

Lesson 3 Key Terms

Value of sounding:

This is just what it sounds like, the numeric value of a sounding, but it has a special meaning in that it is an official ENC chart attribute (VALSOU). It applies not just to regular soundings, but mainly to the depth of the water (relative to zero tide) on top of various isolated hazards such as rocks and wrecks. Positive values are below the tide zero level, minus values are above, which means they are drying heights.

A rock with VALSOU of 2.4m will be 2.4m below the surface when the tide is zero, or 5.4m below the surface when the tide is 3.0m. Likewise a rock with VALSOU of -1.3m will be 1.3 m above the water when the tide is zero, but it will be 0.7m under the surface when the tide is 2.0m.

major light:

In ENC terminology this is a light that has a nominal range of 10 nmi or more. These lights are shown on an ENC with a large solid color ring (1" to 2" across) and they are also accompanied by a light description, which is similar to the labels found on paper charts. The color of the ring matches the light color, keeping in mind that white, orange, and amber lights are *all* shown as yellow on ENC.

In an ENC, a major light that is obscured from certain angles becomes a sector light and it then has no label.

Some ECS do not follow strictly the ECDIS standard with regard to these rings. Some offer an option called "Highlight major lights" and then this option toggles on or off these rings; otherwise major lights on those ECS just show the flare (teardrop) symbol.

minor light:

In ENC terminology, this is any light with nominal range less than 10 nmi that is also not a sector light. It is shown on the chart as a tear drop of the light color, pointed toward 135T, intending to indicate a flash. White lights use a yellow symbol. If two lights are located at the same position (rare but seen), the second one has its tear drop directed toward 045T. Minor lights include a full light description but lights on buoys often do not include a nominal range. On ENC, it is not a "lighted buoy" it is a "light" and it is a "buoy," and maybe a "daymark," and maybe a "fog signal."

sector light:

A charted light that has more than one horizontal angular sector of visibility. The sectors are defined as bearings to the light from the vessel. On paper charts and the RNC based upon them, the printed light descriptions define the sector where the light is obscured, but on ENC the sector

ranges (found by a cursor pick to the light) defines where the light is visible.

For sector lights there will not be a light description shown on the screen, so we must cursor pick the light to learn the digital values of the sector limits. These limits are drawn on the screen, usually as short lines (one inch or so), with an option to extend them out to the nominal range of the colors. Sector lights do not show the descriptions, likely because each sector usually has different descriptions and some lights have very many sectors, over a dozen in places.

Sector lights are marked with large rings (about 2 inches in diameter) marking the sectors.

light description:

This is the ENC terminology for the label shown on lights such as "FL R 4s 48ft 8NM"

The first element is the characteristic (or pattern) of the light, next is the color, then the period, then the height of the light above MHW, and then the nominal range.

A nav program with the option to "show light labels" usually means showing or hiding these light descriptions. Sector lights are the only ENC light category that does not display a light description.

light characteristic:

In modern ENC terminology, this refers only to the flashing pattern of a navigational light as described on a chart or in a Light List.

mean high water:

A tidal datum abbreviated MHW. The MHW at a specific location is the average of all the high water heights observed over the 19-year National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent of a 19-year datum.

This is an especially important reference in US charting because it is also the vertical height datum used on charts. The heights of lights, the vertical clearances of bridges, and the drying heights of rocks are specified as above MHW. Thus when the tide is lower than MHW you have more clearance under a bridge, lights are higher above the water and can thus be seen a bit farther off, rocks are higher above the water than stated on the chart. All of these are reversed when the tide is above MHW.

On US RNC, we find the value of MHW from tables printed on the chart. It is generally listed for several locations. On a smaller scale chart (1:80,000 or less) this can vary up to 1 ft or so.

On US ENC, we find the value of MHW from a cursor pick of the green foreshore that will show a depth area extending from 0 to -MHW, which is from the soundings datum to the height datum. The value is given as negative because soundings are listed as positive numbers and this is going the opposite way from zero tide, which is the reference point. In contrast to RNC, US ENC only list one value of MHW for the full span of the ENC cell.

harmonic constants:

Sometimes shortened to just "harmonics," this refers to the set of numbers that are needed to compute tide height and tidal current at one of the NOAA reference stations, now called harmonic stations. This is the data set that navigation programs need in order to compute tides and currents and display them on the screen. See samples at tidesandcurrents.noaa.gov. NOAA makes public these constants for US waters, but most other nations do not share their corresponding data.

The single file format will have an extension TCD (tidal constituent database), or it will be in two files, one called HARMONIC and the other HARMONIC.idx. The single file version covering all US tides and currents is about 4 MB in size.

The harmonics for most major ports of the world were at one time public domain, arriving there from various published research papers. But at some point several nations decided to treat this data as their own intellectual property that they use to create and sell tide and current forecasts each year. Some, led by the UK, aggressively prohibit the sale or even distribution of this one time public data. The US is leader of a small, elite club of nations who still provide this data at no charge to mariners.

Since this data was at one time public, there are still unofficial sets international harmonic constants available from various unofficial sources. Any use of such data must be done with extreme caution as there can and even likely will be errors in it.

USCG Navigation Center:

Often referred to as just "navcen," this is a USCG web page portal to all manners of valuable marine navigation information. The address is www.navcen.uscg.gov. It is a primary resource for information on GPS, Navigation Rules, AIS, Notices to Mariners, Light Lists, radio frequencies and schedules, and more.

Lesson 3. Tides, Lights, and Hazards

Practice Exercises

Check that you have the Sample Training Charts selected on the ENC set up page: menu Preferences/Configuration/Charts/Rasters and vectors/Folders (shortcut = cmd+opt+v for Mac or ctrl+alt+v for PC).

3.1. Practice searching the charts. What is the reported depth area in Camper Bay. To refresh the use of the search engine, see Lesson 3 Resources Online.

3.2. Practice searching the charts for Cape George.

3.3. There is a series of 16 rocks along the Cape George shoreline stretching to the NE for 1.6 nmi, along with another 4 that are just offshore, as shown in Figure 3-1.

The ENC cursor picks of soundings are shown for each. Compare what we see in the RNC to the ENC data (top to bottom figure). You will see that three ENC rocks do not show up on the RNC (15,16,12), but otherwise they all agree well except for two (13,14). What is the ENC and RNC difference for these two?

Note the drying heights and how they are presented in the ENC, i.e., water level effect (WATLEV). Easiest way to do this is turn on both R and V, then leave R on and turn V on and off to reveal R. Keep in mind that the RNC has soundings in units of “Fathoms (fathoms and feet to eleven fathoms),” i.e., 34 means 3 fathoms and 4 ft = 22 ft.

3.4. Describe the extent of the beach (charted green foreshore) you would see from a kayak just offshore in that area as the tide varies from low to high water.

3.5. When the tide is zero, how far from the water’s edge is rock “2”? Our in-house numbers, shown in Fig 3-1.

3.6. Same question for rock “17” (sounding = 3 ft)? Zoom in and measure from center of rock symbol.

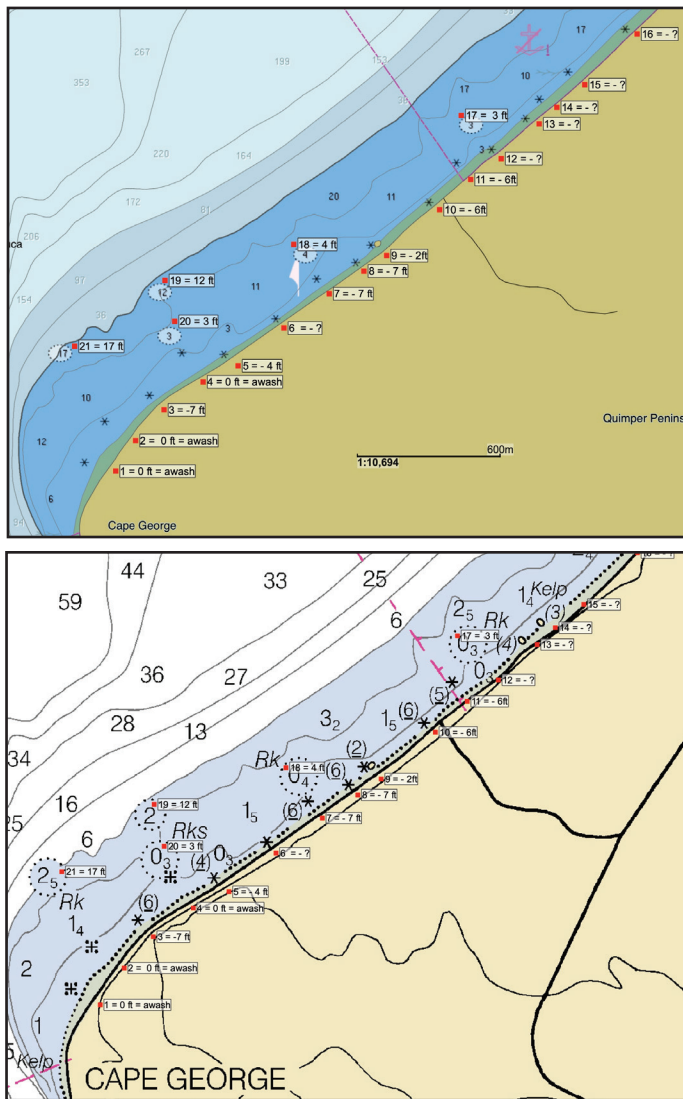


Figure 3-1. Rocks along Cape George, with POI labeling them with the cursor pick values of their soundings. Top is ENC with units set to feet; bottom is RNC, with chart units of fathoms and feet and qT/m still set to feet. ENC drying heights are shown as negative soundings.

3.7. Using the ENC chart, what is the value of mean high water along Cape George?

3.8. What does the RNC say that MHW is for this area? What is the nearest reported location? (It is often easiest to find such information on an RNC by right click and Show this chart only; then when done, click the R icon to go back to all RNC.)

3.9. What is the vertical clearance of the bridge over the Port Townsend Canal? Give your answer in feet.

3.10. Your mast height is 59 ft. What would be the best time of day to pass under this bridge with the most clearance on Monday, July 4, 2022. (z=UTC).

3.11. What would be your clearance in feet between mast tip and bridge when passing under it at the best time?

3.12. What is the charted depth in feet at the center of this bridge?

3.13. Search for the Burlington Northern Railroad bridge that is just before entering the locks in Seattle (“railroad” should find it.) Recall that bridges are area objects, meaning they are a closed figure. You should end up on chart US5WA13M.

3.13a. Experiment to see what part of the bridge symbol you need to click to get the report.

3.13b. There are actually two types of bridges that make up the railroad bridge. Two are fixed and one opens. Do cursor pics to learn about this. Take a look at the RNC to see if that helps.

3.14. Practice viewing the nominal range of lights in qtVlm using bottom feature of Figure 3-2. When you put the cursor on a light, it will expand to the nominal range. For this exercise we have to assume we are viewing from a high elevation, such as standing on the main boom, i.e., we base the answers on nominal range alone (usually not realistic!).



Figure 3-2. Lighthouse icon in the toolbar. This only shows up in vector chart mode, but it is a handy tool when shown.

The top is a Lights off switch, below is Lights on. This is the same as turning lights on and off in the ENC preferences page.



The bottom view, being the third click of the icon, is a unique qtVlm display of all lights within view of the vessel... assuming you are viewing from high enough perspective that the visible range is limited only by the charted nominal range of the lights.

This is rarely true for small boat navigation where our visible range to the light is more often determined by the height of the light than its nominal range.



Note too that qtVlm assigns a nominal range to lights on buoys of 2.5 nmi. At present, the US does not include the nominal range of buoy lights, despite the fact that they are now almost all known and presented in the Light List. We are in ongoing discussions with NOAA about this. Canada does indeed include value of the nominal range with buoy lights.

A quick check of the USCG Light List (i.e., looking at the first 150 buoys in Vol. 6) shows that about 45% have VALNMR = 3, with 56% with value 4, and 15% with value 5 nmi, the latter are usually the large mid-channel buoys.

Taking into account the low height of most buoys, we think the qtVlm estimated buoy light range is a good practical solution.

3.14a. With your boat located 3.9 nmi from San Juan Point in direction 191 what lights would be visible and what colors?

In qtVlm you can put the cursor on the light to see how it displays. This is true for all sector lights, not just these narrow ones.

3.14b. With your boat 6.5 nmi from San Simon Point in direction 257 T, what lights would be visible and what colors?

What can you say about the shilshole bay entrance leading light regarding how far off you could see it? Suppose your height of eye above the water was 5 ft?

3.15. Experiment with showing narrow sector leading lights. There is one near the railroad bridge. Below in Figure 3-3 is a sample from the Texas-Mexico border at Brownsville.

Figures 3-4, 3-5 are reminders about the main rock types and light characteristics in ENC.

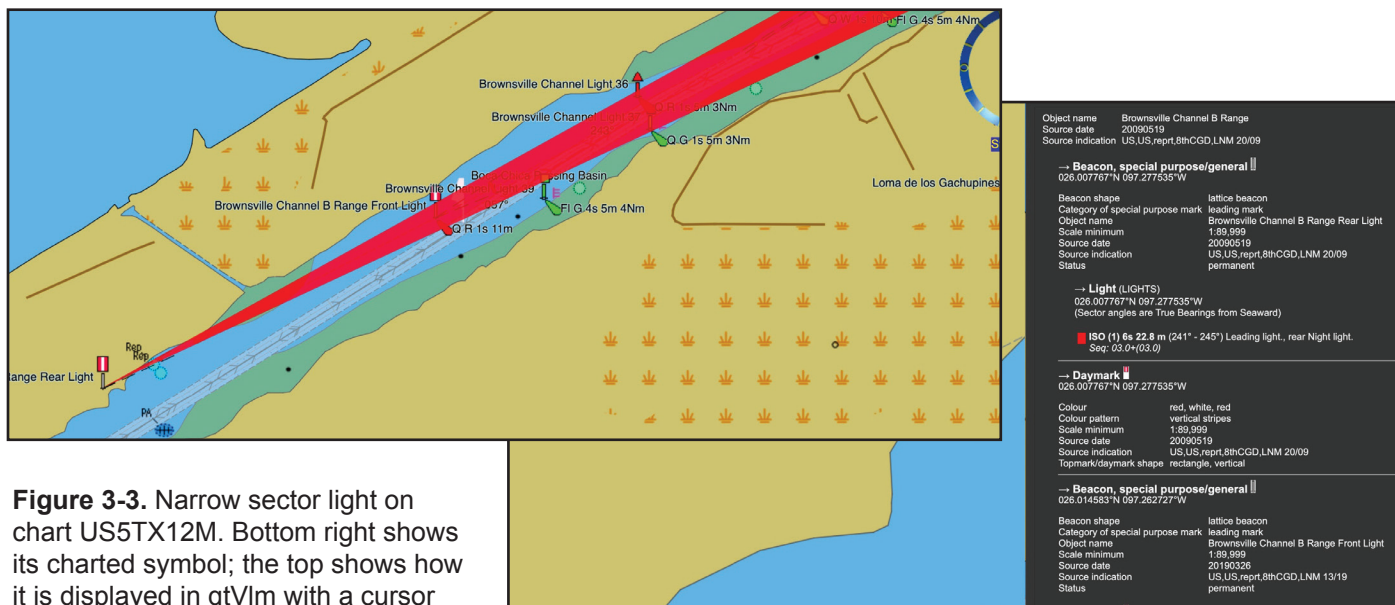


Figure 3-3. Narrow sector light on chart US5TX12M. Bottom right shows its charted symbol; the top shows how it is displayed in qtVlm with a cursor over the light. All sector lights can be illuminated in this manner in the program. Recall that all sector lights do not show any light descriptions, so we have to cursor pic to learn about them.

ENC		RNC	
✱	Rock which covers and uncovers or is awash at low water	✱	✱
⊕	Dangerous underwater rock of uncertain depth	+	⊕
10	Underwater hazard with a depth of 20 meters or less	+	⊕ Rk
⊗	Isolated danger of depth less than the safety contour [This is activated by safety contour, not safety depth.]	✱	✱ +

Figure 3-4. ENC rocks symbols compared to RNC

CHARACTERISTICS OF LIGHTS ... The Basic Four		Abbreviation
Illustration	F = Always on	
	FIXED A light showing continuously and steadily.	F
	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.	Oc
	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.	Fl
	ISOPHASE A light in which all durations of light and darkness are equal.	Iso

Figure 3-5. A reminder about the main light characteristics.

Lesson 3 Quiz

03-01. On paper charts, a rock that is always underwater (regardless of tide height) whose actual depth is unknown has a symbol of a plain plus sign. How is this type of underwater rock represented on an ENC?

- A. An asterisk and we have to cursor pick it to learn its Water level effect (WATLEV).
- B. The symbol is the same as on paper charts, a plain plus sign.
- C. A plus sign within a dotted ring.
- D. An asterisk with a dotted ring.

03-02. A rock object with attribute “Value of the sounding” = 0.0 is...

- A. only exposed in still water when the tide is negative.
- B. always awash.
- C. always exposed.
- D. only exposed during a spring tide.

03-03. Unlike RNC and paper charts, updated US ENC charts contain all of the same information for lighthouses as the...

- A. Coast Pilot
- B. Light List
- C. Lighthouse Research Catalog
- D. Lighthouse Directory

03-04. RNCs have multiple different symbols for different types of hazardous rocks. How many different symbols can represent a hazardous rock on an ENC?

- A. 8
- B. 6
- C. 4
- D. 2

03-05. A cursor pick on a US ENC green foreshore will reveal...

- A. the composition of the beach.
- B. the steepness of the shoreline.
- C. the tide range from sounding datum (tide = 0) to the height datum (tide = MHW).
- D. the quality of the foreshore as a radar target.

03-06. A Major Light on an ENC has a nominal range of 10 nm or greater, and is displayed as...

- A. a teardrop-shaped flare only.
- B. a prominent ring in the color of the light only.
- C. a magenta diamond with a small magenta circle at the base.
- D. either a teardrop-shaped flare or a prominent ring.

03-07. On an ENC chart, an Alternating light will be depicted by...

- A. a prominent ring.
- B. a teardrop flare symbol.
- C. two teardrop flares at 45° angle.
- D. Could be any of the above depending on the brightness of the light and other factors.

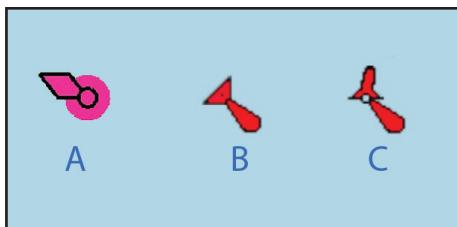
03-08. A cursor Pick on a Canadian ENC chart on a green “foreshore” will reveal...

- A. the composition of the beach.
- B. the steepness of the shoreline.
- C. the predicted range of tide from Mean Lower Low Water to Mean High Water.
- D. almost nothing.

03-09. From the USCG Navcen web page, we can download PDFs of..

- A. Annual Light Lists.
- B. Weekly Notices to Mariners to update our Light Lists.
- C. Accumulated weekly updates.
- D. all of these.

03-10. For practice using the search function of qtVlm, what would be your best guess of the depth of Lake Hancock



03-11. Which of the 3 symbols above represent the same object?

- A. A and B
- B. B and C
- C. A and C
- D. They all represent the same object

03-12. Which of the ENC light categories typically does not show a light description on the chart such as “Fl R 4s 48ft 9Nm.”

- A. Major lights
- B. Minor lights
- C. Sector lights
- D. All ENC lights have the option to display a text description

03-13. On paper charts, the text actually painted on a buoy or beacon is indicated with quote marks on the object label. This convention is not used on ENC. What is our best way to guess what is actually painted on a buoy or beacon using a cursor pic of the object?

03-14. Search our training charts for Glen Cove. Once there, you see 2 mooring buoys and 4 other objects near by. Part 1. What are those 4 objects? Part 2. Are they floating or fixed to the seabed?

03-15. What is the vertical clearance of the Burlington Northern bascule railroad bridge, just before the entrance to the locks in Seattle? Give your answer in feet.

03-16. Your mast height is 50 ft. You know with help of the tides you can get under this, but timing is important. What would be the best time of day to pass under this bridge with the most clearance on July 14, 2022. (z=UTC). Note that this bridge is usually kept open, but periodically it can be down for long periods of time.

- A. 0700z
- B. 1200z
- C. 1630z
- D. 1900z

03-17. What would be your clearance in feet between mast tip and bridge when passing under it at the best time? Explain how you got your answer.

03-18. What is the charted depth in feet at the center of this bridge?

03-19. You are located at 48.4159, -123.4394 (decimal degrees) and you see north of you a light that is on 2 seconds and off 2 seconds. What color is that light?

- A. White
- B. Yellow
- C. Red
- D. Green

03-20. If a light has a name, where do we look for that name?

HINT: Checking a few on a chart is likely best approach here.

- A. On the Light object
- B. On the object supporting the light
- C. In a separate object called Name of light.
- D. Light names, when available, are listed on the Light object and the support object.

03-21. Near the railroad bridge of question 15 there is a light called Shilshole Bay Entrance Leading Light. If you were located 120 ft south of Shilshole Bay Buoy 4, would you see that light and if so what color would it be?

Lesson 3 Practice Exercises

3.1. Find it at 48.5570,-124.5512. Depth area = 0 to 5.4 m. (0 to 18 ft)

3.2. Find it at 48.10,-122.88.

3.3. Rocks 13 and 14 do not have the proper descriptions in the ENC. These are always dry islets. We have a video note on these to confirm that the RNC is correct, so this is clearly an ENC error (as of this writing 10/10/21).

3.4. When the tide is zero, water meets land where the blue meets the green. When tide = MHW, the green is fully covered and water extends to where the green meets the tan. Depending on the beach, at higher tide the water may be over the tan, but if a bold black line is there, it is blocked. (When such a bolder line is present, it is usually just barely discernible, but you can cursor pick it to learn the nature of it.)

But on tide below zero there will be more dry than shown in the green... the green will effectively reach more into the water depending on the slope of the beach.

For tide halfway between 0 and MHW, we might guess that the green is about half there... but this is rough estimate.

3.5. When the tide = 0, the water meets the land where the blue meets the green—in other words, the green is all dry then. Use the ruler tool to learn: About 90m (98 yd).

3.6. 120 m

3.7. Cursor pick the green foreshore to get a depth area of -2.7 to 0, so MHW = 2.7m = 8.9 ft.

3.8. Port Townsend is nearest station and value is 8.6 ft on one chart and 8.5 ft on the other one. Might have to open this chart only after switching to RNC

to get the tables. The two charts we have of this area have slightly different values. Recall that ENC can only show one value of MHW which must be an average for the full chart.

3.9. Clearance is 17.6m = 57.7 ft. Bridge at 47.8598,-122.6250

3.10. At 22 z we have the lowest tide, being just below zero on this date

3.11. 8 ft. Vertical clearance is 58 ft, MHW is 9 ft, tide at best point is 0, so $58+9 - 59 = 8$.

3.12. 13.1 feet (4m). It is a dredged area. [3/4 credit for 15 ft (4.5m), which is the project depth, not actual depth.]

3.13a. Can click the line or anywhere within the closed figure. Trying for just the line might miss it.

3.13b. There is a fixed bridge on the south side and a bascule bridge on the north side. Use s-57.com to learn the official definition of a bascule bridge.

3.14a. Vessel location is at 48.469,-124.485 . Should see 3 white lights.

3.14b. Vessel location is 48.407,-124.268. No lights visible from here.

3.15. The light does not have nominal range charted, which is contrary to most of these. It is 22 ft high so we have a geographic range of $1.17 \times [\text{Sqrt}(22) + \text{Sqrt}(5)] = \text{about } 8 \text{ nmi}$, which is clear across Puget Sound. Chances are this light does not actually show from that far out. The Light List does not say much more, but does say “Visible 1.5° each side of channel centerline.” Presumably it reaches out to the shipping lanes, which is about 4.5 nmi.

Lesson 3 Quiz

03-01. C. The ENC symbol for a rock that is always underwater is a plus sign within a dotted ring. There are no plain plus sign rocks on ENC.

03-02. A. This is one whose highest point is just at the surface when the tide = 0.0, so on all positive tides it is covered, and it only shows in negative tides. Those are the principles that answer the question, but in practice we might see waves breaking on this type of rock with 0 or very low tides, or maybe it might show in the trough of a deep swell.

03-03. B. Light List

03-04. C. Hazardous rocks have four ENC symbols:

- 1) an asterisk (same as paper charts) when the rock covers and uncovers with the tide or is awash at tide = 0.
- 2) a danger symbol for a rock outside of the safety contour with a sounding shallower than the safety contour. (Some programs have the option to use the danger symbol inside of the safety contour)
- 3) a plus sign with a ring of dots for a rock always underwater with an unknown sounding.
- 4) a sounding within a ring of dots for a rock always underwater of a known sounding.

03-05. C. the tide range from sounding datum (tide = 0), on the water side, to the height datum (tide = MHW), on the land side. The latter will be a negative number, as it is a sounding relative to 0, with positive values being water soundings that go down from the zero level.

03-06. D. The base display is a teardrop flare, but all ECS offer the option to enhance the display of these lights (nominal range ≥ 10 nmi) with a full ring. The rings should be about 1" diameter on your screen regardless of zoom level.

03-07. D. The alternating light characteristic is presented various ways. Generally a major light is a single ring, with minor lights being a single teardrop, and we learn it is alternating only by the light characteristic printed in the light description. But sometimes an alternating light is interpreted as one light with two colors, or two lights of different colors, which would then be two flares. In all of these cases, the light characteristic is called alternating.

03-08. D. almost nothing.

03-09. D. All of these pubs are there. For the latest List we need to download the Annual volume plus the accumulated weekly update.

03-10. The lake is at 48.1129,-122.5902. The depth area for most of the lake is 0 to 1.8m so we have to guess it is about 1.8 m.

03-11. D. They are all the same lighted buoy. A is from an RNC, B is ENC simplified style, and C is ENC paper chart or traditional style.

03-12. C. Only sector lights do not officially call for a charted light description. All lights offer the option to hide the text descriptions, but Sector lights do not have any text description line encoded with them. This is a property that can lightly be traced to the preponderance of sector lights with many sectors (up to 14 with up to 4 colors) each of which could have different nominal range and height. This is a valuable tip to know, so we don't think we have something set up wrong on our nav program display options, when we do not see it. It is, however, a way for us to know that it is a sector light, and not a major light, which has the option to turn on a large ring... which sort of looks like a sector light.

03-13. Usually it is the last characters of the Object name, i.e., a beacon whose object name is Port Townsend Light 2A would most likely have the "2A" painted on a sign attached to the beacon. Likewise, an object name Kilasut Harbor Buoy 3 will have a "3" painted on the buoy. This is not an official ENC rule, but a guideline that works most of the time.

03-14. Part 1. (2x25%) Offshore platform used as a mooring tower.

Part 2. (50%) they are fixed to the seabed. (see s-57.com)

03-15. Bridge center is at 47.6669,-122.4020. Clearance is 43 ft. It is on the north end of bridge.

03-16. D. At 1900z we have the lowest tide at -4.0 ft. This is actually about as low as it ever gets at this location. This will give us 4 + MHW extra clearance over the charted values.

03-17. 8 ft clearance. Cursor pick foreshore to learn MHW = 11 ft. Add to that the negative tide of -4 so we get an extra 15 ft of clearance. So $43 + 15 = 58$ ft, and we are at 50, so a good 8 feet of clearance is the answer.

03-18. Depth area is 30 to 60 ft. Half credit for 18 to 30 ft, which is the value off to one side.

03-19. A. It is a white light. Recall that ENC represent white lights with a yellow color, so in general we have to cursor pick a yellow light to see if it is white or yellow.

03-20. B. Light names when available are usually just on the support object. The Object LIGHTS does have an attribute Object name, but US charts do not seem to use it.

03-21. No, cannot see it. this is a tight sector leading light only a few degrees wide. Put cursor on it to see the pattern in qtVlm.