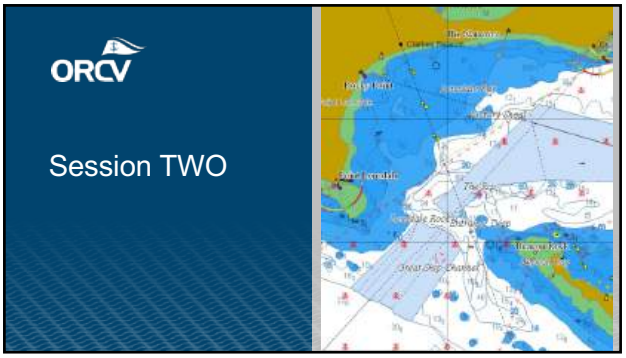
1



2

3

Exercise #02

- You passed Fawkner Beacon at 10am when your GPS stopped working. You keep sailing on a reach when after 2hrs fog sets in. You weren't really keeping track
- The course you have steered, using the magnetic compass was 165 Deg
- The wind is strong, from the West (270 Deg True)
- You expect around 5 degrees leeway
- Your boat has been doing 8 knots

Where are you ?

4

Exercise #02 solution

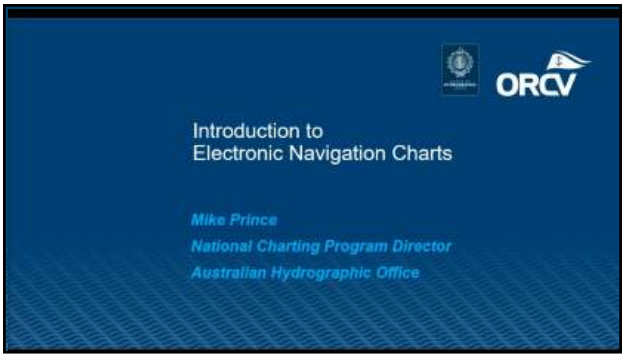
Compass bearing (magnetic)	165 degrees
Adjust for compass variation	+11 degrees east
True direction steered	176 degrees T
West wind – adjust for leeway	-5 degrees to the east
True direction sailed (COG)	171 degrees
2 Hours at 8 Kn = around 16 nm	

5

Exercise #02 solution

6

7



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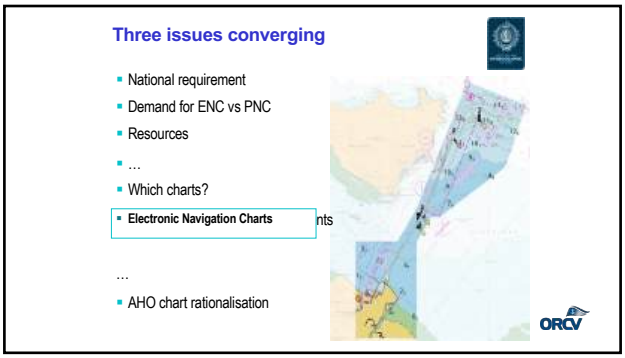


9

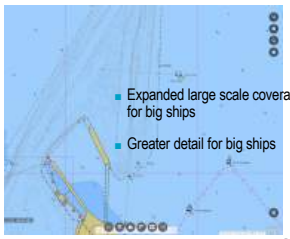
Demand

- 595,000+ (increasing)
- 5,900 international ships
- 29,000 voyages
- 99% of all trade

- 44,000 (decreasing)
- 7% of users
- 60% of production effort

10

Customised ENC



- Expanded large scale coverage for big ships
- Greater detail for big ships

12

Which charts?

- **The SOLAS definition of 'nautical chart' is**

  a 'special purpose map or specifically compiled database from which such a map is derived, that is issued officially by or on the authority of a government, authorised Hydrographic Office or other relevant government institution and is designed to meet the requirements of marine navigation.'

  (Chapter V, Regulation 2, Para 2)

- **special purpose map = paper nautical charts**
- **specifically compiled database = ENC**
- **authorised Hydrographic Office =**

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Which charts?

- **Official**
  - "AU" "SB" "NZ" ENC,
  - "AUS" paper charts
- **Unofficial (Licensed)**
  - C-map
  - Garmin / Navionics
  - Memory-map
  - Others

14

Which charts?

- **Official**
  - "AU" "SB" "PG" "NZ" ENC,
  - "AUS" paper charts
- **Unofficial (Licensed)**
  - C-map
  - Garmin / Navionics
  - Memory-map
  - Others
- **Not warranted for commercial use by:**
  - **Commonwealth**
  - **States (some)**
  - **the manufacturers**

15

Which charts?

Warning by manufacturer - no warranty for unofficial charts…

- **"Only official government charts and notices to mariners contain all the information needed for safety of navigation…"**
- **"these electronic charts are inadequate as a primary means for navigation…"**

16

Which charts?

2007 – Power boat destroyed / fatality in Moreton Bay – breakwater and reclaimed land missing for 5 years from unofficial chart

2008 – Yacht "Asolare" destroyed on reef in Coral Sea – reef missing from unofficial chart

2014 – Yacht "Vestas Wind" (VOR) destroyed on reef in Indian Ocean – reef missing from unofficial chart / poor functionality

2018 – Yacht "Scallywag" (VOR) near miss on reef in Pacific Ocean – reef missing from unofficial chart / poor functionality

2019 – Yacht damaged in Bass Strait – rock missing for 3 years from unofficial chart (+4 near misses)

17

Which charts? (2014)

The yacht "*Vestas Wind*" destroyed itself after hitting a reef in the Indian Ocean at night on 29 Nov 2014

The yacht was using C-Map charts poorly captured from official ENC, along with bespoke software

18

Which charts? (2014)

C-Map 1:3.3M vs ENC 1:3.5M (GB104702)

- The report team considers the cartography in this particular case to be deficient. The omission of the islands, reefs and dangers at display levels A, B and most of the C presentations of C-Map data failed to fulfil the primary function of a chart and warn the mariner of a potential danger."

19

Which charts? (2014)

C-Map 1:3.3M vs E

"The report team considers the cartography in this particular case to be deficient. The omission of the islands, reefs and dangers at display levels A, B and most of the C presentations of C-Map data failed to fulfil the primary function of a chart and warn the mariner of a potential danger."

20

Which charts? (2018)

The yacht "Scallywag" saved by a race control query from destroying itself on a reef in the Pacific Ocean on 6 Jan 2018

The yacht was using C-Map charts poorly captured from official ENC, along with bespoke software

VOR race-control…noticed that Scallywag was on a collision course with Nereus Reef.

To Scallywag's navigator:

"Just so I can relax a bit here in race control, tell me you are happy with your course in relation to Nereus Reef on Lansdowne Bank".

21

Which charts? (2018)

The yacht "Scallywag" saved by a race control query from destroying itself on a reef in the Pacific Ocean on 6 Jan 2018

The yacht was using C-Map charts poorly captured from official paper charts, along with bespoke software

skipper David Witt (during interview):

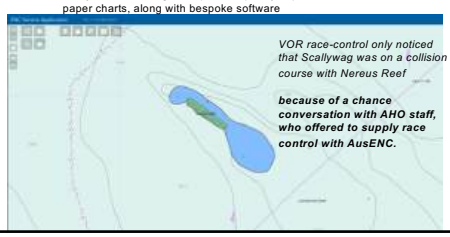
"There's a bit of difference between the electronic and paper charts"

22

Which charts? (2018)

The yacht "Scallywag" saved by a race control query from destroying itself on a reef in the Pacific Ocean on 6 Jan 2018

The yacht was using C-Map charts poorly captured from official paper charts, along with bespoke software



VOR race-control only noticed that Scallywag was on a collision course with Nereus Reef

because of a chance conversation with AHO staff, who offered to supply race control with AusENC.

23

Getting ENC

- **Local & regional coverage:**
  - AusENC (AU, SB, PG, NZ)
  - NZENC (NZ and some Pacific Islands)
  - IC-ENC (international warehouse)
- **Other nations' ENC:**
  - IC-ENC (international warehouse)
  - PRIMAR (international warehouse)
  - (check IC-ENC and PRIMAR websites for retailers)
- **Local availability**
  - AHO
  - 33-South
  - Boat Books
  - Cairns Chart & Map
  - Fremantle Chart & Map
  - Others (www.hydro.gov.au)
- **International availability**
  - Admiralty Vector Chart Service (Boat Books)
  - Chart World
  - ChartCo
  - Datema
  - Others (www.IC-ENC.org)

24

Setting up ENC

- Subscription – tells us what ENC packs you wish to receive, and for how long
- Permit – version control ensures you are using the correct edition of each subscribed ENC
- S-63 User Permit – ('the keys') unlocks ENC Permit files in your system
- S-63 Scheme Administrator Certificate – tells your system which organisations are authorised ENC producers

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Getting ENC

- Details
- Subscription & permits
- Base dataset (new every Jan / Jul)
- Update dataset (recommend 'cumulative')
- New permits (if required)
- (www.hydro.gov.au)

26

How good are charts?

- No charts are perfect.
- Official charts include information about good and poor areas, and what may be missing.
- Unofficial charts omit this information.
- Assuming a chart is good because it is electronic and appears to have seamless coverage is unwise.

27

How good are charts?

- Very little of the world's coastal waters are surveyed to standards where the possibility of an uncharted feature can be ignored.
- To put this in perspective, the following table is an overall analysis of over 14 million square kilometres of coastal ENC [1] from 32 nations:

Category	% area of world's coastal ENC (2019)	Confidence
A1 (6 stars)	11.7%	Very Good
A2 (5 stars)	1.0%	Very Good
B (4 stars)	30.5%	Good
C (3 stars)	21.8%	Fair
D (2 stars)	20.5%	Low
Unassessed (U)	25.4%	Low

[1] From Navigation Purpose 3 and 4 ENC in 2015, from 32 nations, covering 14,210,244 SQ KM. The analysis did not include ports.

28

How good are charts?

- Assessment criteria (in order):
  - Have all features been detected? If not, what size could be missed?
  - What is the horizontal accuracy of detected features?
  - What is the vertical accuracy of detected features?
- Worst result for any criteria defines the overall assessment.

Category	Confidence level	General description - survey characteristics
A1	Significant seafloor features detected and depths measured	High position and depth accuracy achieved using DGPS and a multi-beam echo-sounder, channel or mechanical sweep system.
A2	Significant seafloor features detected and depths measured.	Position and depth accuracy less than ZOC A1, achieved using a modern survey echo-sounder and a sonar or mechanical sweep system.
B	Uncharted features, hazardous to surface navigation are not expected but may exist.	Similar depth accuracy as ZOC A2 but lesser positional accuracy than ZOC A2 (generally pre-dating DGPS), using a modern survey echo-sounder, but no sonar or mechanical sweep system.
C	Depth anomalies may be expected.	Low accuracy survey, data collected on an opportunity basis such as soundings on passage or low accuracy given that the passage of time
D	Large depth anomalies may be expected.	Poor quality data or unsurveyed.
U	Unassessed.	The quality of the bathymetric data has yet to be assessed. Mariners should assume poor data quality until the area has been assessed.

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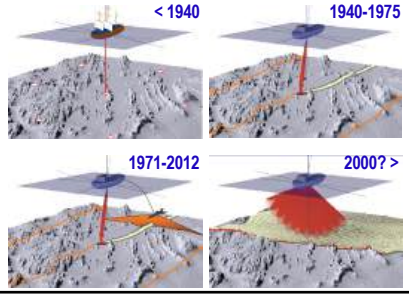
How good are charts? (feature detection)



Source: Caris

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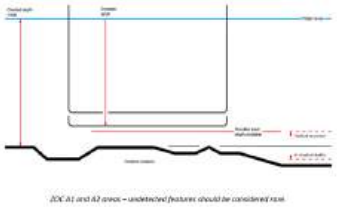
30

How good are charts? (feature detection)



ZOC A1 and A2 areas – undetected features should be considered rare.

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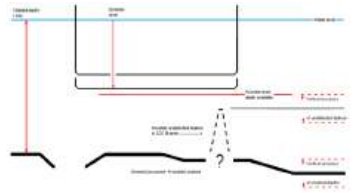
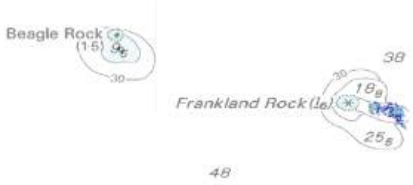
How good are charts? (feature detection)



32

How good are charts? (positioning)



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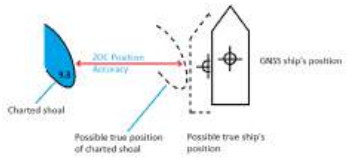
How good are charts? (positioning)



34

How good are charts? (depth)

Chart shows banks submerged, latest survey (Aug 2020) shows banks drying

35

How good are charts?

- In simple terms, mariners should be able to navigate with confidence in areas with ZOC A1 and A2 classifications.
- It is also unlikely that an uncharted danger affecting surface navigation exists in ZOC B areas. If an undetected feature does exist, in depths to 40 metres it should be no larger than around two metres high.
- Mariners should exercise caution In ZOC C areas since hazardous uncharted features may be expected, particularly in or near reef and rocky areas, and the size of any undetected feature may be much larger than two metres.
- A very high degree of caution is required for areas assessed as ZOC D, as these contain either very sparse data or may not have been surveyed at all (and steaming along an apparent line of soundings is no guarantee of safety).
- Finally, it is good practice to treat ZOC U areas with the same degree of caution as ZOC D areas.

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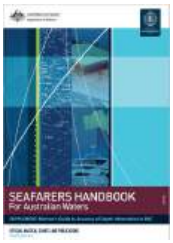
Understanding ENC

- Professional guide

Or go to:
http://www.hydro.gov.au/prodserv/publications/ahp20-supplement.htm



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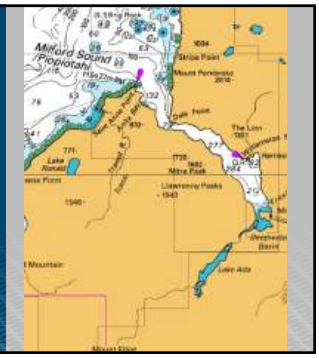
Navigating with GPS and Chart plotters



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Reliability of Information

When you turn on your chart plotter the first thing you get is a message like this…

- This product is an aid to navigation.
- Does not replace Official Charts
- "Only official Government charts and Notices to Mariners contain all the information needed for safe navigation."

B&G are a bit more strident…

"Do not rely on this product as a source of navigation……"

Behind these messages there are some key points:

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Reliability of Information - key points

- As we discussed last week, the charts used in chart plotters do not contain all of the information available in the Official Charts (ENC or paper charts)
  - "zooming down" to lower levels helps BUT
  - Zone of Confidence information not shown or used
- When you look at an image of your boat imposed on a chart with an apparent accuracy of just a few meters it's very easy to have a false sense of security

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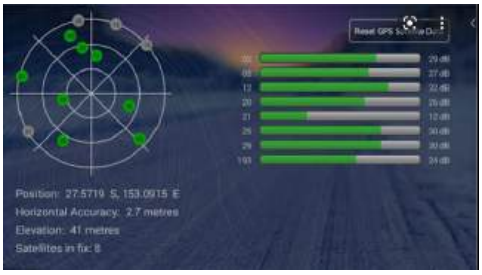
The GPS System

The GPS system comprises:

- 32 coordinated satellites (though only 24 active at any one time) each orbiting Earth twice a day plus ground control stations and the user's GPS receiver.
- Each satellite transmits a unique microwave signal including orbital parameters and very accurate time.
- The user's GPS receiver calculates its distance from the Satellites and with a minimum of three satellites can determine its position (at sea level!), four satellites for a 3-dimensional fix
- The GPS receiver automatically selects the best satellites
- Accuracy at sea level can often be as good as a few metres
- The GPS system uses the WGS84 map datum

41



42

How good is your GPS?

GPS effectively solves the problem of knowing where you are on the globe…..

- It's not infallible
- Most boats have numerous GPS receivers on board and they may not all agree!

43

GPS – What makes the GPS position shown in your plotter inaccurate ?

Antenna position and inability to see the satellites

- crew sitting on it
- is it under the sail (especially a carbon sail)
- effectiveness of antenna at severe angles of heel

The position and number of available satellites

User equipment failure – antennas do fail and degrade

44

GPS – Precautions

- You NEED to KNOW what your plotter does when/if the signal stops
  - Does an alarm sound ?
  - Can the skipper and crew hear the alarm when on deck
  - Does it continue with current position?
  - Does it use dead reckoning?
- Keep watch, cross check where you can
  - Depths, Light houses, transits
- Utilise HDOP & HPE (Horizontal Dilution of Precision),(Horizontal Position Error)
- Satellite tracker/map in your plotter

45

46

Setting up the Chart Plotter

https://www.youtube.com/watch?v=EICeUMI1xyU

Check all the settings – professional assistance in the initial set up may help – e.g.

- Are GPS and Chart plotter set to the same datum ?
- GPS set to degrees, minutes and decimal minutes?
- Helpful to set chart plotter and instruments to display compass True
- Include "confirming data" on Chart plotter displays - depth sounder readings displayed next to your chart are especially useful
- Ensure course over ground is displayed … where you are going is usually more important than where you are pointing!

47

Once you're all set up….

Your instruments do all the hard work for you

- Course over ground (no need to adjust for tides and leeway)
- Bearings, distances and expected sailing time to waypoint
- Speed over ground and Boat Speed
- Velocity made good to your course (VMC)
- Boat speed vs target speeds ("polars")
- Tide levels and some tidal flow information

- ……And the list goes on

48

GPS – your settings

- How is your GPS set
  - dd mm ss
  - dd mm.mmm
  - dd.dddd

- **Question**
  - 38.29934s 144.54397e
  - 38 29.934s 144 54.397e
  - How far apart are these two positions?

49

Convert decimal degrees to decimal minutes

- To Convert Decimal Degrees 38.29934
- Multiply 0.29934 by 60 = 17.960
- Position in Degrees & Minutes is 38 deg 17.960 minutes
- To convert 144.54397
- Multiply 0.54397 by 60 = 32.638
- Position in Degrees & Minutes is 144 deg 32.638 minutes
- Via the internet https://www.pgc.umn.edu/apps/convert/

50

A 21NM difference!

51

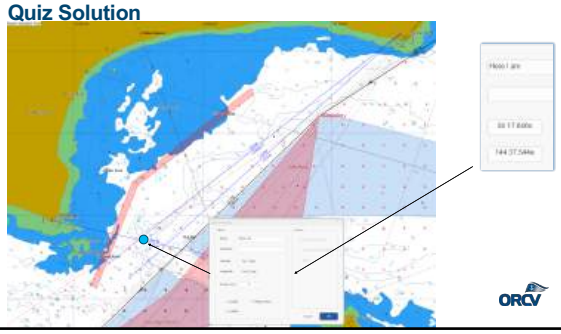
Quick #02

- You're somewhere in the vicinity of Port Phillip Heads in 11m of water
- You take a bearing to the Lonsdale lighthouse of 270º on your hand bearing compass
- You see a white isophasing light just to the left of the Hume Tower

- What is your position in Lat/Long in DD mm?
- What is the light & why?
- What would your bearing be to the light off your hand compass?

52

Quiz Solution



53

Compass Variation (Declination)

- If your instrument settings are TRUE make sure you a fully aware of the difference between your instruments and your wet compass

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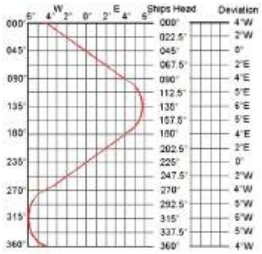
Compass Deviation

Compass deviation is another magnetic error effecting the steering compass. Variation is a magnetic interference common to all vessels. **Deviation is a magnetic interference unique to the vessel itself**.

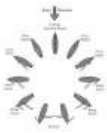
The term 'deviation' is used to describe the effect of interference from magnetic fields created by the vessel's own equipment. This can be from things such as batteries, large metal objects like the engine, speakers, VHF radios etc.

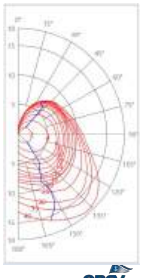


55

Predicting boat speed

- Every yacht is different, you should know approx. Your boat speed at various wind angles and wind strengths
- This can be represented on polar diagrams or tables
- If you don't have one, start a diary and create your own
- Most current chart plotters include "polar diagrams" for select yachts and will generate target speeds at measured wind strengths and angles.
- This "polar data" is the basis for weather routing.





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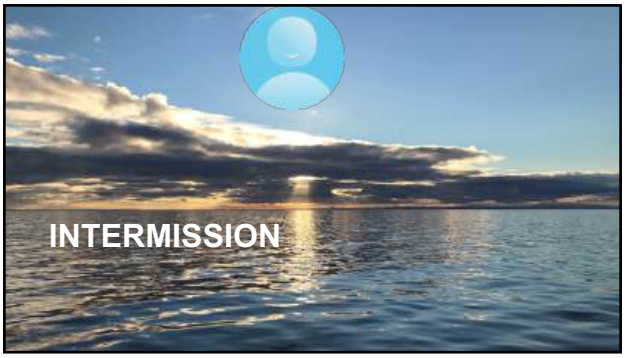

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Exercise #03 Navionics Exercise

- Plot a course from the exit of the Martha Cove Marina at Safety Beach to the entrance of the Queenscliff Cut (use the automatic course option)
- Any shallow water issues we need to keep an eye on?
- What are the key marks we will encounter on the passage?
- Are there any conventions we will need to obey along the way?
- What is the key danger?

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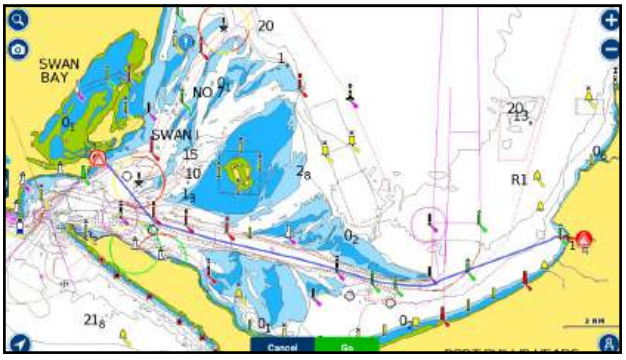

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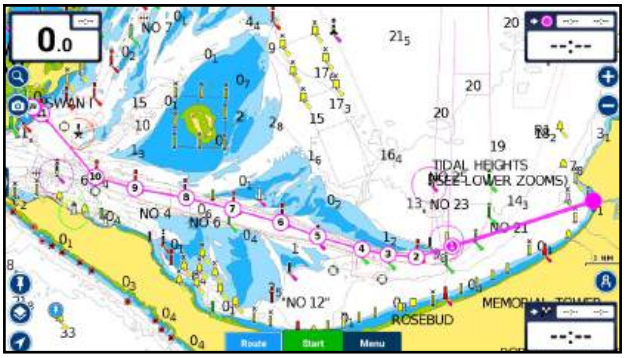

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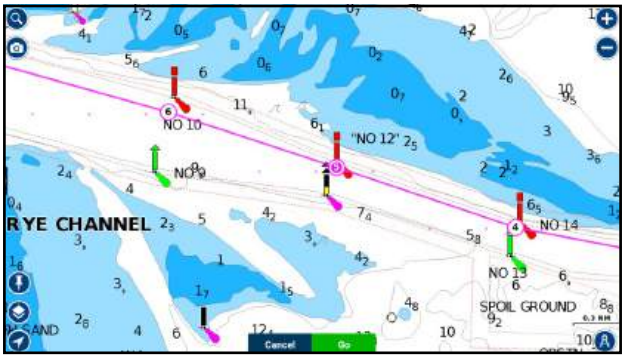

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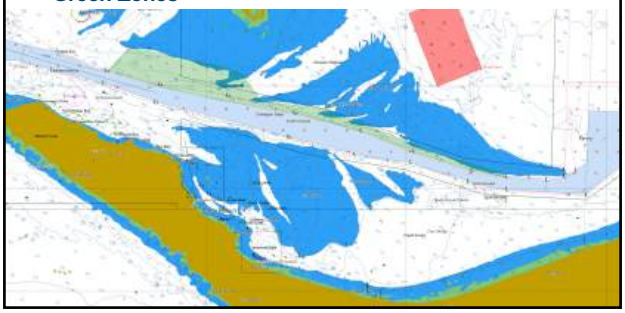
Green Zones



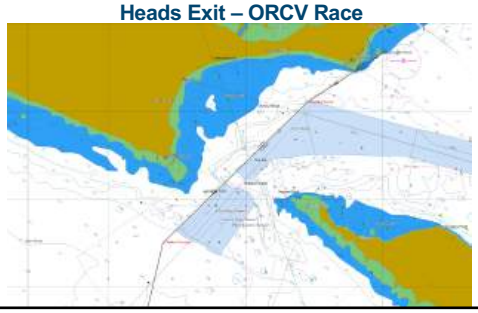
62

Exiting Port Phillip

The next couple of slides consider how you might prepare for a race start through Port Phillip Heads

63

Heads Exit – ORCV Race



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Heads Exit – ORCV Race

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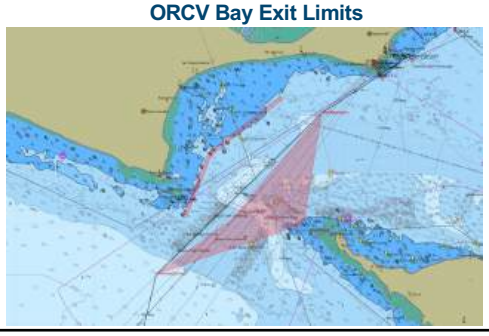
ORCV Bay Exit Limits



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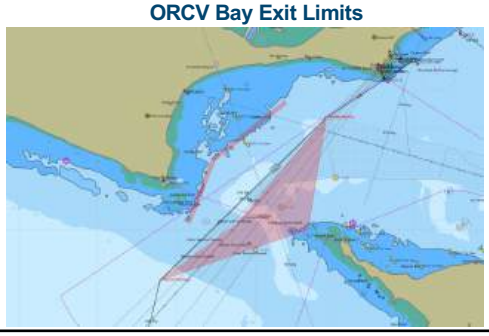
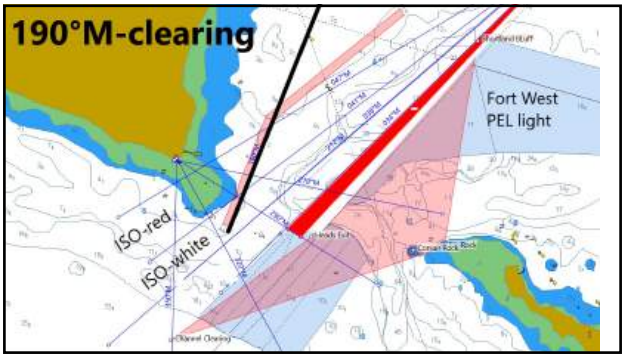
ORCV Bay Exit Limits



67



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Exercise #04 – Heads Exit

- What is the bearing from sea of the Clark's Beacon and Marcus Hill transit on the chart ? What does it indicate?
- What would be the bearing when viewed from the land?
- What lights are displayed by the three beacons on Victory Shoal?
- What is the distance between the ORCV Heads Exclusion Zone and the 5m line off Lonsdale platform?

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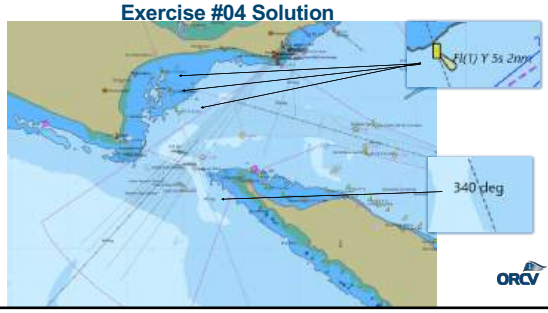
Exercise #04 Solution



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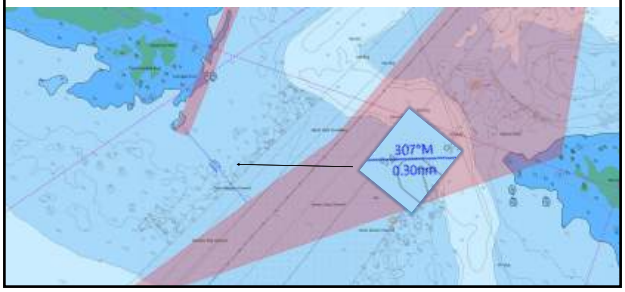
Exercise #04 Solution



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Exercise #04 solution

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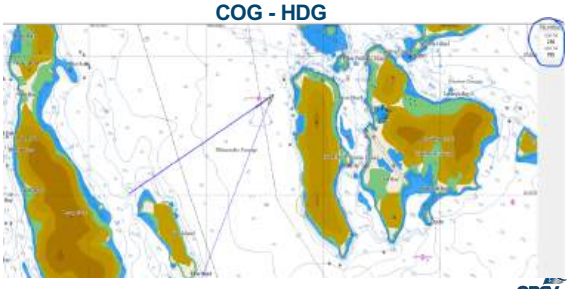
COG - HDG



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Quiz #03 Time – Distance Exercises

- I am travelling at 6 knots. How far will I go in 36 minutes?
- It is 10.00am and the start line for the race is 5 nm away. What speed do I need to motor/sail at arrive by 10.50am?
- I am located at Mornington Pier. I wish to meet another boat at Fawkner Beacon at noon. What time do I need to leave if I think I can travel at 6.5knots

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Answers

- Speed is distance /time. Distance is 6*(36/60) = 3.6NM
- 50 minutes is 50/60 hours, Speed=Distance /Time, speed = 5NM/ (50/60) hours = 6 knots
- Distance to Fawkner Beacon from Mornington Pier is 16.6NM. Speed is Distance/Time so Time= Distance/Speed, the time at 6.5knots is 16.6/6.5=2.55 hours= 2 hours 33 minutes, leave at about 9.30am

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Automatic Identification System (AIS)

- What is AIS? (compulsory Cat 1 & 2 races)
- Automatic tracking system
- Identifies & locates vessels by electronically exchanging data with other nearby ships and AIS Base stations
- Class A and B (smaller vessels)
- Vessels continually transmit their ID, position, course, speed and other data by VHF.
- Receivers only and transceivers

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AIS - Overview

Unlike radar and other aids to navigation, the AIS systems do not need to have visual line-of-sight to share this information.

- Yachts reliant of VHF coverage – ship to ship or ship to station

Benefits of AIS

- Collision avoidance
- Aid to Navigation
- Identify other vessels
- AIS MOB device

Beware of "old" positions

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AIS - Features

- Networked AIS displays show vessel positions across the world (marinetraffic.com)

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AIS marinetraffic.com

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AIS marinetraffic.com

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Collision Avoidance

- Vessel details, position, course & speed shown on chart plotters
- Chart plotters can be interrogated to find:-
  - Whether boats on collision course
  - Passing distance
  - When closest passing distance will be reached.
- Can be linked to alarms

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AIS Additional Features

- AIS AtoN - transmitting position and status of buoys and lights, which can then show up on an electronic chart, display or radar
- Synthetic AIS. Transmitter is located near – but **not on** the object of interest – such as submerged rock
- AIS received by satellites to give extended reception of the VHF signal - even when out at sea

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Good Practice for Safe Navigation

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Key points

- Everyone on a boat should take an interest in navigation
- There should be redundancy – in equipment and people
- There should be a plan, made well before the trip, including plan B catering to "what if"
- Don't blindly rely on technology, use your observations
- Be conservative !!

Proper Preparation Prevents Poor Performance

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Passage / Race Planning

Your passage should be a confirmation of what you have already planned.....

- Estimated times along the route
- Conditions to expect
- Dangers & potential dangers

Include contingencies for unplanned events .....what if

- I need a bolt hole ?
- I break a rudder ?
- I need medical assistance?

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Observations

- Things to note on plan:-
  - Expected sighting of shore line changes (e.g. a headland)
  - Navigation markers
  - Lights and beacons
  - Significant chart features – oil rigs
  - Depth changes
  - Shoaling Water
  - Consider writing them down
    - In your logbook

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Red Zones

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What makes a Red Zone Red ?????

- Potential outcomes if you get it wrong
- Likelihood of getting it wrong..
  - Crew fatigue, especially the helm and navigator
  - Weather - visibility, difficult conditions
  - Tides – possibility of rips, breaking waves
  - Inherent difficulty..... navigation lights and shore lights, condition of leads
  - Been there before ??.... do you know what the entrance looks like in the dark ?
  - Reliability of charts
  - Shipping, fishing boats, cray pots

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Red Zone Procedures – some general rules

- Identify likely red zones when you do your trip plan....
  - Awareness matters – discuss with crew, watch leaders and both navigators
- One person steering... not steering and navigating
  - Nav Person ..... not down below
  - Lookouts
  - Protect night vision – of skipper and lookouts
- Ensure you have boat under proper control before entering red zone
  - Know the limitations of the boat and crew in the conditions you could expect to experience

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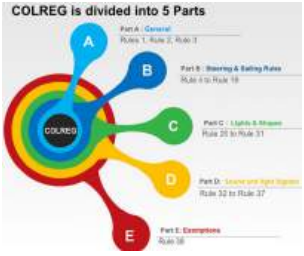
COLREGS

- Know and follow the rules
- Maintain a proper lookout (windward and leeward)
- Travel at a safe speed
- Allow for the actions of others, both reasonable and unreasonable.
- Know how to recognise lights of ships
- knowledge of the Col Regs



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Further Exercises

- Exercise #05 – Port Arlington – Cole Channel Beacon
- Exercise #06 – Blairgowrie Yacht Squadron (BYS) – Queenscliff Cruising Yacht Club (QCYC)
- Exercise #07 – Return trip from Hobart – Melbourne
- Exercise #08 – Fastnet

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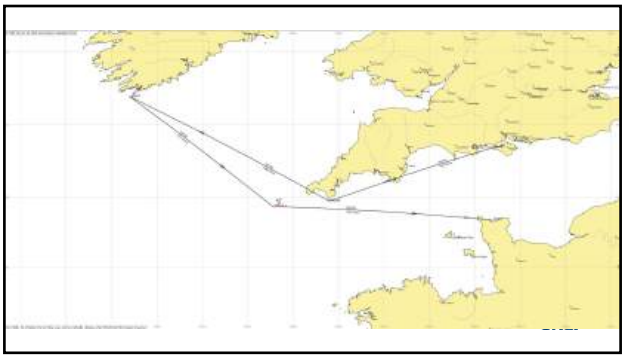

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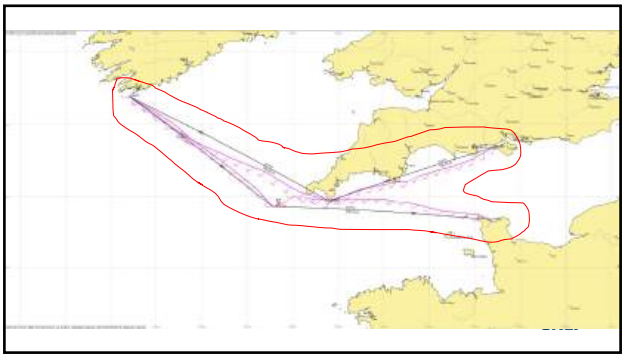

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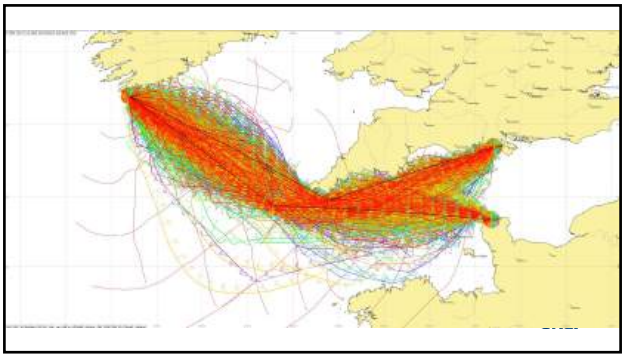

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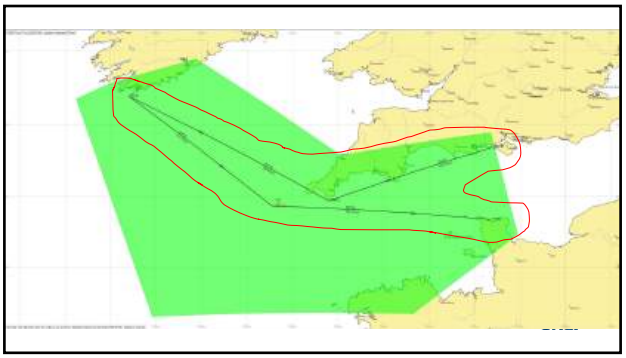

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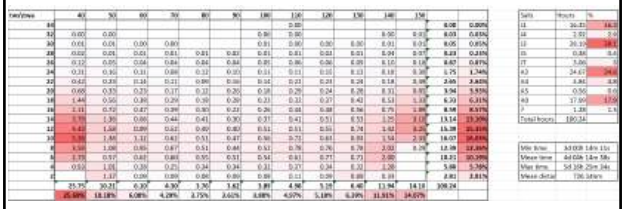

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Key Take Home Messages

- Paper Charts have given way to electronic charts
- Only ENC's are the official charts
- No charts are perfect! Zones of Confidence always need to be considered
- GPS, plotters and AIS are great aids to navigation but need to be set up correctly and constantly monitored
- Plan routes well in advance to identify potential hazards
- Crew vigilance is critical in addition to instrumentation
- Risk management – What could go wrong and how would we cope?

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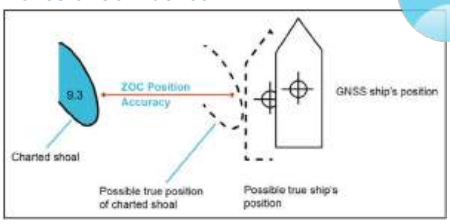
ZOC
Zones of Confidence



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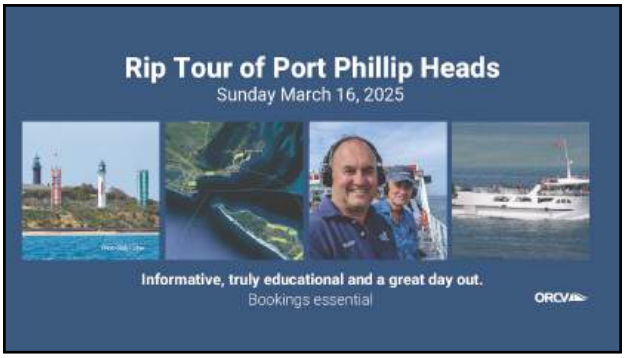

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Interact with Us

Train

Navigation
On Water Rip Tour
Weather
Foredeck Essentials

Race

Destination Races to:
Devonport, King Island, Hobart
Apollo Bay, Port Fairy,
Coastal Sprints

Volunteer

Support
Many Roles
Race Management, Media,
Training Support, Mentoring

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What we want you to do before the Q&A

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- Complete the major exercise using your electronic charting software
- Email training @orcv.org.au
- A written Voyage plan
- Screen captures of your electronic route
- A GPX file of your routes

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What we want you to do before the Q&A

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- It would be great to know what you're asking beforehand so that we can prepare better for your questions.
- Any questions sent to training@orcv.org.au beforehand will head the queue.

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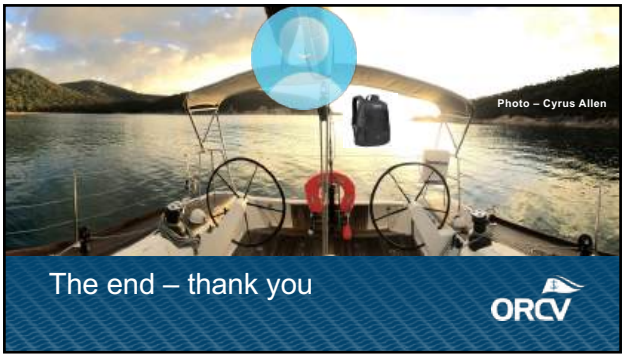

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