Electronics, Their Role in Marine Navigation

- An Overview -

"When meeting the challenges the sea offers, some sailors are lucky, some are prepared …….

I prefer to be prepared and lucky"

Capt. Steve Runals

What We're About

- The range of electronic devices, marine related software and internet resources available to recreational boaters today is truly amazing; from multifunctional display (MFD) units to tablet computers, Smart Phones and internet available information.

- The challenge is how best to take advantage of the capabilities these devices/resources provide for safe and effective navigation **_yet_** be aware of their limitations and how to minimize them.

- It's not a case of "paper" or "electronic" but rather how to **_integrate_** the capabilities electronic charting / tools / resources bring to the tasks required in navigation.

- While addressing some specific capacities and techniques, this overview makes no attempt to identify all the systems, software and internet resources available on the market today.

Navigation Today

Radar

Wi...

Parallel Ru...

SSB
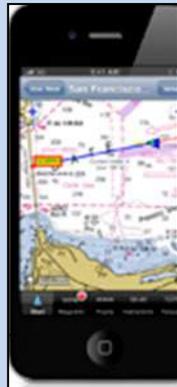
VHF Radio

Garmin NAUTIX IN-VIEW

8.68°

294°

60.21°

MFD w/AIS receiver & Handheld GPS

- **At home**
- **Onboard**

M...S

Raymarine's ClearCruise AR

Raymarine's new **ClearCruise Augmented Reality Navigation Technology system "ClearCruise AR"** accurately **displays nearby navigation markers, au_____ects, and waypoints** - _____al-world **imagery** for _____

A **camera** is _____ltifunction display (MF_____**al information, improving navigation** awareness.

It's a **combination** of newer and "older" technologies and capabilities.
- Options to utilize and integrate
- Determine what **_you_** need / want to use
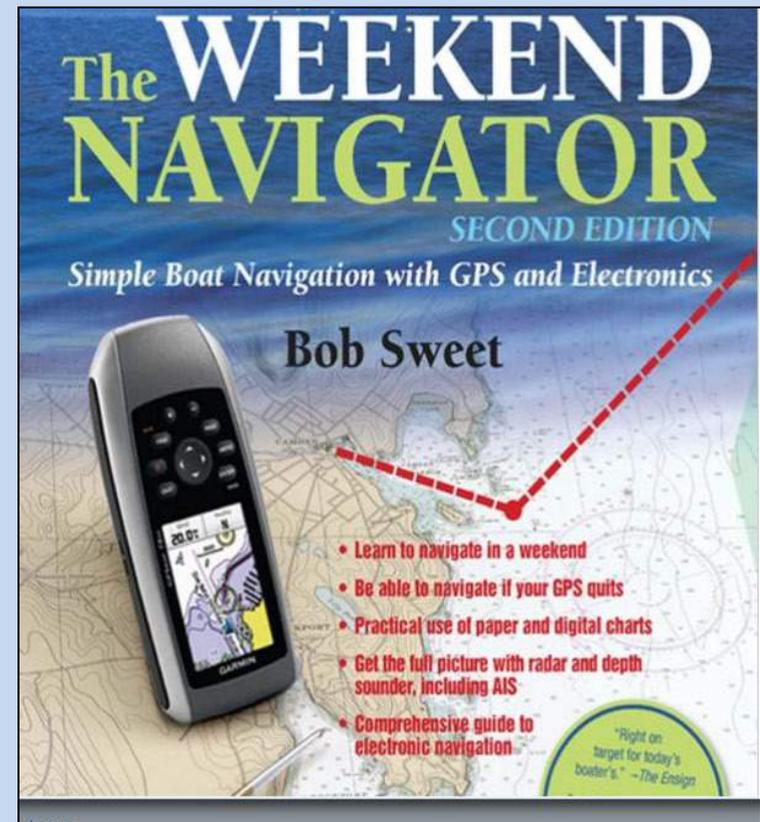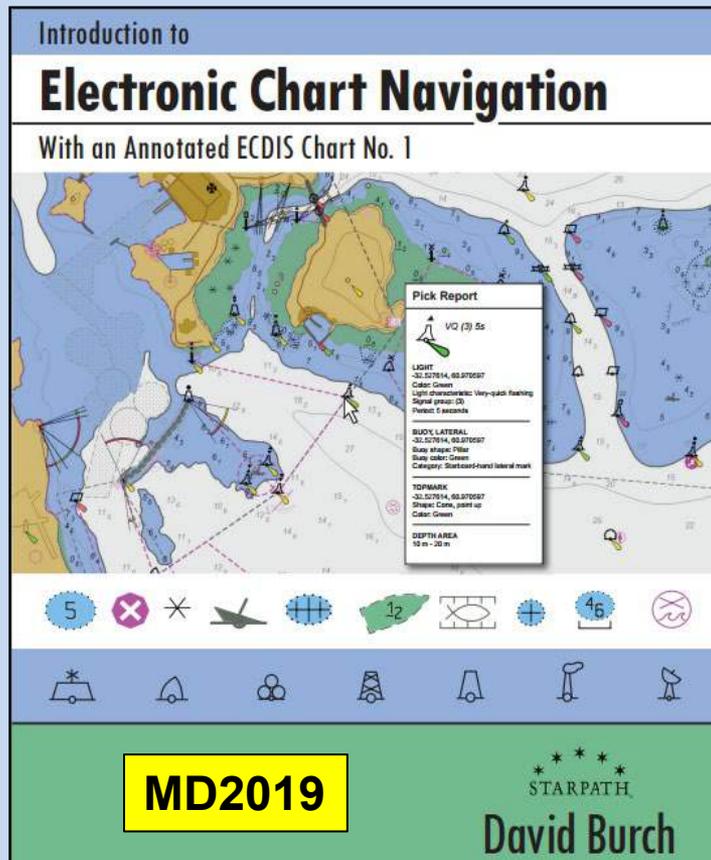- Determine **_how_** and **_where_** info displayed

Camera view

References

- Introduction to Electronic Chart Navigation; by David Burch, StarPath.
- The Weekend Navigator, 2d Ed, Simple Boat Navigation with GPS and Electronics; Bob Sweet; International Marine / McGraw –Hill, 2012.

What Is Electronic Navigation (e-Nav)

- **Navigation** answers two basic questions: "***Where am I***?" and "***How do I safely get from there to where I intend to go***?" (There is a difference between "getting there safely" and "safely getting there".)

- In addition to charts, navigators **traditionally** have used: compasses, plotting instruments, depth and speed instruments, a watch or clock, binoculars, log books, barometers, cruising guides/pilot charts **combined** with **visual observations** and **manual plotting techniques** to plan their routes and track their progress to answer these questions.

- Today's navigators **combine** these "traditional" instruments and plotting techniques with GPS enabled devices and an ever increasing number of electronic aids/tools (AIS, radar, autopilots, Sirius WX, internet resources, etc.) to **answer** these age-old questions.

THE EVOLUTION OF MARINE ELECTRONICS | From Standalone devices, over MFDs to the (integrated & connected) Information Display

1950 - 2000

Standalone Devices

- Several standalone devices each showing chart, radar, sonar etc

- No integration across hardware/displays

~2000 - 2018

Multi-Functional Display

- Integration of marine electronic providers' products suite (Sonar, Rader, Autopilot) into one integrated display unit on the boat

- Slow integration of digital switching to provide a more comprehensive and integrated boating experience

+2019

Information Display

- Integration of all major existing key components on the boat (engine, battery, anchor …) controlled by a central display for easier and better control and comfort

- Cloud connected to provide data and digital services to/from a host of boating industry partners, with the purpose of making boating more safer and more fun

- Seamless, device agnostic, (MFD, phone, tablet) on/off boater experience

navico

LOWRANCE   SIMRAD   B&G   C-MAP

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e-Nav

- GPS enabled devices can help answer the first question – "***Where am I?"***; used properly, they help answer the second; "***How do I safely get there***?"

- **Electronic Navigation:** The use of electronic tools (chart plotters, computers, tablets, Smart Phones, AIS, autopilots, radar, Sirus Wx, etc.) to **aid** in answering these two fundamental questions.

- **e-Nav:** A colloquial term for displaying charts, and optionally navigating using a personal computer, tablet, Smart Phone and other electronic tools.

The science of navigation can be taught but the art of navigation can only be developed with experience.

Defining Some Terms

- **EAC:** Electronically Aided Collisions

- **Electronic Charting System (ECS):** Any **system** of hardware devices, navigation software, chart data files, and additional marine electronicsthat incorporates GPS signals to display a vessels position on a digital chart along with info like COG, SOG . No required standardization in *functionality* and chart symbols.

- **Electronic Chart Display and Information System** (**ECDIS**): An electronic charting **system** satisfying *international* standards for commercial navigation. **An integrated system of hardware, software, sensors (such as radar, depth and automatic identification systems (AIS), communications; *each part* of which must meet rigorous and specific international standards**. It may also display additional navigation-related information, such as sailing directions. *Not all recreational ECS use official ECDIS software or charts. (IHO S- 52, S-57)*

Defining Some Terms

- **Electronic Chart:** The encoding of a navigation chart as a digital file to be viewed on an electronic display. Two file types:

  - **Raster Chart**: A **static**, scanned **image** of a paper chart.
  - **Vector Chart**: A **dynamic data** file of chart features – a collection of geospatially referenced point, lines, polygons, symbols and areas **assembled** as needed for display.

- **NMEA 2000:** A revised data communication protocol replacing NMEA 0183 increasing the number of devices able to be connected – "plug-an-play" connections.

- **Route**: A grouping of waypoints connected in sequence, typically marking a vessel's intended course.

Defining Some Terms

- **Route Planning**: The pre-determination of course, speed and waypoints for waters to be navigated.

- **User Generated Content (UGC):** "Crowd-sourced" information to support navigation: obstructions, anchorages, marinas, etc.. **ActiveCaptain** and **Waterway Guide** are popular UGC programs that can be accessed offline and increasingly integrated as part of many ECS. **Navionics** has a crowd-sourcing online function.

- **Waypoint:** A set of latitude and longitude coordinates that identify a location used for navigation. Individual waypoints can be connected to make a route.

NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 01-16

Subj: USE OF ELECTRONIC CHARTS AND PUBLICATIONS IN LIEU OF PAPER
CHARTS, MAPS AND PUBLICATIONS

c. Due to the current state of technology, the Coast Guard believes that official electronic charts provide substantially more information to the mariner, and therefore may enhance navigational safety beyond that of official paper charts. Official electronic charts, when displayed on electronic charting systems (with integrated systems such as Electronic Positing-Fixing Devices, Automatic Identification System, gyro, radar), can provide the mariner with substantially more navigational information than a paper chart. These

"There are far more unregulated navigation systems in use than type-approved electronic chart display and information systems"(ECDIS). **The Coast Guard Proceedings, Journal of Safety & Security at Sea, Summer 2015**

The State of the Art

Will soon be mandatory on all commercial vessels >500GT

ECDIS

Sea School offers ECDIS courses in Bayou La Batre, Alabama. Classes are 40 hours (5 days) and limited to ensure maximum attention is given to each student. Tuition is $1100 and includes Room & Board.

Call 1-800-247-3080 to register.

ECDIS stands for Electronic Chart Display and Information System and is a computer-based navigation system that complies with all IMO regulations and can be used as the primary alternative to paper navigation charts.

As of December 31st, 2016, all Mates/Masters on ECDIS equipped vessels will be required to have ECDIS training. Without ECDIS training, Mate/Master licenses will be restricted from operating ECDIS equipped vessels.

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ECDIS Competencies Required in Table A-II/1 of STCW

- Operate ECDIS equipment.
- Use the navigational functions of ECDIS.
- Select and assess all relevant information and take proper action.
- Acquire and develop a knowledge and understanding of the basic principles governing the safe operation of ECDIS.
- Understand ECDIS data and their presentation.
- Understand system-related limitations and potential dangers.
- Generate and maintain displays.
- Operate all basic navigational functions and all specific functions for route planning and route monitoring.
- Select and use the navigational data and display the data in the appropriate manner.

- Recognize and analyze nautical alarms during route planning and route monitoring as well as sensor alarms.
- Assess the impact of the performance limits of sensors on the safe use of ECDIS.
- Understand the importance of a back-up system and its limited performance.
- Assess errors, inaccuracies and ambiguities caused by improper data management.
- Awareness of errors in displayed data, errors of interpretation.
- Risk of over-reliance on ECDIS and be able to take proper action. In addition, knowledge of the principal types of electronic chart.
- Knowledge legal aspects in the operational use and management of ECDIS.

ECDIS Competencies Required in Table A-II/1 of STCW

- ✓ Operate ECDIS equipment
- ✓ Use the
- ✓ Select and information
- ✓ Acquire a understa governing
- ✓ Understa presenta
- ✓ Understa and potential dangers.
- ✓ Generate and maintain
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  able to take proper action. In addition, knowledge of the principal types of electronic chart.
- ✓ Knowledge legal aspects in the operational use and management of ECDIS.

- "Treat GPS and e-Nav devices and data with deep appreciation but constant skepticism"

- Spend time learning how to use your system and its capabilities

- Know how to use and use paper charts

- Keep an updated log

So................

Some Capabilities and Limitations

Some Capabilities

- Electronic devices integrating GPS capabilities provide today's ma... ...rmation, capabilities and choices. Ca... ...and software package:
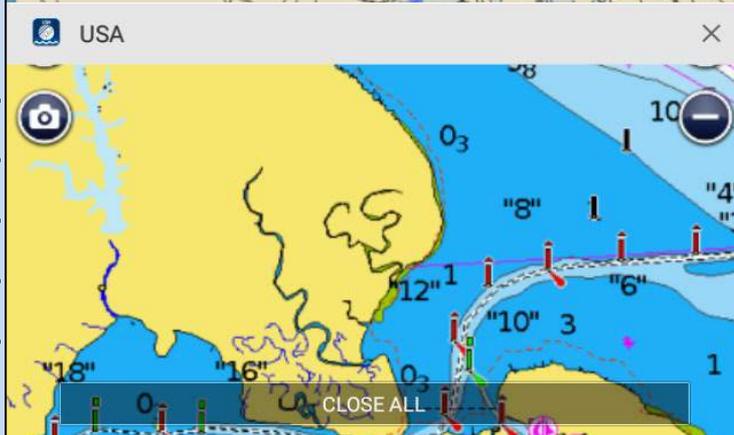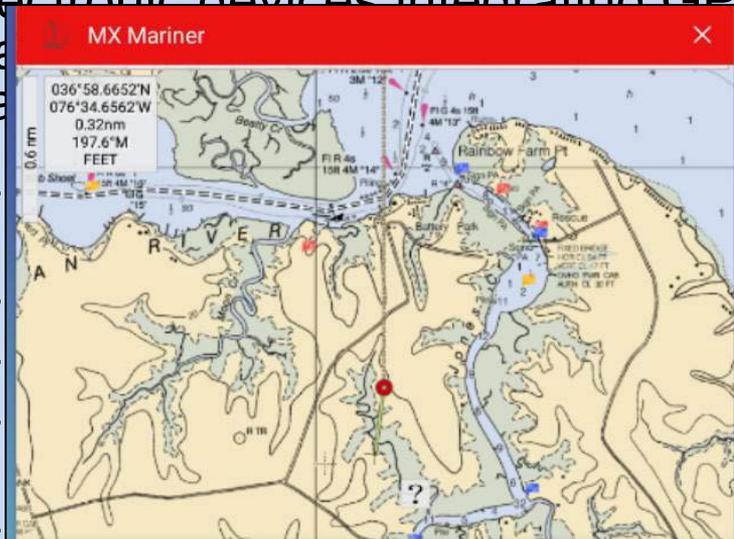
  – ... ...n and speed over the ground
    ...of navigation charts
  – ... ...tellite images of surrounding areas
  – ... ...routes, marks and annotations
  – ... ...mined waypoints and other areas of
  – ... pr... ...on,
  – ... ...ad
  – ...
  – ... ...x,
  – ...
  – ... ...or
  – Electronic logs, celestial computers, st... ...arts ……………
  – **A capability for displaying multiple sources of charting information/formats**

MX Mariner

036°58.6652'N
076°34.6562'W
0.32nm
197.6°M
FEET

USA
CLOSE ALL

Stereo

NavTex

iPad

VHF

VHF

SSB

Some Cautions

"Although GPS is reputedly accurate to within 10 meters, **errors** of as much as **100 meters** have been known. For that reason whenever a navigator finds himself within **3 nm of land or a navigation hazard** they must use conventional methods of navigation. …. **Despite the accuracy of charts and GPS, the number of groundings has not declined. This is because of the over reliance on electrical systems. …**".

Legend data from an Imray-Lolaire chart

"Do not rely on this product as your primary source of navigation".

The operator is responsible for using official government charts and prudent methods for safe navigation. ……..

Autorouting and Easy Routing are for general planning only. They do NOT replace safe navigation practices and should not be used as the sole reference source."

Intro warning page on a B&G Multifunctional Chartplotter

Some Limitations

- Because e-Nav devices depend on access to GPS satellites and user interface, they are subject to:
  - Loss of power
  - Equipment failure
  - Interference from external sources – manmade and natural
  - Subject to damage from the harsh marine environment to include lightening
  - **Incorrect or out of date datum and chart data**
  - **Small areas in great detail, large areas with very limited detail**
  - **Operator error**

While some or all of these factors are not uncommon in many other areas and even to traditional navigation, an over reliance on ECS devices has led to so many accidents the USCG has set up a category for these type accidents, giving it the acronym "EAC" – *Electronically Aided Collisions*"

Don't become a victim of EAC 25

A good anchorage at high tide … not so much at low

Having a chart plotter is good, understanding the information that it provides...priceless.

Some Limitations: Operator Error

- The primary means to enter data on

Waypoint 1

q w e r t y u i o p
a s d f g h j k l
z x c v b n m àëò CAPS 123
◁| |▷ SPACE SAVE
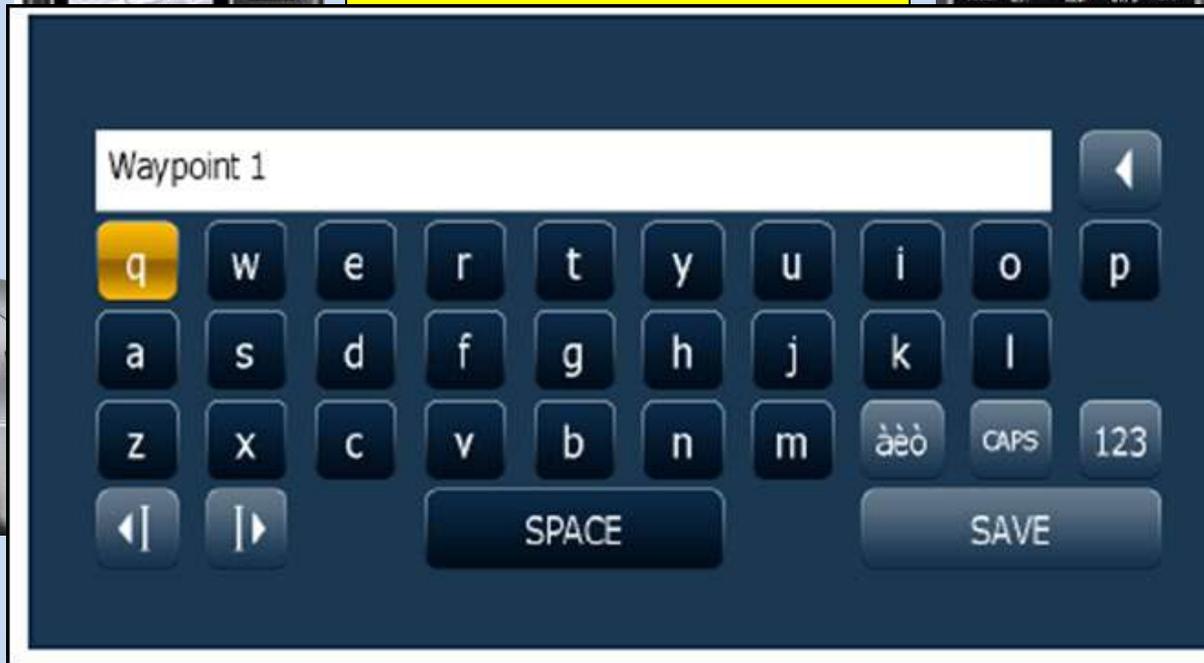
Some Limitations – A Perspective on Detail

Detail – limited perspective
Perspective – limited detail

Viewing Scale Matters

Some Capabilities and Limitations

Some MFD's can accept charts from Navionics, C-Map and Lighthouse.

Two different charting programs

How do you access NOTE G?

(SEE NOTE G)
EMERGENCY RESTRICTED AREA
FOR THE LATEST INFORMATION
REGARDING THE REGULATIONS OF
ANY EMERGENCY RESTRICTED AREA,
CONTACT THE ARMY CORPS OF
ENGINEERS, NORFOLK
DISTRICT REGULATORY
BRANCH AT (757)
201-7653/7652

Keeping Charts Updated

List of websites

- Weekly publication by U.S.C.G online as a PDF file
- Published by District w/ 8 Sections:
  - Abbreviations
  - Special Notices
  - Discrepancies
  - Temporary Changes
  - Chart Corrections
  - Advance Notices
  - Proposed Changes
  - General Light List Corrections

Weekly Chart Updates

Weekly Chart Updates

Affected Charts

Chart |#Crit,#Non-Crit

NE New Edition

11542 [1,0] NE

Near: -75.85 , 38.04

ID   278944

SAFETY/MD-CHESAPEAKE BAY-CHOPTANK RIVER AND HERRING BAY-KNAPPS NARROWS WEST CHANNEL (CHART 12266)/ATON/CCGD5 BNM 115-18   Inbox x

U.S. Coast Guard <uscoastguard@

to me ▼

Broadcast Notice to Mariners - BNM

4:35 PM (16 hours

United States Coast Guard
U.S. Department of Homeland Security

CCGD5 BNM 115-18

MD - CHESAPEAKE BAY - CHOPTANK RIVER AND HERRING BAY-KNAPPS NARROWS WEST CHANNEL (CHART 12266)

1. THE FOLLOWING AIDS TO NAVIGATION HAVE BEEN TEMPORARILY DISCONTINUED FOR DREDGING.

A. KNAPPS NARROWS WEST CHANNEL LIGHTED BUOY 3A (LLNR 25930.5).

B. KNAPPS NARROWS WEST CHANNEL BUOY 4 (LLNR 25931).

C. KNAPPS NARROWS WEST CHANNEL BUOY 5 (LLNR 25933).

2. CANCEL AT TIME //201200Z MAR 18//

3. THIS MESSAGE IS PART OF A PILOT PROJECT. SEVERAL FORMAT CHANGES WILL BE EVALUATED AS PART OF THIS EFFORT. INFORMATION ON THE CHANGES CAN BE FOUND HERE.

Email update:
Knapps Narrows West Channel lights temporally discontinued due to dredging.

https://www.navcen.uscg.gov/?pageName=lnmMain

Updated every Thursday

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Keeping Charts Updated

United States Coast Guard
U.S. Department of Homeland Security

Weekly email - Tues

Feedback Req...

Maritime Safety

- Maritime Safety Information Distribution
- Local Notices to Mariners
- Light List Volumes
- Navigation Rules - Amalgamated
- Maritime Telecommunications
- PAWSA
- International Ice Patrol (IIP)
- Public Notices for Bridges
- Nav Pubs and Documents
- Vessel Traffic Services
- USCG Homeport Website
- Coast Guard Safety Alerts (uscg.mil)

Subscribe / Report (free)

- Subscription Services / RSS (free)
- Report an ATON Discrepancy
- Report a GPS Problem
- Report an NDGPS Problem
- Report an LRIT Problem
- Report an AIS Problem
- Contact Our Watch or SME

The United Stat... ...ary survey on the current utilization of 'Synthetic' AIS-Aids To Navigation duri... ...n on the navigable waters within the United States. If you would like to participate in th... ...click the following hyperlink: https://www.surveymonkey.com/r/CG-AIS-ATON. You... ...ated

https://www.navcen.uscg.gov/

The following p... ...tion Center website:

- The F... ...to Mariners (52-2018): https://www.navcen.uscg.gov/
  pdf/I...
- The v... ...List, Volume Two: https://www.navcen.uscg.gov/?pageName=
  lightL...
- The S... ...navcen.uscg.gov/pdf/lightLists/corrections/V2D05.pdf

If the links abov... ...and paste the links into your web browser or follow the LNM links from
the Navigation ...

The Local Notic... ...y of Corrections are in Portable Document Format (PDF) and viewing
them requires a... ...available on the internet, generally free of charge.

Keeping Your Charts Updated

NAVIONICS | Chartplotter | Mobile | WebApp | Downloads & Updates

NAVIONICS+

Navionics+ provides more marine and lakes content and the best value!

2,000 updates a day

Buy now

Coverage   Compatibility

"Freshest Data": Register online within two months of purchase and get free daily updates for one year.

Charts

Everything on one card! Nautical Chart,

When was the last time you updated your electronic charts?

NAUTICAL CHART   SONARCHART™   COMMUNITY EDITS

e-Nav, Its Components

e-Nav, Its Components

Hardware:

- MFDs, chartplotter/fish finders, chart plotters, hand held GPS units, computers, tablets and Smart Phones.

- In ad... ...ta, MFDs **integ**... ...dar, depth, wind... ...boat syste...

- Most... ...-Fi to serve as th... ...cal area netw...

- MFDs, chart plotters and handheld GPS systems are **designed** for use in the marine environment (heat, humidity, sunlight); can be permanently mounted or removable.

e-Nav, Its Components

Hardware:

- **Computers, tablets and Smart Phones** have limitations for use in the humid environment and strong sunlight typical of maritime operations; don't generally operate from fixed locations on the boat.

- MFDs, chart plotters, Smart Phones have integrated GPS capabilities, many now with Wi-Fi.

- **Not all tablets or computers** are GPS enabled but many can be enabled through additional hardware / software additions.

- Several Apps for tablets and Smart Phones can be used to interface with MFDs.

e-Nav, Its Components

Hardware:

– Ma[...]D's:

Si-Tex Explorer NavPro with External GPS Antenna

The NavPro Charting System from Si-Tex is a Black Box System that can turn any VGA Display or PC Monitor into a full C-Map Charting System. Includes 2 NMEA183 Ports and comes packaged with External GPS Smart Antenna.

SIEXPNAVPE   MAN#: EXPNAVPRO   ID#: 5028

Our Price: $719.95

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e-Nav, Its Components

Hardware:

- **Considerations when selecting a personnel computer:**
  - Computers or laptops with charting software offer significant computing power and storage capability, work well for planning, waypoint and route creation, viewing info like tides/currents and back up route management while underway.
  - The more capable the software program, the more memory needed.
  - A computer sufficient for graphic-intensive games or displaying and manipulating large photos should be sufficient for e-Nav.
  - Have GPS interface and Wi-Fi internet capable.
  - **Must be protected from dropping, vibration, spills, high humidity and extreme temp changes.**
  - If protected, most computers are capable of performing well onboard as long as they can operate off 12v DC (monitor too).
  - Improvements in power management are helping to solve the major challenge: screen brightness.
  - **"Bigger (screens) is not always better".**

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e-Nav, Its Components

Software for marine hardware and computers:

- Navigation system applications and charts need to be regularly updated. **This can be an issue with older devices.**

- Some e-Nav systems use proprietary charting software, others can display free government charts, some can do both.

- C-M_____rts® are som_____overage. Othe_____**OpenCPN**.

> *After buying new hardware or software, always check to see if there are factory updates before using.*

- Charting data can be displayed as Raster Navigation Charts (RNC) or Electronic Navigation Charts (ENC) (Vector).

- There are international standards for commercial navigation systems, **not all recreational ECS use officially recognized ECDIS software or charts.**

"There are far more unregulated navigation systems in use than type-approved electronic chart display and information systems". The Coast Guard Proceedings, Journal of Safety & Security at Sea, Summer 2015

e-Nav, Its Components

Consolidation of marine hardware and software:

- **Jeppeson** has sold its **C-Map** to the Swedish company that owns **Navico** – parent to **B&G, Lowrance and Simrad.** In 2018 merged C-Map with Navico.

- **Navico** will continue to support **Raymarine** and **Furuno** systems.

- **Garmin** acquired **Navionics** in late 2017 w/ intention of eventually blending Navionics data with its proprietary Blue Charts

- **Navionics** brand is retained and continued to be supported - "no intention of making Navionics proprietary to Garmin".

- **Note, not all recreational ECS use officially recognized ECDIS software or charts.**

"The changes we are seeing in cartography are making it easier for us to provide innovative electronics solutions along with trusted mapping systems to our customers." West Marine's electronic manager

e-Nav, Its Components

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e-Nav, Its Components

Software for marine hardware and computers:

- Some considerations when choosing ENC's:
  - ❑ Raster or Vector formats
  - ❑ Availability of ENCs for desired cruising area. Check for regional chart coverage, level of detail and data sources - Coverages varies in availability of small and large scale charts of desired cruising areas i.e. Explorer Bahamas charts licensed by GARMIN and Jeppessen. NV charts for Cuba. Check the "definition" of cruising areas
  - ❑ Available paper versions
  - ❑ Availability for periodic updates; many publishers moving to "subscription" services for updates
  - ❑ Features and display formats desired for the type of sailing you do – racing, coastal cruising, offshore voyaging
  - ❑ Ability to integrate input from existing hardware
  - ❑ Access to "crowd-sourced" or User Generated Content (UGC) input – **ability to update information**
  - ❑ **Fully operational offline**

e-Nav, Its Components

Instruments and Sensors:

- Most boats incorporate some degree of networked marine electronic interface – a GPS sensor integrated with chartplotter and VHF radio.

- The trend is to interconnect more sensors to provide an ***integrated picture***

PRODUCT PREVIEW

Watch Axiom Take Flight

Raymarine unveiled an exciting future capability for Axiom and Axiom Pro multifunction displays – full integration with Unmanned Aerial Vehicles (UAVs), aka drones, making the sky the limit for Axiom!

- – Satellite Wx
- – Video

- Issues of cabling and data compatibility exist between manufactures but can generally be resolved with "work arounds". *Common systems share data more consistently.* Digital Yacht's *SeaTalk to NIMEA Gateway*

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e-Nav, Its Components

Automatic Identification System (AIS)

- Automated system using transponders and receivers over VHF to tran... ...rogress:
  - ❑ ...
  - ❑ ...
  - ❑ ...
- Diff...
- Mos... ...tio...
  boa...

AIS Transceivers in US Waters		
	Class A	**Class B**
Transmitting Power	12.5 W	2 W
Transmit rate	2-3 sec	30 sec
Commercial Vessels	>65 ft	
Passenger Capacity	>150	
Fishing Vessels		
Recreational Vessel	Optional	Optional

Can be used to broadcast application-specific msgs (ASMs): cordon off areas, shift traffic lanes or identify hazards to navigation.
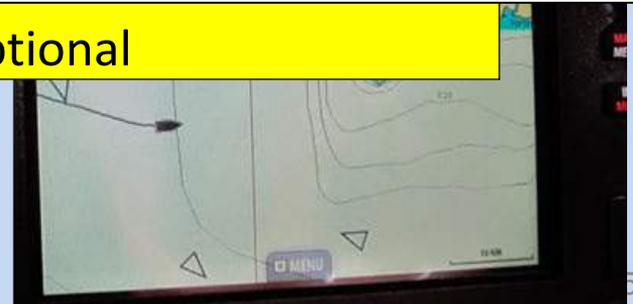
e-Nav, Its Components

Automatic Identification System (AIS)

LORETTE

My vessel

1/2

00:00:04

Accuracy: Low
N 36°59.801' W076°18.590'
Range: 0.5nm
Bearing: 169°M
GPS Speed: 5.5kt

CPA: 0.5nm
TCPA: 00:00:33

e-Nav, Its Components

Automatic Identification System (AIS)

Although standardized in ECDIS, there is variation in these basic icons seen in many ECS programs. Except for red on dangerous CPA and SART targets, colors and fill of the other symbols vary between ECS programs. User set options can
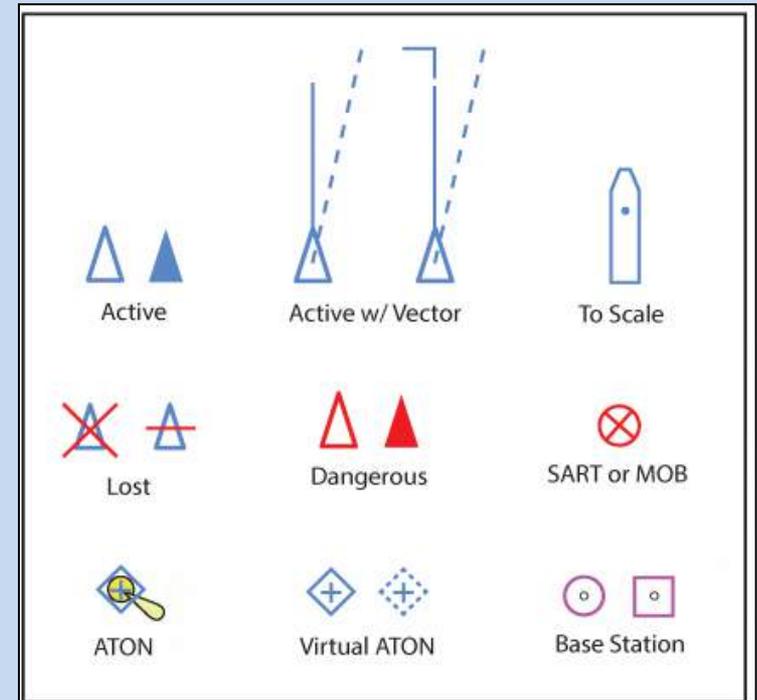
CAUTION: AIS smartphone apps may not show complete or timely data and not all vessels have an AIS transponder.

It Can Get Crowded Out There

Marine Traffic App

4 Nov 0800 hrs

ICW →

CAUTION: AIS smartphone apps may not show complete or timely data and not all vessels have an AIS transponder.
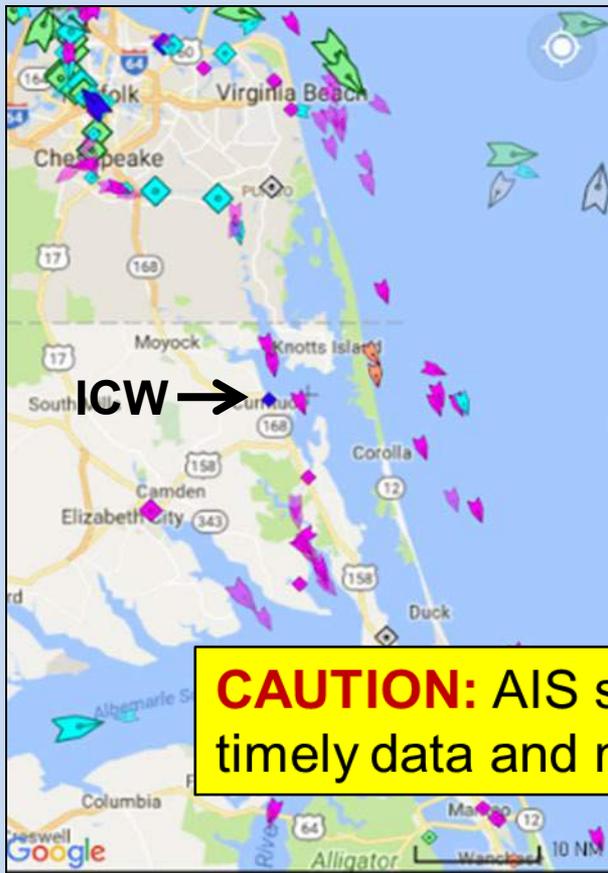
3 Nov 1400 hrs

3 Nov 2000 hrs

Purple – Pleasure
Green - Commercial
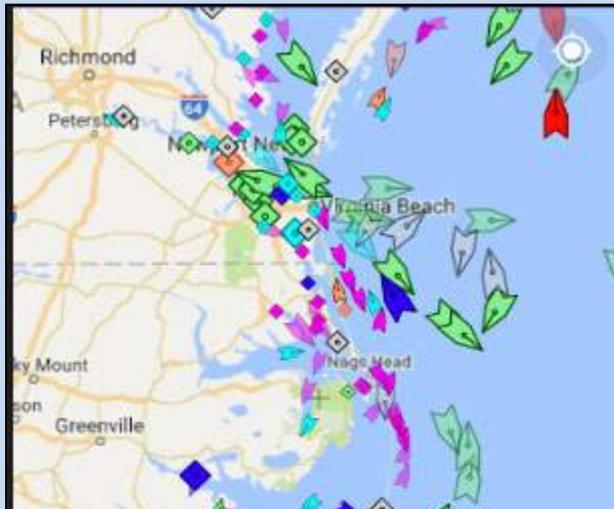
From USCG Frequently asked Questions on AIS

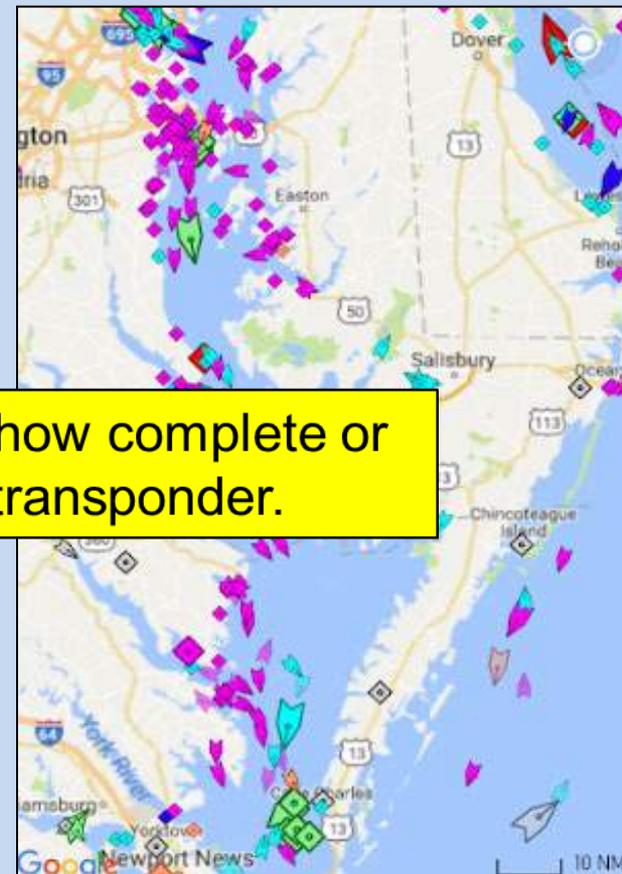(d) *Operations*. The requirements in this paragraph [33 CFR 164.46 (d)] are applicable to ***any vessel equipped with AIS,* either by mandatory carriage or voluntarily:**

    (1) Use of AIS does not relieve the vessel of the requirements to sound whistle signals or display lights or shapes in accordance with the International Regulations for Preventing Collisions at Sea, …….

    (2) AIS must be maintained in effective operating condition, which includes:

        (i) The ability to reinitialize the AIS, which requires access to and knowledge of the AIS power source and password

        (ii) The ability to access AIS information from the primary conning position of the vessel

        (iii) The accurate broadcast of a properly assigned Maritime Mobile Service Identity (MMSI) number

        (iv) The accurate input and upkeep of all AIS data fields and system updates

Code of Federal Regulations 33 – Navigation and Navigable Waters

e-Nav, Its Components – What's New

__Radars__ with a familiar look but new capabilities:

- Found under names like: solid state radar, broadband radar, Frequency Modulated Continuous Wave (FMCW), pulse compression radar and CHIRP.

- Id targets closer to your boat, as close as 18 feet. Clearer images, and resolve smaller or overlapping objects.

- Instant-on operation means there is no warm-up time, so radar is available in seconds.

- RF radiation output reduced. Solid state radars transmitting outputs of 40W or less, compared to 4kW for a typical small pulse radar. Mounting options available that were not possible before.

- With less transmitting power, solid state radars draw significantly less power.

e-Nav, Its Components

Software: Apps for Tablets and Smart Phones:

– An ever increasing number of apps are available to support e-Nav. Broad categories include:

Astronomy	Navigation	Community (UGC)
Fishing	Medical/First Aid	Wx
Tide/Current	Reference	Safety
Utilities	Sailing	

– Some apps need to be connected to cell service or Wi-Fi to access data.

– For use as navigation tools, make sure charts and navigation applications can be accessed when **offline** and chart **data is regularly updated.**

– A variety of waterproof cases for both tablets and Smart Phones are available.

The Argonnaut A165 Marine Smart Monitor preforms all the functions of an MFD but also is a fully functional Android device. Everything from navigation and wx to Facebook are fully integrated.

e-Nav, Its Components

- **Sooo many Apps available. Some worth considering**:
  - Navionics: NOAA charts by region and chart plotter capabilities
  - iNavX: charting program, raster and vector charts

  14 iPad Navigation Apps Evaluated, Bob Sherer, Waterway Guide. With evaluation spreadsheet

  - MX Mariner: basic charting program with ActiveCaptain integrated
  - iSAILOR: basic charting program (Android & Apple)
  - MyNOAA Charts: basic charting program with updates

  Navigation applications can pull from the server directly on NOAA's website to obtain the latest updates for free. **A word of caution:** if you're using an app, make sure they're authorized through NOAA, otherwise they may be using their own data sources or accessing the NOAA database once per year leaving you without necessary critical updates.

  - FieldCompass+: hand bearing compass, records bearings
  - ASA: marine compass and many good online references
  - Tides Near Me: Tide and Sun/Moon data
  - Weather from NOAA: Satellite images, marine info and Ocean storms

Make Some Choices

- Lots of choices in e-Nav hardware/software: new "stuff" all the time.

- **Key questions**: what do you want / need based on the type of sailing you do:

  - Navigation display – multiple formats
  - Position, speed, depth, wind
  - Communication – routine and emergency
  - Situational awareness – weather, boats, shore lines, other hazards
  - Autohelm

and

- Where to put it / how displayed

- AIS: or

<u>Possible Solutions</u>

- (1) All new ($$$$$)
  - Buy a new boat or …….
  - Upgrade/replace the fixed equipment suite
    - A fully integrated system

- (2) Keep what you have and add multitask devices ($)
  - Load up a smart device (tablets, etc.) with Apps – "good to go"
    - Limited integration

- (3) Mix ($$$)
  - Reuse/replace/add selected fixed equipment
  - Leverage new or create redundant capability with smart devices:
    - Bluetooth connectivity with MFD and Autohelm
    - Numerous chart plotter and crowd sourced data
    - Wx prediction and route planning
    - Reference
    - Entertainment
      - Some system integrated, some not

So, at the End of the Day

- Do you have the information you need for the type of sailing you do / located where you need it?

- Is your system reliable?

- Any money left to enjoy some cruising?

- Do you have enough for a ginger beer for a Dark & Stormy?

B
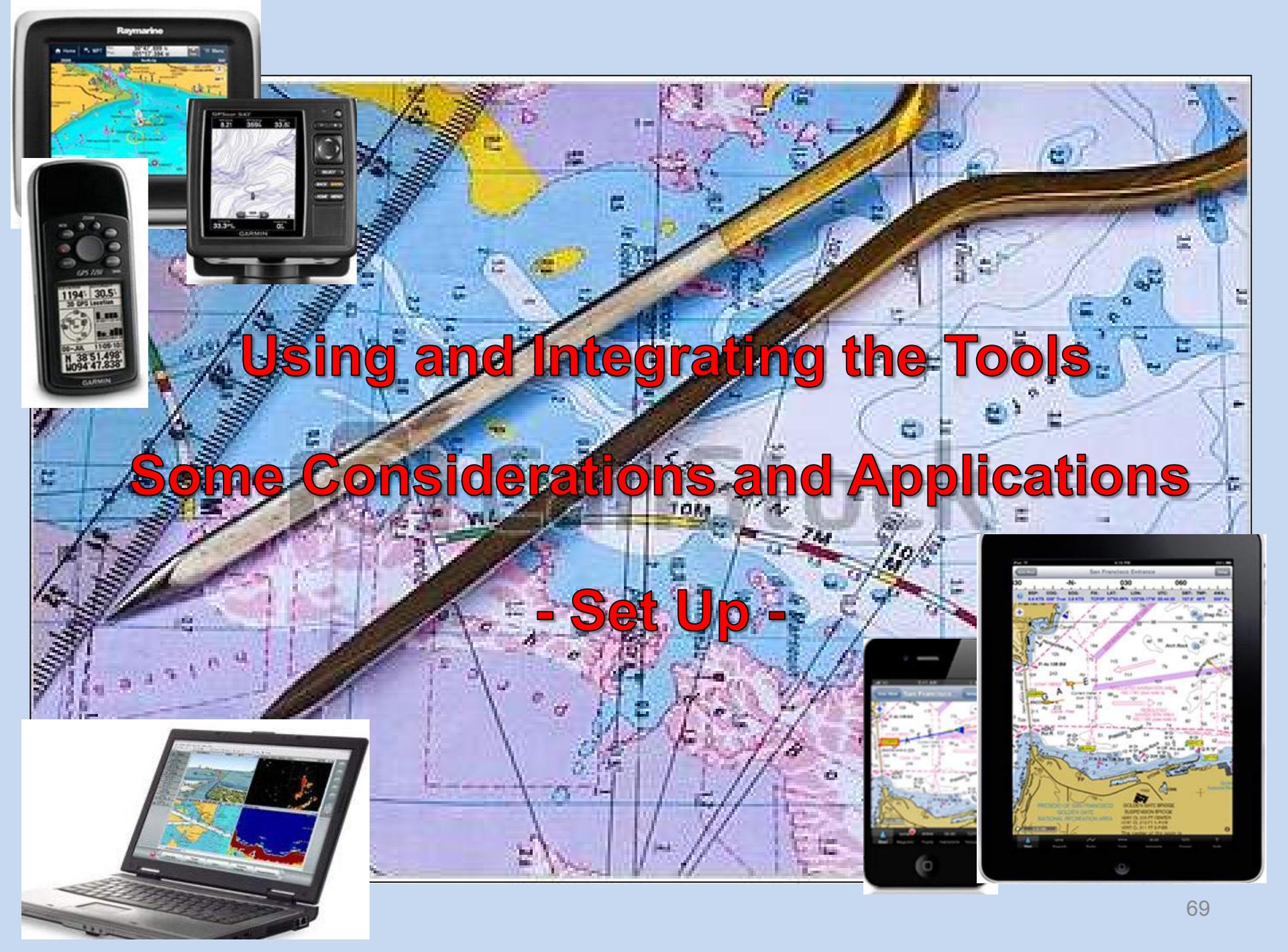
Using and Integrating the Tools

Some Considerations and Applications

**- Set Up -**

Considerations and Applications

Set Up:

- **Never rely on a single source/tool** – electronics are **aids** to navigation. Electronics make a **good navigator better** – know the questions to ask, answers to be expected; makes a **weak navigator dangerous.**

- **Keep your operator manuals, CD's and permits numbers aboard** – you have them if need to reformat or refer to features you need to "relearn".

- **Screen refresh rates vary –** based on processor speeds, amount of information to be displayed and satellite availability, the "picture painted" on your screen may be where **you were** not where **you are** at a specific time. This difference increases with boat speed, sea state especially with older ECS**.**

Considerations and Applications

Set Up:

- **Practice** with your MFD to ensure you know how to maximize the system capabilities and update waypoint and routes as you go.

- **Practice** use of the instruments at the helm to ensure you know what info they *can* provide and **how** to access / use it.

- **Have and know how to use both electronic and paper charts** – Many common elements. GPS enabled devices *should not replace* a solid knowledge and ability to work with basic navigation tools and paper charts.

Navigation Charts
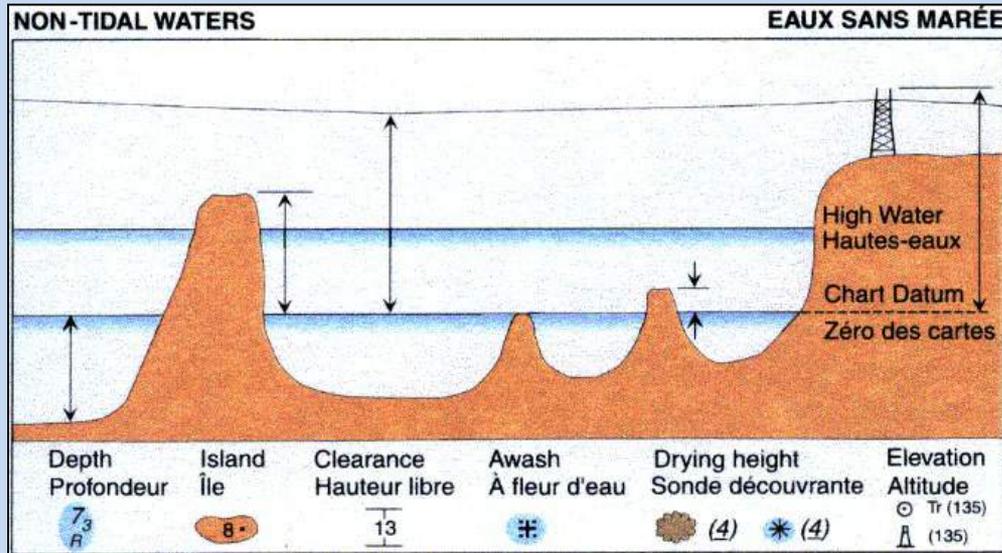

NOAA Chart 12221
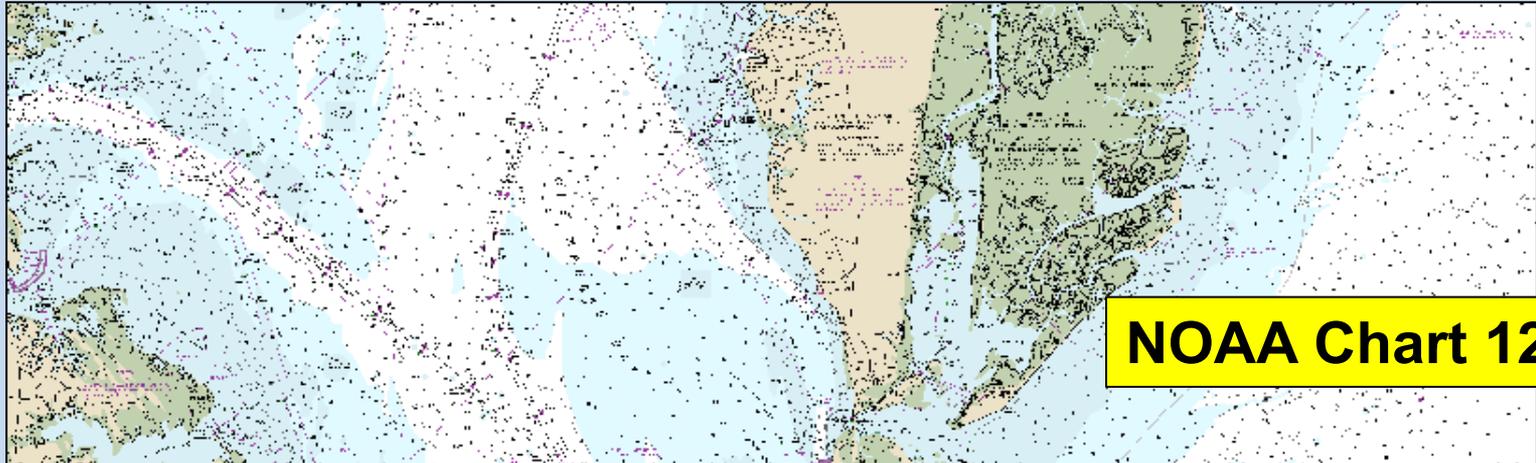
Navigation Charts:

- **Paper**
- **Electronic Navigation Charts (ENCs):**
  - ❖ **Raster Chart**: A **static**, scanned **image** of a paper chart.
  - ❖ **Vector Chart**: A **dynamic data** file of chart features

http://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml
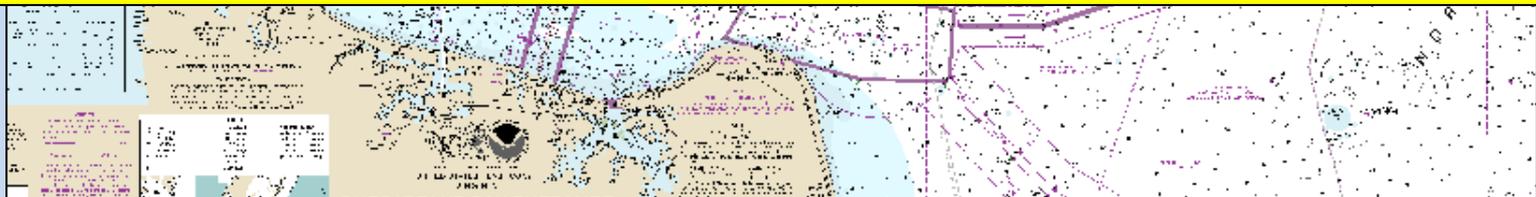
Understanding Chart Accuracy

Coastal navigation has been more about referencing landmasses to the sea bottom then astronomical fixes.

Charts more accurately depicted soundings and hydrographic features relative to land masses than with absolute accuracy to Lat/Long.

		SOURCE	
A	1990-2016	NOS Surveys	full bottom coverage
B1	1990-1995	NOS Surveys	partial bottom coverage
B2	1970-1989	NOS Surveys	partial bottom coverage
B3	1940-1969	NOS Surveys	partial bottom coverage
B4	1900-1939	NOS Surveys	partial bottom coverage
B5	Pre-1900	NOS Surveys	partial bottom coverage

All charts have errors

Reliability and Confidence:
All chart are **jigsaws** of individual **surveys**, some old, (even ancient) some newer pieced together to form a single chart. ENCs are seamlessly integrated and encoded within a composite data quality indicator '**Category of Zone of Confidence**' (CATZOC). Data quality based on:
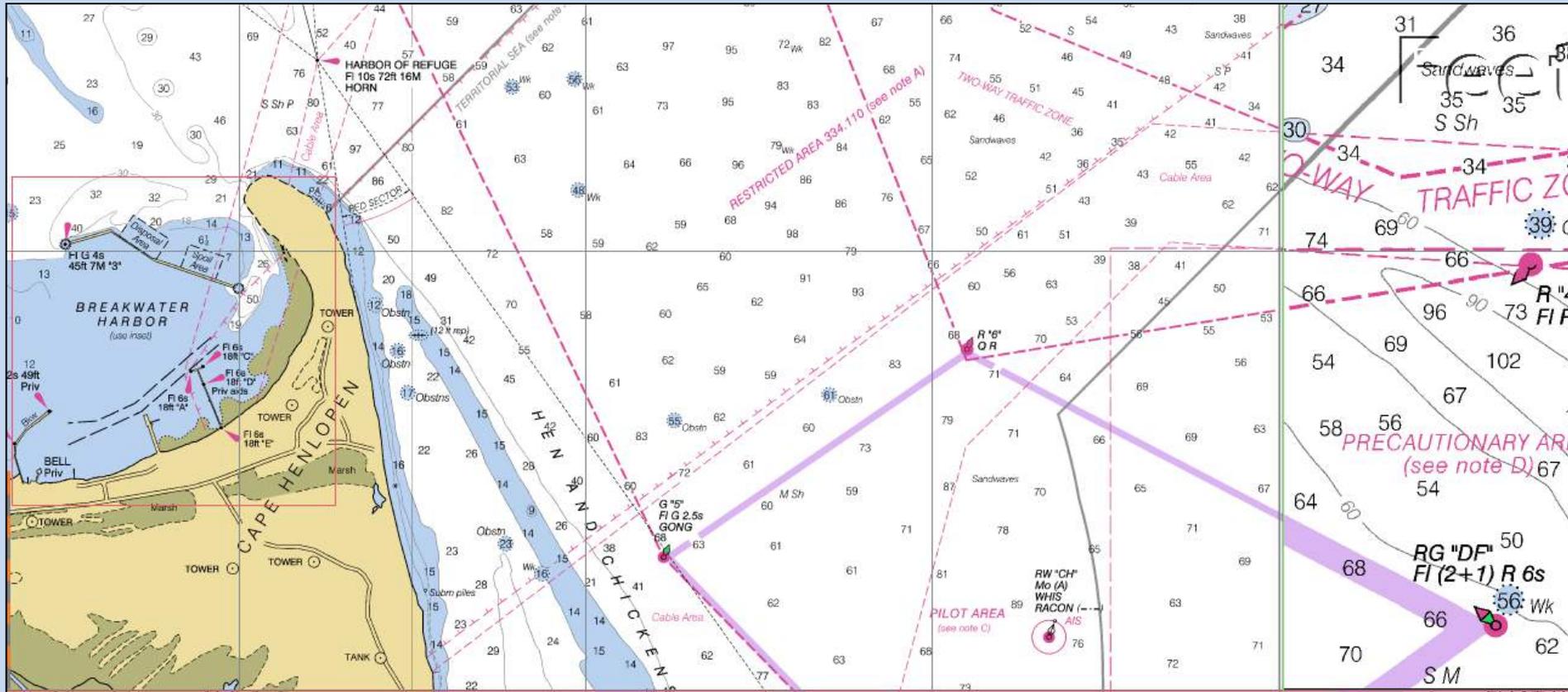- **Measurement uncertainty** (e.g. the variation between similar measurements at the same location)
- **Completeness** (e.g. seafloor coverage)
- **Currency** (e.g. temporal degradation)

Electronic Navigation Charts (RNC)

RASTER NAVIGATIONAL CHART (RNC)	RNC Characteristics
	- Can be updated with weekly raster patches - No inherent safety warning capability - Does not have the capability to show denser data when zooming in. - Cannot suppress specific charting features - Cannot rotate text

- Raster charts NOAA's first priority.

- Conversion of raster to vector charts is a time consuming "hands-on" effort to de-conflict scale and content differences.
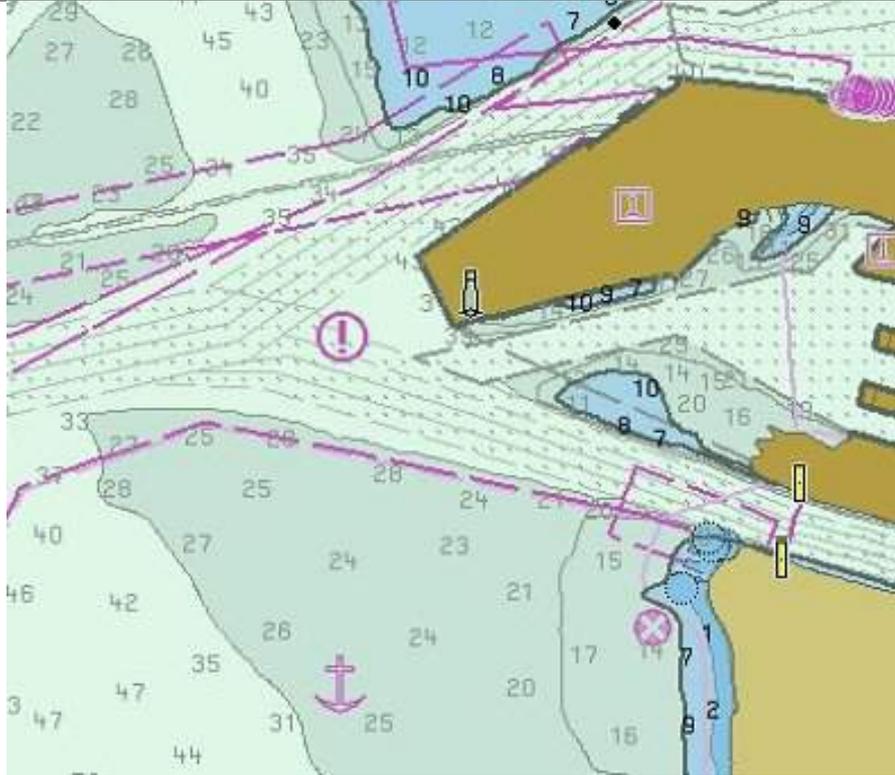
Raster Chart: A **static**, scanned **image** of a paper chart

Raster Chart – 1:40,000

Raster Chart: A **static**, scanned **image** of a paper chart

Electronic Navigation Charts (ENC)

ELECTRONIC NAVIGATIONAL CHART (ENC)	ENC Characteristics
	- Vector Database *Each chart feature has attribution* *Has different look and feel than paper chart* *Categories of data can be suppressed by software. For example, just show depth contours and suppress specific text.* *"Zooming in" has capability to show denser data* *Chart image can be rotated and text will remain upright* *Electronic chart systems can issue warnings of impending danger ahead*

Information or shore-based information that was on a Raster chart may not appear or be incomplete at all zoom levels.

Vector Chart – 1:40,000

Vector Chart: A **dynamic data** file of chart features.
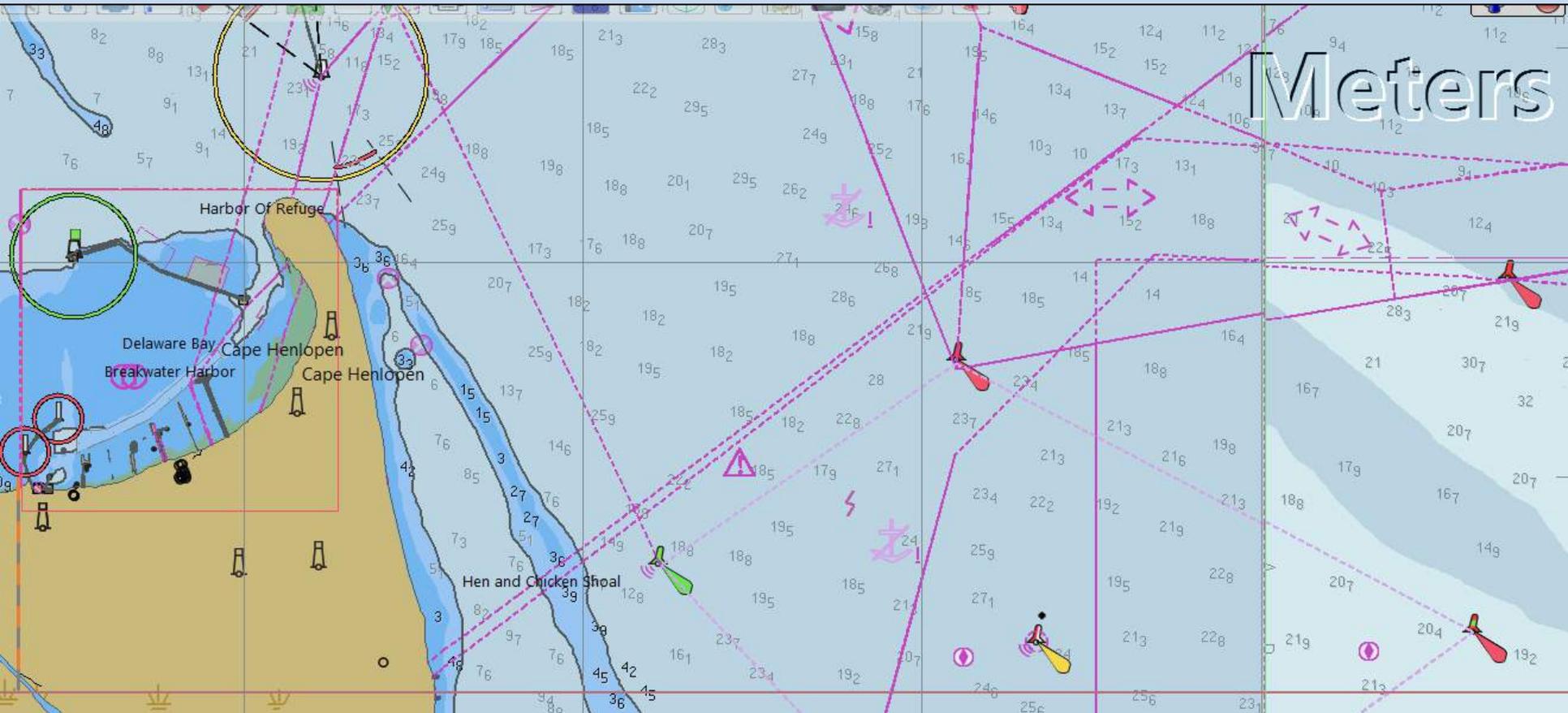
Electronic Navigation Charts (ENC)

Vector Charts

NOAA Chart 12221

http://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml

Chart: US5VA13M

Chart: US4VA12M

Title:	Chesapeake Bay Entrance
RNC:	12221
Scale:	1:80,000
Edition:	36.7
Published:	1/3/2019

Available Products
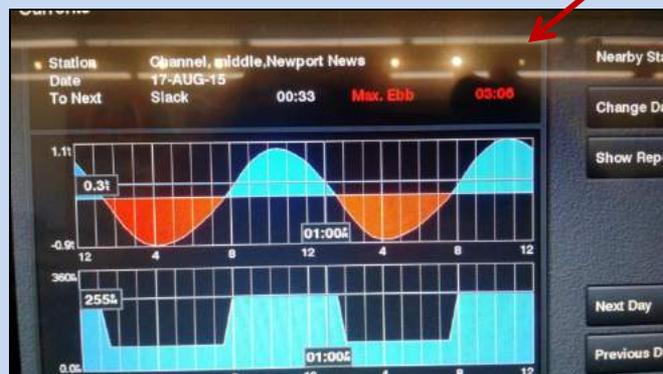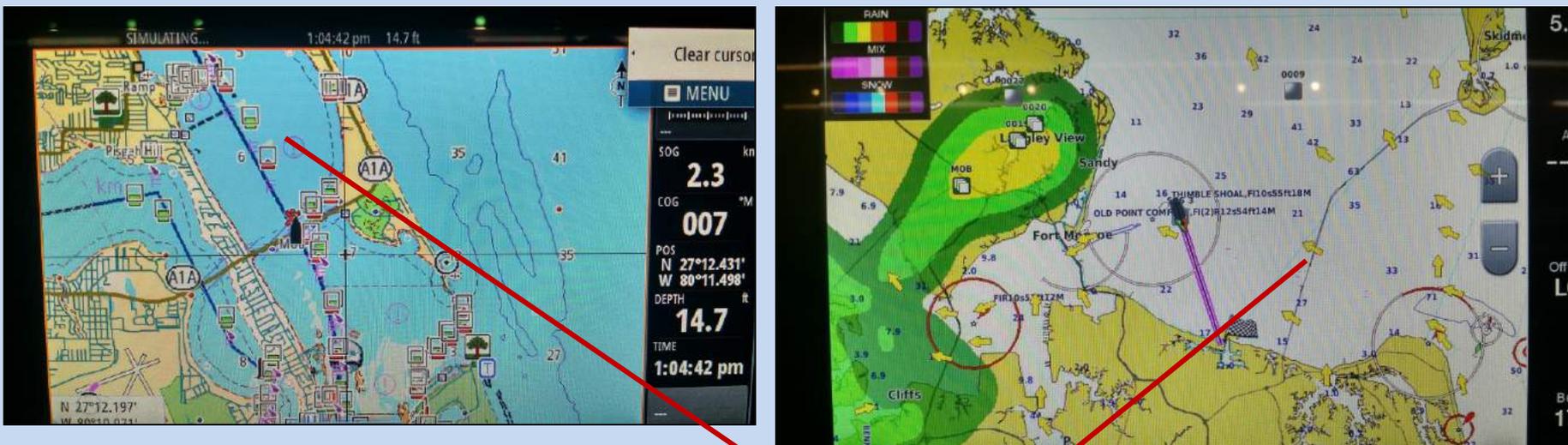
ENC

Chart: US3EC08M

Chart: US2EC03M

Vector Chart: A **dynamic data** file of chart features.

Electronic Navigation Charts (ENC)

- Using a vector data base with layered data, ENCs can display a wealth of information not found on raster charts.

Tide and current data can be referenced directly from the chart

Electronic Navigation Charts (ENC)

MAPTECH
computer program

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89

NOAA Charts & Publications

Office of Coast Survey
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

https://nauticalcharts.noaa.gov/

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PRODUCTS & SERVICES

Certified Charts & Products
meets U.S. Coast Guard carriage requirements for commercial vessels

NOAA ENC® ›
Find out about NOAA's vector electronic navigational charts.

NOAA Paper Nautical Charts ›
Find out about NOAA's Paper Nautical Charts.

United States Coast Pilot® ›
Download free sailing directions or buy a paper copy from a NOAA certified publisher.

General Use Charts
does not meet U.S. Coast Guard carriage requirements for commercial vessels

NOAA RNC® ›
Find out about NOAA's raster navigational charts.

Full-size Nautical Charts ›
Find out about free full-size images of nautical charts.

Booklet Charts™ ›
Find out about free page-size images of NOAA nautical charts.

Historical Charts ›
Download free images of maps and charts dating back to 1807.

Chart Viewers

ENC® Viewer ›
View a seamless display of all NOAA electronic navigational charts using ECDIS symbology.

RNC® Viewer ›
View a seamless display of all NOAA raster navigational charts using traditional paper chart symbology.

Nautical Chart Viewer ›
Find, view, and download individual raster NOAA nautical chart products using the NOAA nautical chart catalog and chart viewer.

Other Services & Publications

nowCOAST™ ›
Access real-time coastal observations, forecasts and warnings.

U.S. Chart No. 1 ›
Get the guide to the symbols, abbreviations and terms used on NOAA nautical charts and ENCs.

NOAA Nautical Chart Catalog›
View and download regional NOAA nautical charts.

Chart Updates ›
Find out what has changed on NOAA nautical charts and ENCs since the last new edition.

90

ENCs vs. Paper

NOAA ELECTRONIC NAVIGATIONAL CHART (ENC) FOR NAVIGATION IN U.S. WATERS:

- **NOAA recommends** that mariners take advantage of the most recent chart updates by using the **NOAA Electronic Navigational Chart (ENC)** for navigation in U.S. waters.

- **ENCs provide the most up to date information,** whereas paper and raster nautical chart updates may be up **to one month behind the corresponding ENC coverage**.

- Over the next few years, mariners will see **continued improvement in the extent and detail of ENC coverage, while there will be a reduction in RNC and paper chart coverage and service**.

- **ENCs will include routine changes between editions that are not published through notices to mariners**.

LMN 50/18

U.S. Chart No. 1

Symbols, Abbreviations and Terms used on Paper and Electronic Navigational Charts

12th Edition, April 15, 2013
Corrected through NM   Nov. 16, 2013
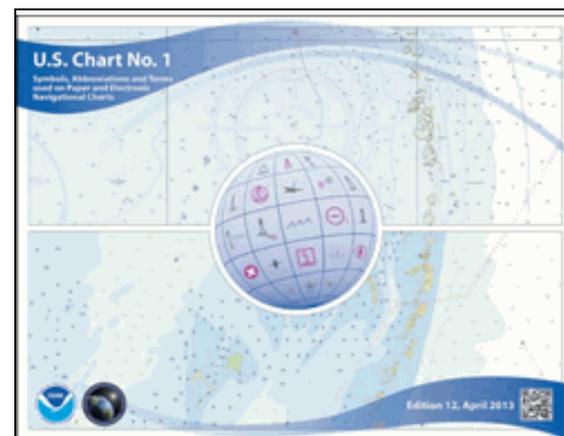Corrected through LNM Nov. 12, 2013

Prepared Jointly by

Department of Commerce

National Oceanic and Atmospheric Administration

Department of Defense

National Geospatial-Intelligence Agency

ENCs vs. Paper

- ENCs can display the same features differently than traditional "paper charts" depending on ___user preferences and settings___ such as the draft of your vessel.

    - Display of wrecks, rocks, and other obstructions if they are deeper than the depth of the "safety contour" set for the vessel. Dangers that are shoaler are displayed with a unique "isolated danger" symbol.

- "Safety contour" – a thick line for a depth contour that separates "safe water" from shoaler areas – changes in shading. User selected.

- Display additional info about a feature through a "curser pick" (purpose, status, color, shape, height, etc.).

- Change the color palette of the display – day, dusk, night.

- Buoys and beacon are displayed differently.

U.S. Chart No. 1

Symbols, Abbreviations and Terms used on Paper and Electronic Navigational Charts

Edition 12, April 2013

Introduction to

Electronic Chart Navigation

With an Annotated ECDIS Chart No. 1

STARPATH

David Burch
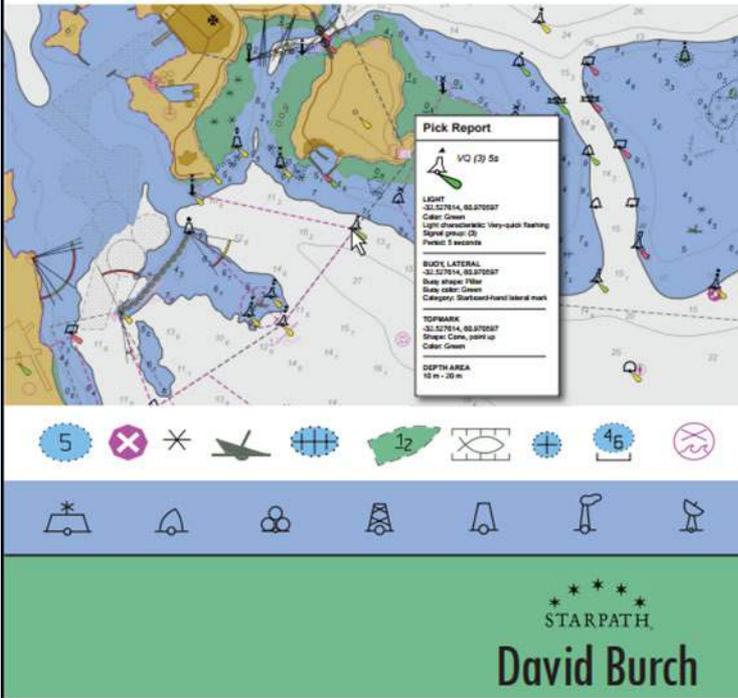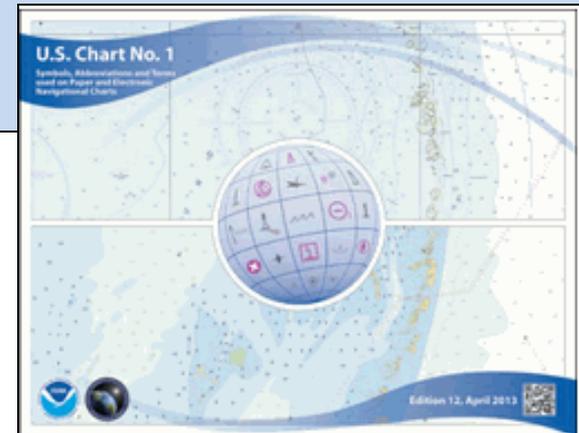
s and Terms

ectronic Navigational Charts

"The symbology used to display ENCs or other non-ENC nautical navigation data on *non-ECDIS systems*, such as geographic info systems, *recreational GPS and other chart display sy*stems *can differ significantly* from the symbology specified for ECDIS type systems. Chart No 1 *only* displays the symbology used on ECDIS."

National Geospatial-Intelligence Agency

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Schematic Layout of U.S. Chart No. 1:

K   Rocks, Wrecks, Obstructions

Rocks

Supplementary national symbol: a

|							
Plane of Reference for Heights → H			Plane of Reference for Depths → H				
No.	INT	Description	NOAA	NGA	Other NGA	ECDIS	
11		Rock which covers and uncovers, height above chart datum				✳	rock which covers and uncovers or is awash at low water
						4	underwater hazard which covers and uncovers with drying height
						✖	isolated danger of depth less than the safety contour

Ⓐ	Section designation
Ⓑ	Section
Ⓒ	Sub-section
Ⓓ	Reference to "Supplementary national symbols" at the end of each section
Ⓔ	Cross-reference to terms in other sections
①	Column 1: Numbering system following the "Chart Specification of the IHO". A letter in this column indicates a supplementary national symbol or abbreviation for which there is no international equivalent.
②	Column 2: Representation that follows the "Chart Specifications of the IHO" (INT 1 symbol)
③	Column 3: Description of symbol, term, or abbreviation
④ⓐ*	Column 4a: Representation used on charts produced by the National Oceanic and Atmospheric Administration (NOAA)
④ⓑ*	Column 4b: Representation used on charts produced by the National Geospatial-Intelligence Agency (NGA)
⑤	Column 5: Representation of symbols that may appear on NGA reproductions of foreign charts
⑥**	Column 6: Representation used to portray ENC data on ECDIS
⑦**	Column 7: Description of ECDIS symbols

* When columns 4a and 4b are combined then NOAA and NGA both use the same symbol. When either column 4a or 4b is blank then the respective agency uses the INT 1 symbol shown in column 2.

** When columns 6 and 7 have several rows for the same symbol number, then ECDIS portrays this feature differently depending on the ship's draft and other conditions as defined in ECDIS by the mariner (as is the
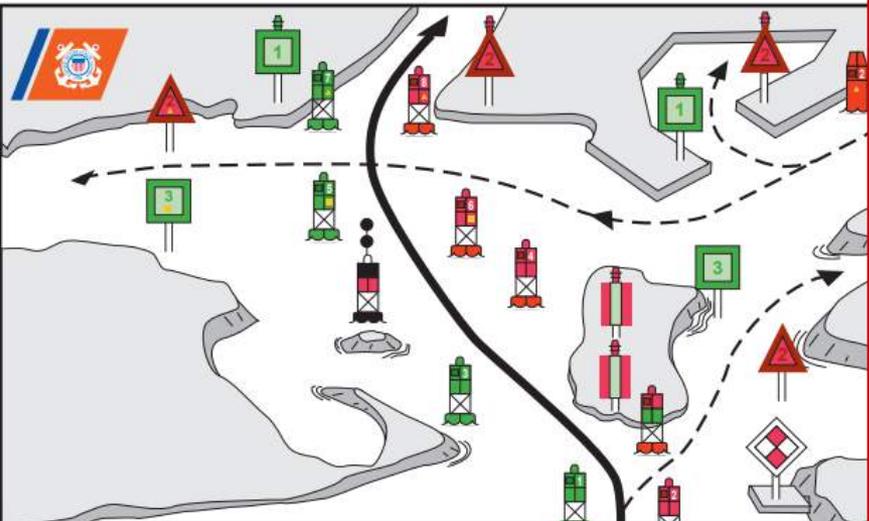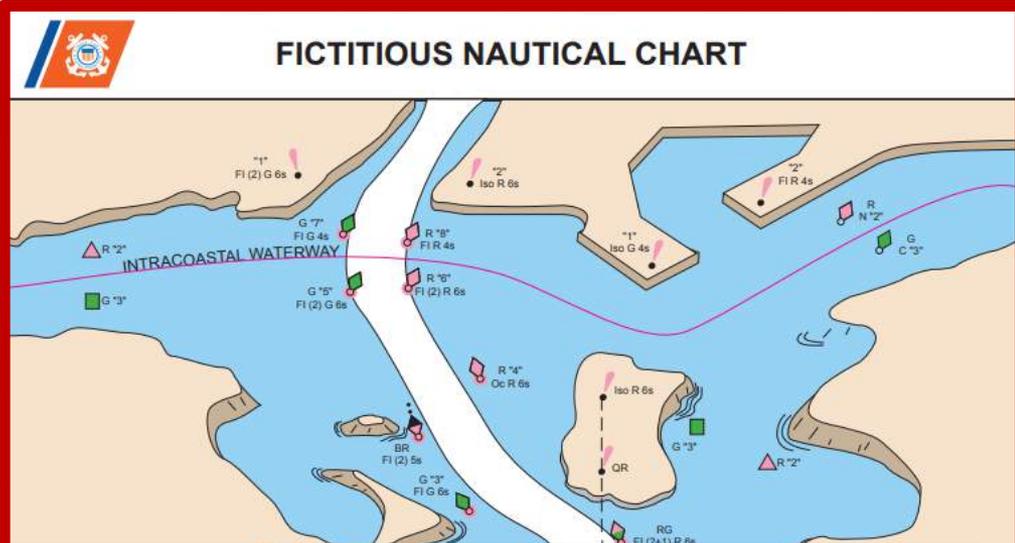
- Lights – display the most complex and varied objects on an ENC …….. and the most confusing.

- Wide variance in how displayed.

REGION

Preferr
Secon

FICTITIOUS NAUTICAL CHART

INTRACOASTAL WATERWAY

2. OCCULTING.
A light in which the total duration of light in a period is longer than the total duration of darkness and the intervals of darkness (eclipses) are usually of equal duration

2.1 Single-occulting.
An occulting light in which an eclipse is regularly repeated.

Oc

2.2 Group-occulting.
An occulting light in which a group of eclipses, specified in numbers, is regularly repeated.

Oc (2)

2.3 Composite group-occulting.
A light, similar to a group-occulting light, except that successive groups in a period have different numbers of eclipses.

Oc (2+1)

3. ISOPHASE.
A light in which all durations of light and darkness are equal.

Iso

4. FLASHING.
A light in which the total duration of light in a period is shorter than the total duration of darkness and the appearances of light (flashes) are usually of equal duration.

4.1 Single-flashing.
A flashing light in which a flash is regularly repeated (frequency not exceeding 30 flashes per minute).

Fl

4.2 Group-flashing.
A flashing light in which a group of flashes, specified in

Fl (2)

REGION-B - by night

Preferred Channel
Secondary Channel
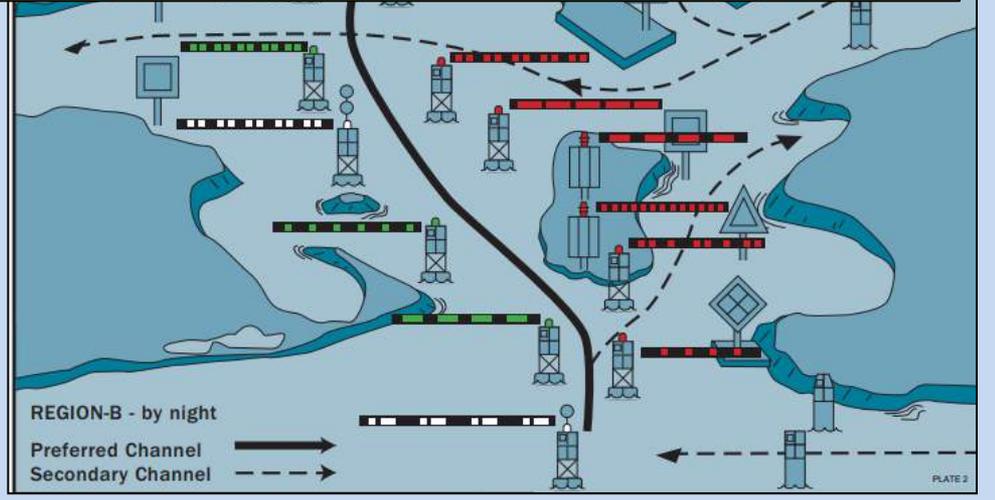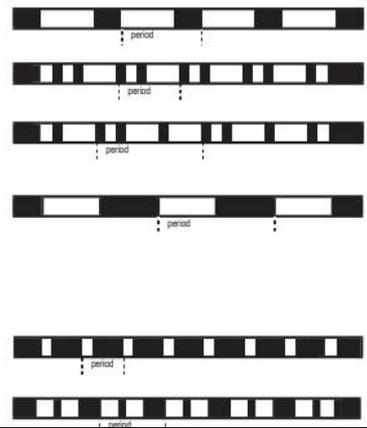
No.	INT		Description	NOAA	NGA	Other NGA	ECDIS	

Light Structures and Major Floating Lights

Min...

ECDIS Traditional (Paper Chart) and ECDIS Simplified Symbols

ECDIS can be set to display aids to navigation with either traditional paper chart symbols or what they call "simplified symbols." The two symbol sets are shown here. Some ECDIS color fill the paper chart buoy shapes, but this is not required by IHO ECDIS specifications.

1

2 — Lighted offshore platform — (lighted) — Lighted offshore platform, paper chart

3 — tower,

[On both paper charts and ECDIS displays, floating objects are tilted, whereas fixed beacons are shown vertical—a convention that helps us interpret the symbols. Even the labels are tilted (italics) to support the convention.]

4

5 — ☆ Bn — Articulated light, buoyant beacon, resilient beacon — Art — paper chart

Shapes of Buoys

Features Common to Buoys and Beacons → Q 1–11

							Paper Chart	Simplified	
20			Conical buoy, nun buoy, ogival buoy	N					Conical buoy
21			Can buoy or cylindrical buoy	C					Can buoy
22			Spherical buoy	SP					Spherical buoy
23			Pillar buoy	P					Pillar buoy
24			Spar buoy, spindle buoy	S					Spar buoy
25			Barrel buoy, tun buoy						Barrel buoy
26			Superbuoy						Super-buoy
									Lanby, super-buoy
									Super-buoy odas & lanby

Differences in Charting Symbols: RNCs and ENCs

Lighted Buoys

- **RNCs and Paper Charts top**
- **ECDIS bottom**
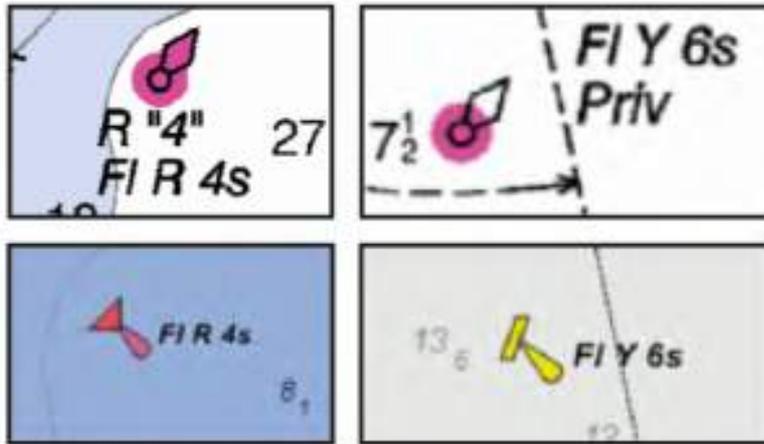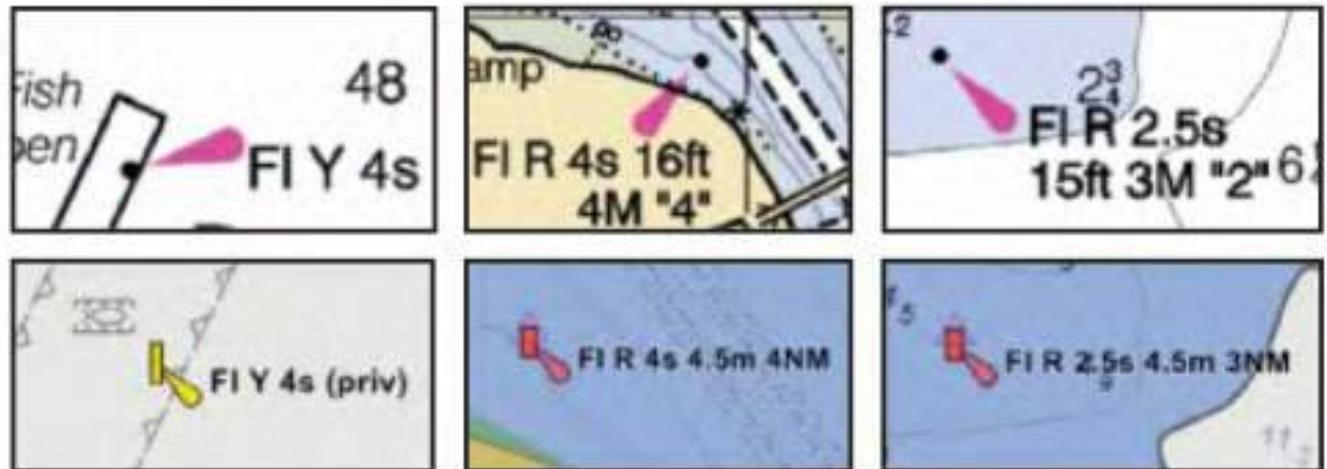
Lights on Beacons

Comparison of Raster and Vector Charting Symbols

Raster
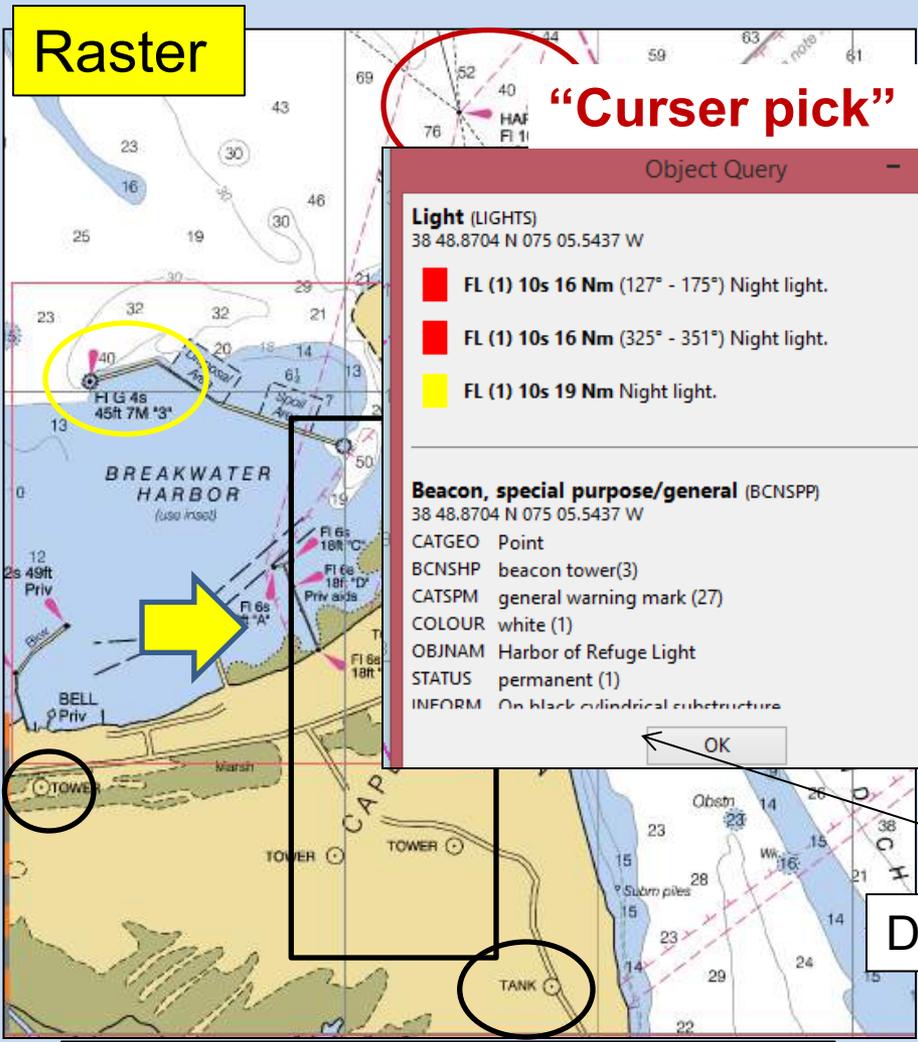
Vector

"Curser pick"

Object Query

Light (LIGHTS)
38 48.8704 N 075 05.5437 W

FL (1) 10s 16 Nm (127° - 175°) Night light.

FL (1) 10s 16 Nm (325° - 351°) Night light.

FL (1) 10s 19 Nm Night light.

Beacon, special purpose/general (BCNSPP)
38 48.8704 N 075 05.5437 W

CATGEO	Point
BCNSHP	beacon tower(3)
CATSPM	general warning mark (27)
COLOUR	white (1)
OBJNAM	Harbor of Refuge Light
STATUS	permanent (1)
INFORM	On black cylindrical substructure

OK

Depth contours

Harbor Of Refuge

Delaware Bay

Cape Henlopen

Breakwater Harbor

Cape Henlopen

Hen and C

A single layer of information / data

Each item a separate entry with "attributes"

Automatic Identification System (AIS) Aids to Navigation

In the near future, the U.S. Coast Guard and other authorized agencies and organizations will begin **transmitting AIS ATON messages** and **marine safety information**. The exact content, location, and times of these broadcasts will be announced in future **LNM**.

Broadcasts can **originate** from an AIS station located on an **existing physical ATON (Real AIS ATON) or from another location** (i.e. AIS Base Station). An AIS Base Station signal broadcasted to coincide with an **existing physical aid** to navigation is known as a **Synthetic** AIS ATON.

An electronically charted, but **non-existent** as a physical aid to navigation, is identified as a **Virtual** AIS ATON. Can be used to depict an existing aid to navigation that is **off station or not watching properly** or to convey an aid to navigation that **has yet to be charted**.

These variants can be received by any existing AIS mobile device, but they would require an external system for their portrayal (i.e., AIS message 21 capable ECDIS, ECS, radar, PC).

eATONs

Adding eATONs to the ATON Family

Synthetic AIS

A physical location

Virtual AIS

No physical location

Potential Physical AIS

Missing

Virtual AIS
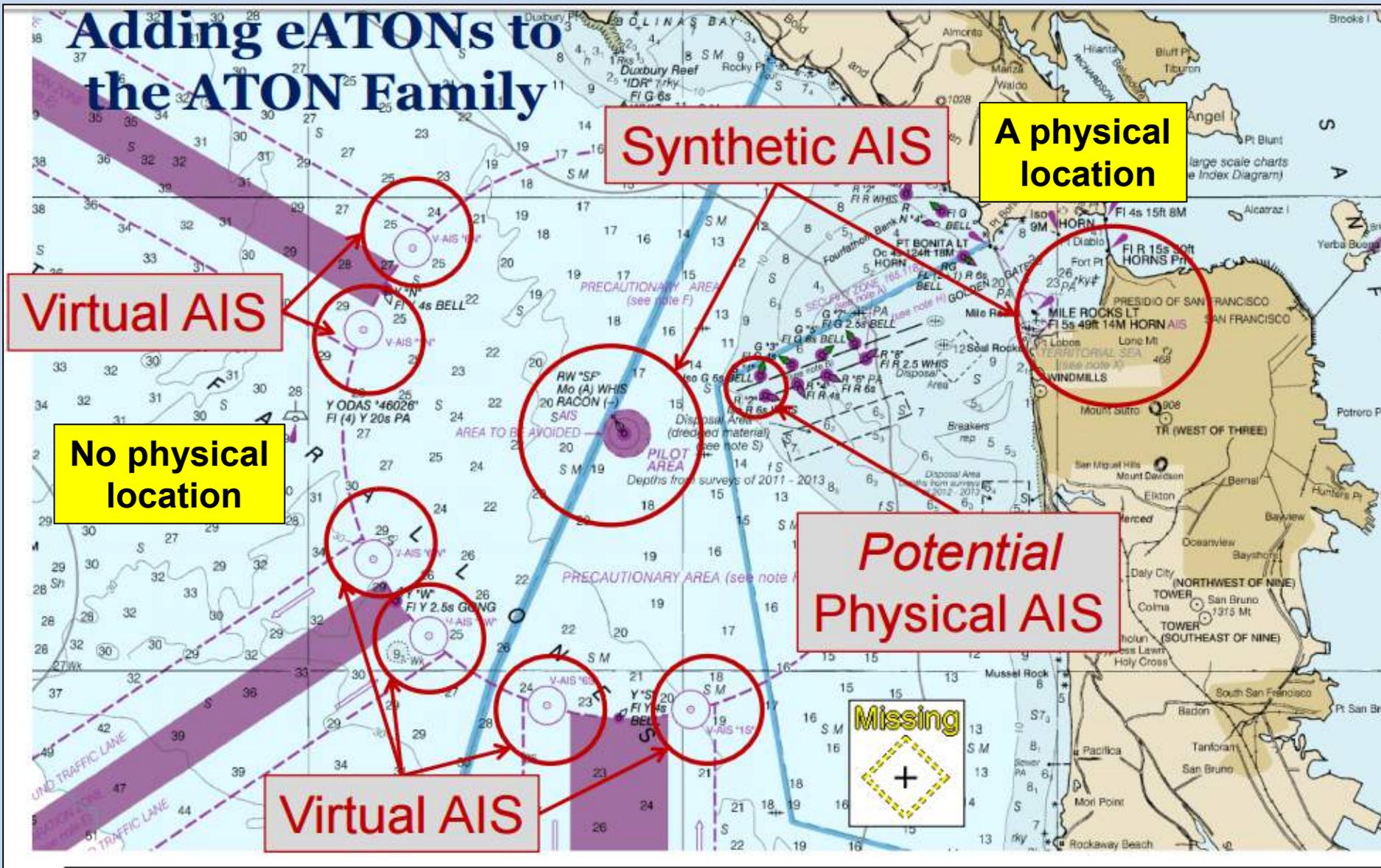
AIS ATON Symbology for ECDIS

Paper Chart Symbol *			Type	What they look like out the window of a ship's bridge.
Green Lateral Buoy	Red Lateral Buoy	Safe Water Mark		
			Physical non-AIS aid	
AIS	AIS	AIS	Physical AIS aid	
V-AIS	V-AIS	V-AIS	Virtual AIS aid	

* These examples are based on the IALA-B buoyage system that is used in the 50 states and the Caribbean. In the IALA-A system, used in U.S. territories in the South Pacific, the square and triangle top marks shown on V-AIS aids are switched with each other. Refer to the graphic at Q-130.1 in U.S. Chart No.1 for more information about IALA buoyage regions.

AIS ATON stations broadcast their presence, identity (9-digit Marine Mobile Service Identity (MMSI) number), position, and status at least every three minutes or as needed.

eATONs

390	North Chesapeake Entrance Lighted Gong Buoy NCB	36-56-57.540N 075-50-17.040W	Fl Y 6s	6	Yellow.	
395	North Chesapeake Entrance Lighted Bell Buoy NCC	36-56-24.000N 075-52-24.000W	Fl Y 4s	6	Yellow.	
400	North Chesapeake Entrance Lighted Gong Buoy NCD	36-56-24.000N 075-53-42.000W	Fl Y 2.5s	6	Yellow.	
403	North Chesapeake Entrance Lighted Buoy NCE	36-56-24.000N 075-54-57.000W	Fl Y 6s	6	Yellow.	
405	Chesapeake Bay Entrance Lighted Whistle Buoy CH	36-56-08.329N 075-57-26.543W	Mo (A) W	6	Red and white stripes with red spherical topmark.	RACON: C (- . - .) AIS: MMSI 993672082.
	Chesapeake Bay Southern Approach					
410	- Lighted Whistle Buoy CB	36-48-59.743N 075-45-36.013W	Mo (A) W	6	Red and white stripes with red spherical topmark.	RACON: K (- . -) AIS: MMSI 993672083.

Lighted Ice Buoy (LIB): A lighted buoy without a sound signal, and designed to withstand the forces of shifting and flowing ice.

2710	- CHANNEL LIGHT 12					
2713	- CHANNEL LIGHT 13					
2715	- Channel 14 V-AIS					AIS: MMSI 993672159.
	Delaware River (Main Channel)					
2720	Delaware River Lighted Buoy 11	39-33-06.467N 075-32-36.904W	Q G	5	Green.	Replaced by LIB of reduced intensity from Jan. 1 to Mar. 1 AIS: MMSI 993672077.

108

AIS ATONs

Phy
pos...
ash...
por...

All
AS...
Key...
rad...
thes...
star...

AIS...
and ...non-lateral significant marine safety information (e.g., **environmental conditions, wind speed and direction, tidal/current data, bridge air clearances, area notices, etc. and navigation warnings**).

United States Coast Guard
U.S. Department of Homeland Security

BNM

CCGD5 BNM 010-19
VA- CHESAPEAKE BAY ENTRANCE - CHESAPEAKE CHANNEL (CHART 12221)
1. AIS HAS BEEN ESTABLISHED ON THE ASSIGNED POSITION OF MISSING TAIL OF THE HORSESHOE SHOAL LIGHTED BUOY 2T (LLNR 7065), MMSI NUMBER 993672663 AND WILL REMAIN ACTIVE UNTIL THE BUOY IS RE-ESTABLISHED.
3. FOR SECTOR HAMPTON ROADS, BROADCAST UNTIL CANCELLED.
4. CANCEL AT TIME //241200Z JAN 19//

Considerations and Applications

Set Up:

- **Have and know how to use a chart: Finding location**
  - Can **you and *your crew*** answer these questions:
    - ○ I want to go to this position on the chart but how do I select the waypoints to put into my e-Nav device that get me there?
    - ○ How do I locate the waypoints on my e-Nav device to see where they are on the chart?
    - ○ Where am I and where is this on the chart?

  - Some tools which help in answering these questions on paper charts.

Tools for chart work.

Parallel Ruler

Dividers

Eraser

STAEDTLER
MARS PLASTIC

Pencil
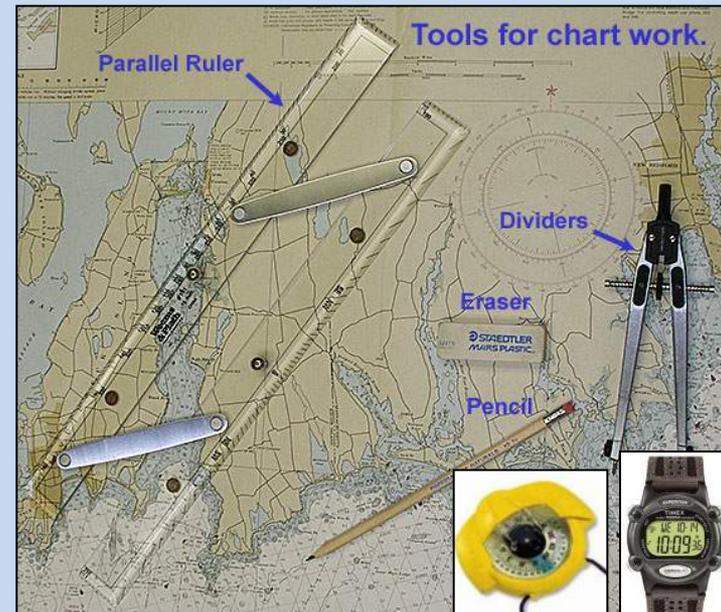
Considerations and Applications

<u>Set Up:</u> **Know how to use an electronic or paper chart:**

- Being able to apply these basic navigation skills:
    - Read a chart and understand the information it displays - its scale, buoys, surface and sub surface features, etc.
    - Find location, distance, and direction
- Allow the navigator to ask the **right questions** and help ensure information like waypoint locations, routes, course to steer (CTS), etc. on and from e-Nav devices **make sense**.
- Where there is **difference** between the information displayed on your e-Nav device and that from traditional plotting techniques, you need to work to understand the **reasons** behind the difference.
- **Remember:** Electronics are **aids** to navigation. Electronics make a **good navigator better** – know the questions to ask/answers to be expected; makes **a weak navigator dangerous.**

Considerations and Applications

Set Up:

- **Make sure critical units are set properly**. Distances in NM, speed in knots, Lat/Long in degrees/minutes/tenths for coastal charts; degrees/minutes/seconds for Great Lakes, WGS 84 datum or to match charts datum, heading direction in True or Magnetic. Set safety depth/contours. **Note: on the ICW and Great Lakes distances are measured in statue miles not nm**.
    - Note: know what your depth sounder is recording

- **Use updated charts**: Like paper charts, electronic charts need to be updated. **NOAA updates up to 1500 charts weekly.** Some e-Nav systems can be updated via Wi-Fi or Bluetooth links, others need new chips – some older systems can't be updated ☹.

- **Know the source/date of chart data**: Especially important in boating outside major shipping areas; keep in mind that the initial survey and the soundings data can be decades old. Even on a chart recently updated, the most current soundings could be from 1950's and 1960's. A 100 yr. backlog in chart survey needs.

Considerations and Applications

Set Up: MFD's allow Individual screen displays to be tailored.

Considerations and Applications

Set Up: MFD's allow Individual screen displays to be tailored.

AIS Targets

Current vector /speed

Tidal indicators

12 user tailored Info boxes

Using and Integrating the Tools

Some Considerations and Applications

- Planning Capabilities -

Considerations and Applications

Planning: Utilize internet recourses like on-line cruising guides, coastal pilots, weather forecasts, etc. to assist in planning.

- **Take advantage of the information available from "crowd sourcing":** Many e-Nav devices now include access to User Generated Content (UGC). This "crowdsourced" data can provide great info but issues of quality assurance, calibration, and clutter need to be considered. **Regularly update your data.**
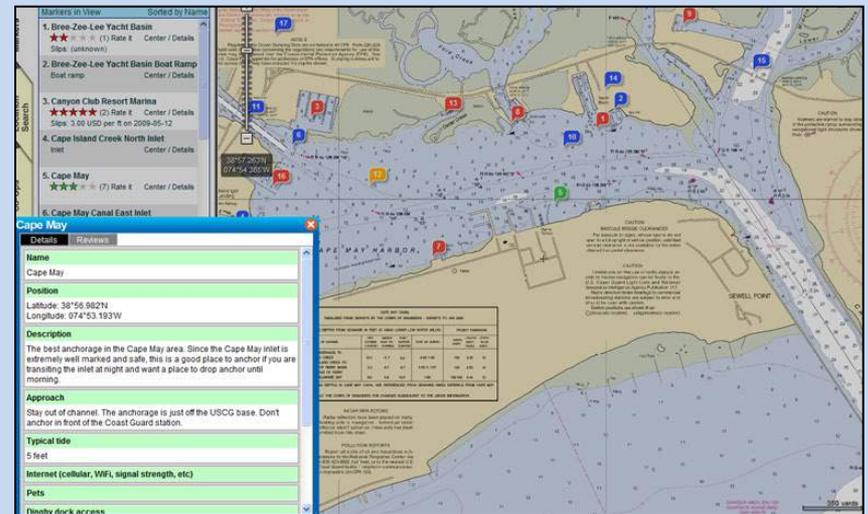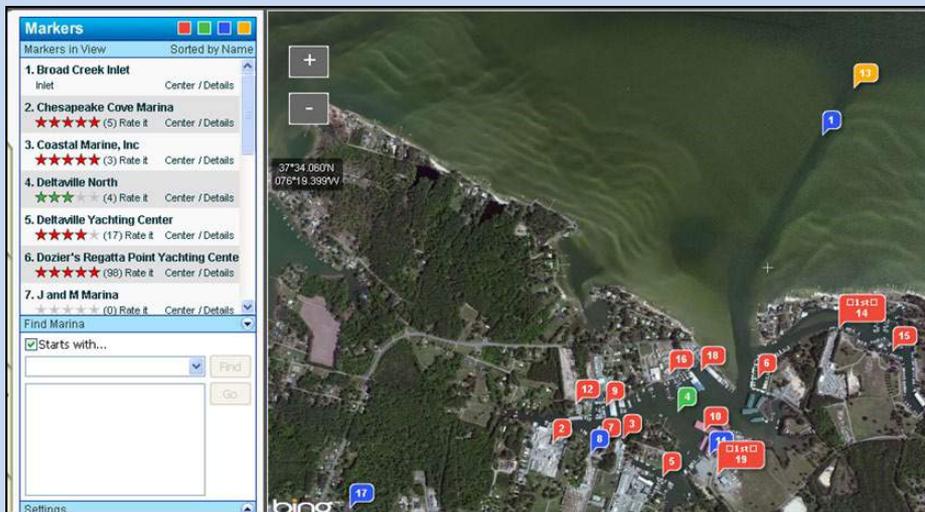
ActiveCaptain images. Integrated in 600+ software products, 650+ chartplotter models

UGC

MX Mariner* with ActiveCaptain on an Android Tablet

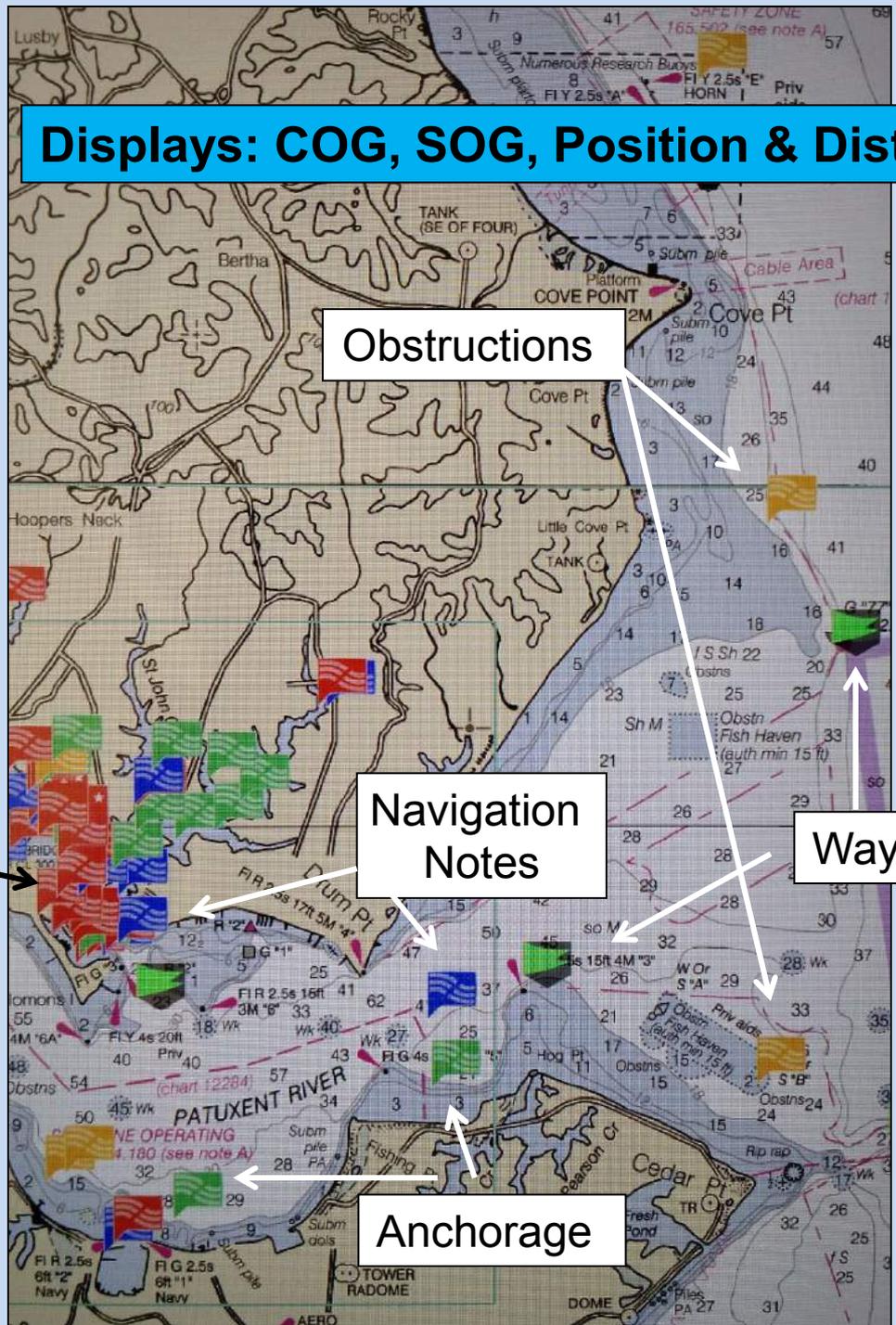*One of many basic mobile chartplotter apps featuring **quilted, offline** marine charts.

Displays: COG, SOG, Position & Distance

Obstructions

Marinas

Navigation Notes

Waypoints

Anchorage

UGC – "Waterway Guide"

Waterway Guide continues to open its database of marine-related information to users of popular navigation apps that now include *Aqua Map*, *SEAiq* and *iNavX*, with more pending as well as a "*Waterway Guide Explorer*" web app.

The information is shown as overlays on the charts as one of six symbols that include an alert for hazardous conditions, marinas, anchorages, free docks, bridge data and lock information.

Data is stored in the app and no in   or periodic downloads

Nav Alerts embedded in the *Water* displayed as a text box with inform   fied when posted by other boaters.
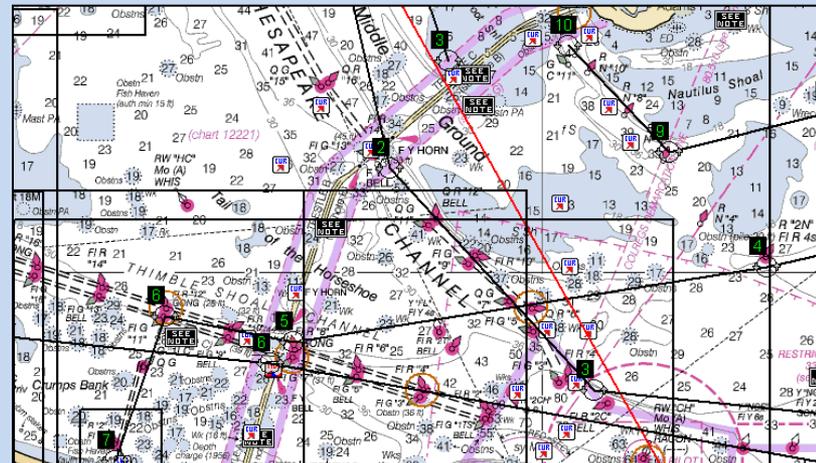
Considerations and Applications

Planning:

- **Building waypoints** (WP). A WP can be created in one of two way.

  - **Working off a paper chart**: Specific locations along a path or route between two or more points are selected and their coordinates (Lat / Long) determined. These positions are then entered into the e-Nav device using the curser key. Same process for entering WPs from other sources like cruising guides.

    - **Physically check their location on the e-Nav device to make sure they are where you think they should be.**

  - **Working on an E-Nav device:** Specific locations are selected on the ENC by placing the curser over a selected location. The Lat and Long will be displayed, WP created.

  - Waypoints can be connected to build a route.

Easier to build and load waypoints at the dock or at home on a computer then when while underway.

Considerations and Applications

Planning:

- **Set waypoints in middle of narrow passages** – don't just route through them. In areas subjected to strong currents and wind this helps to minimize to impact of leeway.

- **Exercise care in using WPs from sources other than your own work**, including cruising guides. Don't let someone else's error get you into trouble.

Charting Programs

Cruising Guides
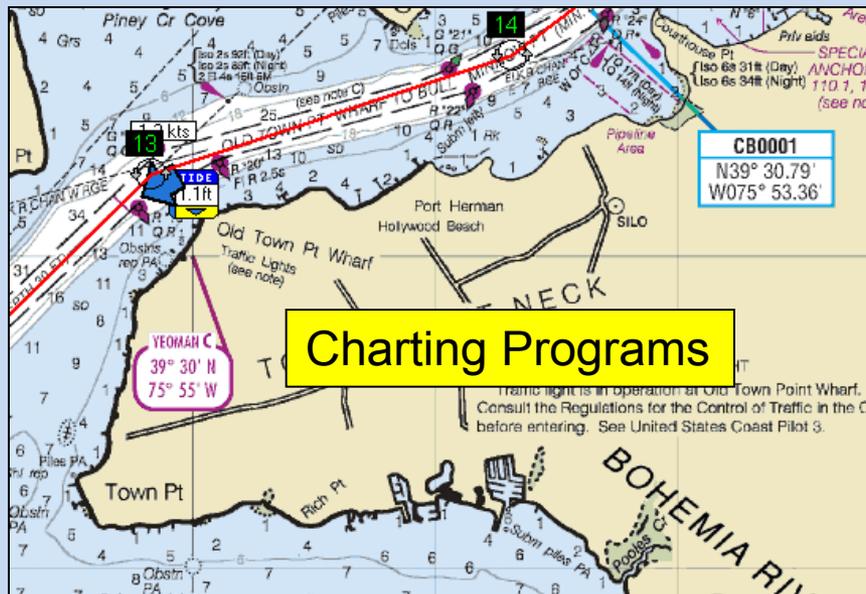
WPT	Description of Position	Latitude	Longitude
SEBAST	E Sebastian Inlet (not shown)	N 27° 51.674'	W 80° 26.450'
FTPRCE	E Ft. Pierce inlet	N 27° 28.680'	W 80° 15.180'
STLCY	Outer mark St. Lucy inlet	N 27° 10.000'	W 80° 08.000'
JUPTR	1 NM E Jupiter inlet	N 26° 56.605'	W 80° 03.877'
BOCAR	E Boca Raton inlet	N 26° 20.061'	W 80° 03.940'
HLSBRO	½ NM SE Hillsboro Inlet	N 26° 15.116'	W 80° 04.420'
FTL	FtL outer mark	N 26° 05.400'	W 80° 04.700'
BAKHL	½ NM E Baker's Haulover inlet	N 25° 54.011'	W 80° 06.625'
MIAMI	S Govt. Cut Outer Mark	N 25° 45.950'	W 80° 05.000'
LTLSAL	½ NM NW Little Sale Cay	N 27° 03.274'	W 78° 10.809'
SALRCK	¾ NM N Sale Cay Rocks	N 27° 03.229'	W 78° 06.552'
CRTBSW	¾ NM SW of Carters Bank	N 27° 00.994'	W 78° 01.049'
WSRIDG	33 NM NNW West End	N 27° 08.000'	W 79° 10.500'
MEMRKS		.000'	W 79° 06.000'
GTSANC*		581'	W 78° 13.149'
TRIRKS		750'	W 78° 23.500'
TRIRKW	4 NM W Triangle Rocks	N 27° 10.638'	W 78° 30.045'
WALKER	S of Walker's Cay Markers	N 27° 14.077'	W 78° 24.145'
SWPNT*	3 NM WSW South West Point	N 25° 48.000'	W 77° 17.000'
OFFOCP	1 NM ESE Ocean Point	N 26° 17.079'	W 76° 59.349'
HOLEWL*	2 NM SE Hole-in-the-Wall	N 25° 50.000'	W 77° 09.000'

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Considerations and Applications

Planning:

- **Be careful about using buoys as waypoints** – esp. in fog – others are likely using the same location for their WPs.

- With the accuracy of today's GPS enabled systems, following a waypoint to a buoy may lead you to ……..

- Set waypoints several boat lengths away from channel markers or navigation aids.

- Using channel markers and navigations aids as WP's provides a "target" to steer toward.
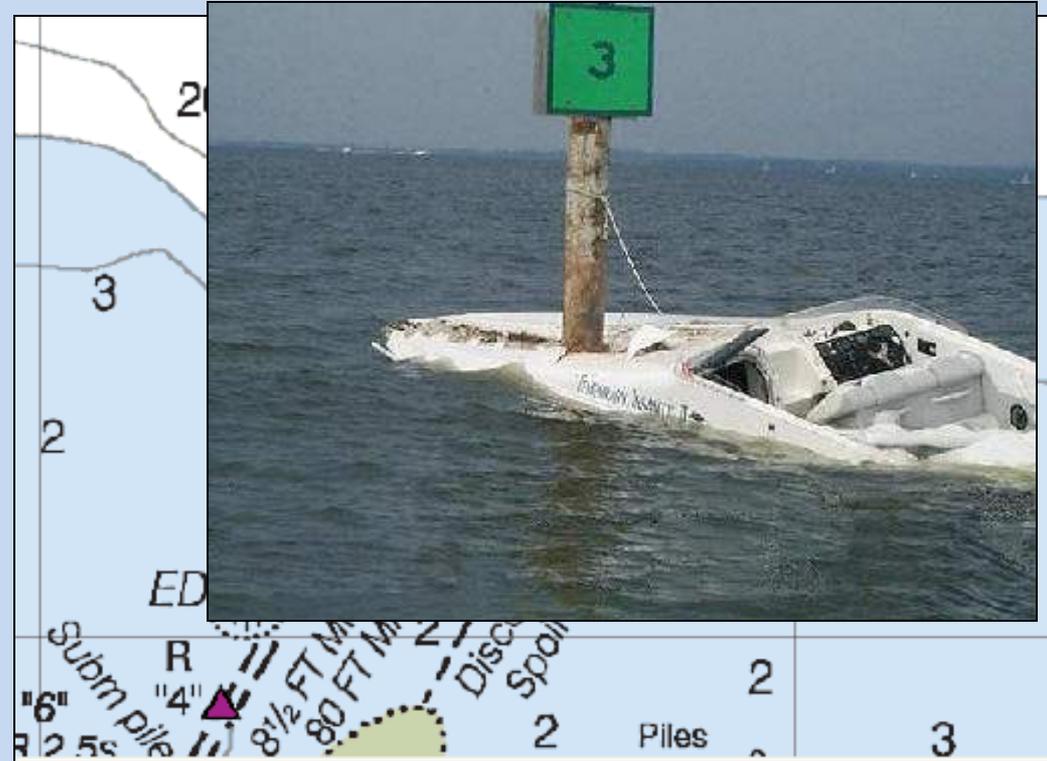
Offset waypoints from buoys,
you just might confirm its position

Develop a localized naming convention for WPs to help in Iding them
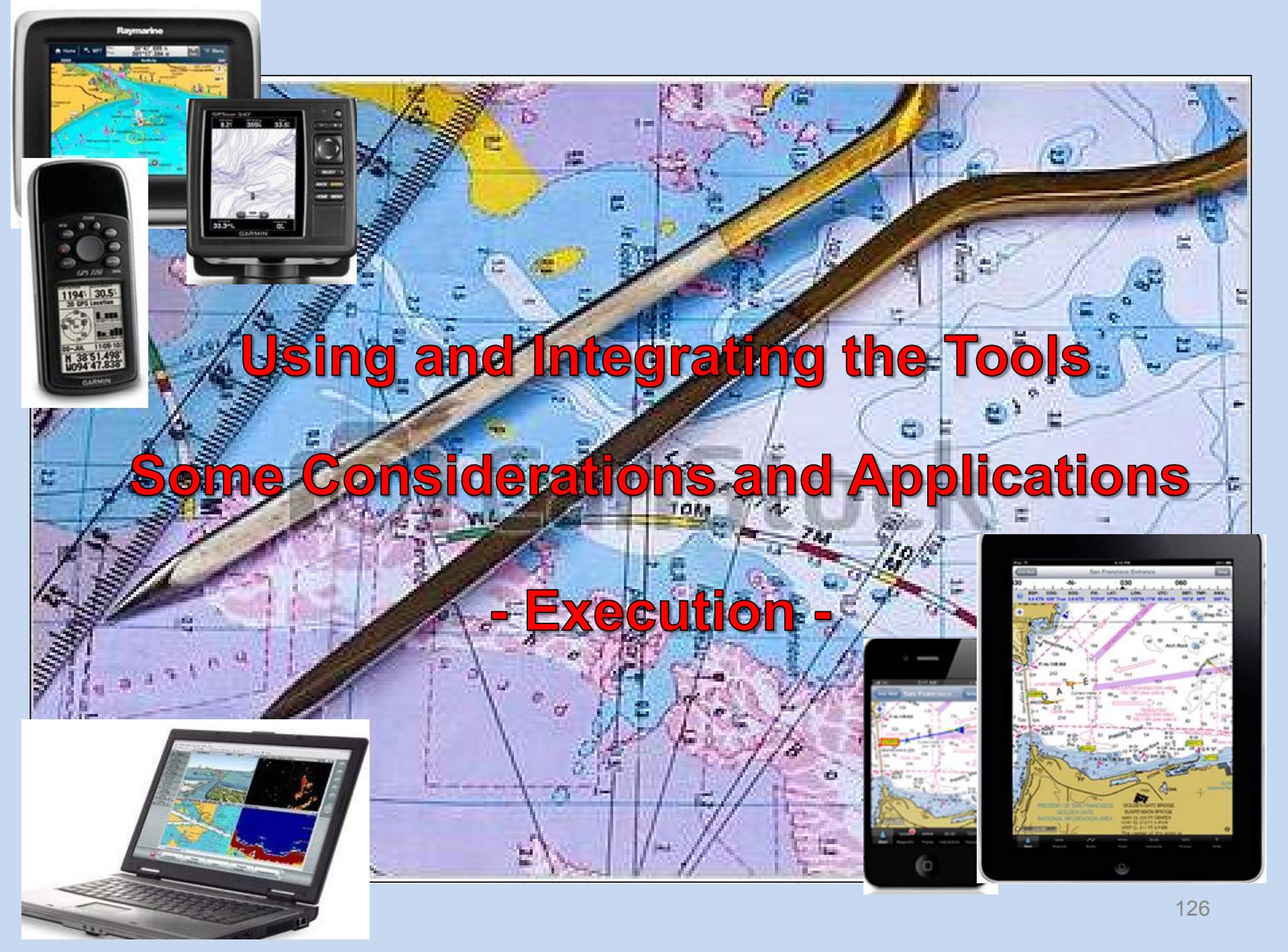
"Fly Your Route"

Planning:

- Make sure routes make sense:
  Scale out to plan the general route, scale in to refine and finalize ("fly the route").

- Initial route "layout" must be refined based on a review of larger scale charts.

  Remember scale matters in the amount of detail displayed.
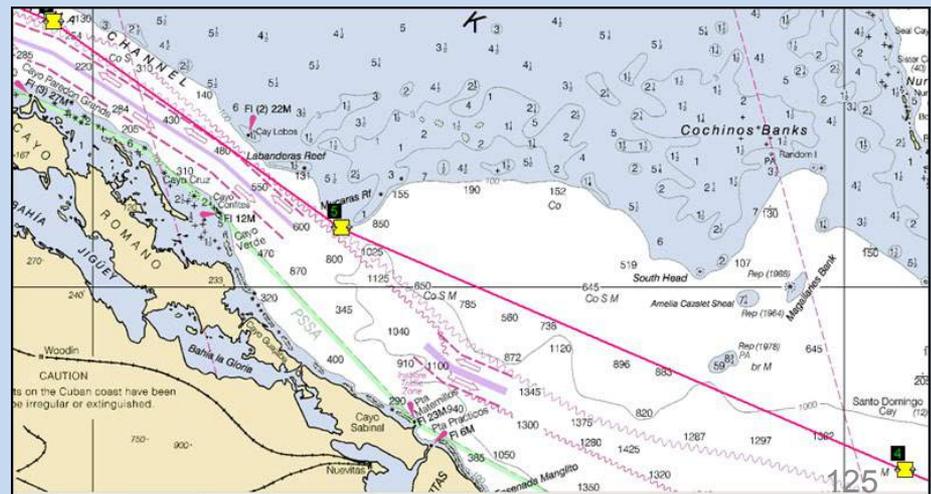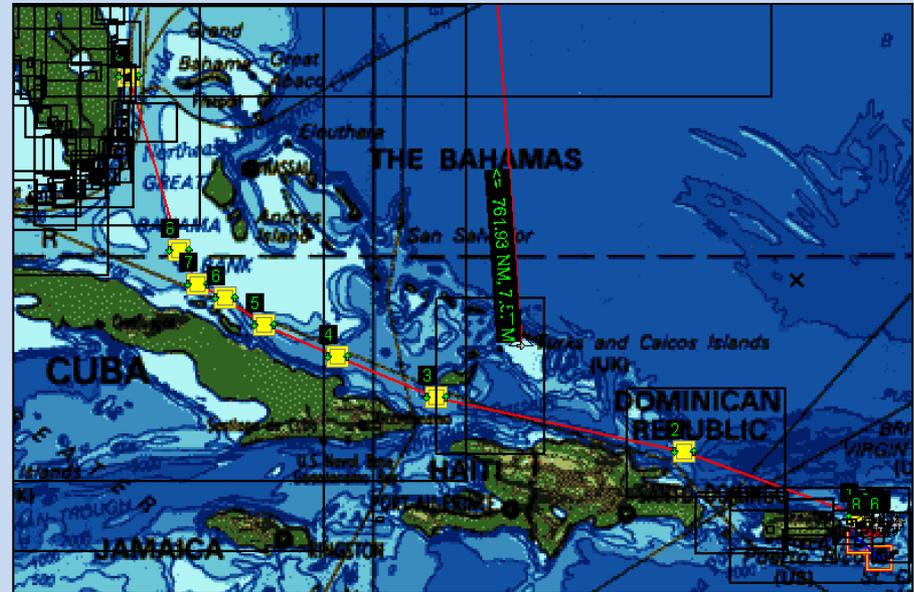
Using and Integrating the Tools

Some Considerations and Applications

- Execution -

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Considerations and Applications

Execution:

- **Would you "do it" of you did not have "it"?** Over-reliance on GPS/Chartplotter accuracy has many risks - especially at night. "Do I have backup means of navigation available?" (charts, compass, DR plot, etc.) **Am I taking a chance to go there if my ECS should fail?**"

Navigation with a Chartplotter

⚠ **CAUTION**

The Auto Guidance feature is based on electronic chart information. That data does not ensure obstacle and bottom clearance. Carefully compare the course to all visual sightings, and avoid any land, shallow water, or other obstacles that may be in your path.

When using Go To, a direct course and a corrected course may pass over land or shallow water. Use visual sightings, and steer to avoid land, shallow water, and other dangerous objects.

Navionics app: "Dock-to-Dock" Autorouting now available

Considerations and Applications

Execution:

- **Would you "do it" of you did not have "it".** Over-reliance on GPS/Chartplotter accuracy has many risks - especially at night. "Do I have backup means of navigation available (charts, compass, DR plot, etc.)?" "Am I taking a chance to go there if my ECS were to fail?"

- **Beware of the scale of electronic charts**: On small-scale charts important detail can be missing – no indication that important info can be found in larger-scale, zoomed-in depictions. Similar issue when selecting the "declutter" function on some ENCs.
    - Scaling in beyond the scale the cartographers intended may show more detail than is actually there.

Because of screen size, digital charting displays show a lot of detail in a small area or a larger area with very limited detail.

How Much Detail is Enough
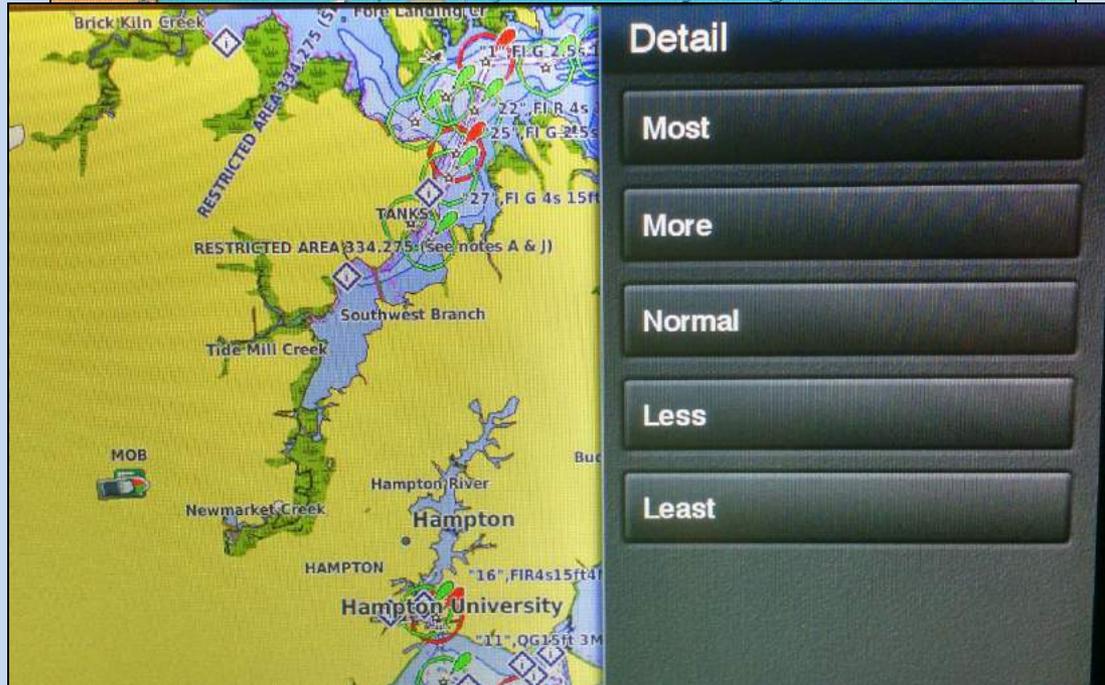
"Declutter on"

Execution:

- Exercise care when using the "declutter" or "less detail" feature available on chartplotters /MFDs.

- Remember to turn it off or add detail when navigating close to shore or near potential danger areas.

- **The questions is: "do you know where those danger areas are?"**

Considerations and Applications

Execution:

- **Look and listen.** Take your eyes off the screen. Look around, see what is going on around you. With so much info available it's easy to develop a "game show mentality".

- **Maintain situational awareness**. There can be significant difference between where objects are shown on electronic charts and where they actually are located.

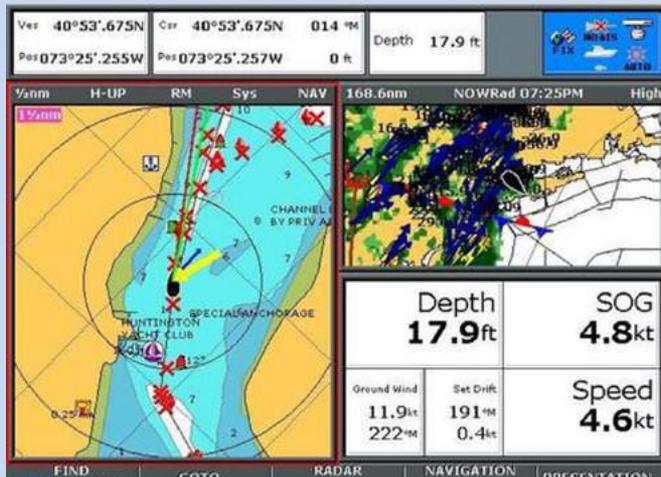- e-Charts **will not** show boats or other obstacles floating in the water.

*It's Not a Game Show
Don't become a Victim of EAC*

Considerations and Applications

Execution:

- Utilize MFDs to provide an integrated picture of vessel data and the operating environment to increase your "situational awareness". Tailor the screens to your needs.

- Be aware, especially with older units, the more data the device has to "paint", the slower the "refreshed rate" of the "picture" you may be seeing. What you see may be where your **were**, **not** where you **are** now.

Plotting Your Position – A Technique

Bearing: 092º M
Distance: 2.4 nm
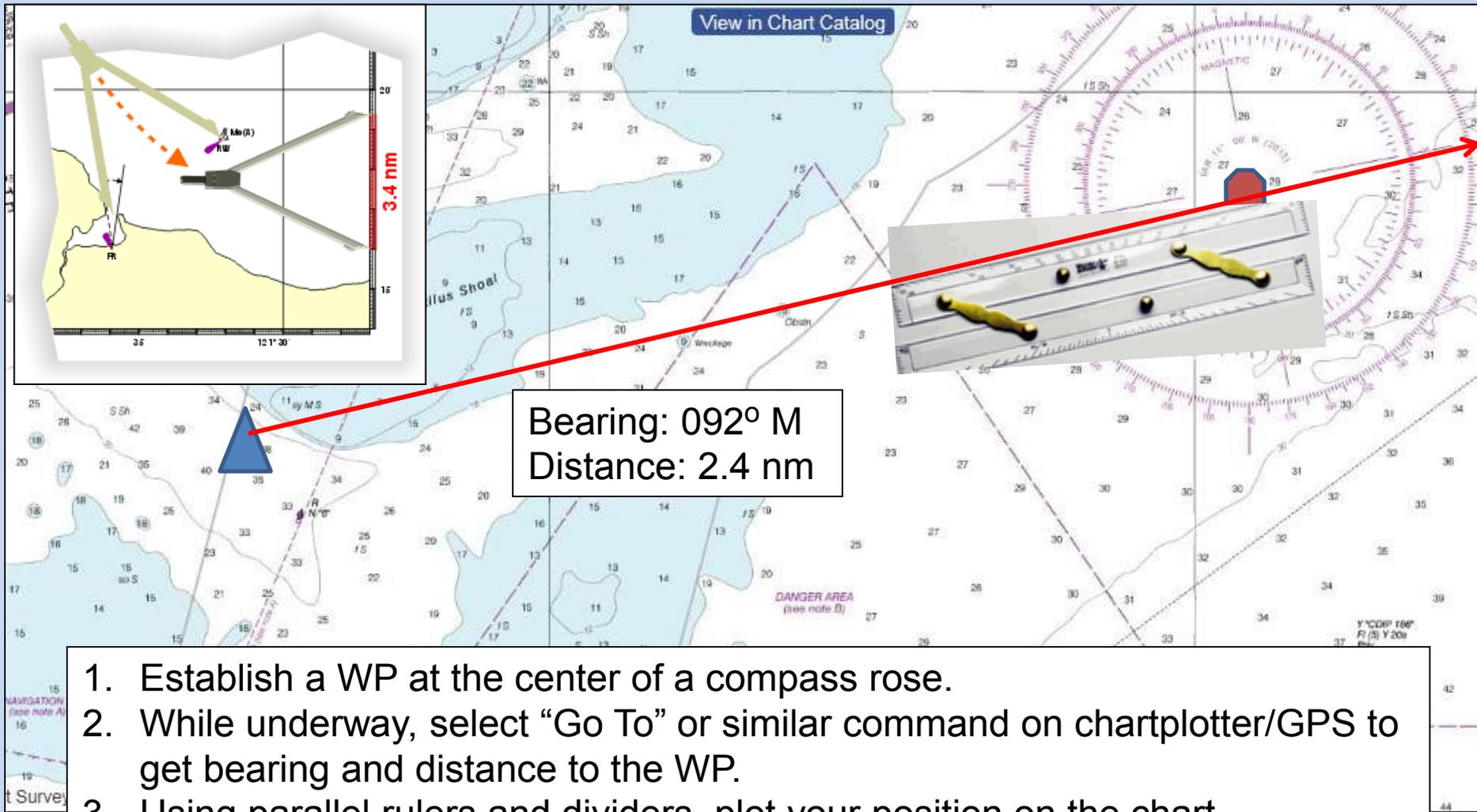
1. Establish a WP at the center of a compass rose.
2. While underway, select "Go To" or similar command on chartplotter/GPS to get bearing and distance to the WP.
3. Using parallel rulers and dividers, plot your position on the chart.

Some Thoughts/Observations

- Take time at the **dock** to get familiar with your e-Nav devices. The Owner's Manual is a great reference but **only "hands-on"** practice will get you comfortable with using the equipment. Most devices have a **"factory reset"** feature so "play" with it before heading out on the water.

- **"Touch pad"** (TP) features are found on Smart Phones, tablets and many computers. They are becoming more common on MFDs. Some even have the option of ""hard key" or TP control. The TP feature works well at the dock or in calm conditions but underway getting a wet finger to the right place on a moving screen can sometimes be a challenge. **"Try before you buy"**

- Determine what new capabilities *you need*; know how to use them, be aware of their limitations.

- Having **paper charts** available of the entire cruising area helps give you a good idea of the actual distances to be traveled and points of interest/major aids/obstacles along the way, gives you a **"birds eye"** perspective.

Summary

- **The first rule of navigation is to never rely on a single source for navigation.**

- e-Nav devices help us to navigate in all kinds of weather, get wx and avoid hazards, to include other boats, but they should always be considered **aids** to navigation and not the sole tools used for navigation. Treat e-Nav devices and data with deep appreciation but at least a little skepticism.

- **All electronics will fail**. This means knowing how to and maintaining a plot on a chart, running and updating a DR, and keeping a log while underway. Keeping a Log takes on increased importance.

- Remember we are **legally and morally** obligated to keep a lookout while underway.

- It should not be a **"one-or-the other"** approach but one that seeks to take advantage of the best capabilities each can provide.

- Don't become a **victim** of EAC.

e-Nav Training Class – 6 April

A **1 – day**, two part class designed to identify the advantages e-Nav devices provide to recreational boaters yet be aware of their limitations and how to minimize them. Apply during a cruise planning problem.

This course might be for you or key members of your crew if:
- ✓ You're looking to upgrade onboard systems and wondering how best to integrate new and old equipment.
- ✓ Looking for criteria for selecting new software for your navigation system, Smartphone or tablet.
- ✓ You're looking for information available on the internet to support navigation planning and execution.
- ✓ **You're unsure if you can answer these questions when planning a trip or while underway:**
  - • I want to go to this position on the chart but how do I select the waypoints to put into my e-Nav device that will get me there?
  - • How do I locate the waypoints on my e-Nav device on my chart?
  - • Where am I and where is this on the chart?

e-Nav Training Class – 6 April

✓ You're comfortable using a chart plotter or other e-Nav devices but not sure how to use paper charts and "traditional" navigation tools.
✓ You're comfortable using paper charts and "traditional" navigation tools but are a little hesitant when using e-Nav tools or knowing how to take full advantage of their capabilities.
✓ Wondering why what you see on the chart plotter does not match what you see on a paper chart of the same area.
✓ You want to know how to better take advantage of the ever increasing range of internet resources and apps available to today's navigators.

Course first discusses what is e-Nav, the capabilities and limitation of e-Nav devices, criteria for selection hardware and software for onboard use to include Apps for Smartphones and tablets and an overview of key traditional navigation skills and plotting techniques.

Followed by a **cruise planning problem** demonstrating how to integrate e-Nav devices, internet resources and traditional navigation tools for a weekend cruise.

Electronics, Their Role in Marine Navigation

- An Overview -

Full presentation with an application problem - 6 April

Capt Steve Runals