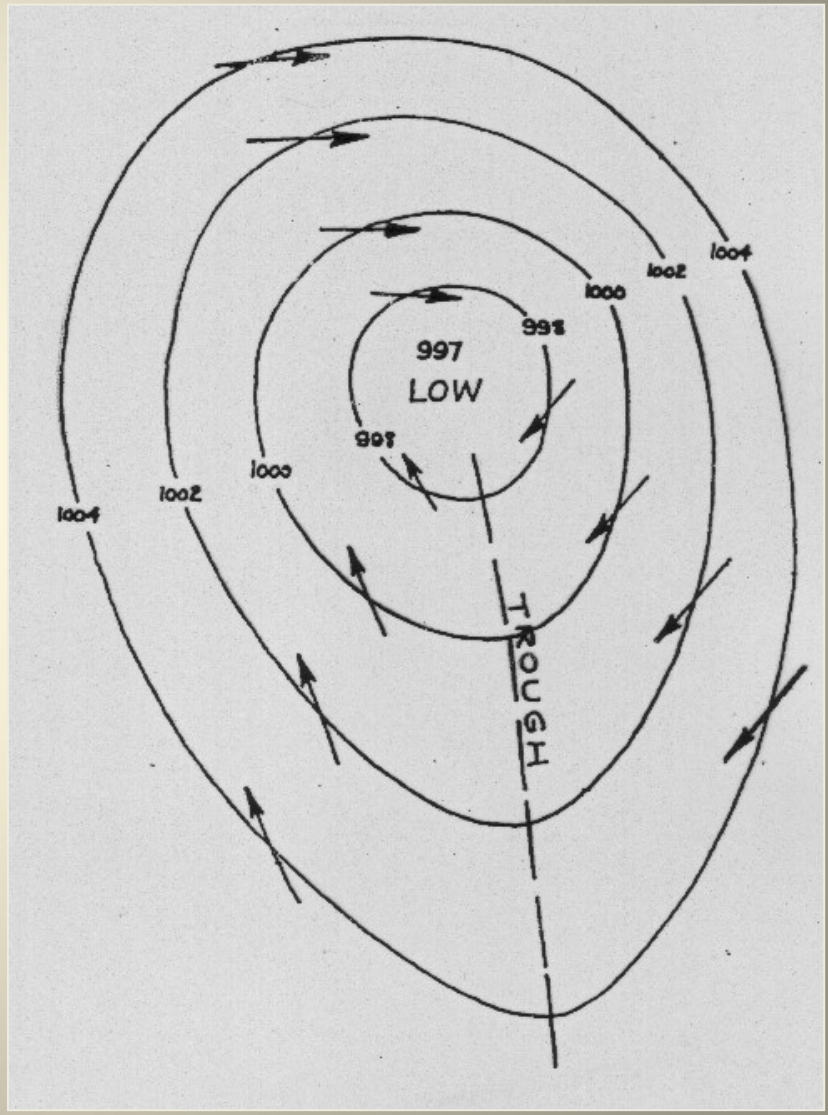


A **LOW PRESSURE SYSTEM** (cyclone) develops where relatively warm air ascends from the Earth's surface.

As the rising air cools, clouds will begin to form. The instability of the air will produce large vertical cumuliform clouds with associated rain showers (such as cumulonimbus cloud).

General Weather Terms

<u>Trough of Low Pressure</u> "An area of Low pressure extending into or penetrating an area of High pressure"

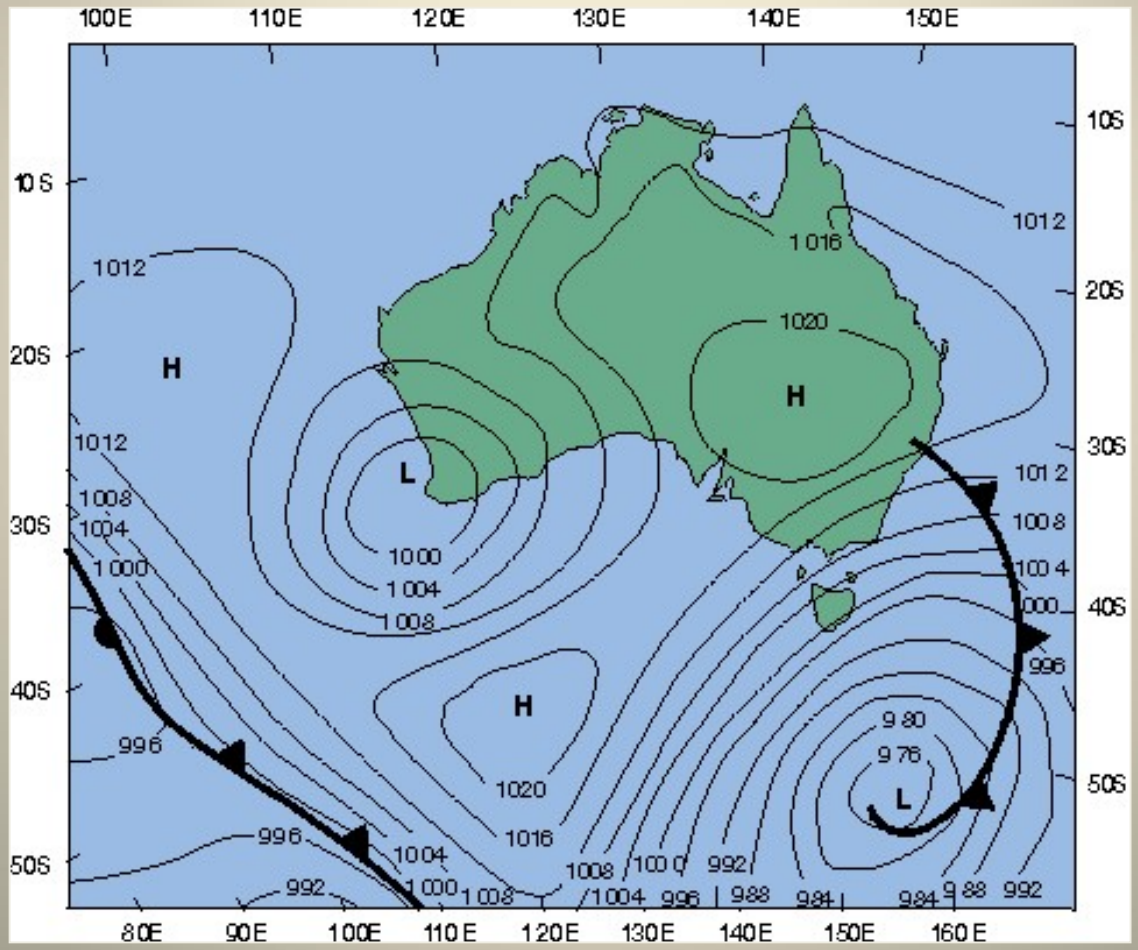


It is called a trough because the atmospheric pressure over the region is lower than its two adjacent sides, in contrast to a ridge of high pressure.

A trough usually contains one or more Cold Fronts

General Weather Terms

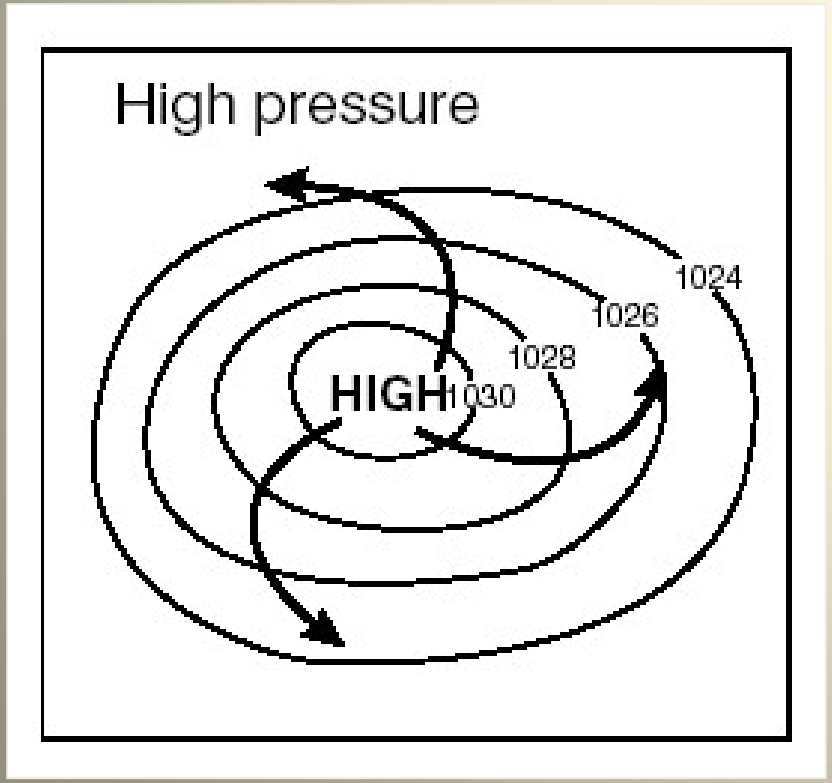
<u>High or Anti-Cyclone</u> – An area of high pressure within a closed system of isobars

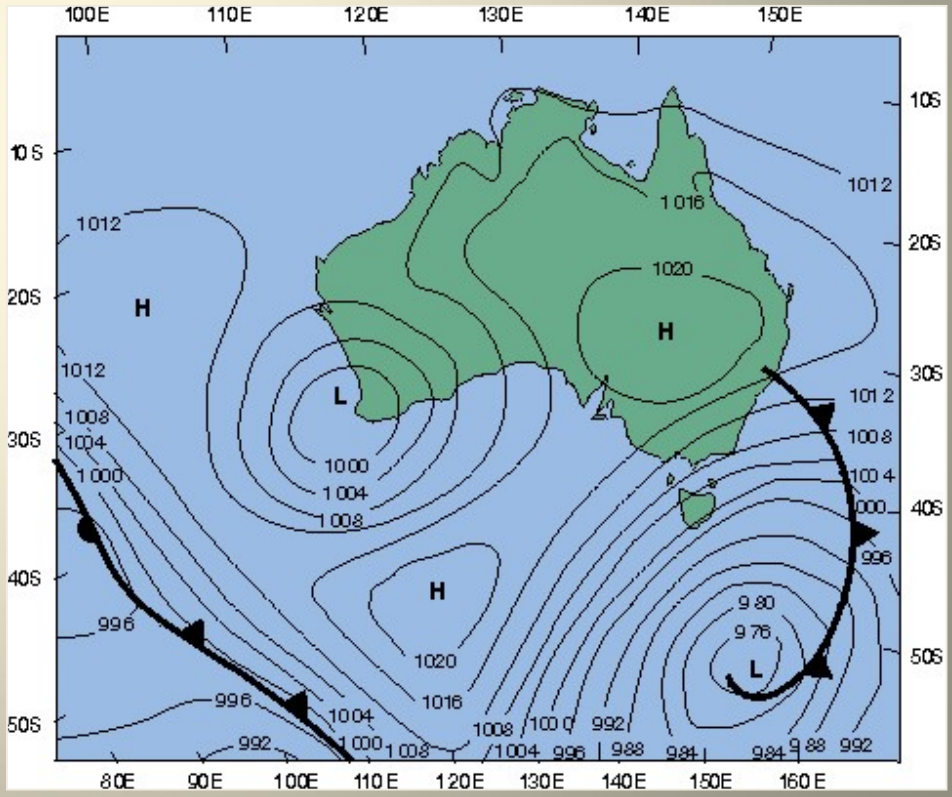


High Pressure System

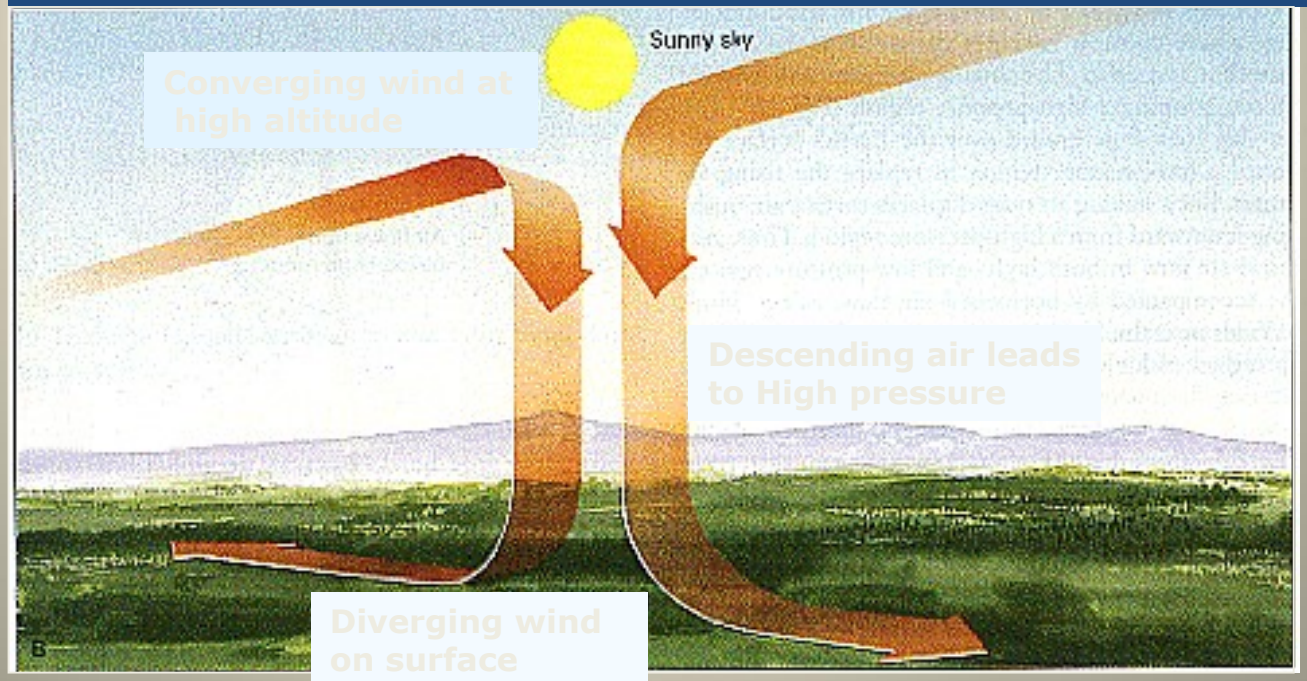
“Region of sinking air”

- Highest pressure in centre
- Winds circulate anti-clockwise *(Southern Hemisphere)*
- Usually associated with good weather



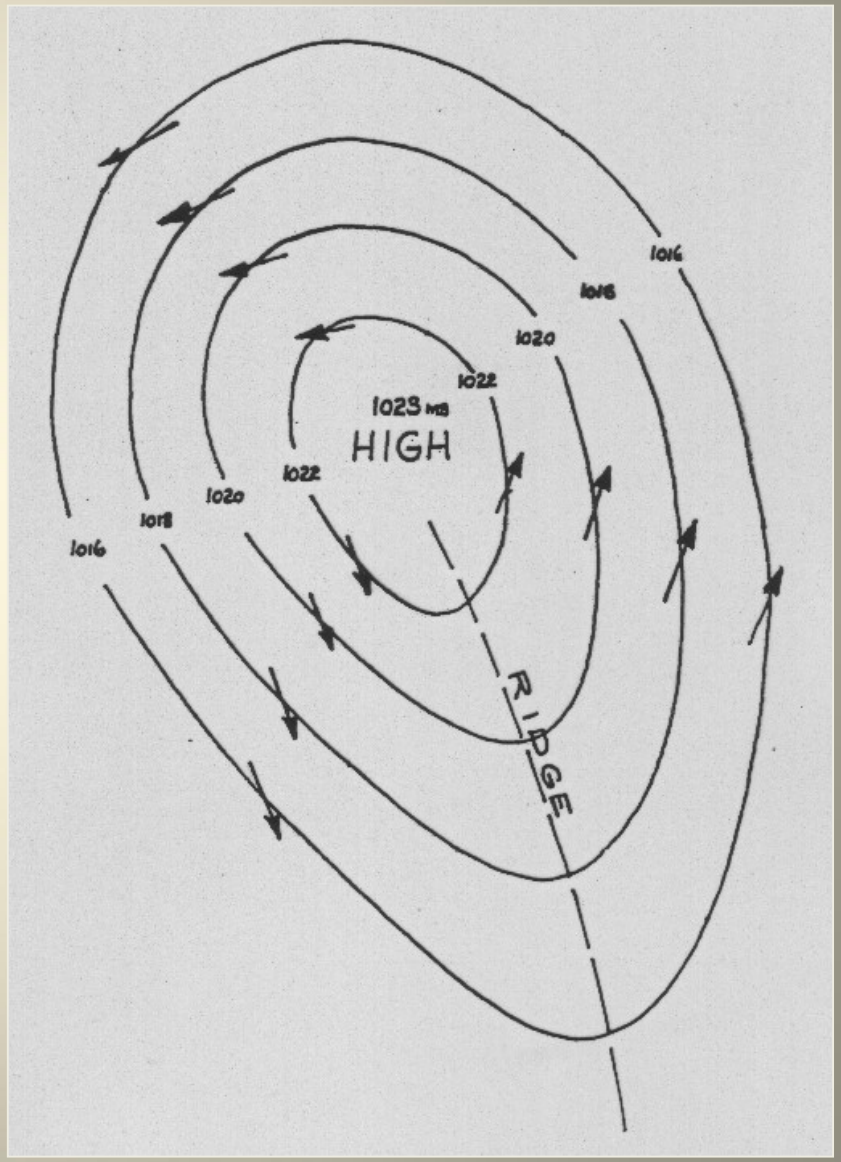


The air associated with a **HIGH PRESSURE SYSTEM** sinks down from above, warms and is very stable.



General Weather Terms

<u>Ridge of High Pressure</u> – "An elongated area of High pressure extending into or penetrating an area of Low pressure"

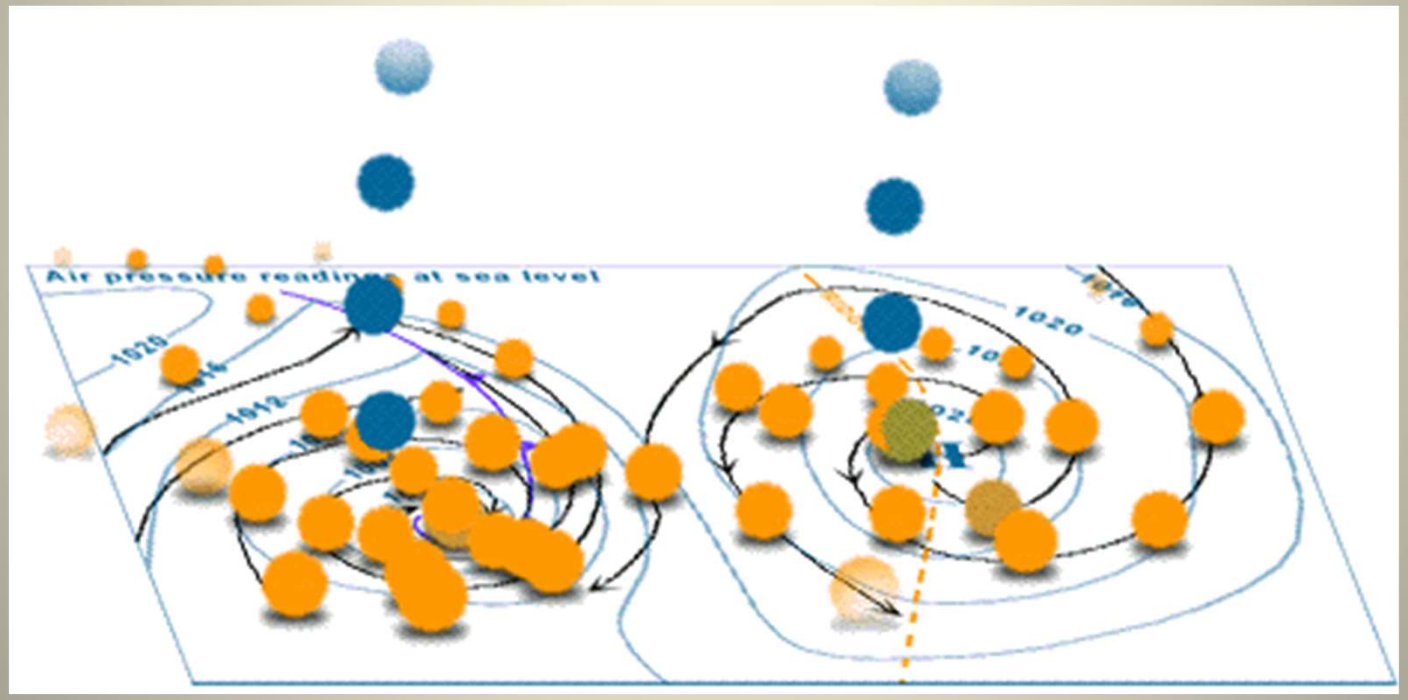


The atmospheric pressure over such a region is higher than its two adjacent sides, figuratively similar to the ridge of a high mountain.

The weather under a ridge of high pressure is generally stable and fine.

In the **Low** pressure region the rising air spirals inward, in a clockwise direction (southern hemisphere).

In the **High** pressure region sinking air spirals outward, in an anticlockwise direction (southern hemisphere).



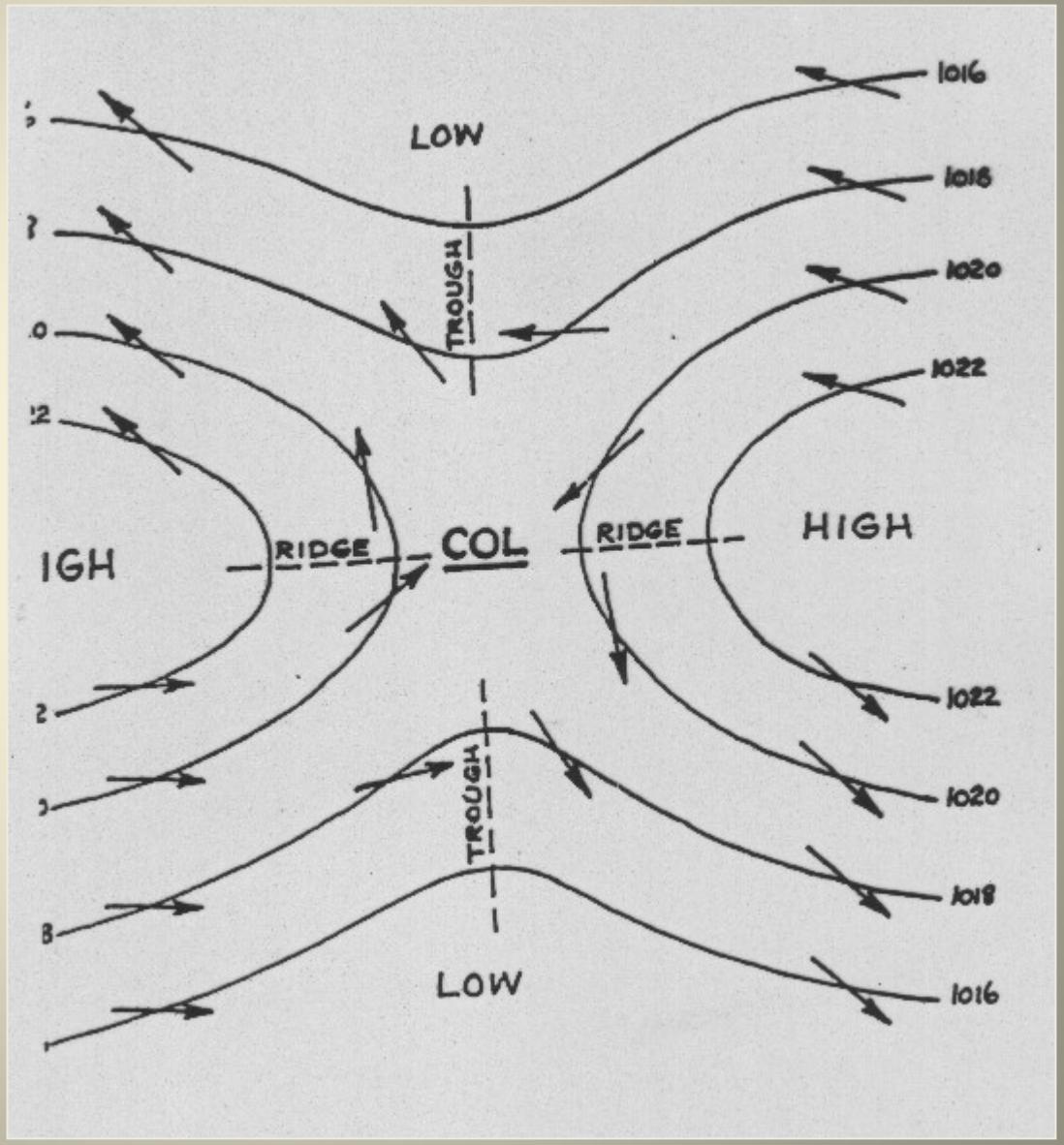
Low **High**

General Weather Terms

<u>Col</u>

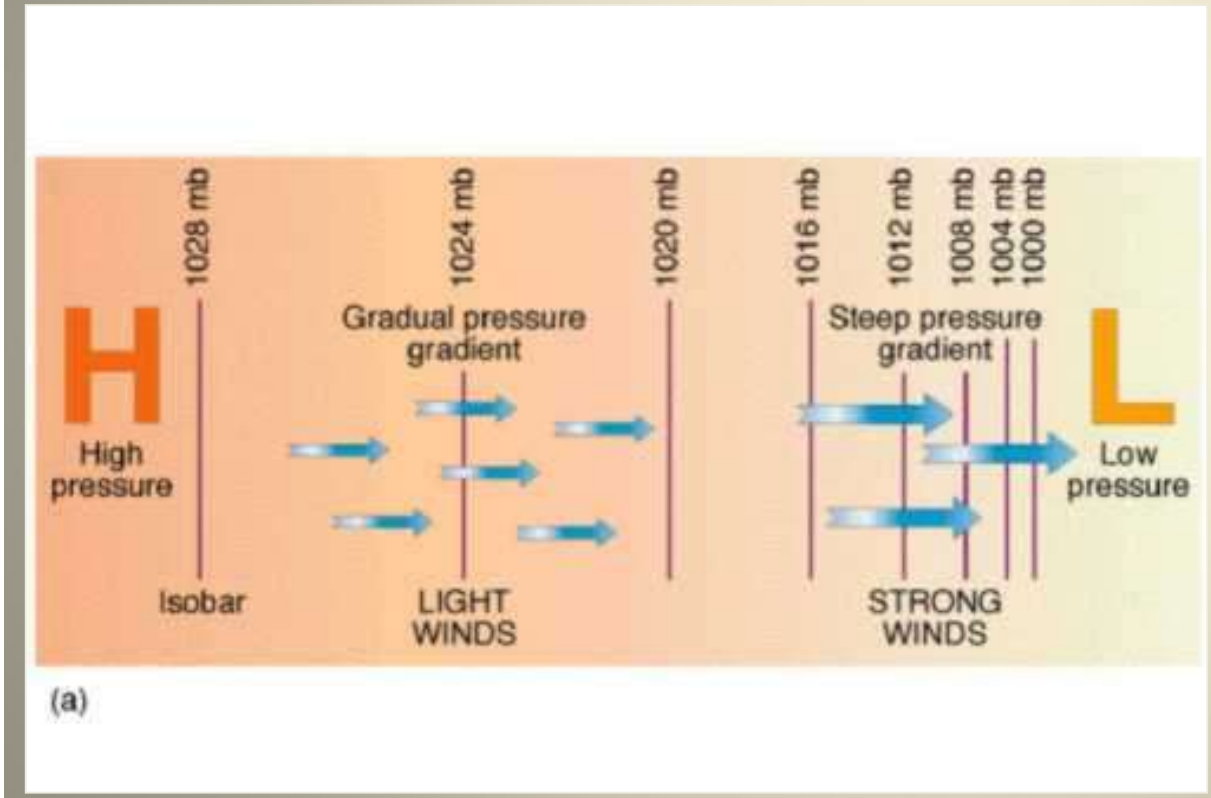
"An area between 2 diagonally opposed Highs and Lows"

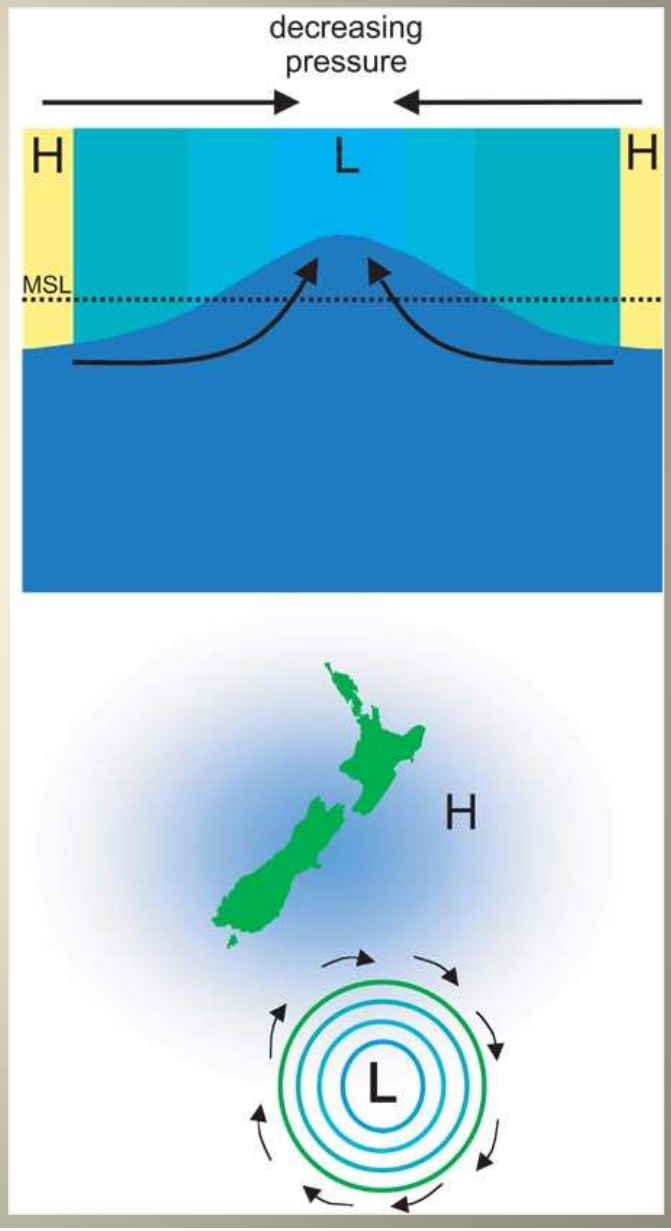
Generally light, variable winds near centre of COL



General Weather Terms

Pressure Gradient – a measure of the rate of change in atmospheric pressure with distance





The closer together the isobars, the stronger the winds

General Weather Terms

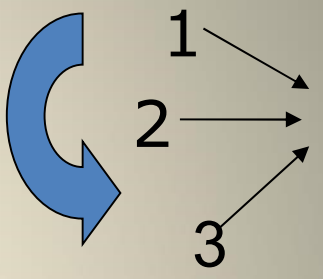
HUMIDITY - a measure of the amount of water vapour in the air.

Relative Humidity – a comparison of how much water vapour is in the air, compared to how much water vapour the air can hold at the same temperature.

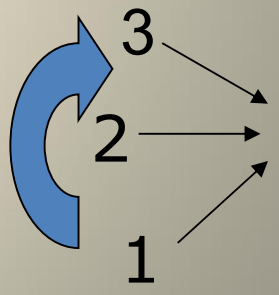
If air temperature is 20°C, each cubic metre of air can contain up to 17g of water vapour. If there is only 8.5g of water vapour per cubic metre at 20°C, we can say the relative humidity is 50%.

Wind - Backing & Veering

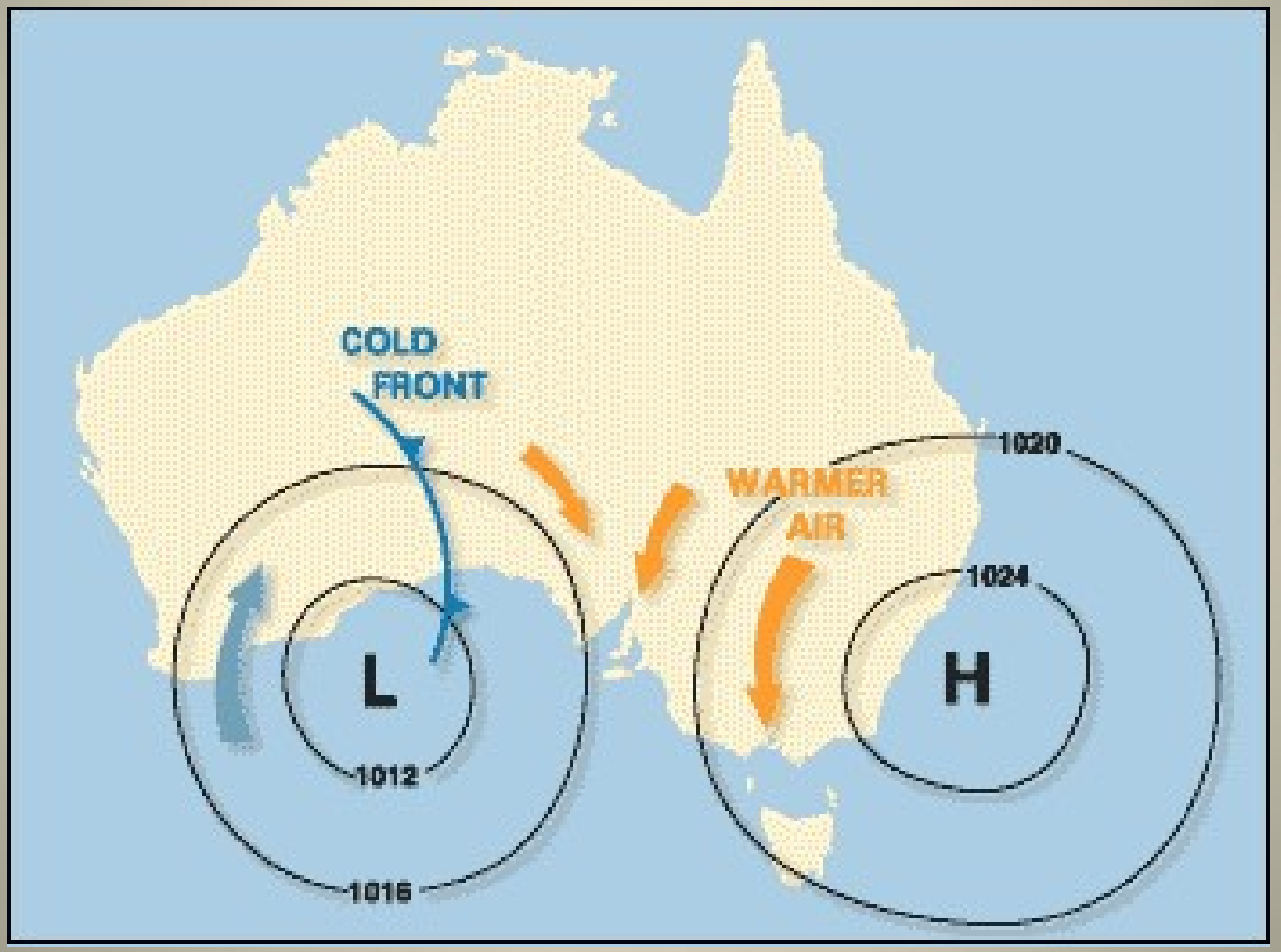
- BACKING:
  Direction changes in a counter clockwise direction,
  i.e. NW – W – SW



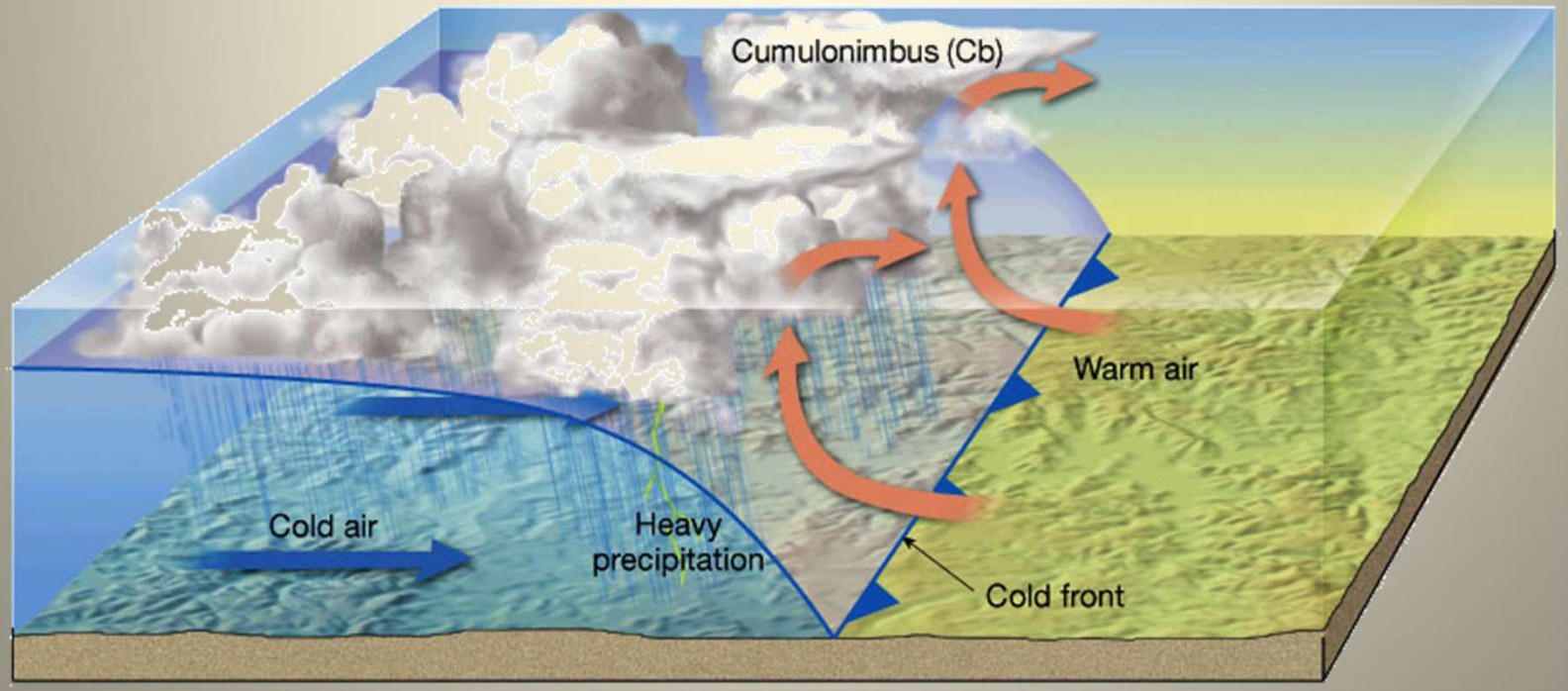
- VEERING:
  Direction changes in a clockwise direction,
  i.e. SW – W- NW



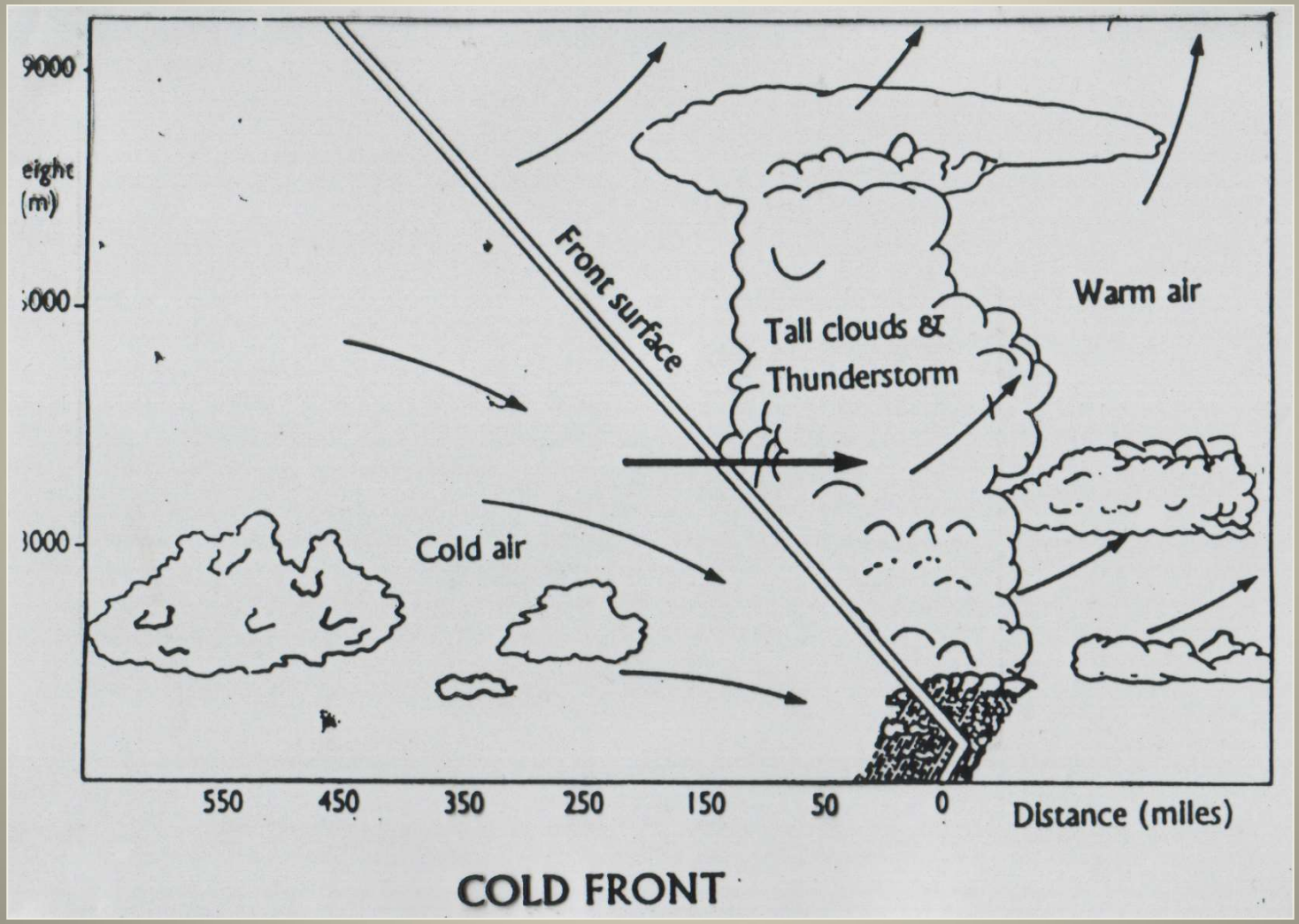
COLD FRONT



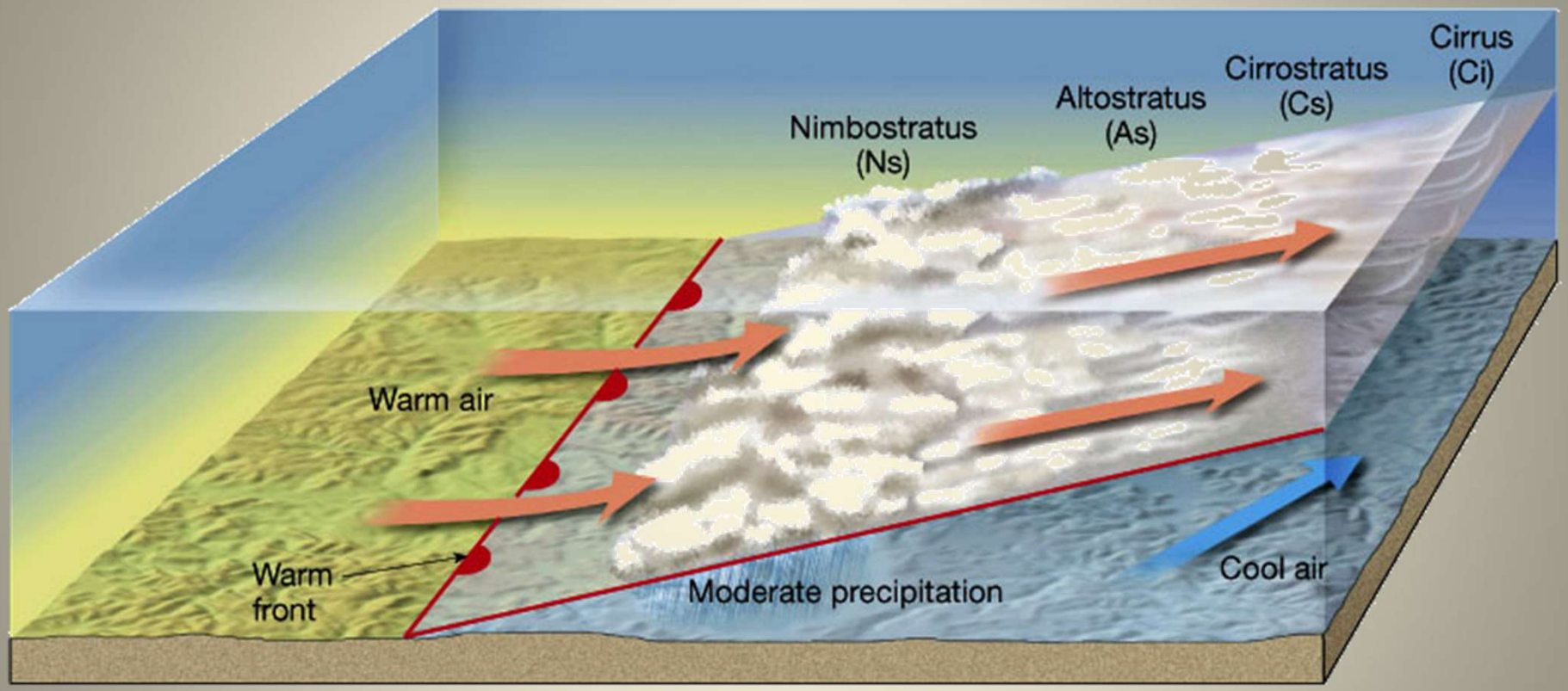
Cold Front


Cumulonimbus (Cb)
Warm air
Cold air
Heavy
precipitation
Cold front

Cold Front

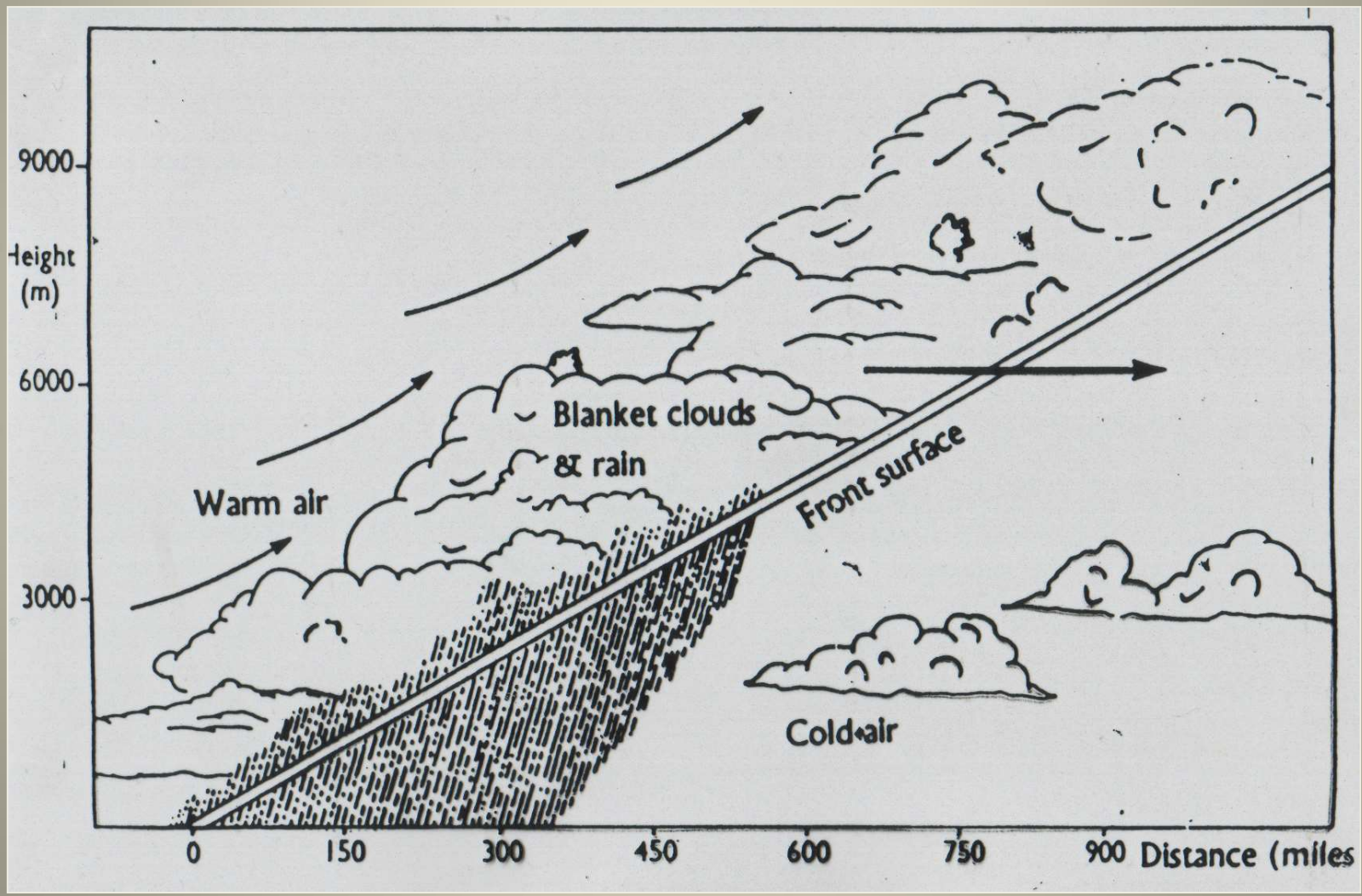

9000
eight
(m)
Front surface
Warm air
Tall clouds &
Thunderstorm
Cold air
550
450
350
250
150
50
0
Distance (miles)
COLD FRONT

Warm Front

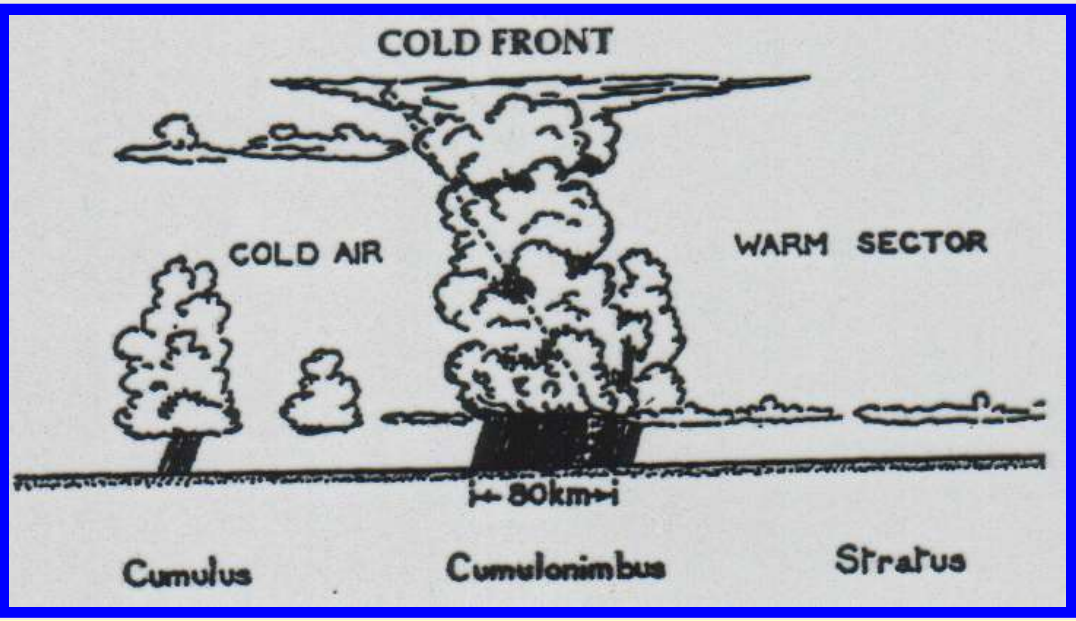


Very occasionally occur near Tasmania, but mostly won't be seen on an Australian chart

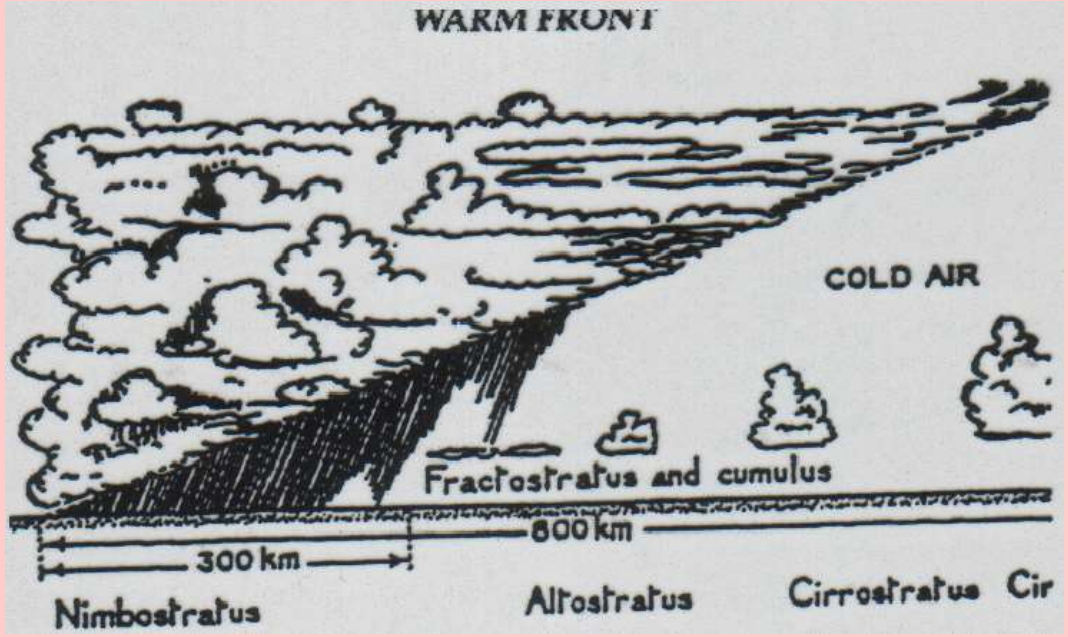
Warm Front

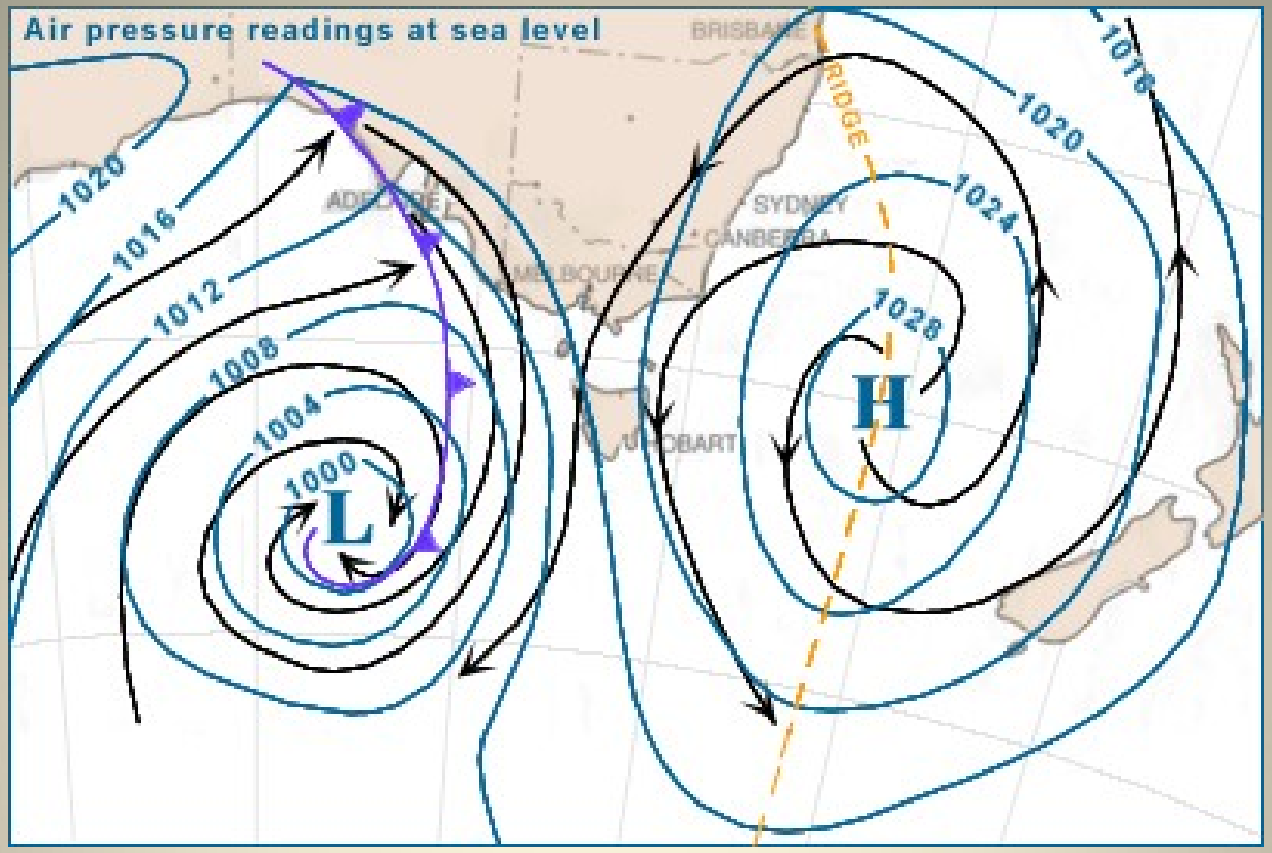

9000
Height (m)
6000
3000
Blanket clouds & rain
Warm air
Front surface
Cold air
0
150
300
450
600
750
900
Distance (miles

Cold Front →



Warm Front →





- Blue lines are Isobars
- Black arrows show wind direction
- Purple line with barbs is a Cold Front – the barbs point in the direction the front is moving
- Orange line shows a Ridge of High Pressure

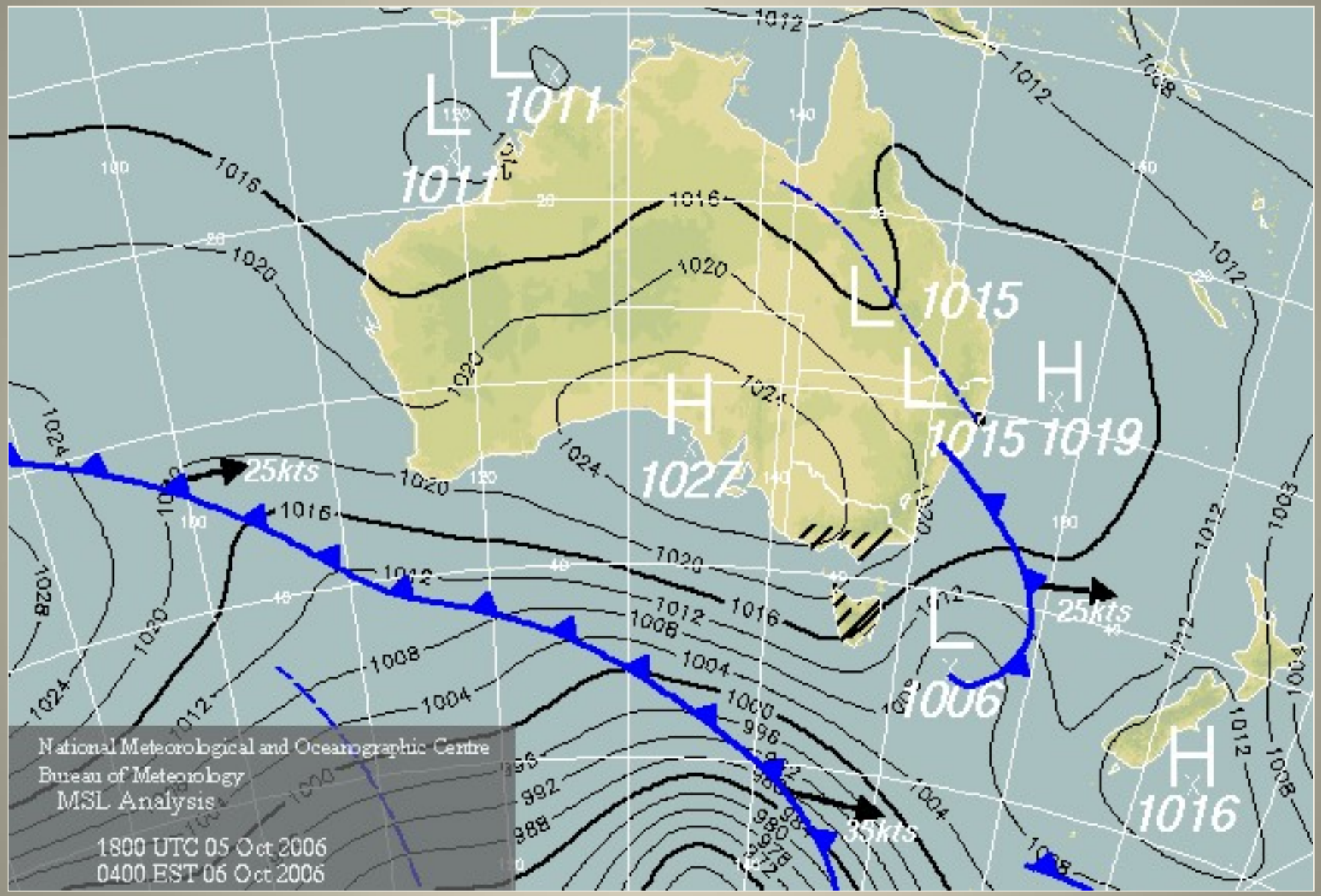
To Find Weather Forecasts

- Commercial Radio
- Television
- Newspapers
- Internet, BOM
- Weather Fax, HF radio
- Telephone (Weather Bureau)
- Coast Radio Stations
- Sea Rescue Organisations
- Other vessels
- Observations
- Barometer

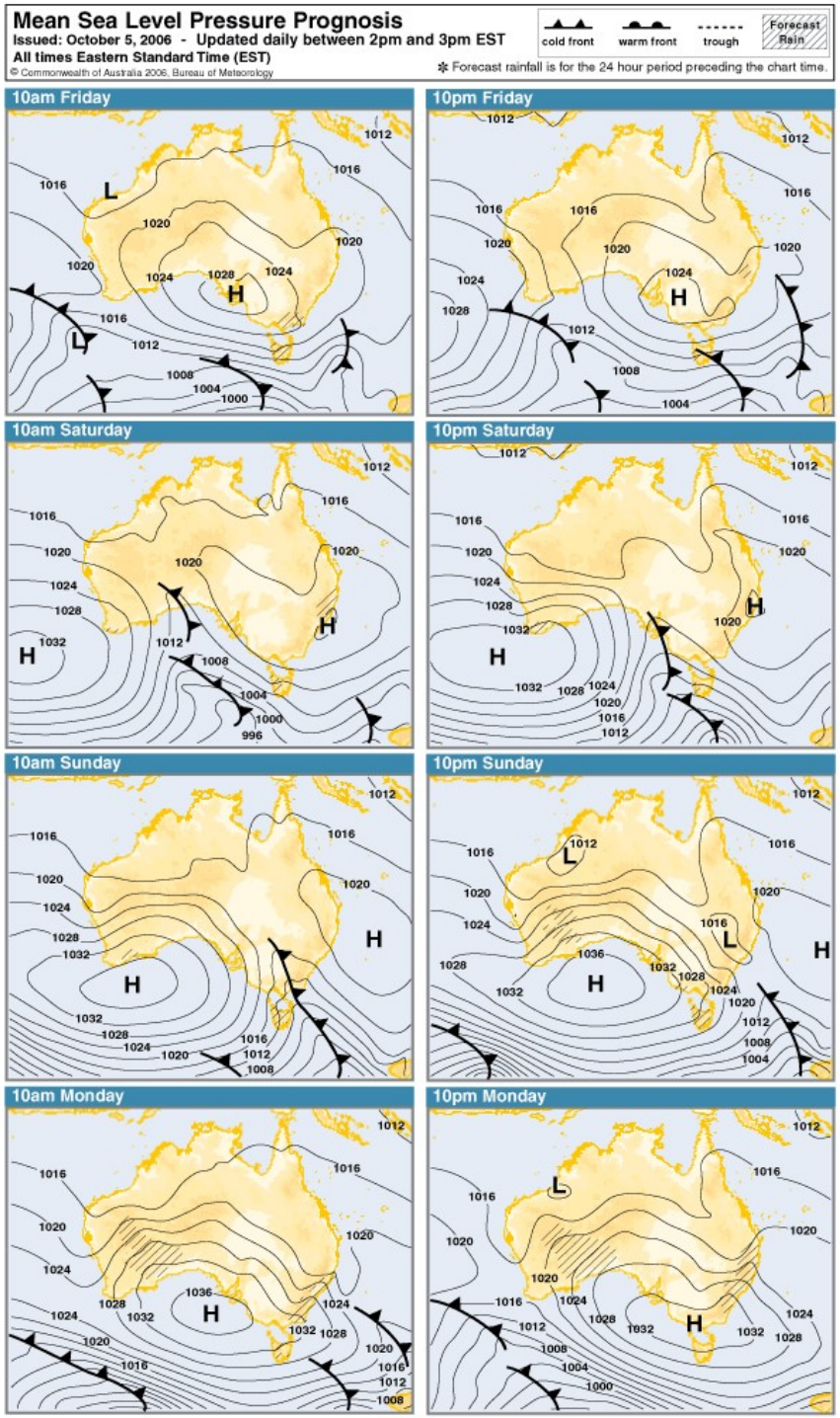
Bureau Of Meteorology Forecasts *(Coastal Waters)*

- Time of issue (0500 & 1530 hrs daily)
- Area affected (wide bay, Frazer island, double island point, Capricornia waters)
- Wind direction and strength
- Sea state
- Outlook (next 2 days)

PROGNOSIS – 0400 EST 06 Oct 2006



4 – DAY FORECAST



Friday

Saturday

Sunday

Monday

Wind Warnings

- Strong wind warning 26 – 33 knots
- Gale warning 34 – 47 knots
- Storm force warning 48 – 63 knots
- Hurricane force warning 64+ knots

Note:

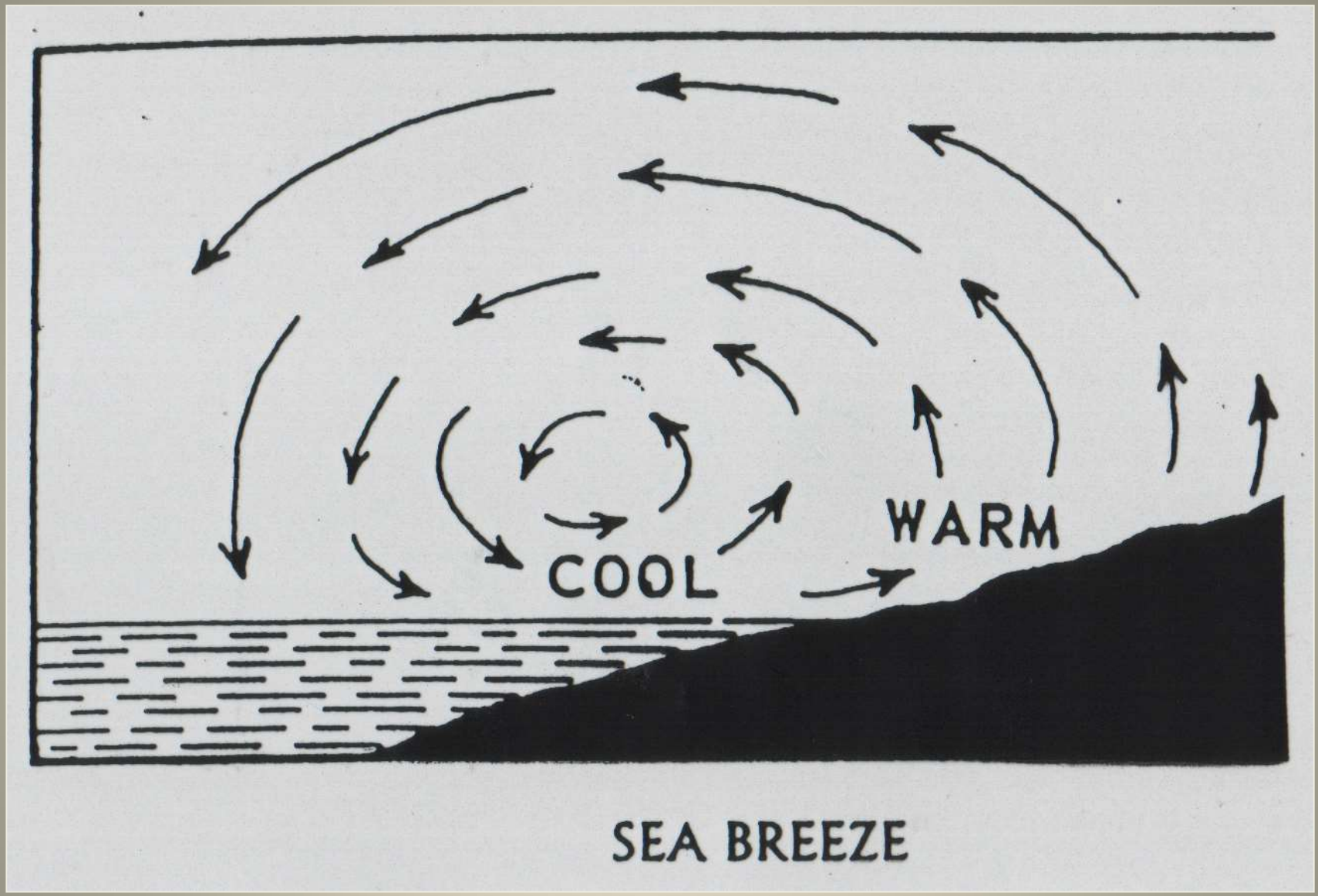
- Wind gusts of up to 40% greater than forecast winds may occur

[Amount of Kn] = [Amount of km/h] ÷ 1.852
[Amount of km/h] = [Amount of kn] x 1.852

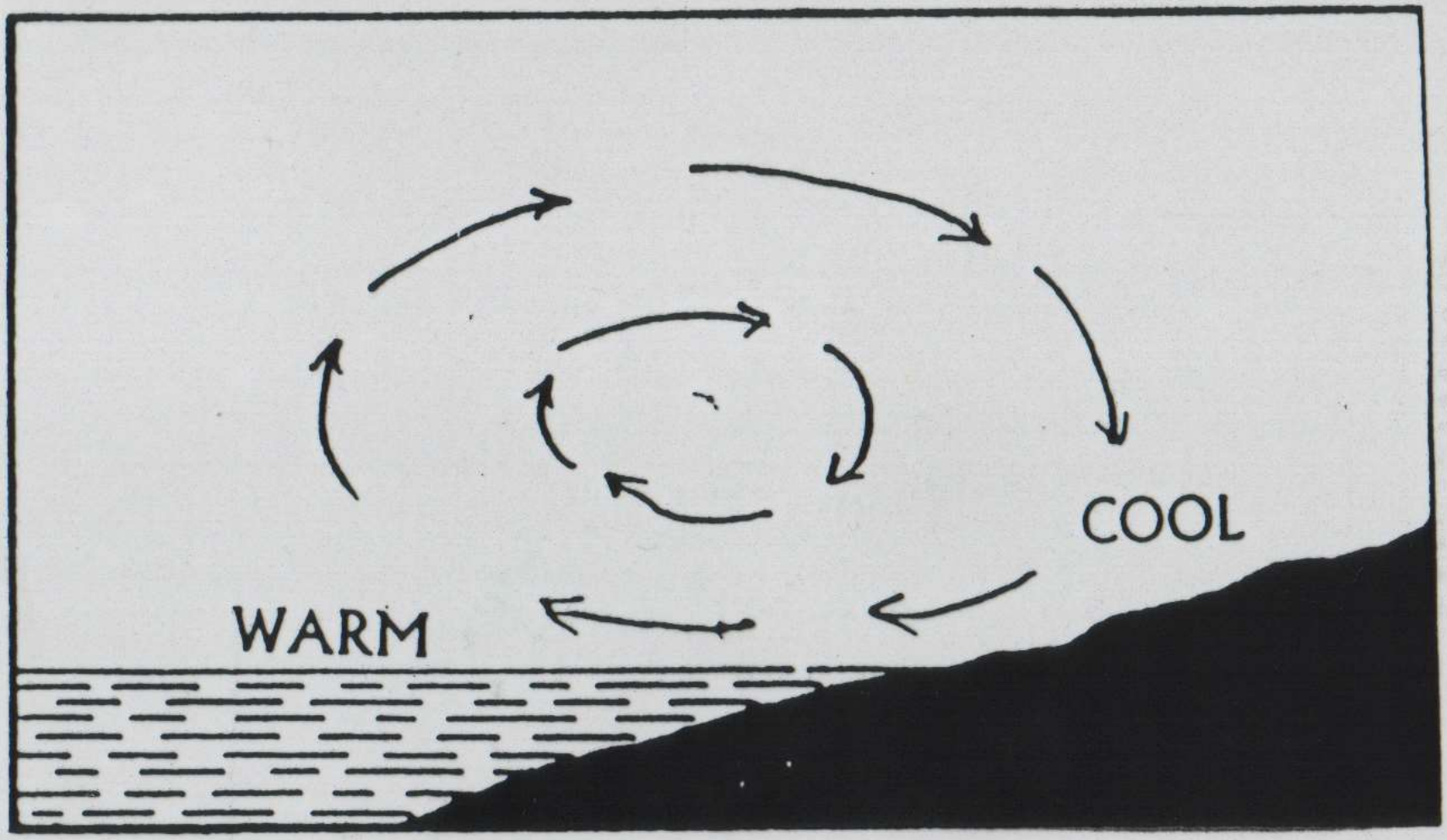
Approach Of Bad Weather

Common Indicators

- Steep fall in barometric pressure
- Large change in direction and strength of wind
- Very clear atmosphere and excellent visibility
- Extensive high cirrus cloud, swirling in towards the storm centre
- High humidity and rain increasing as storm approaches
- Abnormal behavior of marine life (birds, fish)
- Frequent weather warnings broadcast by Coast Radio Stations



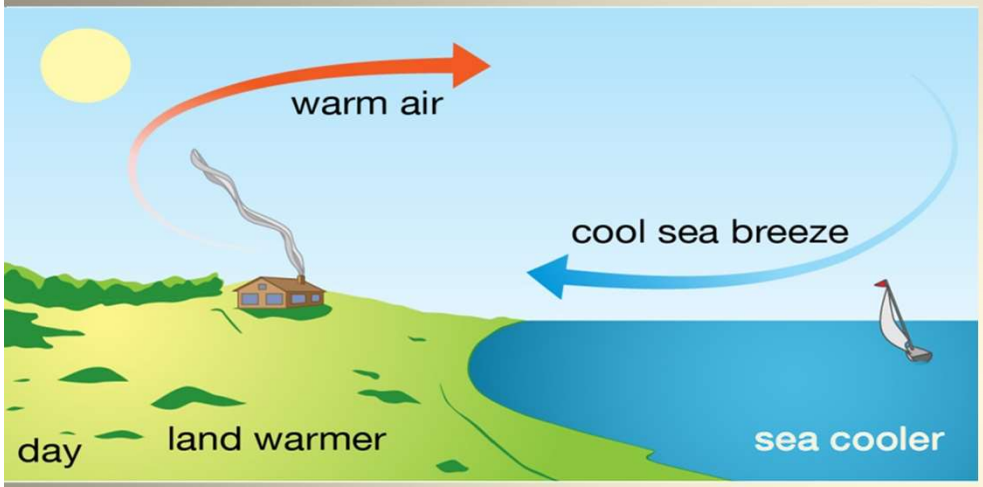
SEA BREEZE

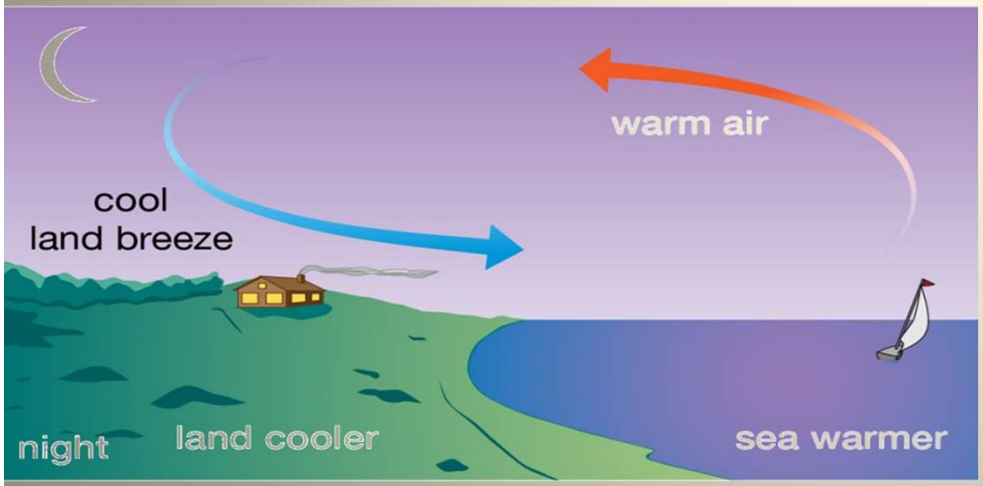


LAND BREEZE

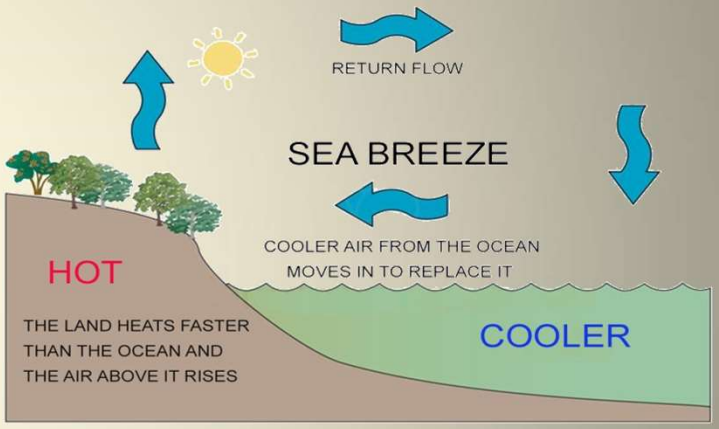
Sea and Land Breeze's

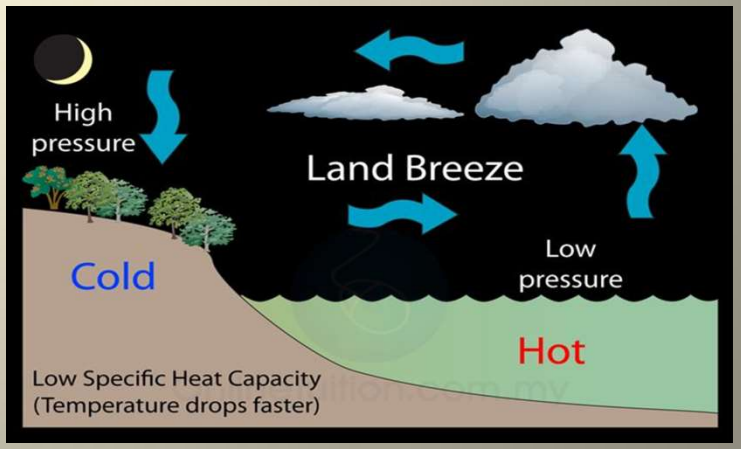
Strong afternoon sea breeze





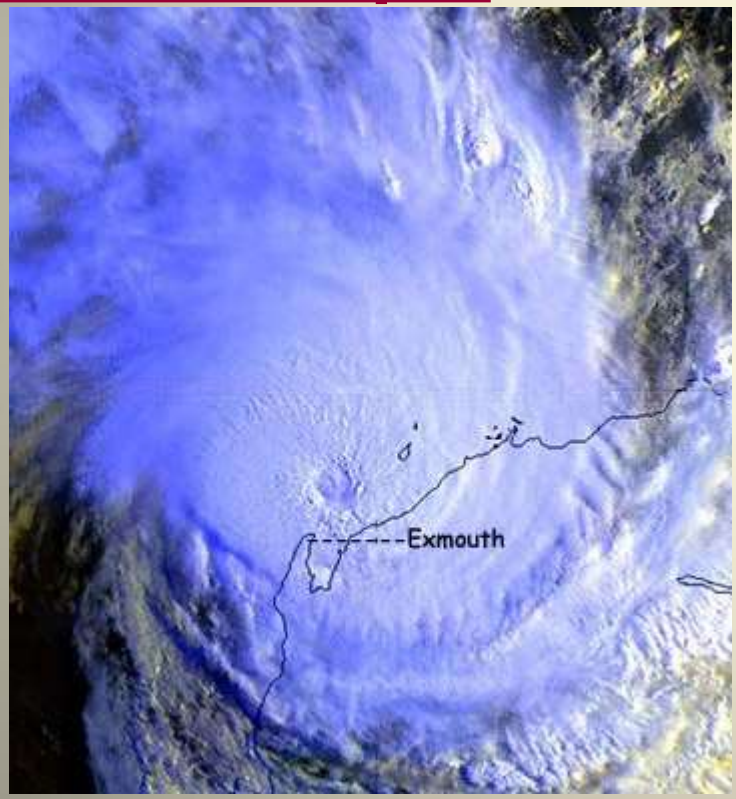
Weak night land breeze





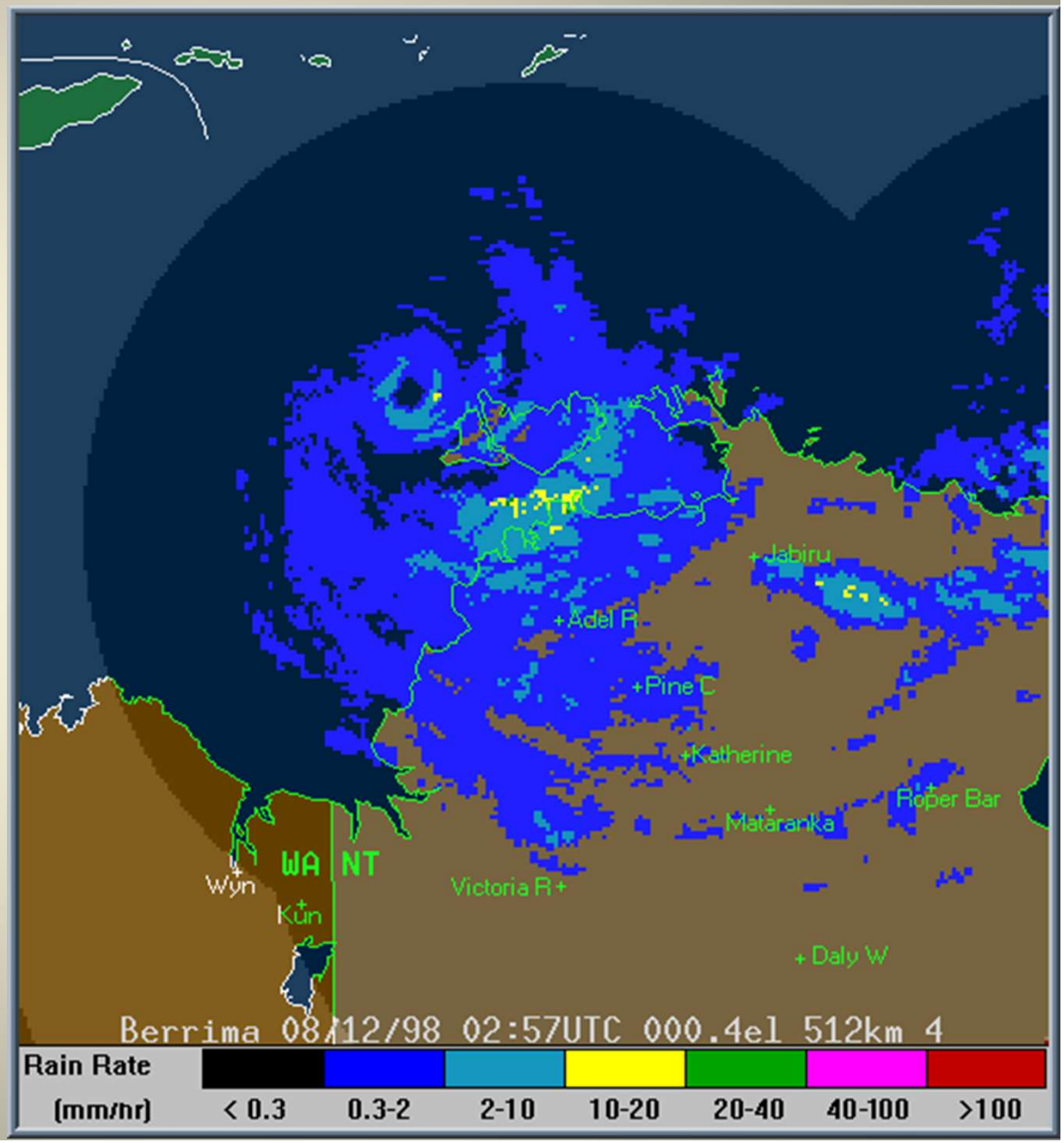
Tropical Revolving Storms

Tropical Cyclone season
November - April



Tropical Cyclones form between Latitudes 5°S and 15°S

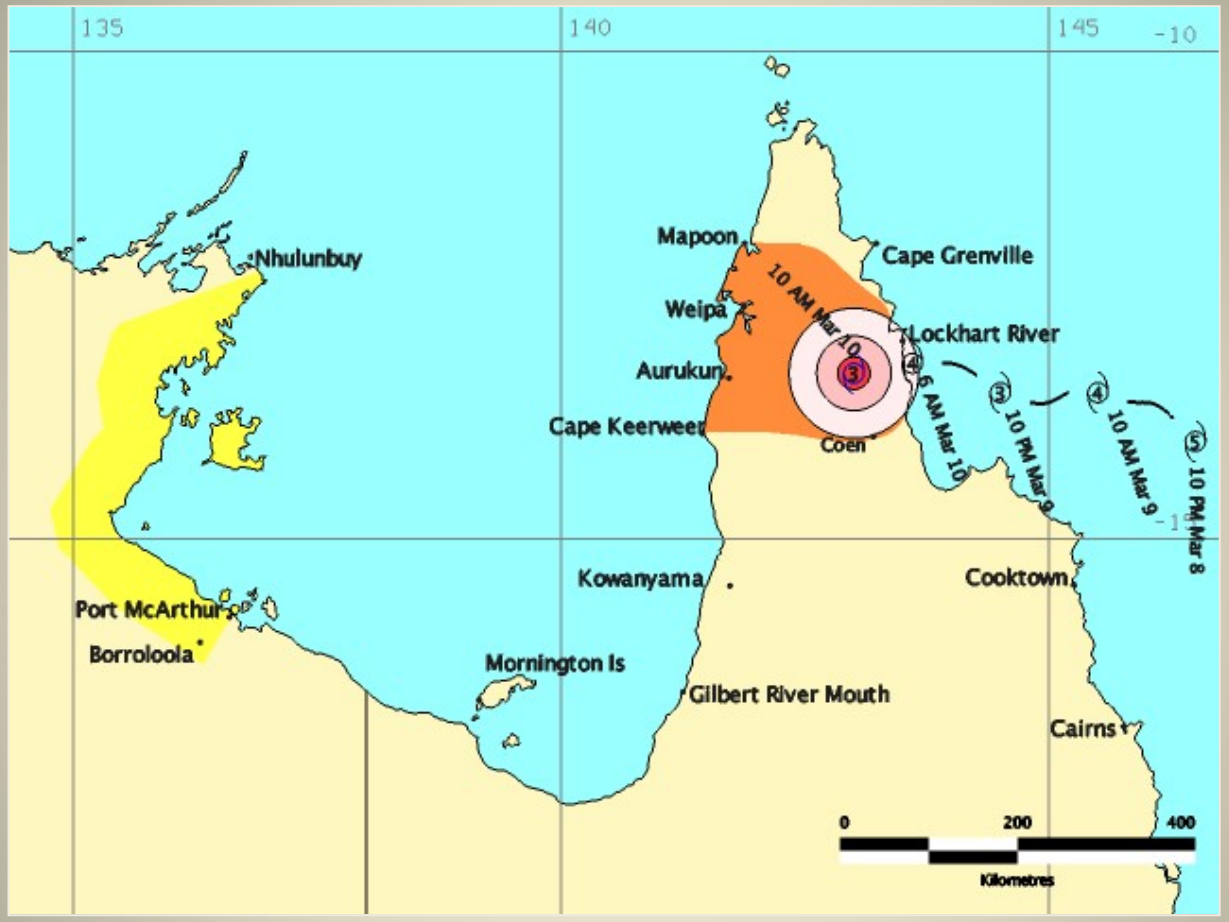
Radar Image of TRS



Tropical Cyclone Track And Threat Map

Severe Tropical Cyclone Ingrid

Tropical Cyclone Advice Number 26 issued 11AM EST (10:30AM CST) Thursday 10 March 2005



Warning Area: gales within 24 hours

Watch Area: gales within 24-48 hours

Very Destructive Winds

Destructive Winds

Strong Gales

IDQ20008
SECURITE
HIGH SEAS WEATHER WARNING FOR METAREA 10
ISSUED BY THE AUSTRALIAN BUREAU OF METEOROLOGY, BRISBANE 0133 UTC 10 March 2005

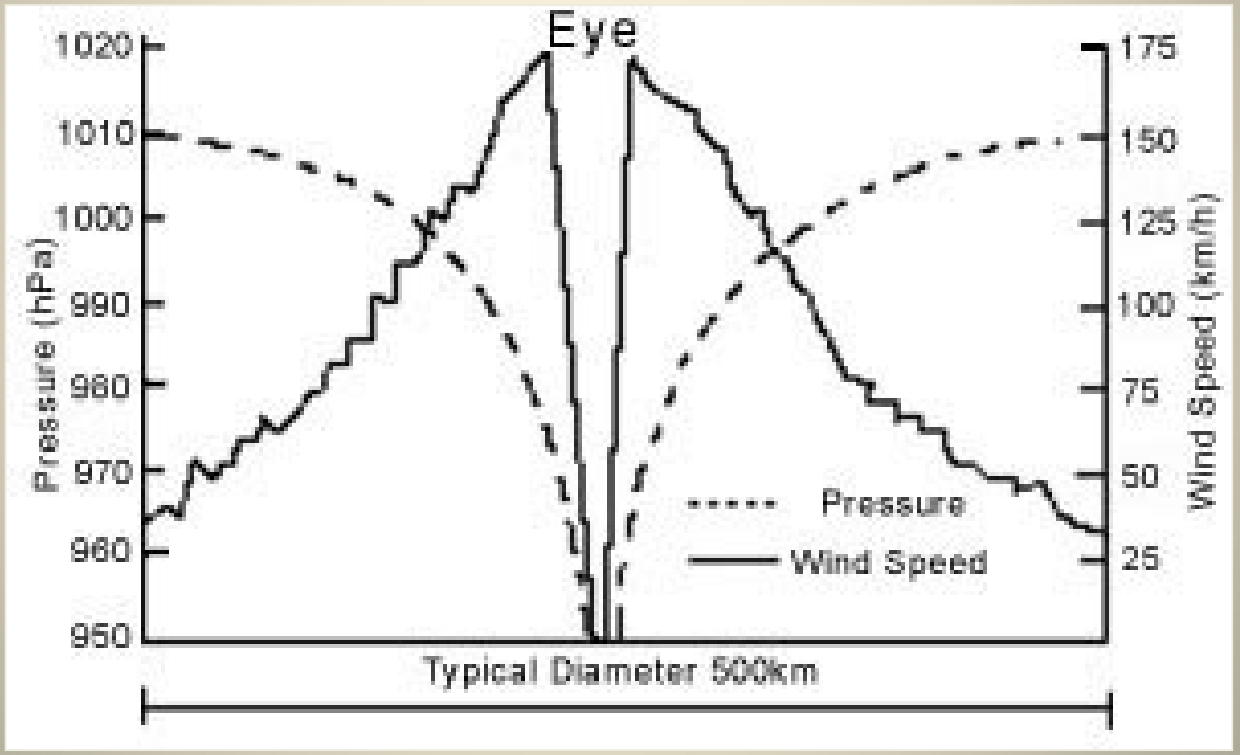
GALE WARNING FOR NORTH EASTERN AREA
SITUATION Severe Tropical Cyclone Ingrid, category 3 with central pressure 975 hectopascals centred at 100000UTC near 13south 143 east, over land. Recent movement west at 9 knots. Position good. Ingrid is expected to weaken and move into the Gulf of Carpentaria later today.

AREA AFFECTED Within 50nm of the centre of the cyclone.

FORECAST Expect clockwise winds 34/40 knots. Very rough seas. Moderate swells. Forecast position 101200UTC 13.3S 141.4E. Central pressure 980 hPa. Forecast position 110000UTC 13.1S 139.8E. Central pressure 970 hPa. Darwin Tropical Cyclone Warning will issue the next warning for the Gulf of Carpentaria at 100700UTC.

REMARKS All ships in the area please send weather reports every three hours. WEATHER BRISBANE

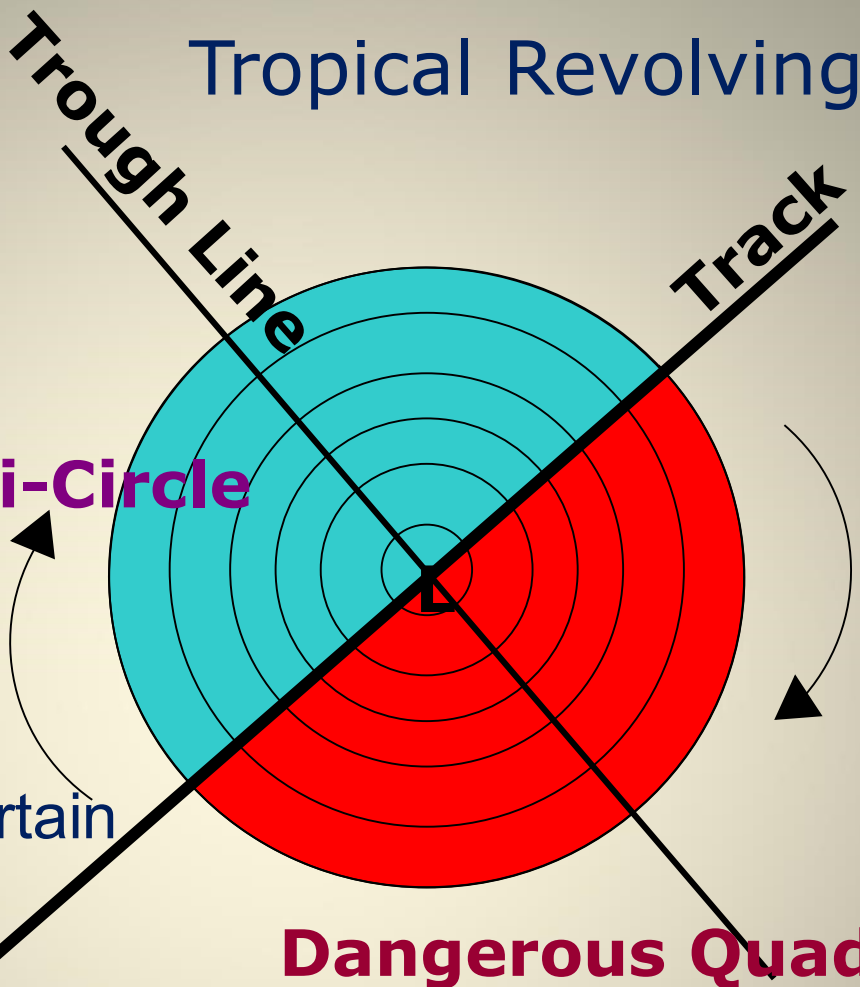
Structure Of A Tropical Cyclone



Tropical Cyclones

Category	Strongest Gust (km/h)	Typical Events (Indicative only)
1	Less than 125	Negligible house damage. Damage to some crops, trees and caravans. Craft may drag moorings.
2	125 - 169	Minor house damage. Significant damage to signs, trees and caravans. Heavy damage to some crops. Risk of power failure. Small craft may break moorings.
3	170 - 224	Some roof and structural damage. Some caravans destroyed and blown away. Power failure likely.
4	225 - 279	Significant roofing loss and structural damage. Many caravans destroyed and blown away. Dangerous airborne debris. Widespread power failure.
5	more than 280	Extremely dangerous with widespread destruction.

Tropical Revolving Storm



Wind direction?

Navigable Semi-Circle

It is important to ascertain in which part of the approaching Tropical Cyclone you are located to determine your best course of action

Dangerous Quadrant

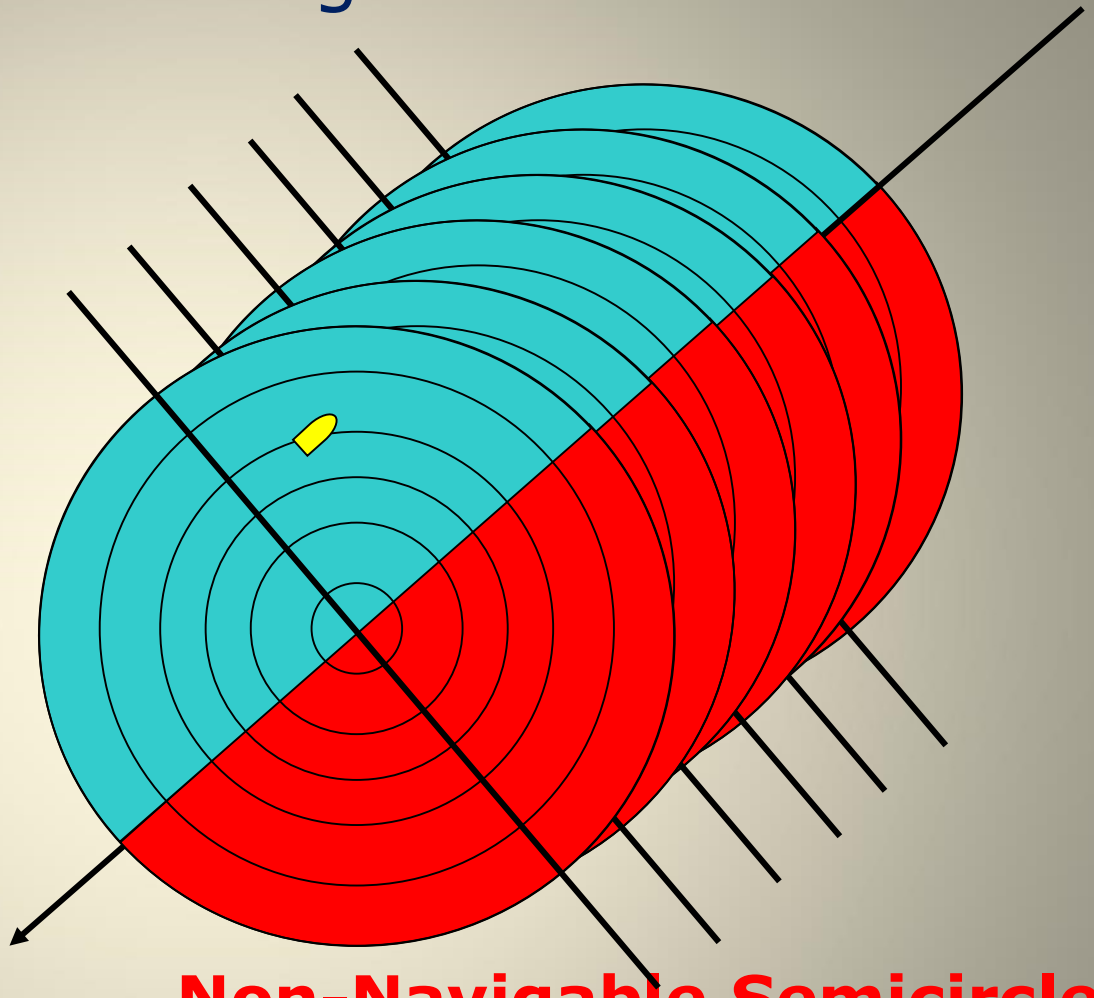
Non-Navigable Semi-Circle

AVOIDING ACTION TO TAKE

1.Determine in which quadrant the vessel is situated:

- Navigable semicircle?
- Non-Navigable semicircle?
- In Direct Path?

Observe the Wind Shift as TRS approaches

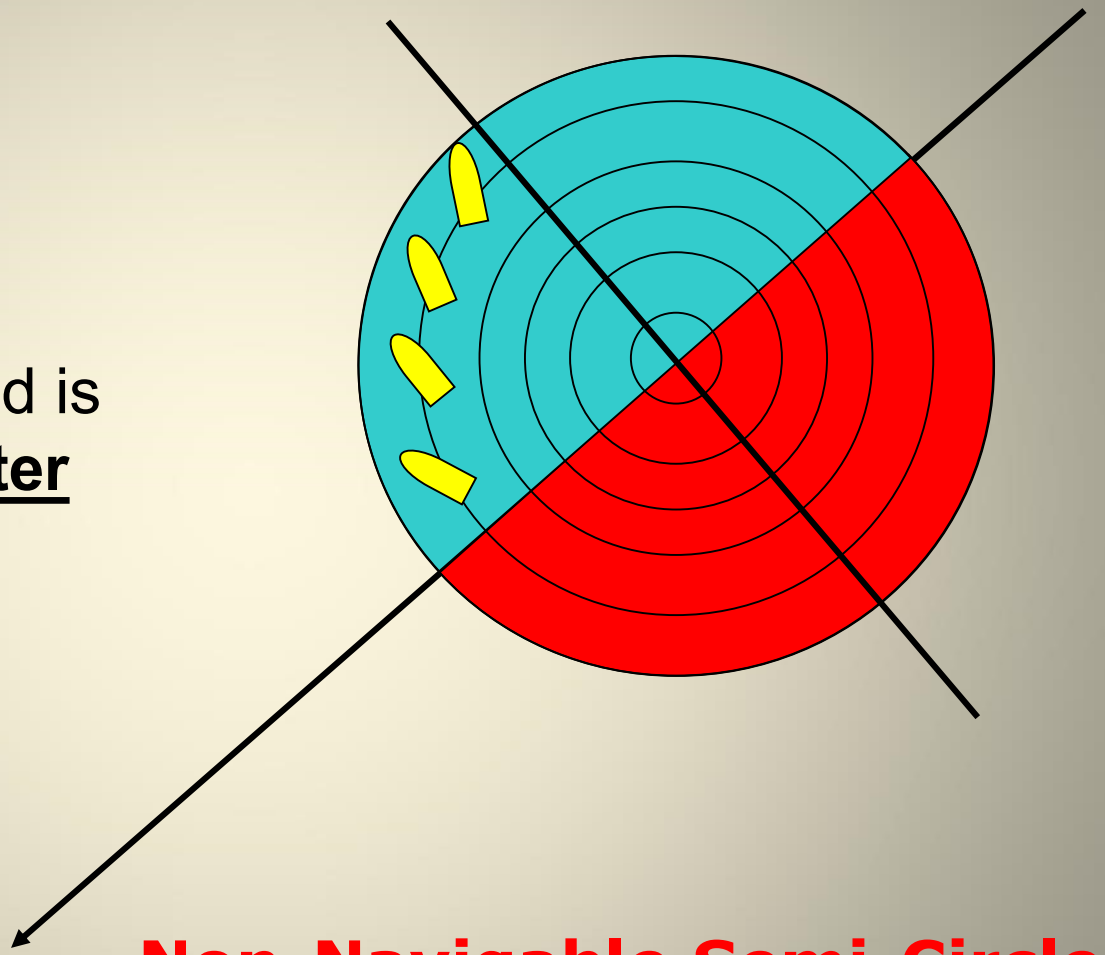


What is the Wind Shift doing – Veering or Backing?

VEERING (direction shifting clockwise) = Navigable Semicircle

Navigable Semicircle

- If in **Navigable Semicircle,** steer vessel so that wind is on the **Port Quarter**

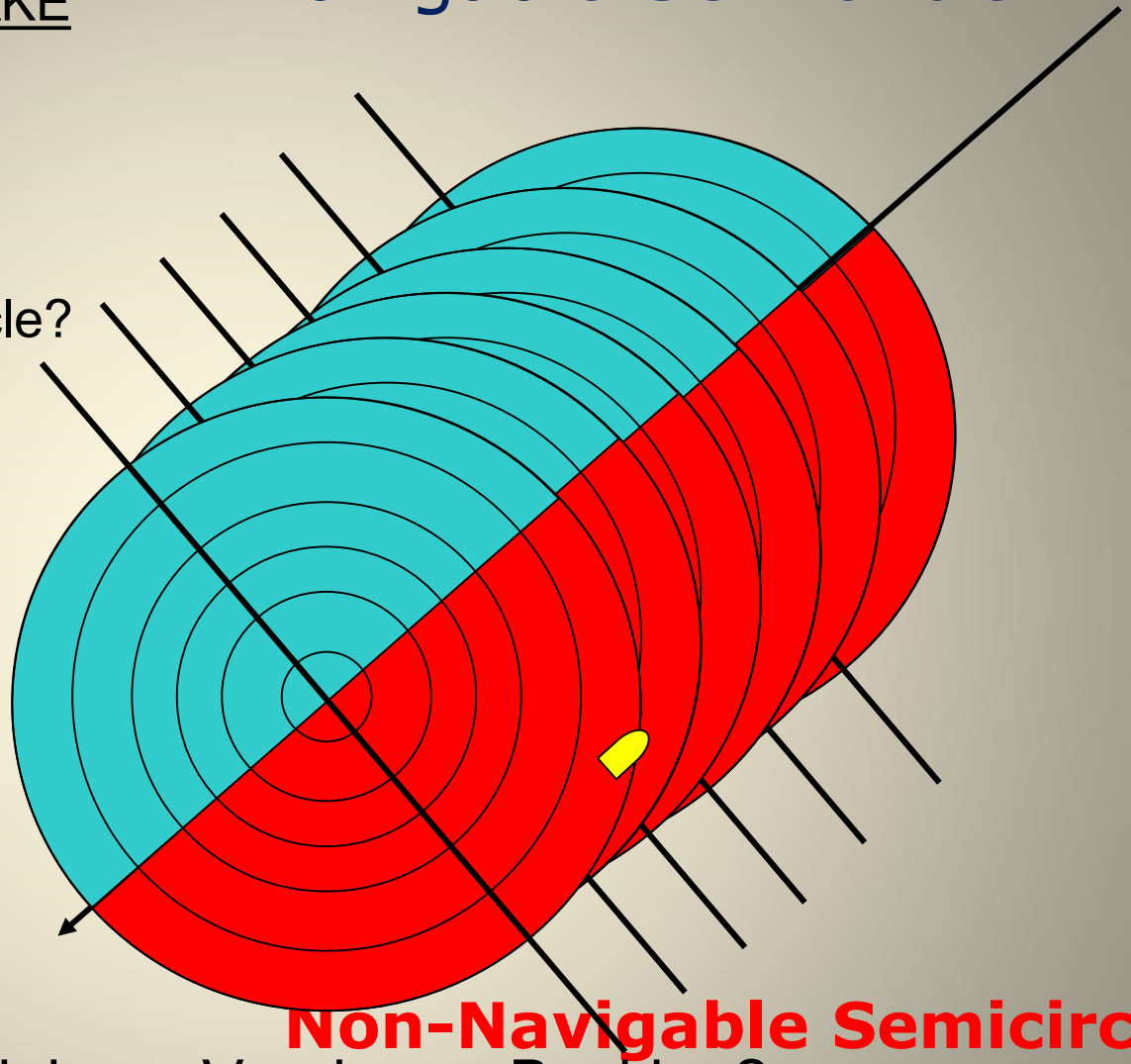


Non-Navigable Semi-Circle

AVOIDING ACTION TO TAKE

1.Determine in which quadrant the vessel is situated:

- Navigable semicircle?
- Non-Navigable semicircle?
- In Direct Path?



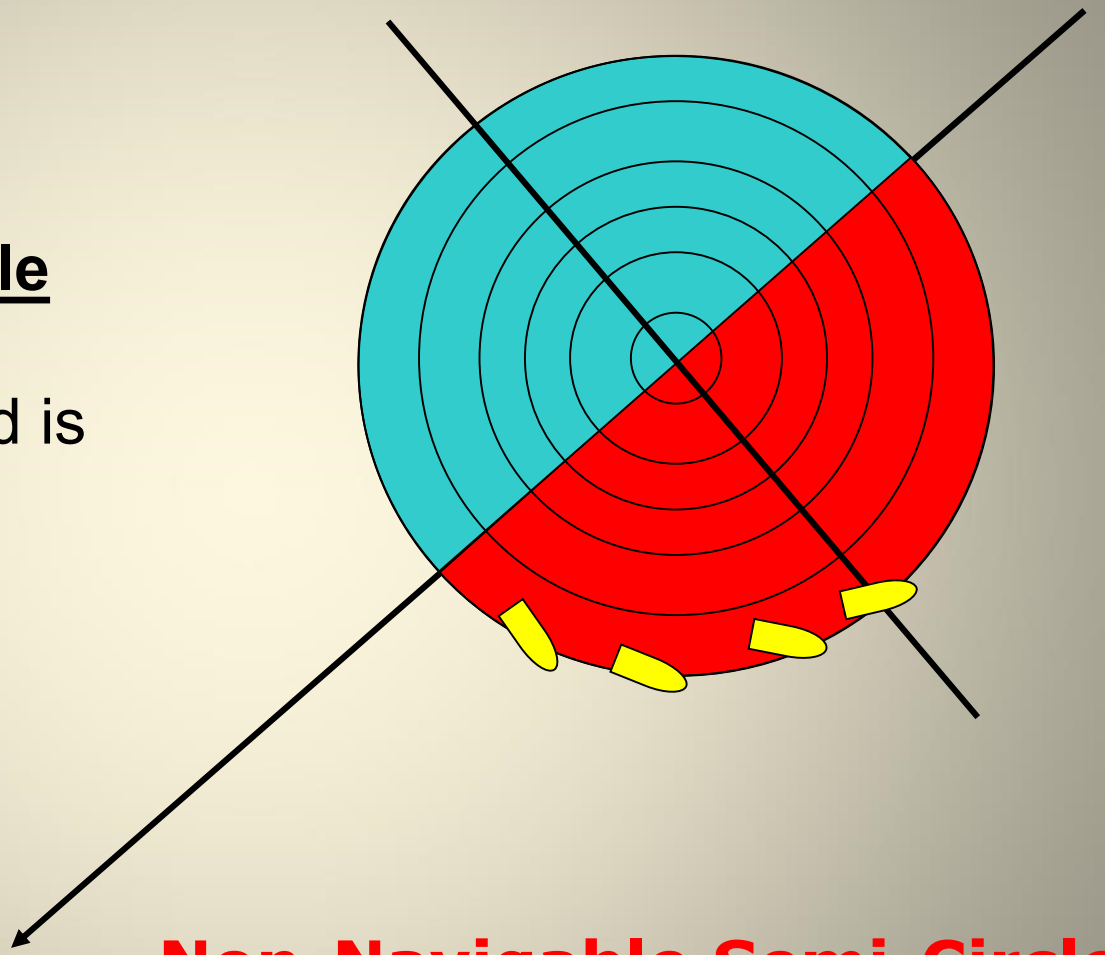
Observe the Wind Shift as TRS approaches

What is the Wind Shift doing – Veering or Backing?

BACKING (direction shifting anti-clockwise) = Non-Navigable Semicircle

Navigable Semi-Circle

- If in **Non-Navigable Semicircle,** steer vessel so that wind is on the **Port Bow**



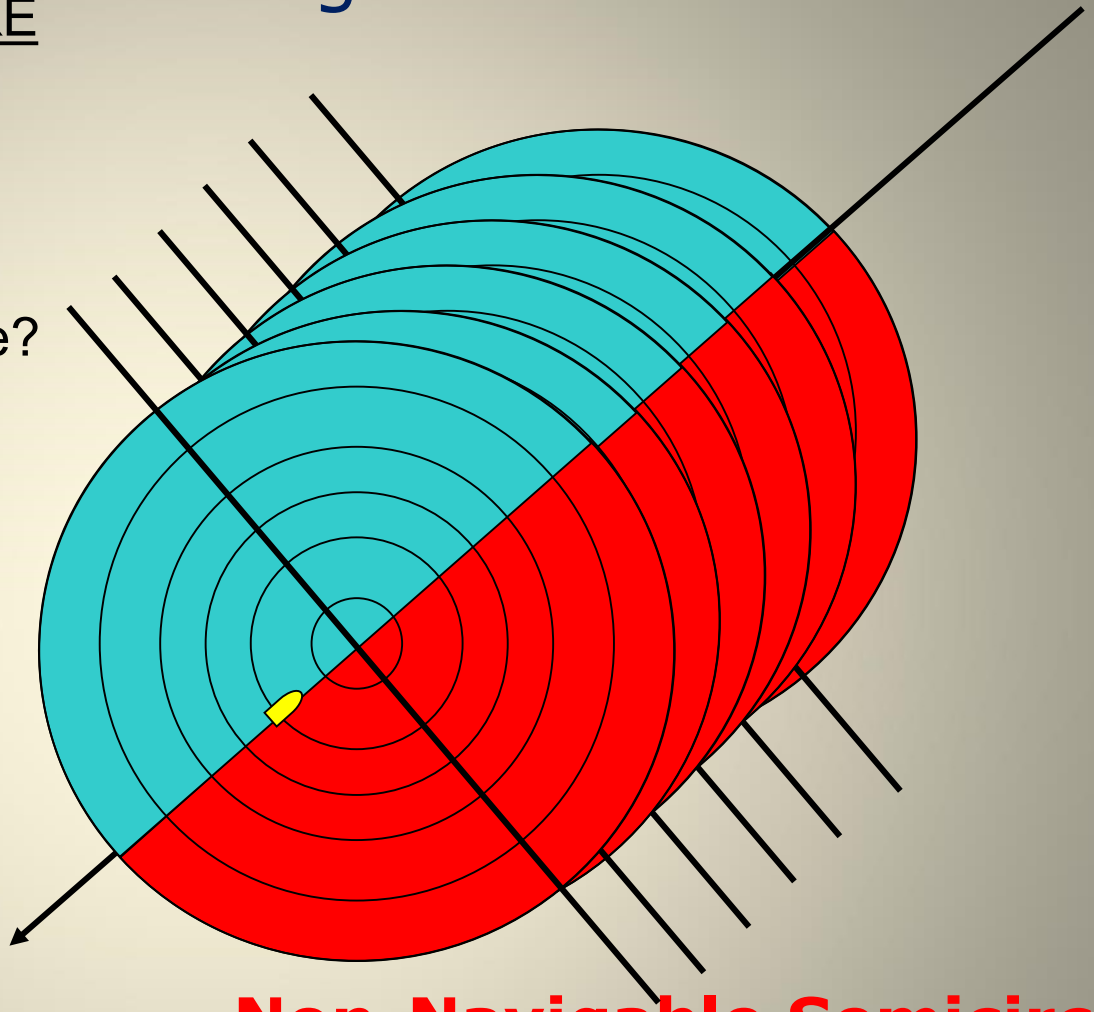
Non-Navigable Semi-Circle

Navigable Semicircle

AVOIDING ACTION TO TAKE

1.Determine in which quadrant the vessel is situated:

- Navigable semicircle?
- Non-Navigable semicircle?
- In Direct Path?



Observe the Wind Shift as TRS approaches

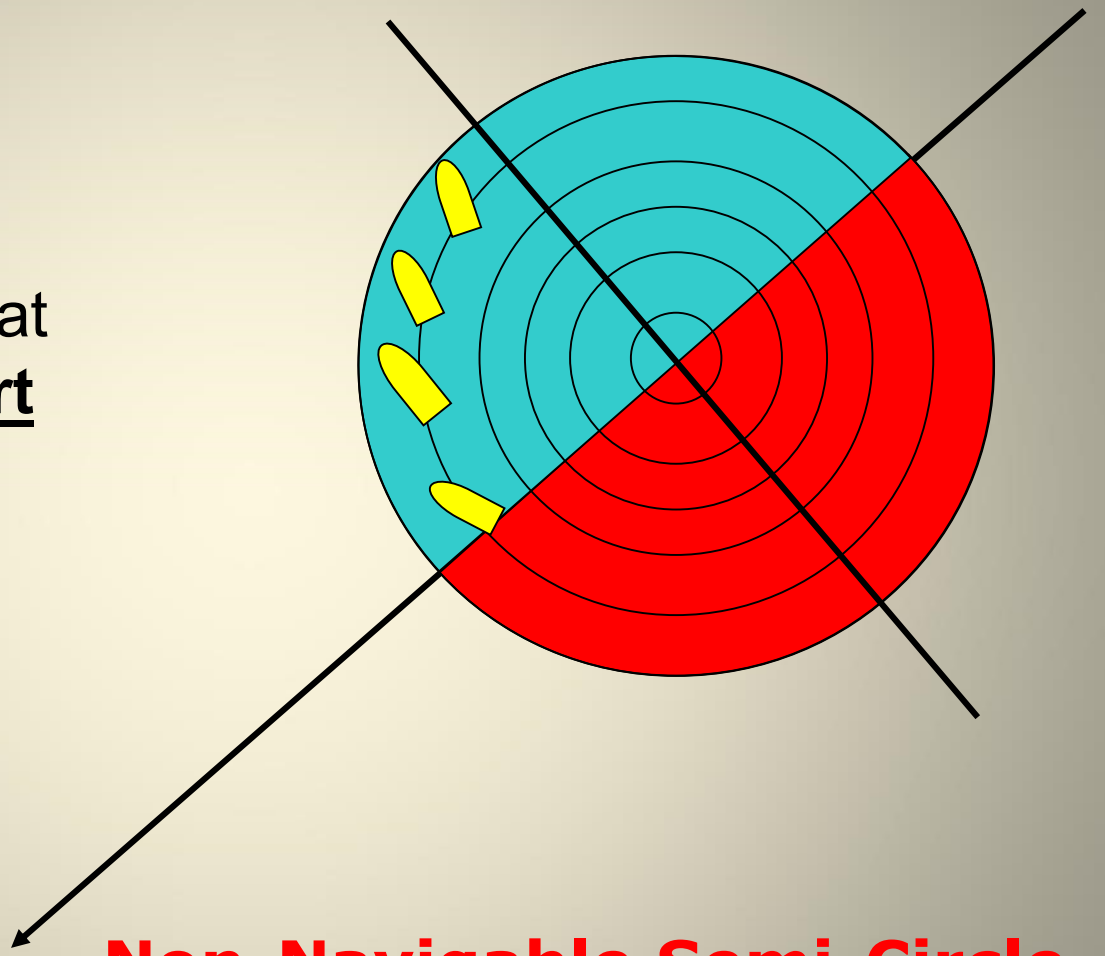
Non-Navigable Semicircle

What is the Wind Shift doing – Veering or Backing?

STEADY (wind direction not shifting) = In Direct Path

Navigable Semi-Circle

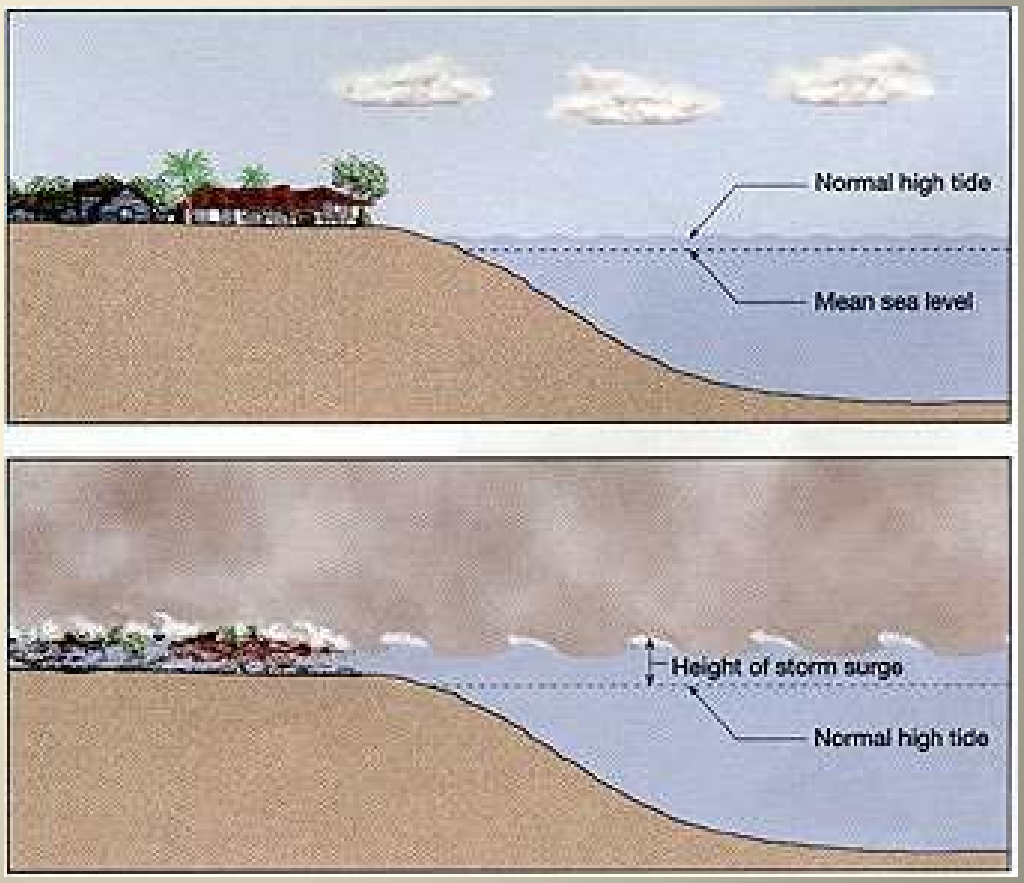
- If in **Direct Path**, steer vessel so that wind is on the **Port Quarter**



Non-Navigable Semi-Circle

General Weather Terms

<u>Storm Surge</u> – a rise in sea level due to the effects of a severe Low pressure system



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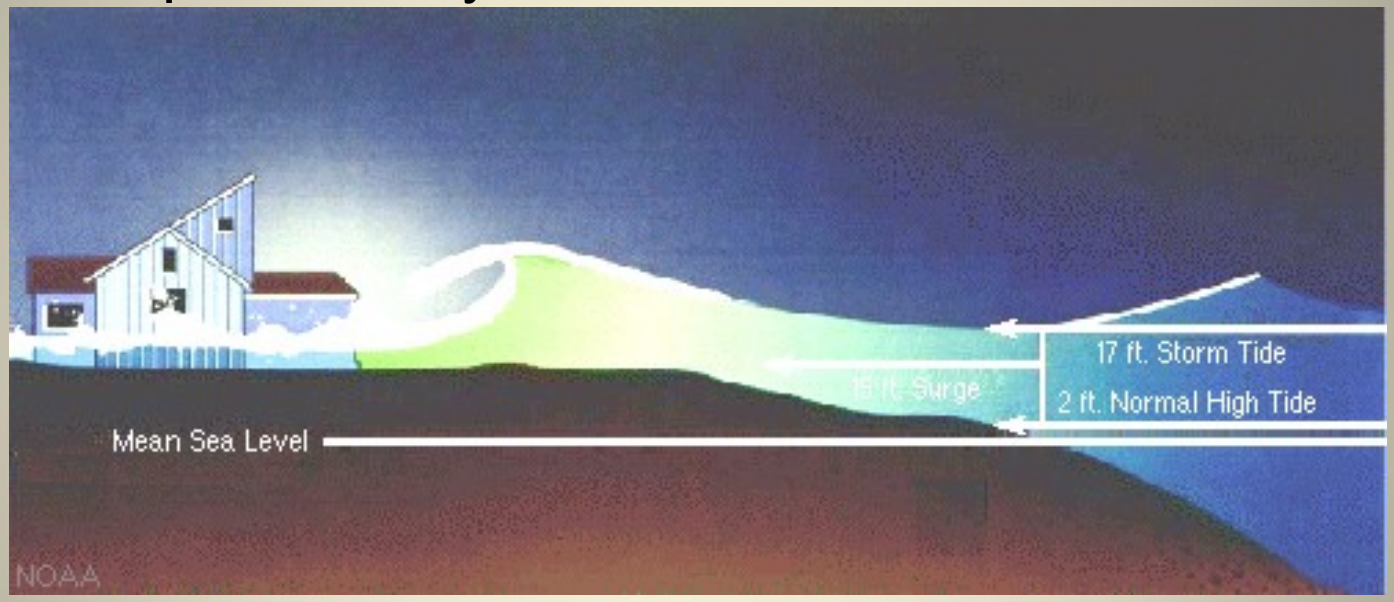

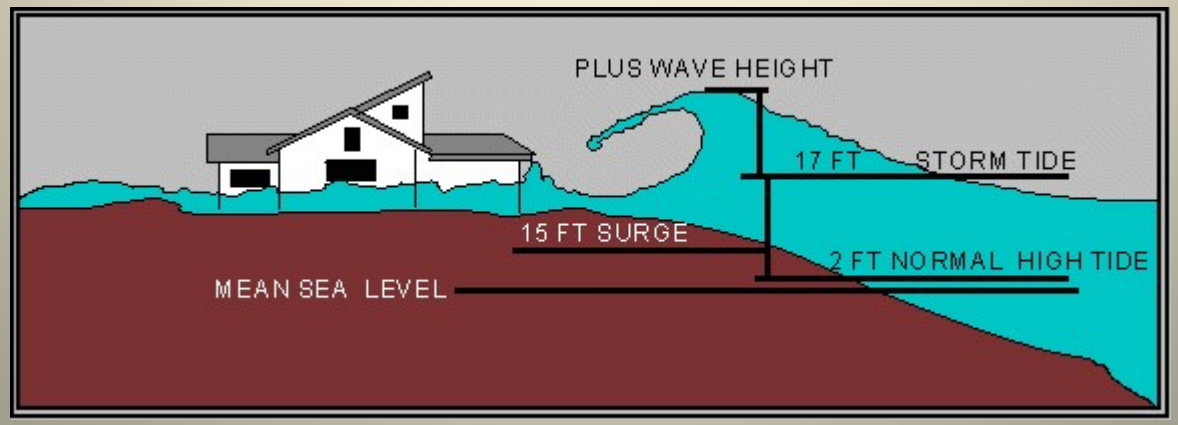

Thankyou