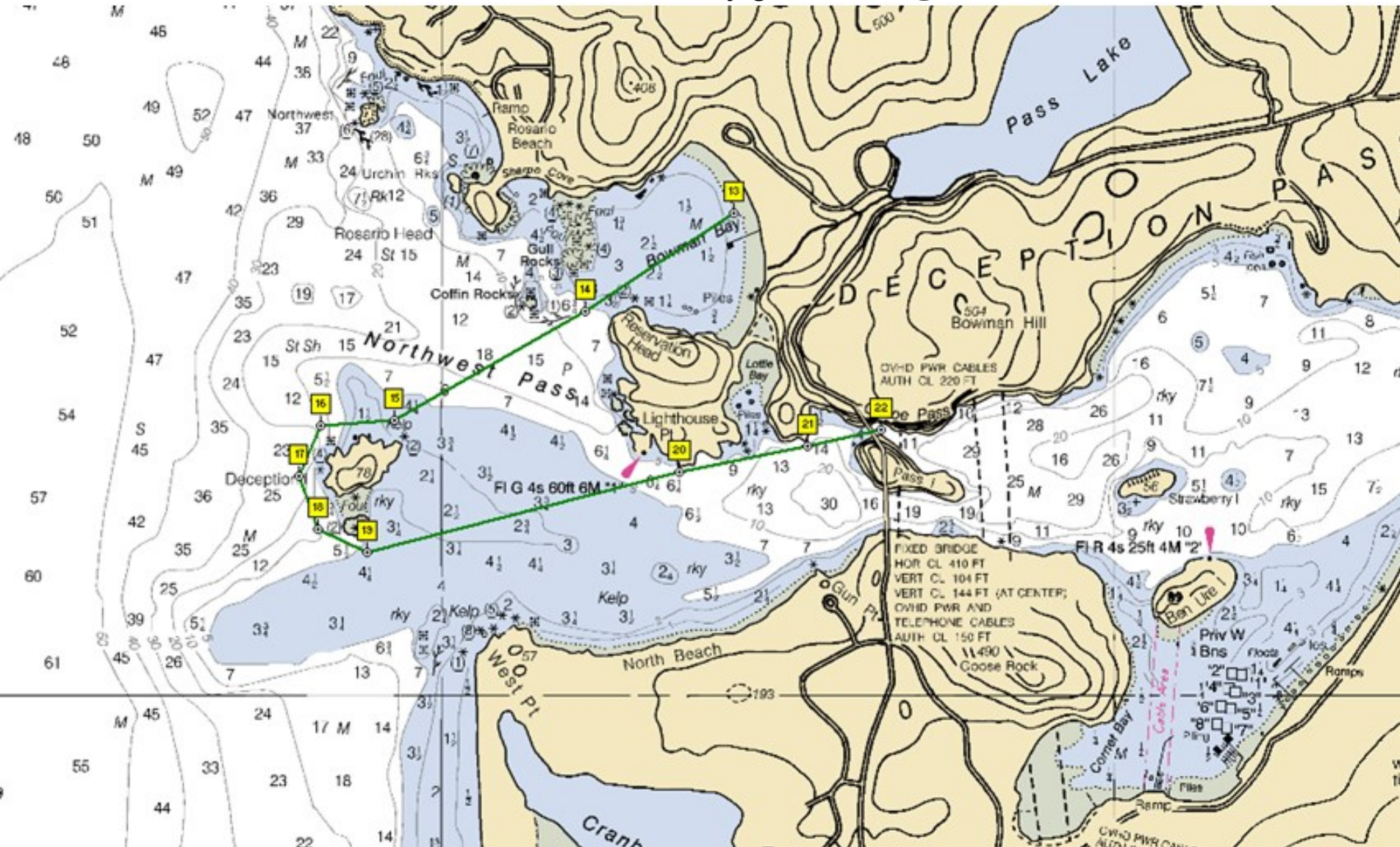


Kayak Navigation for Normal People

Tim Mattson, timothy.g.mattson@intel.com



Deception pass chart provided by Don Beale

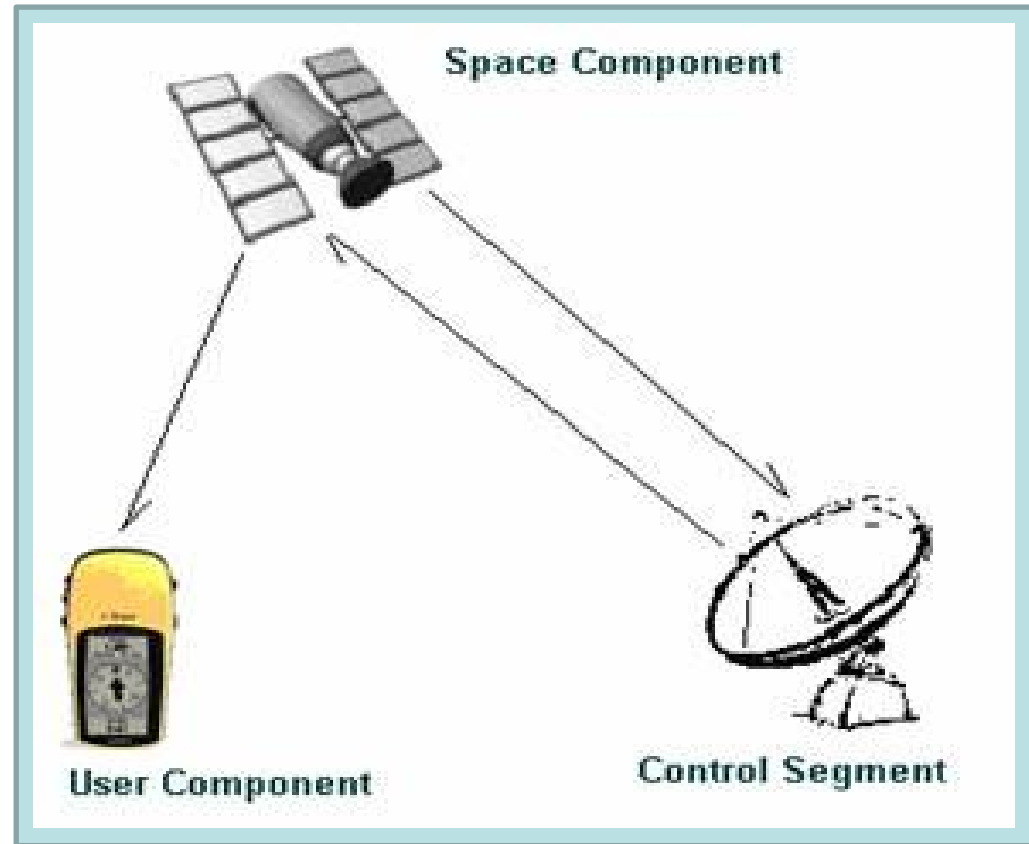
The Essence of Kayak Navigation

- A kayaker at ANY point should be able to answer the following questions
 1. Where are we?
 2. How are we moving (direction and speed)?
 3. When will we get there?
 4. What risks are we taking?

Kayak navigation is the set of skills required to answer those 4 questions.

Why not just use a GPS

- **GPS Advantages:**
 - Easy to use.
 - Accurate ... even with restricted visibility
- **GPS Problems:**
 - Electronics can fail ... a marine environment is hard on electronics
 - Batteries have limited life-spans ... and seem to fail when you need them most.



It fundamentally comes down to Aesthetics ... we paddle to immerse ourselves in nature. So why navigate with your nose in a tiny LCD screen?

A GPS is a great back-up for limited visibility emergencies.
Leave it in your day hatch.

The Practice of Navigation



- Orientation
- Locations and Directions
- Moving consciously across the water
- Dealing with the environment

Orientation in the marine world

- Home based orientation... know the direction towards home at all times.
 - Great for your “home waters”. Not practical for long distance journeys or navigation in unfamiliar waters.

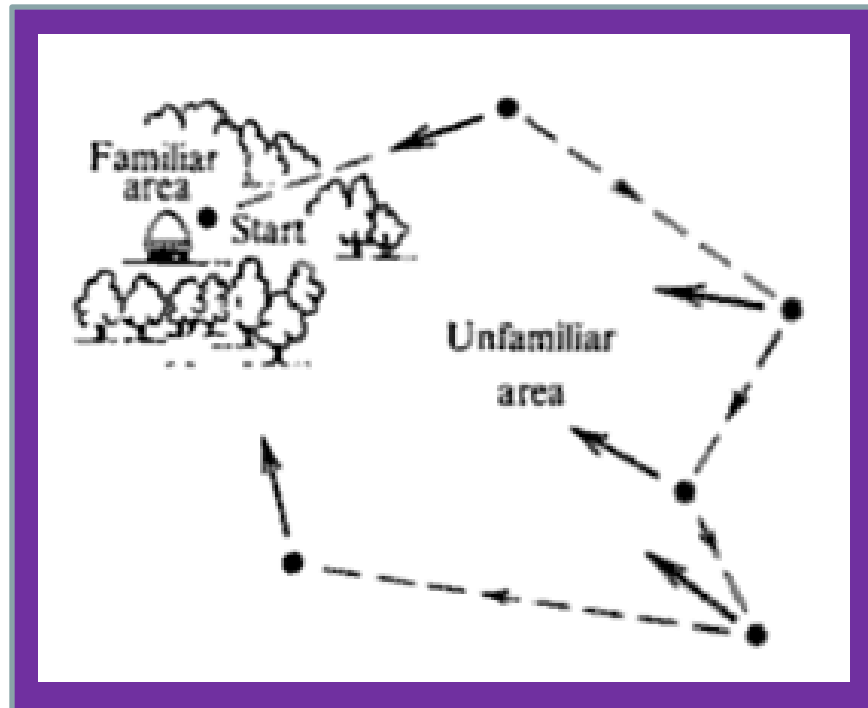
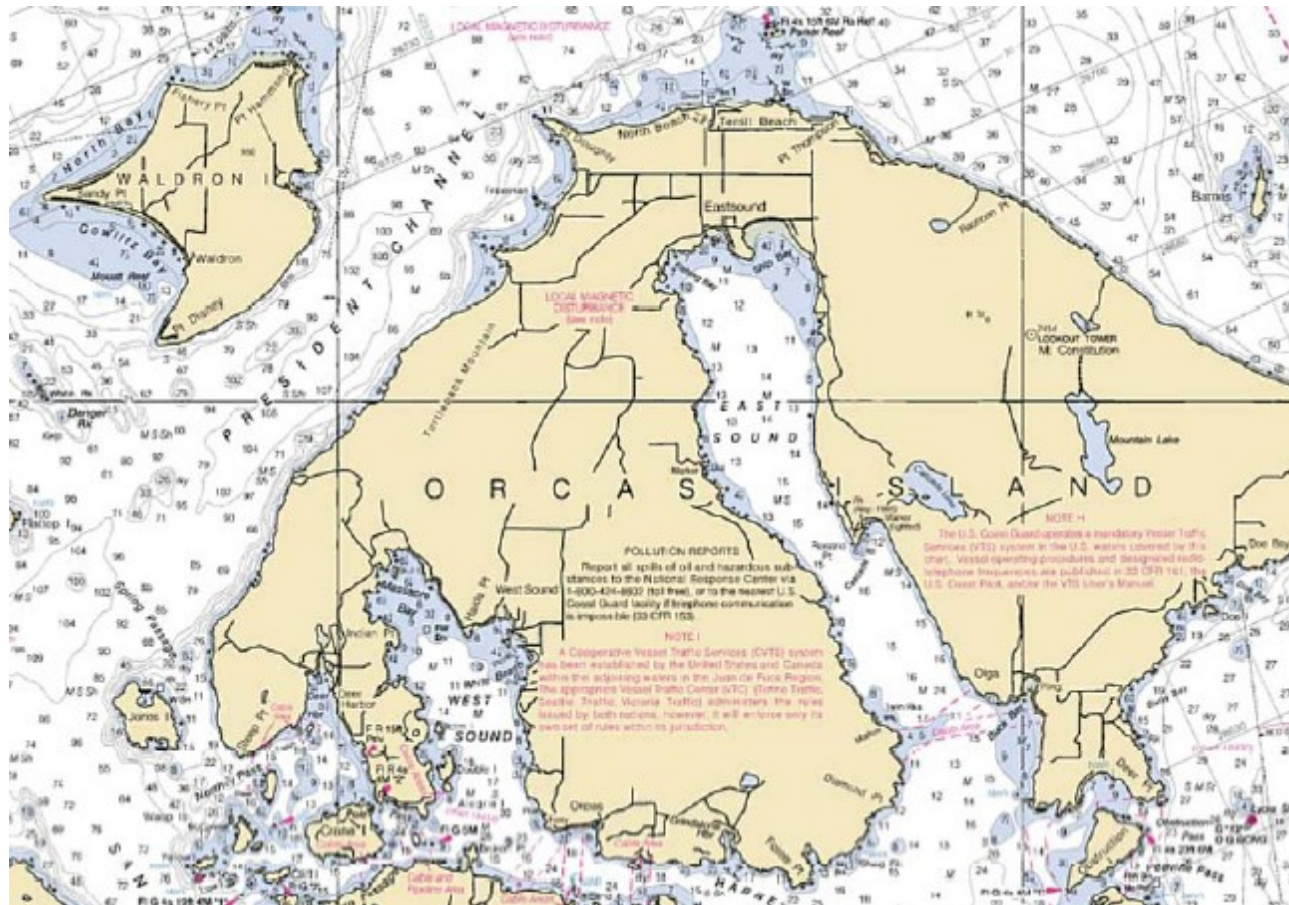


Figure 18 from David Lewis, “We the Navigators”

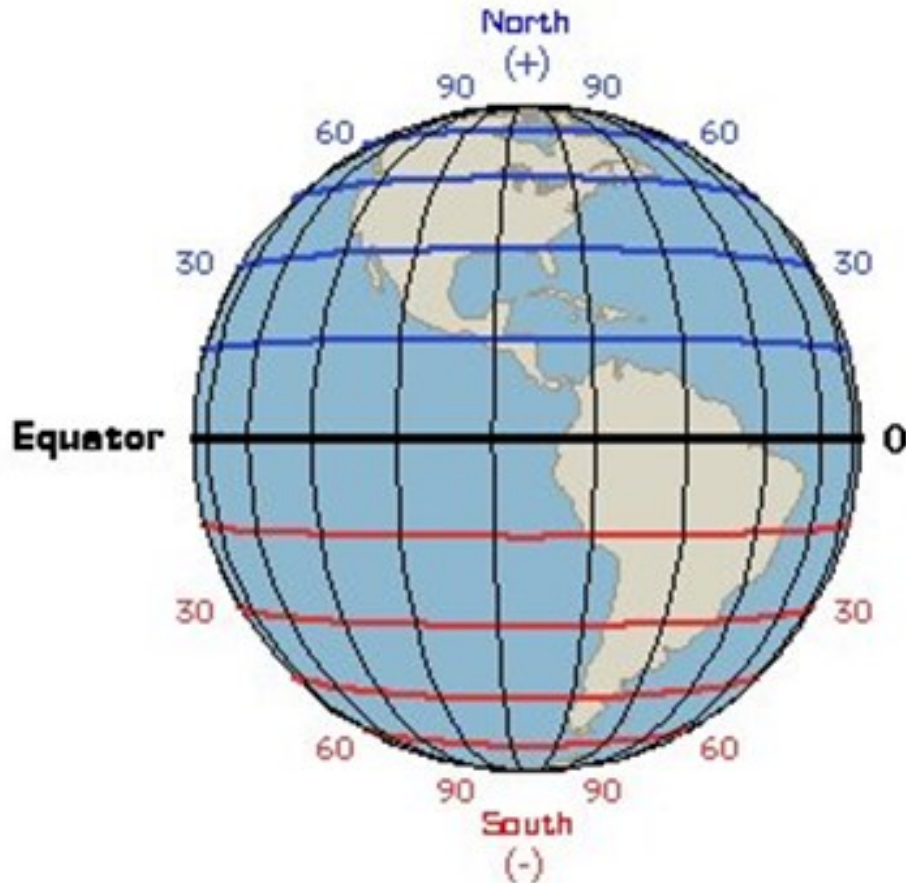
Orientation in the Marine World

- Chart-based orientation ... I know where my “home” is relative to a chart, and I know where I am relative to features on the chart.



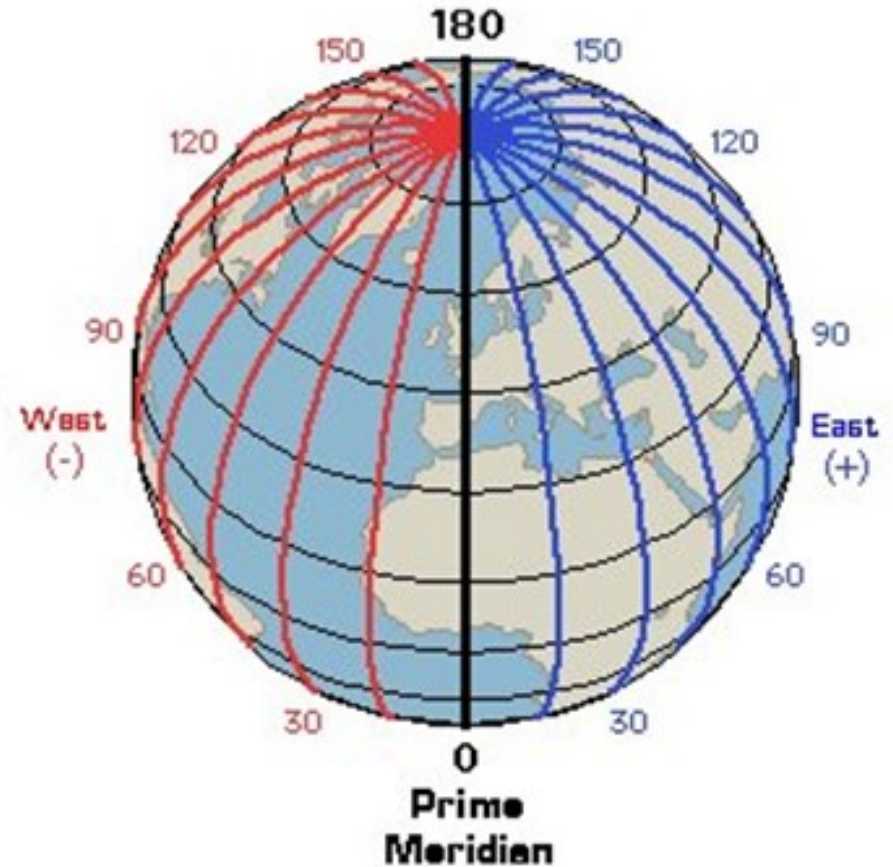
Earth's Coordinate System

Latitude



Equally spaced lines
North to South

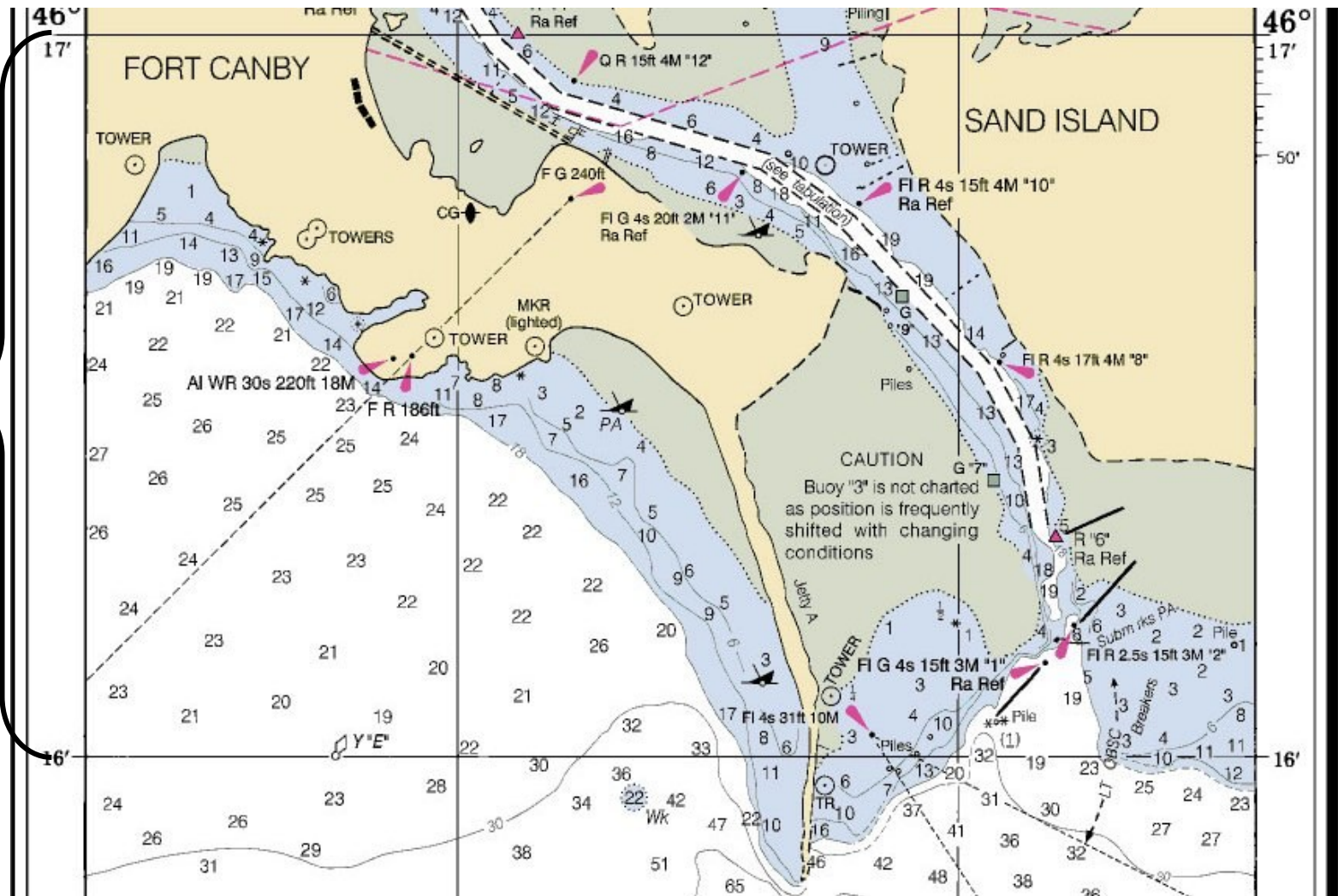
Longitude



Closer together east to west as
you approach the poles

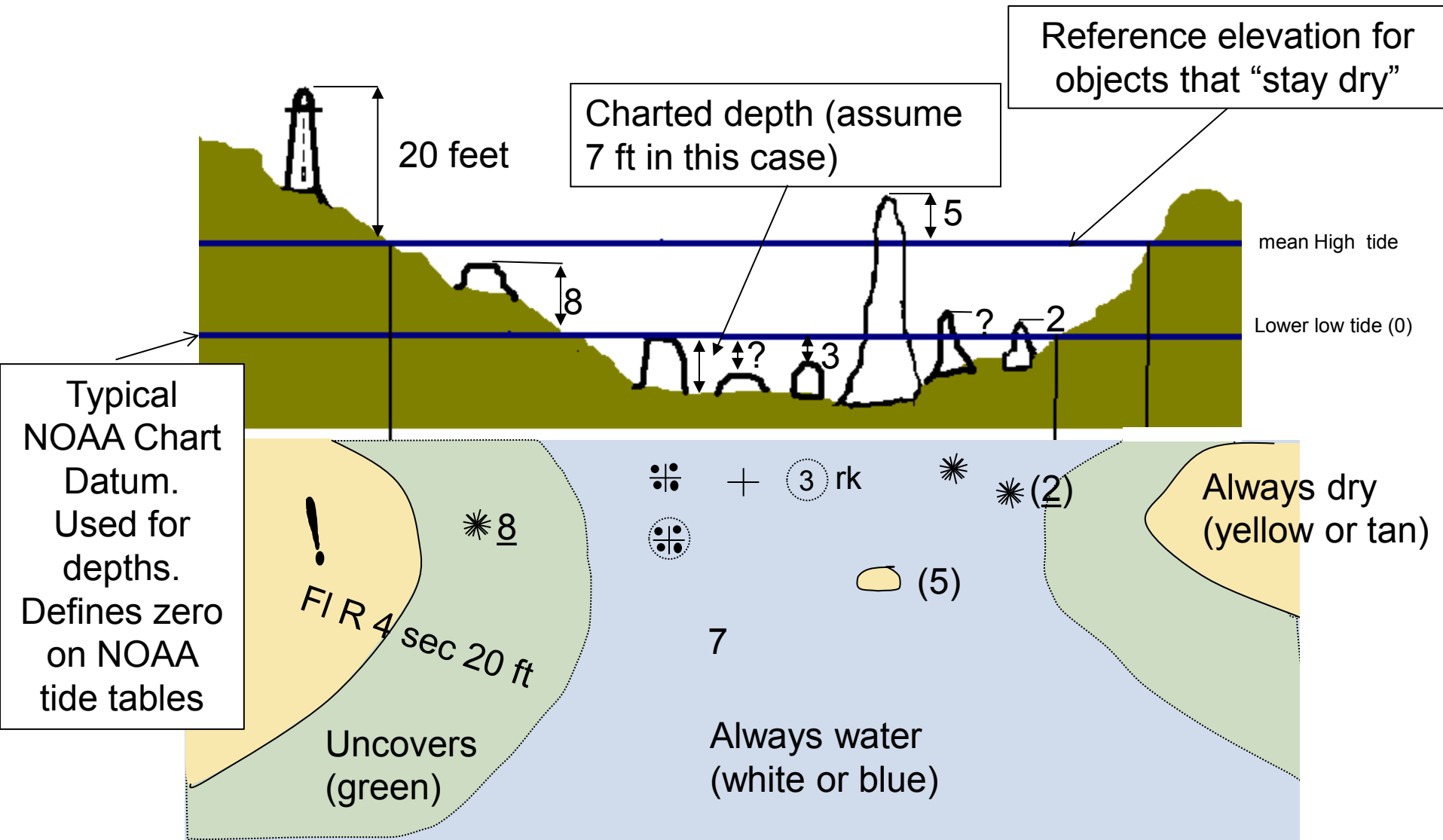
Reading a Nautical Chart

1 minute of latitude = 1 nautical mile

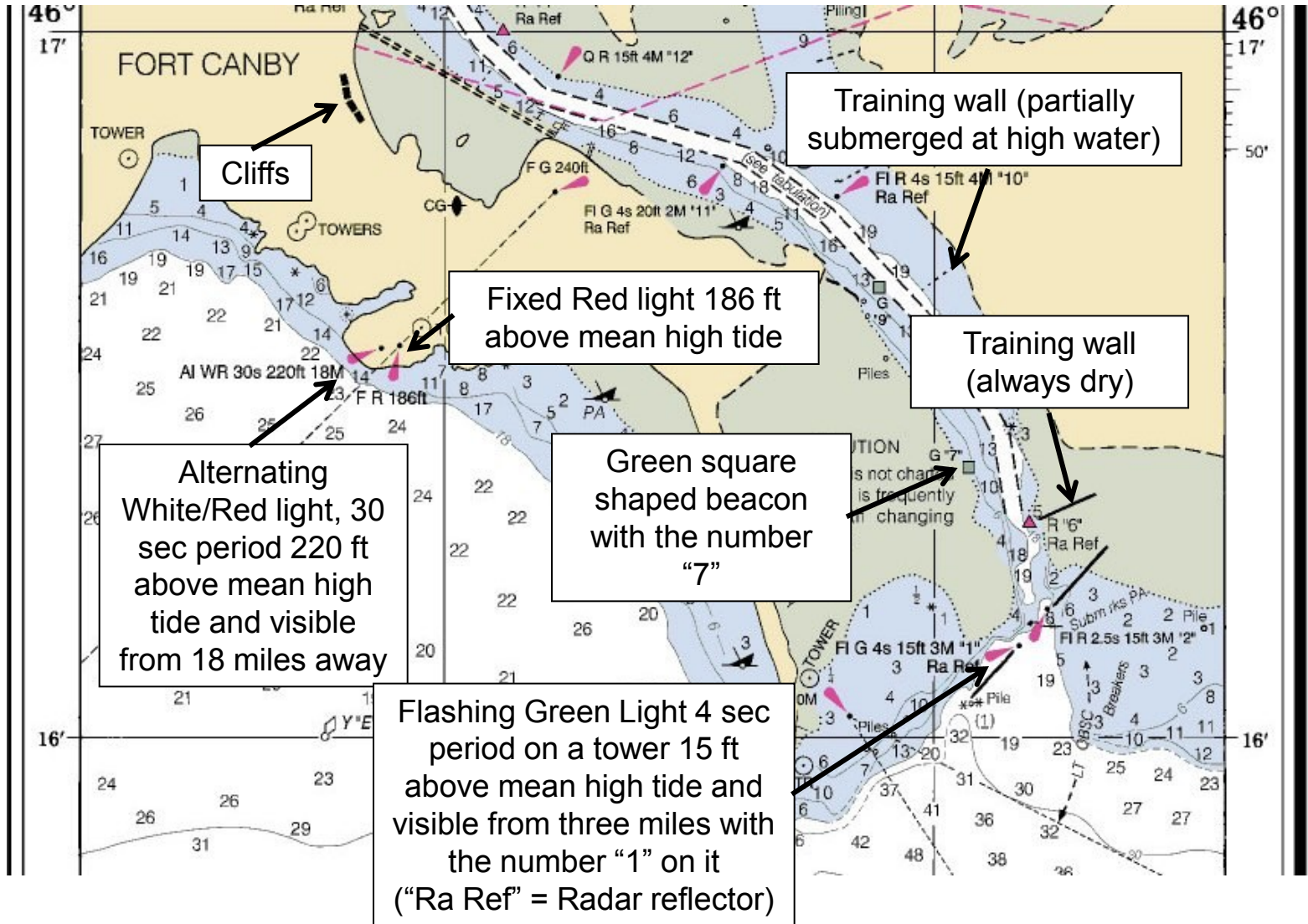


Soundings (depths) from chart datum ... the mean lower low tide (when in doubt, check the chart legend). NOAA tide tables use the same datum.

Charted depths and elevations



Reading a Nautical Chart



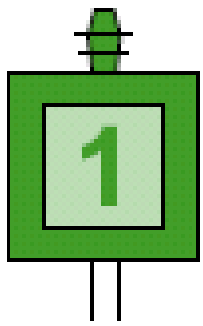
Meaning of symbols from "Chart No. 1"

Aids to navigation: Channel Buoys

Port side: odd numbered aids

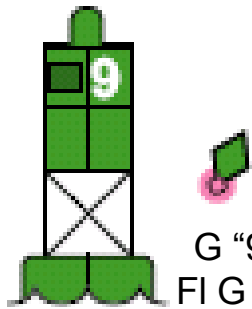
Starboard side: even numbered aids

When heading into port (In North America)
Red Return Right



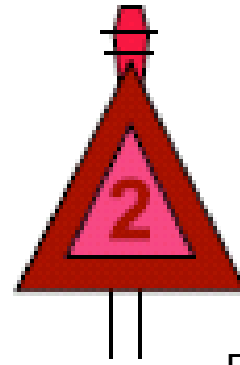
"1"
Fl G 6s

Light



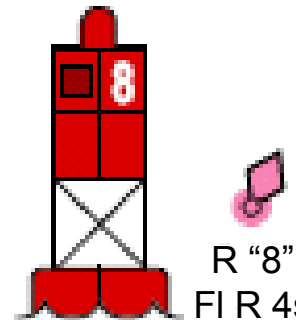
G "9"
Fl G 4s

Lighted Buoy



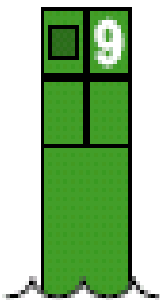
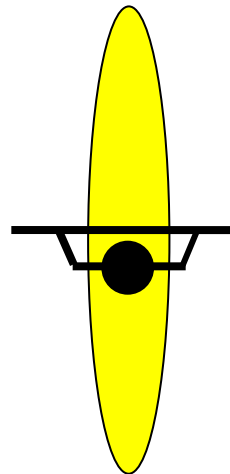
"2"
Fl R 6s

Light



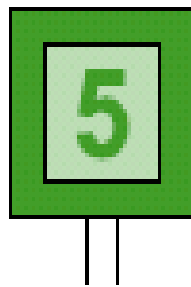
R "8"
Fl R 4s

Lighted Buoy



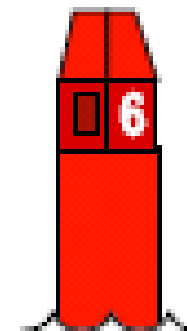
G
C "9"

Can



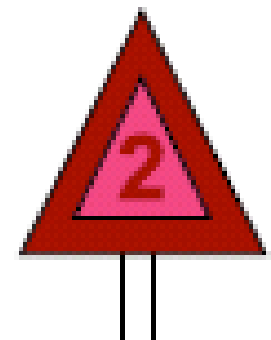
G
"5"

Day Beacon



R
N "5"

Nun



R
"2"

Day Beacon

Aids to Navigation: A mark or object "outside the boat" to support navigation (e.g. buoy).
Navigational Aids: A tool used "inside the boat" to support the navigator (e.g. compass)

Learning about the symbols on a chart

Chart 1 defines the full set of symbols found on a nautical chart

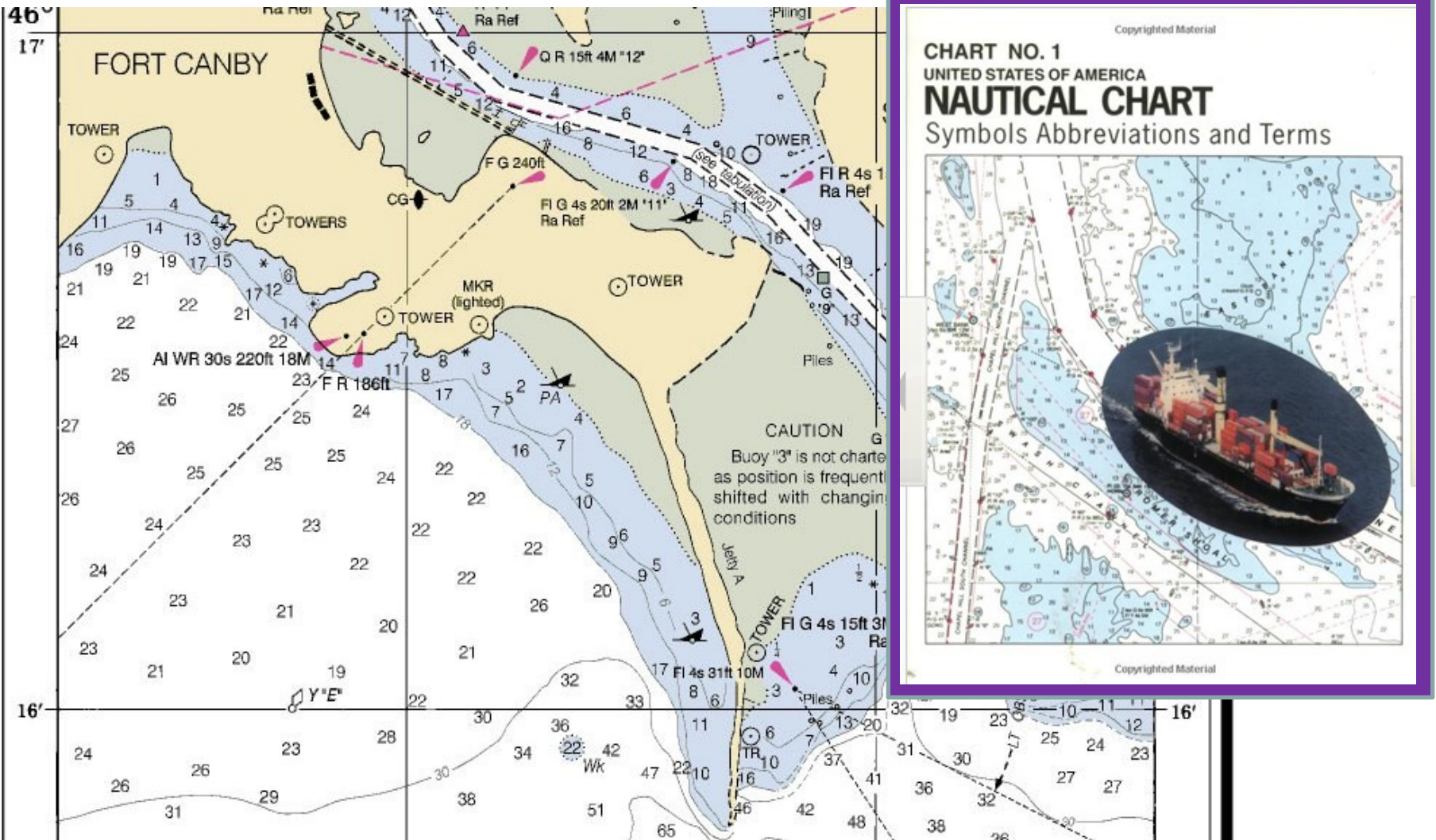
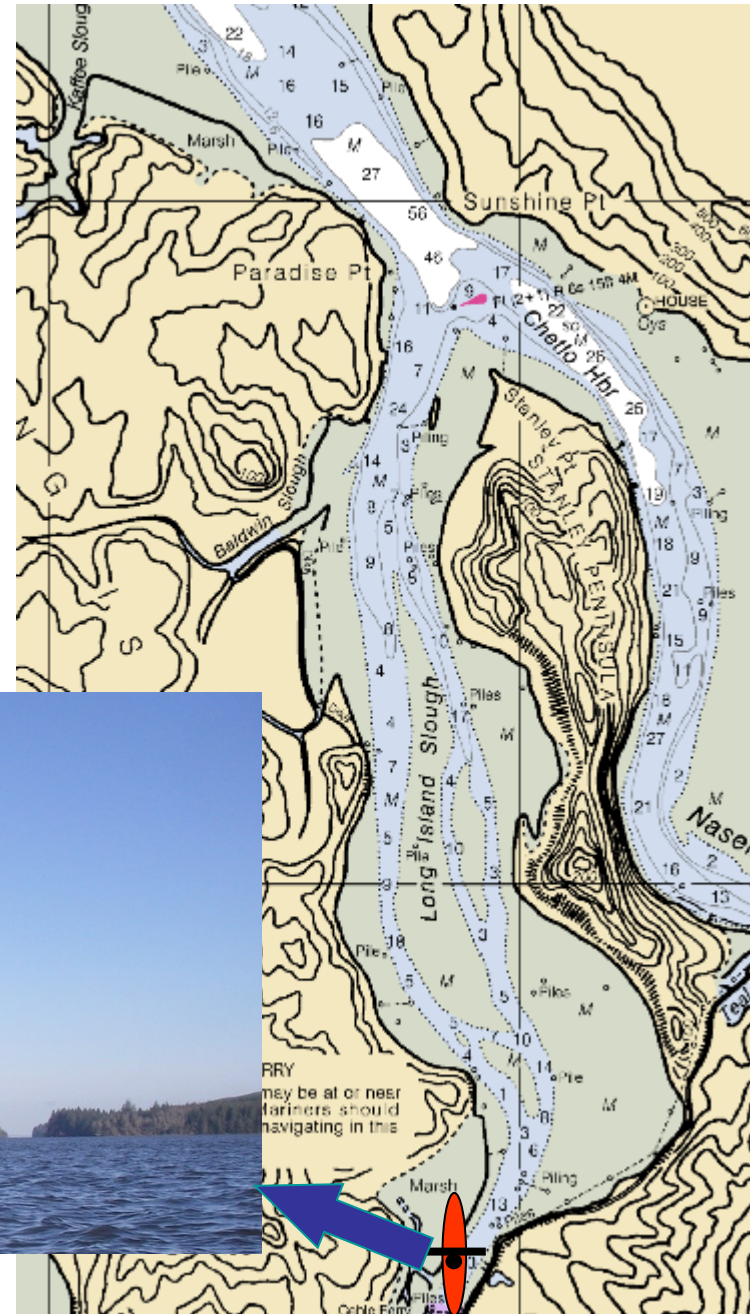


Chart 1 ... It's free www.nauticalcharts.noaa.gov/mcd/chartno1.htm

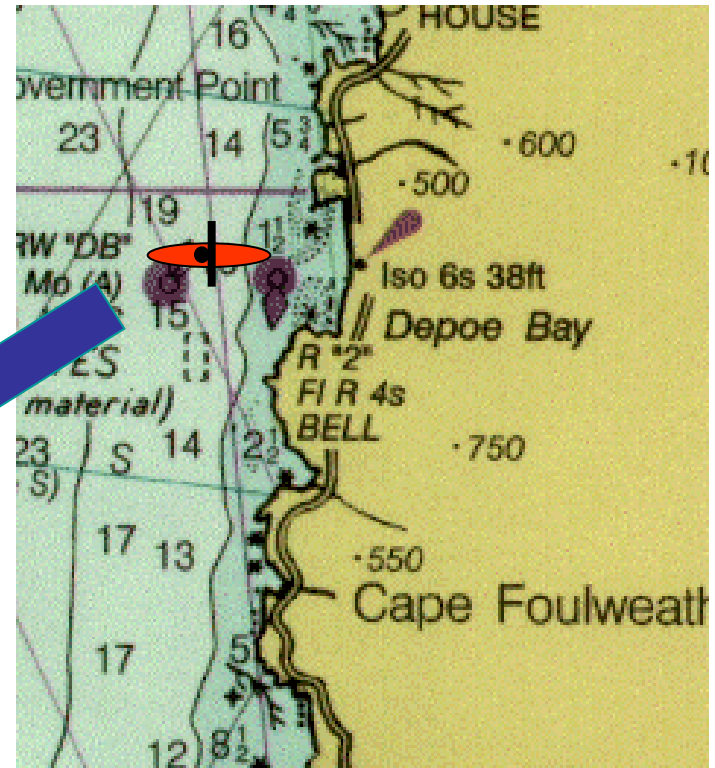
Navigating by chart alone can be tough

- Connecting what you see with what's on the chart can be hard.
- The picture below is what you'd see if you were sitting in the red kayak on the chart.



Navigating by chart alone can be tough

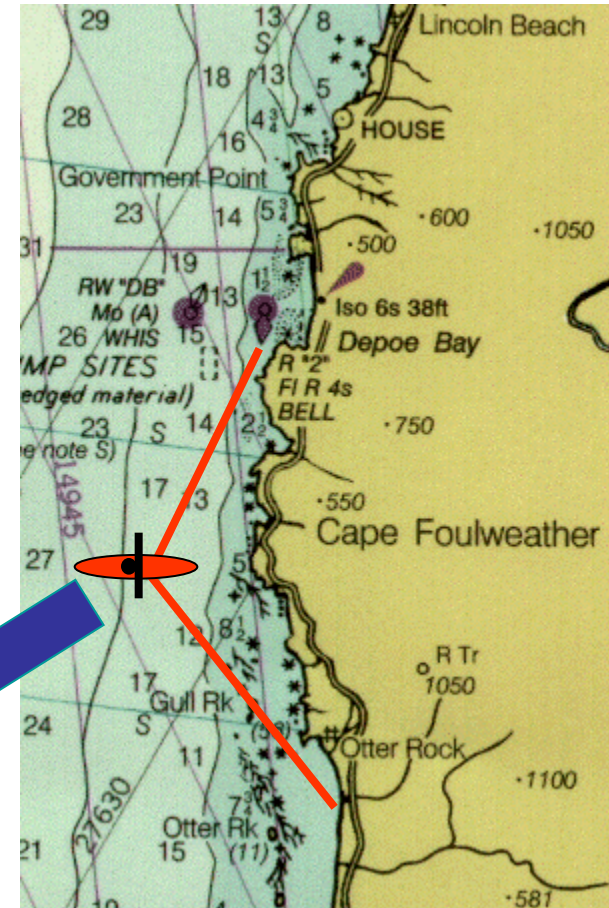
- Connecting what you see with what's on the chart can be hard.



- This picture is what you'd see if you were sitting in the red kayak on the chart

Navigating by chart alone can be tough

- Connecting what you see with what's on the chart can be hard.
- The picture below is what you'd see if you were sitting in the red kayak on the chart.



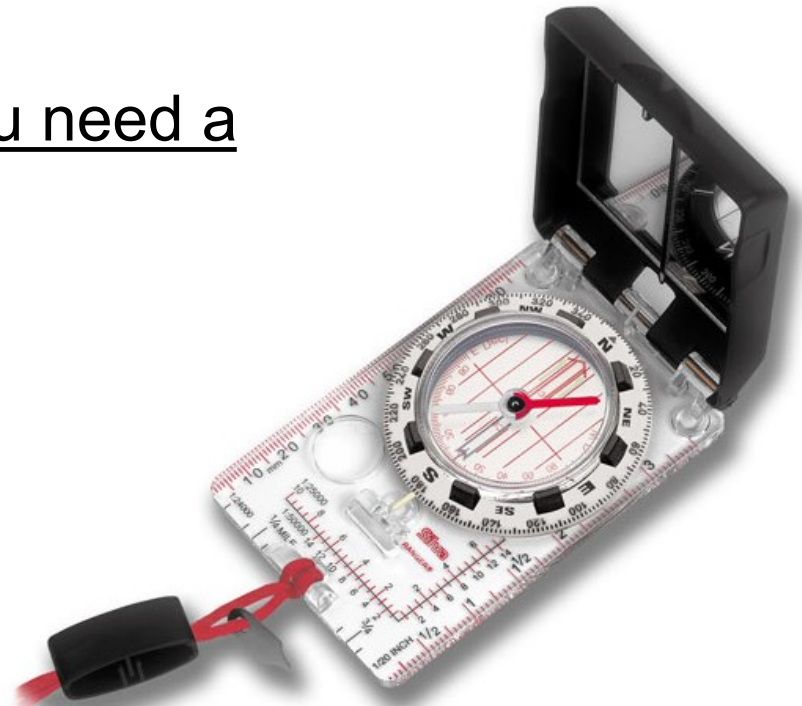
Jen Rahn off Cape Foulweather Oregon, picture by Tim Mattson and Kathleen Mattson

The Practice of Navigation

- Orientation
- • Locations and Directions
- Moving consciously across the water
- Dealing with the environment

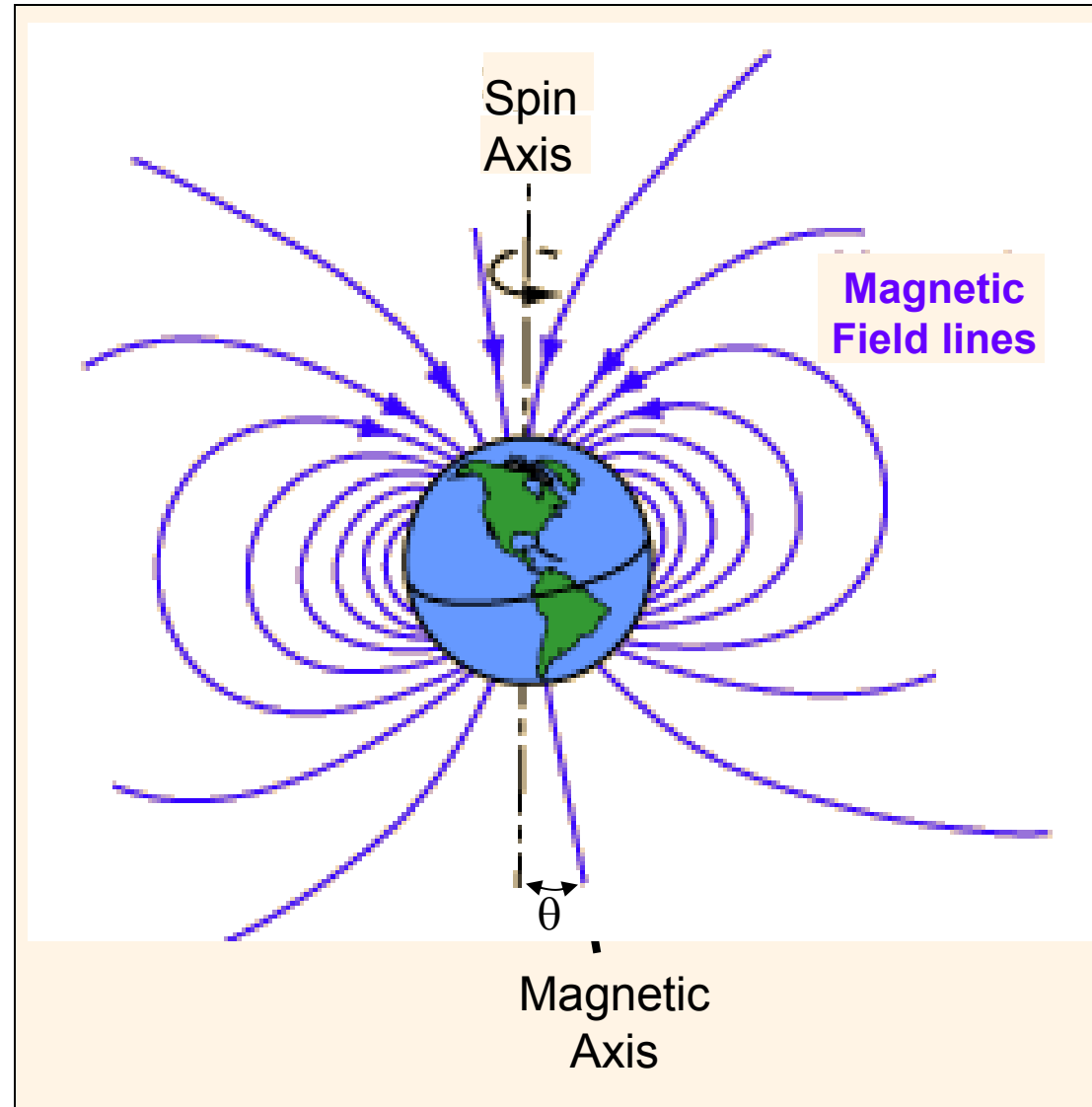
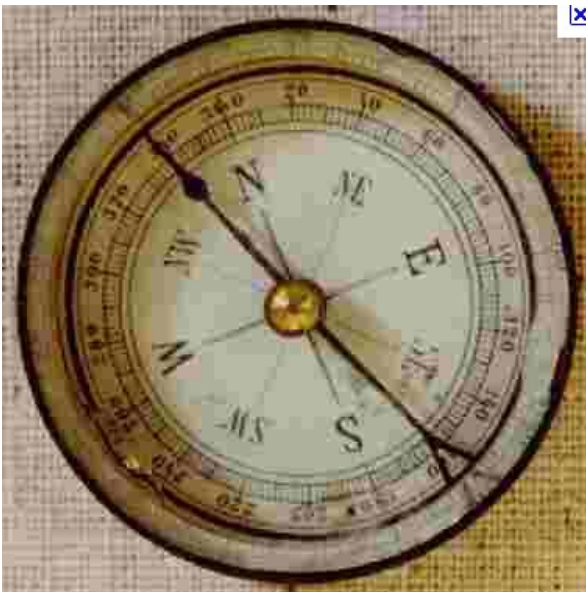
Finding directions and fixing locations

- When a chart is not enough ... you need help fixing your location.
- When visibility is restricted or a crossing is too far to eyeball navigable features ... you need help fixing your direction.
- When the going gets touch, you need a compass

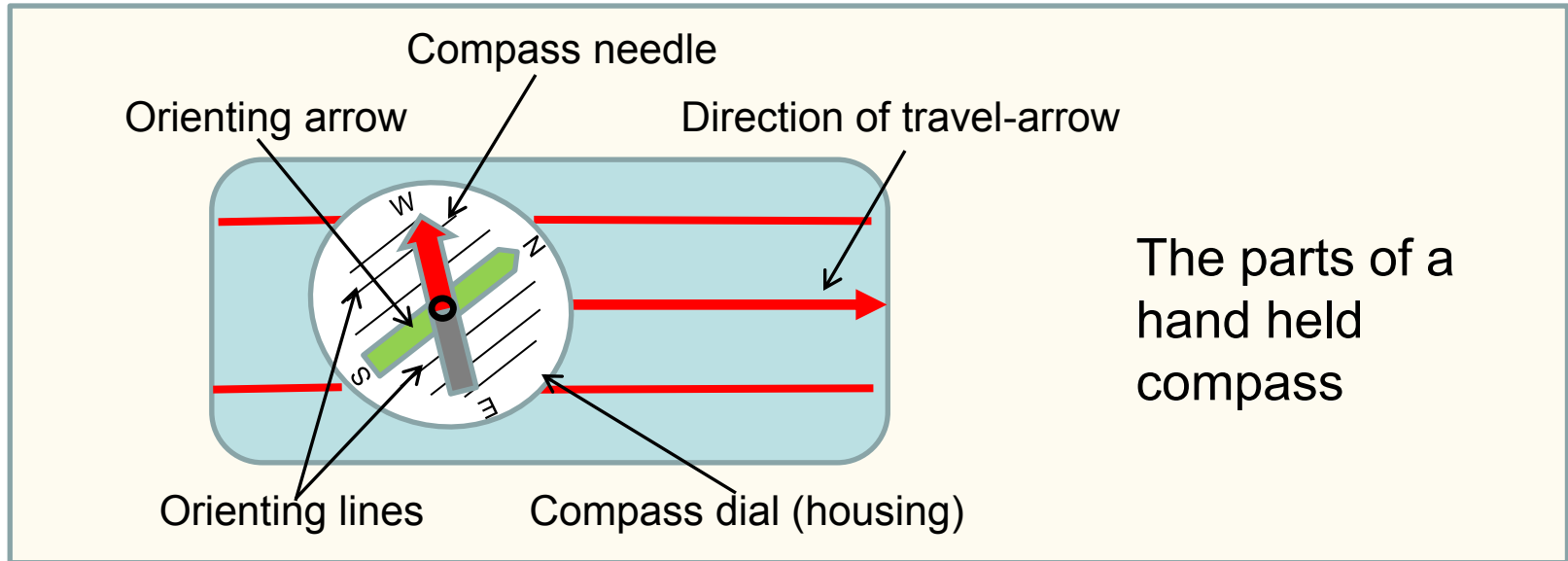


Earth's magnetic field and the compass

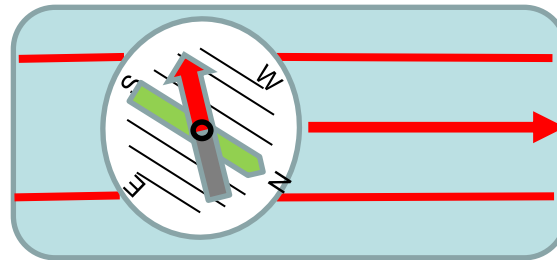
- **Compass:**
 - a magnet that aligns with the earth's magnetic field ... points to “magnetic north”.



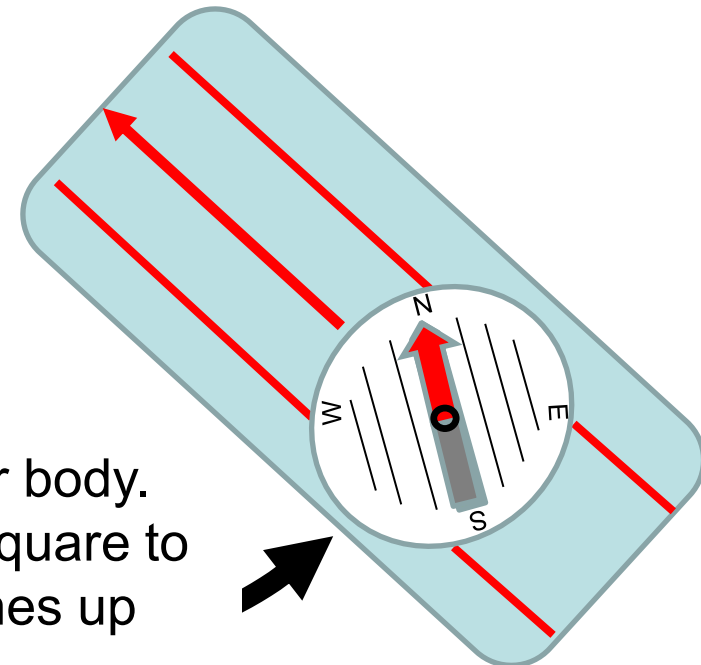
Compass basics: parts and usage



If you want to face Northwest, (1) rotate the compass dial to point Northwest

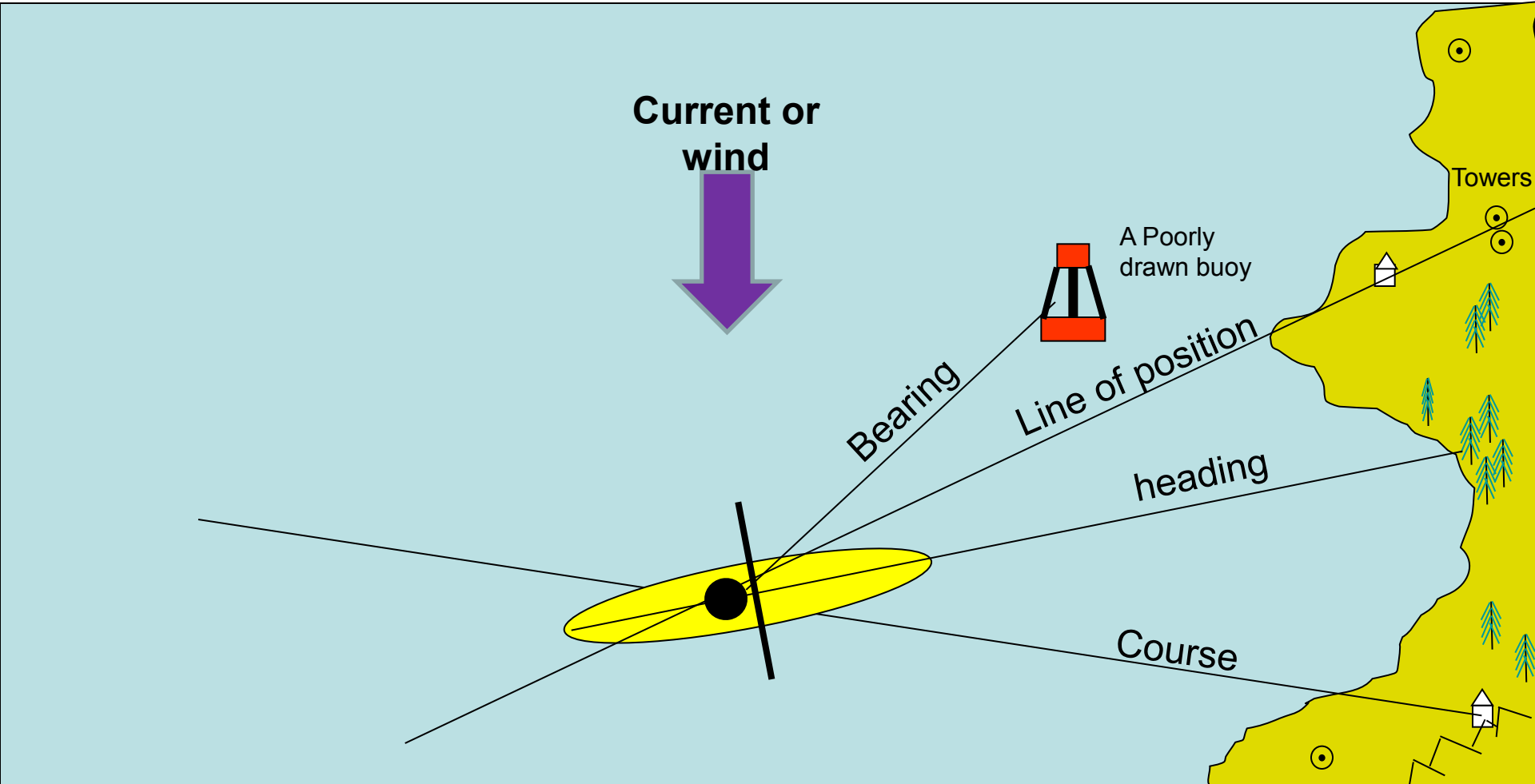


... (2) hold the compass flat and square to your body.
(3) rotate yourself (keeping compass flat and square to your body) until North on the orienting arrow lines up with the red compass needle.



Compass jargon

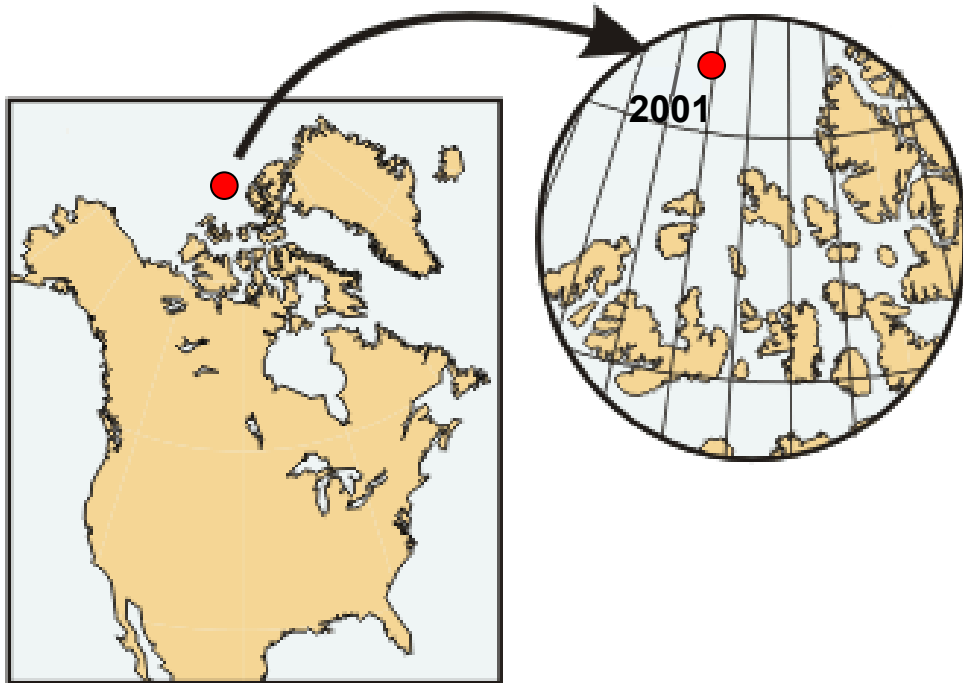
- Basic terms: bearing, heading, course, and line of position



- Deviation: the difference between an accurate and the observed magnetic bearing due to man made compass interference. For example, a large metal object packed beneath a deck compass will cause a deviation.

Magnetic North Pole

Location of the North Pole



Magnetic North is different than true north pole.

The Angular difference between true and magnetic poles (θ) is called "variation" on sea or "declination" on land.

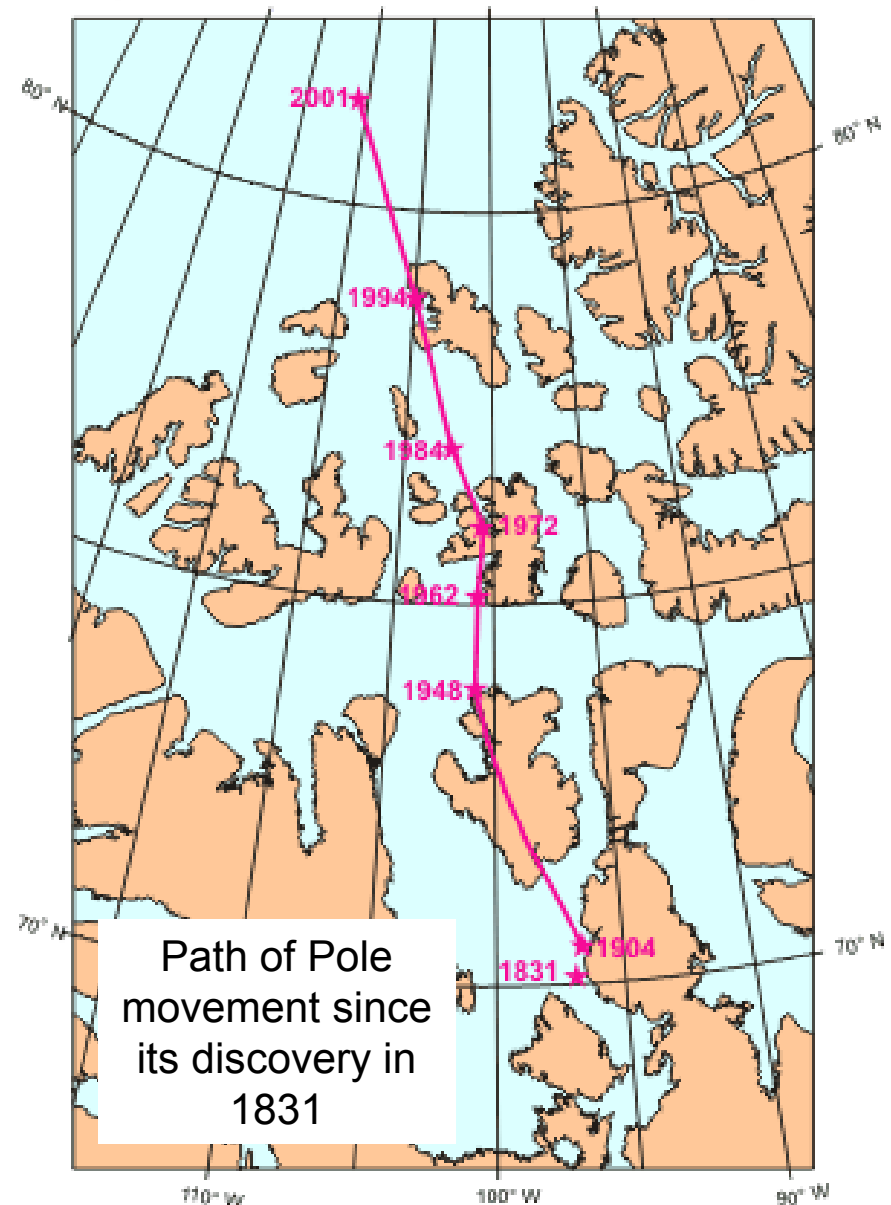
Note that the north pole is actually a south pole since the field lines go "into the earth" at this point ... but its traditionally been called the north pole and the name has stuck.



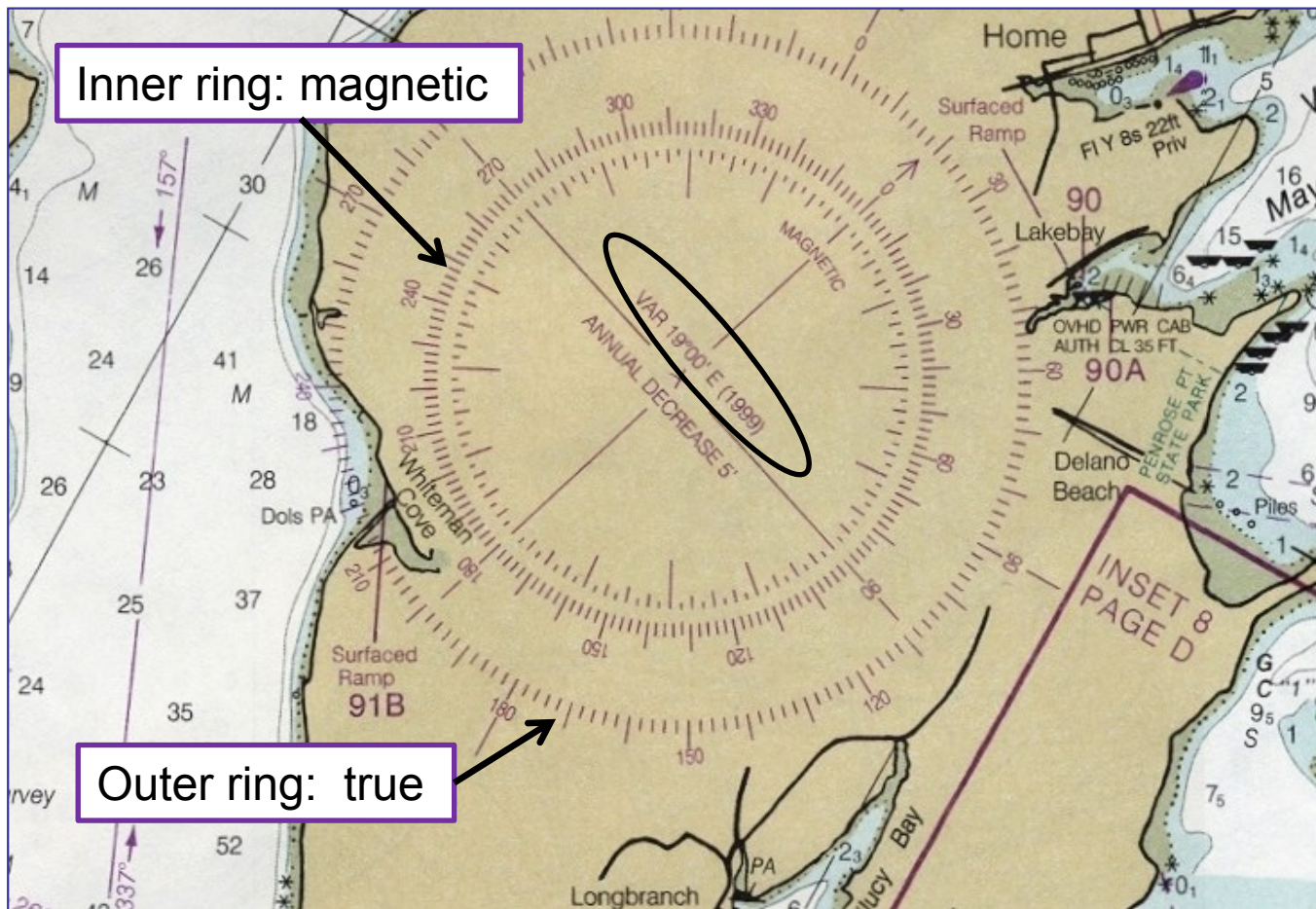
North Pole Movement (secular variation)

- The North Pole is drifting at about 25 miles per year ... the rate of drift seems to be increasing.
- It could be in Siberia in 50 years!

<i>Year</i>	<i>Latitude (°N)</i>	<i>Longitude (°W)</i>
2001	81.3	110.8
2002	81.6	111.6
2003	82.0	112.4
2004	82.3	113.4
2005	82.7	114.4



Connecting the compass to a nautical chart: The compass rose

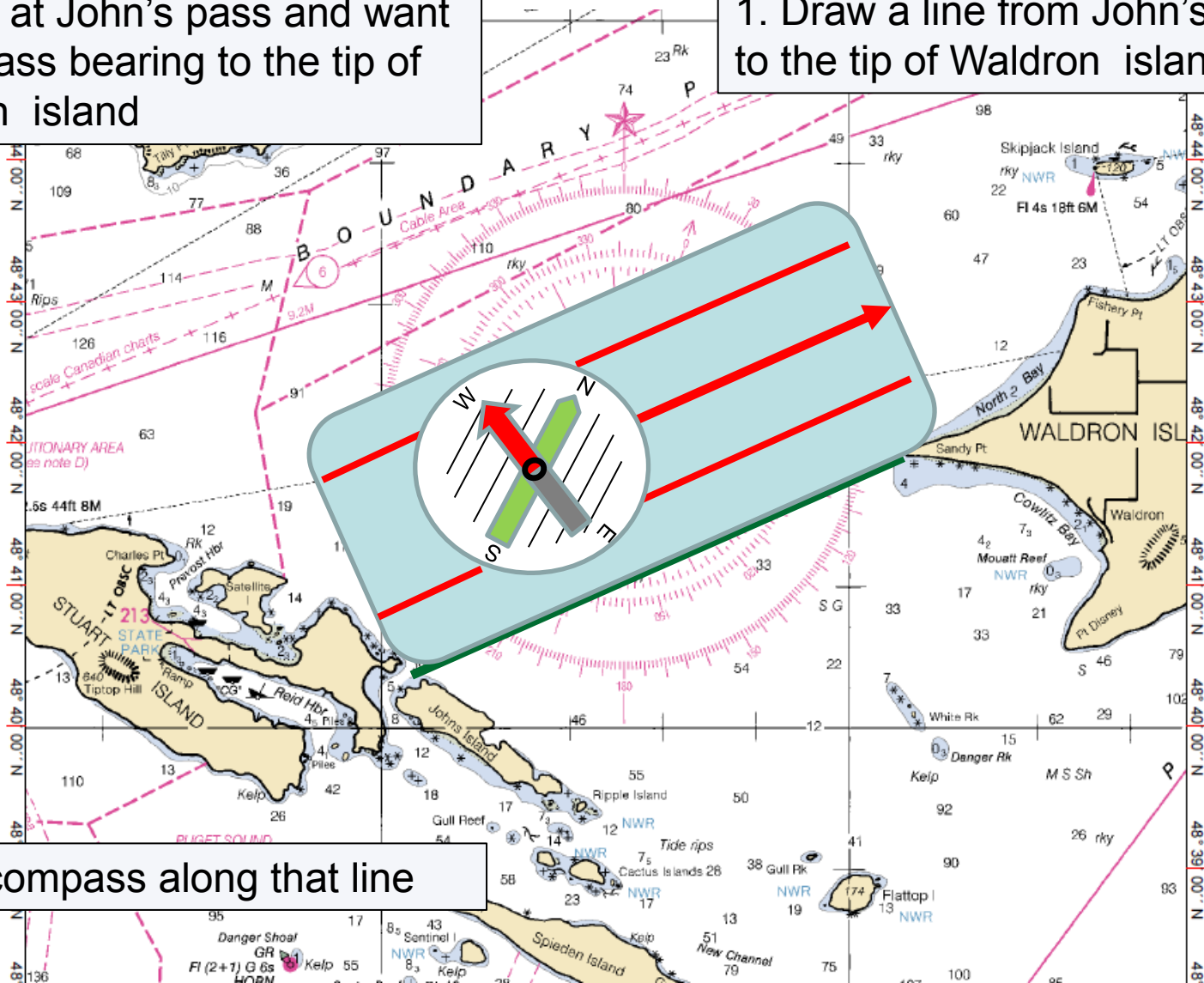


- You read magnetic bearings from your compass
- You read true bearings from the longitude lines on the chart.
- The compass rose reports the difference between true and magnetic north ... this is called the “variation”.

Using Bearings from a chart

You are at John's pass and want a compass bearing to the tip of Waldron island

1. Draw a line from John's pass to the tip of Waldron island

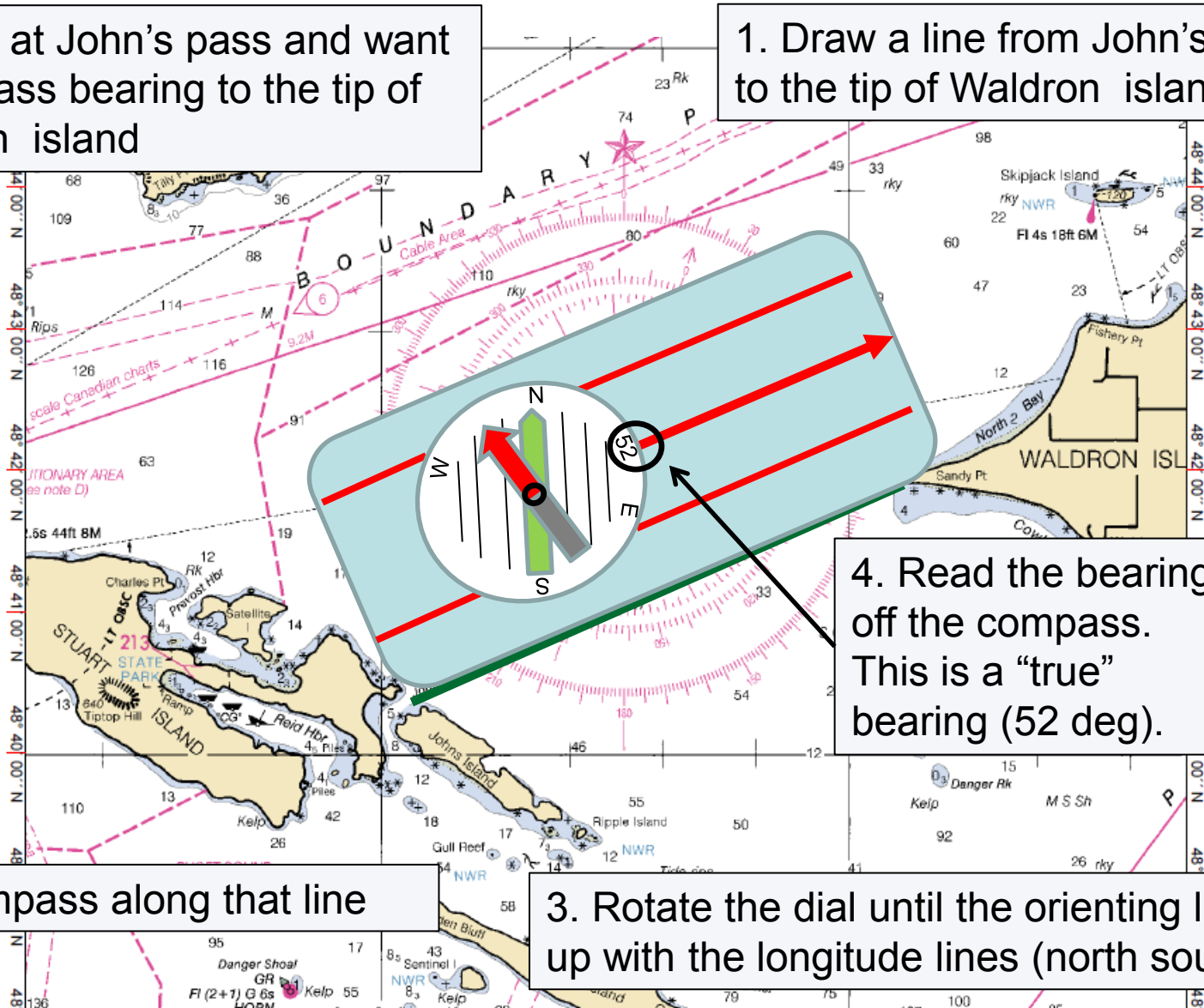


2. Put compass along that line

Using Bearings from a chart

You are at John's pass and want a compass bearing to the tip of Waldron island

1. Draw a line from John's pass to the tip of Waldron island



2. Put compass along that line

3. Rotate the dial until the orienting lines line up with the longitude lines (north south lines)

4. Read the bearing off the compass. This is a "true" bearing (52 deg).

Using Bearings from a chart

You are at John's pass and want a compass bearing to the tip of Waldron island

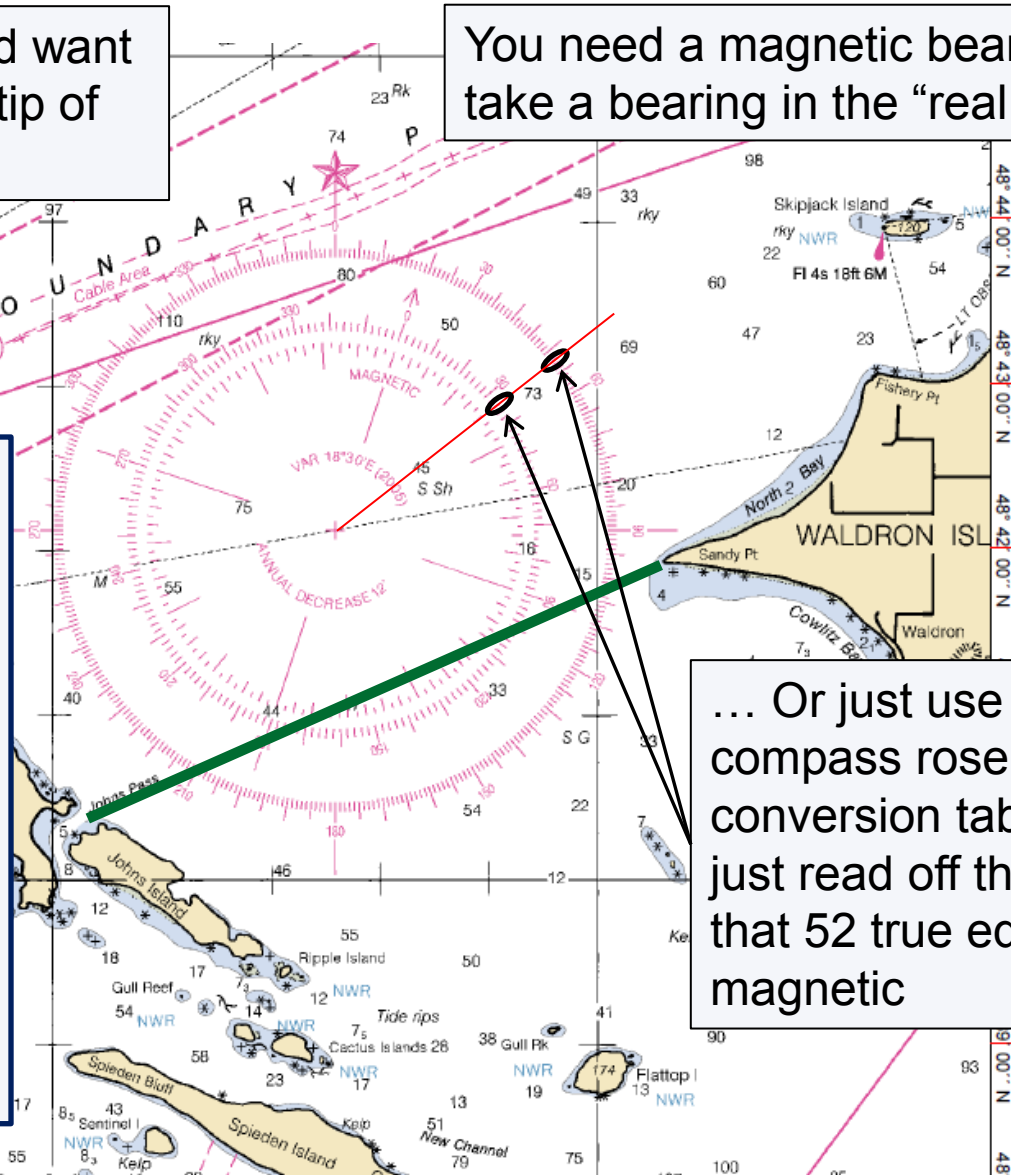
You need a magnetic bearing to take a bearing in the "real world".

Memorize the formula to modify true bearing with the variation to produce the magnetic bearing.

In the west U.S.

- Put compass onto chart, (mag. to true) add variation.
- Take compass off the chart (true to mag.), subtract variation

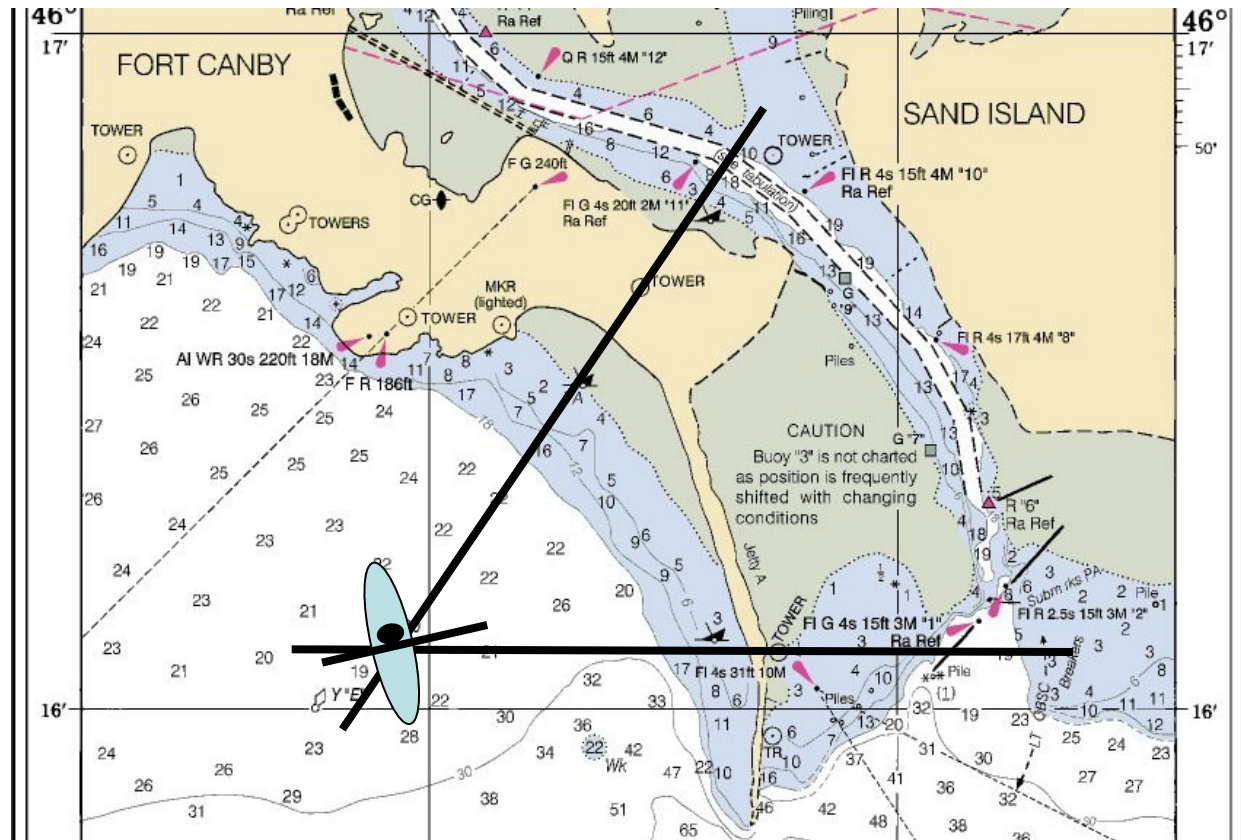
$$52 \text{ deg} - 18 \text{ deg} = 35 \text{ deg.}$$



... Or just use the compass rose as a conversion table ... just read off the rose that 52 true equals 34 magnetic

Triangulation to fix your position.

- Take your bearing to two known points on a chart. Draw the lines to fix your location.



The Practice of Navigation

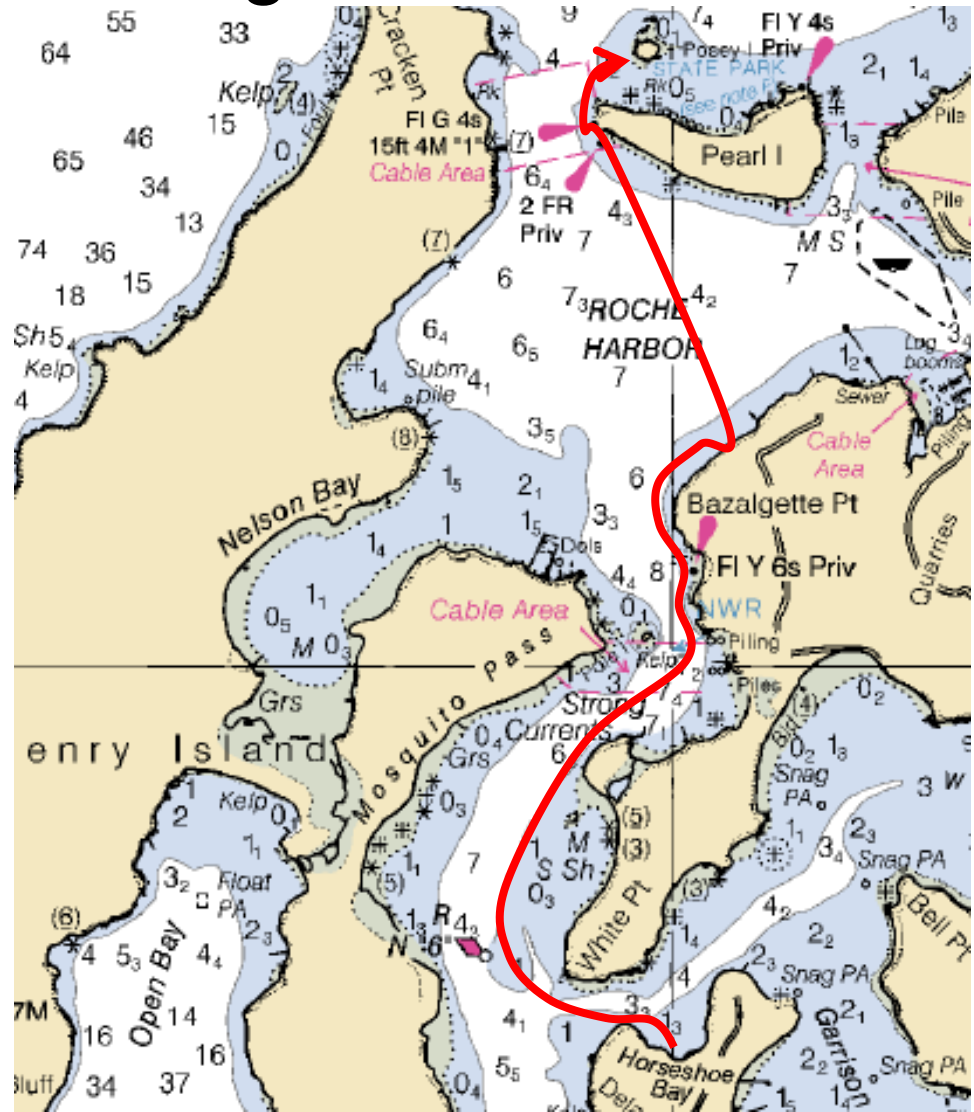
- Orientation
- Locations and Directions
- • Moving consciously across the water
- Dealing with the environment

Moving consciously across the water

- As you move across the water, you need to know where you are from one moment to the next.
- You need to move across the water in a well defined and controlled way.
- You need to know how you are moving at any moment.
- Two key methods:
 - Piloting ... using landmarks and other features
 - Dead reckoning ... deducing motion based on time and velocity

Piloting

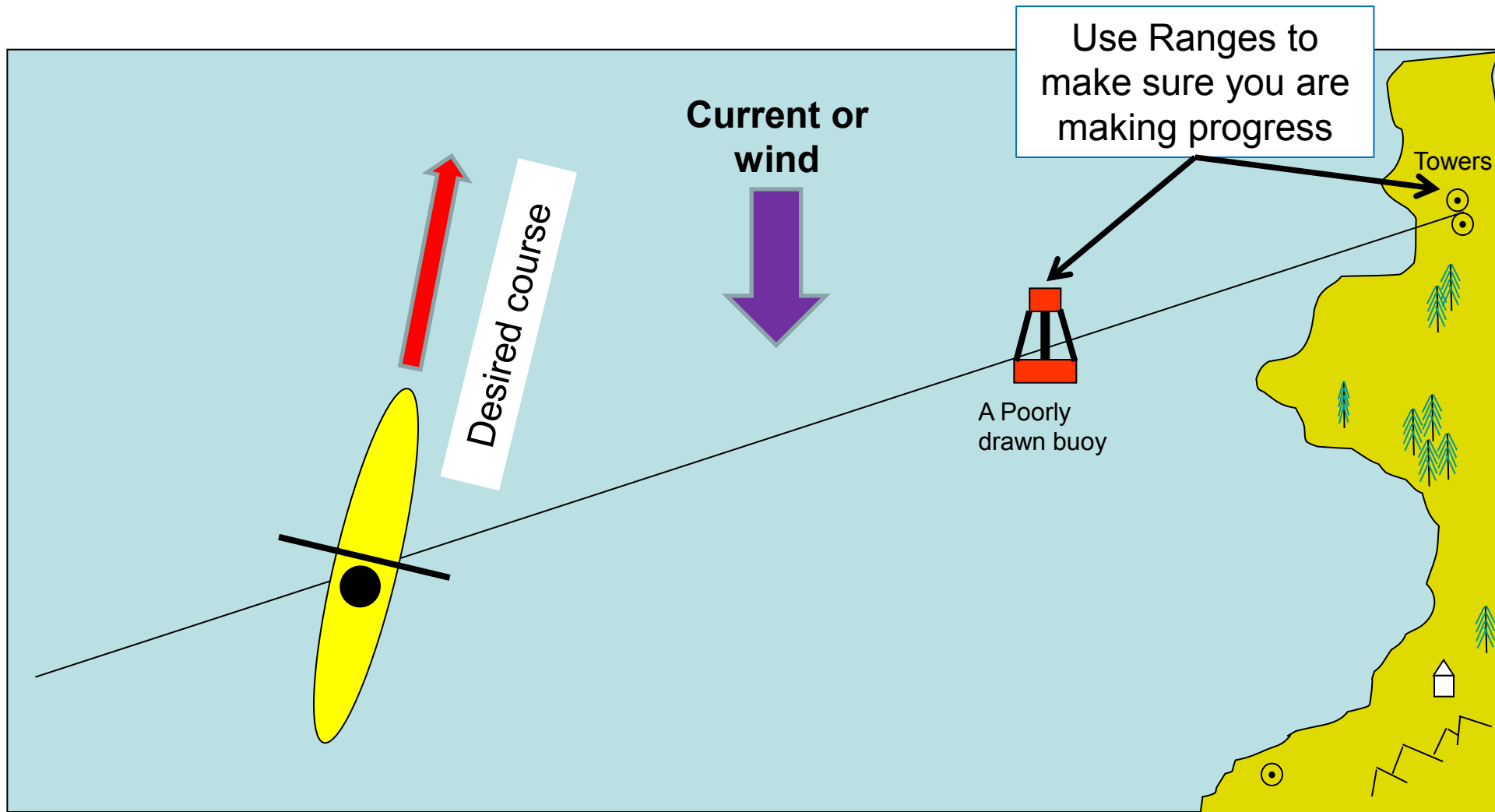
- Piloting ... navigating by traveling from one known feature to the next
- Combine a set of features to define a route to your destination
- The key to piloting is to always keep track of where you are with respect to features on your chart.
 - Use triangulation from time to time to verify your position.
 - Use ranges underway to gauge progress relative to known features.



Piloting is straight forward if you pay attention and continuously gauge your location relative to key landmarks.

Ranges and detecting motion off-shore

- **Ranges:** a pair of objects lined up to define a line of position.
- Pick two well separated objects. The motion of the rear object shows your motion.



Dead Reckoning

- Dead Reckoning ... deducing your position over time based on your velocity and the elapsed time:
 - Requires accurate idea of your paddling speed and environmental forces that impact your speed (current, wind, etc.).
- When do we use Dead Reckoning:
 - when there are no landmarks or
 - when there is reduced visibility.
 - to keep track of progress between chart features when piloting.

Dead Reckoning Example

- Paddling at a three knot pace against 1 knot of current for 30 minutes. How far have you traveled?

$$(3 \text{ nm/hr} - 1 \text{ nm/hr}) * (1/2 \text{ hr}) = 1 \text{ nm}$$

To use Dead Reckoning correctly, you must develop a feel for your paddling speed and pay close attention to the currents around you.

The Practice of Navigation

- Orientation
- Locations and Directions
- Moving consciously across the water
- • Dealing with the environment
 - Current
 - Weather
 - Tides

Current and wind

- Current (and wind) can push you off course.



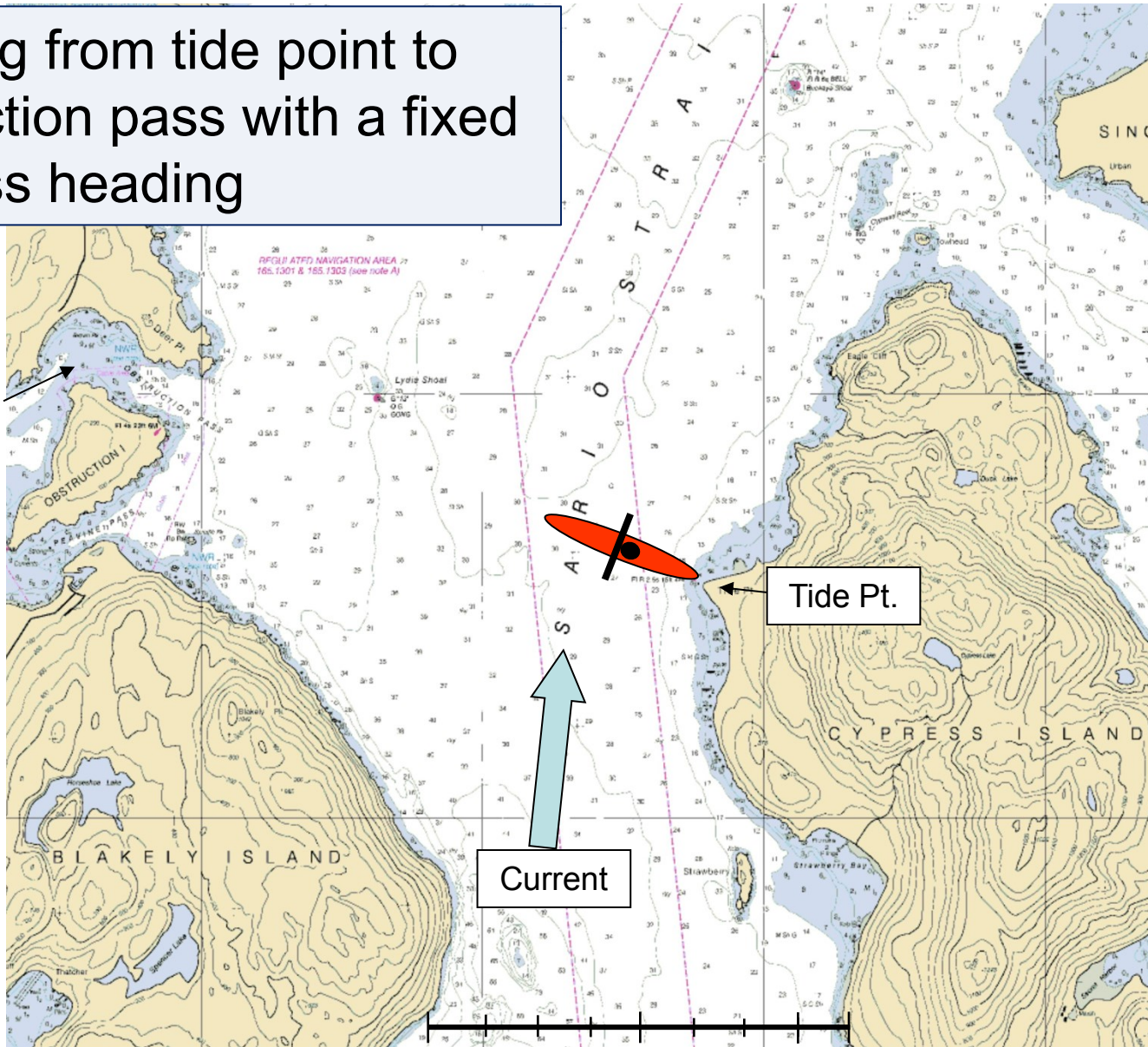
- You must learn how to plan around current
 - Paddling with current can be fun.
 - Paddling against the current can be difficult, stupid or even dangerous.
 - Current squeezing through obstructions and over submerged shelves forms rough water ... called a “tide race”.

Warren Williamson at deception pass in 50+ knots of wind and 6 knots of current. Photo by Pam Powell taken from the deception pass bridge. Source: Sterling's kayaks web page.

Crossing in Current (Rosario Strait)

Crossing from tide point to
Obstruction pass with a fixed
compass heading

Obstruction
Pass



Tide Pt.

Current

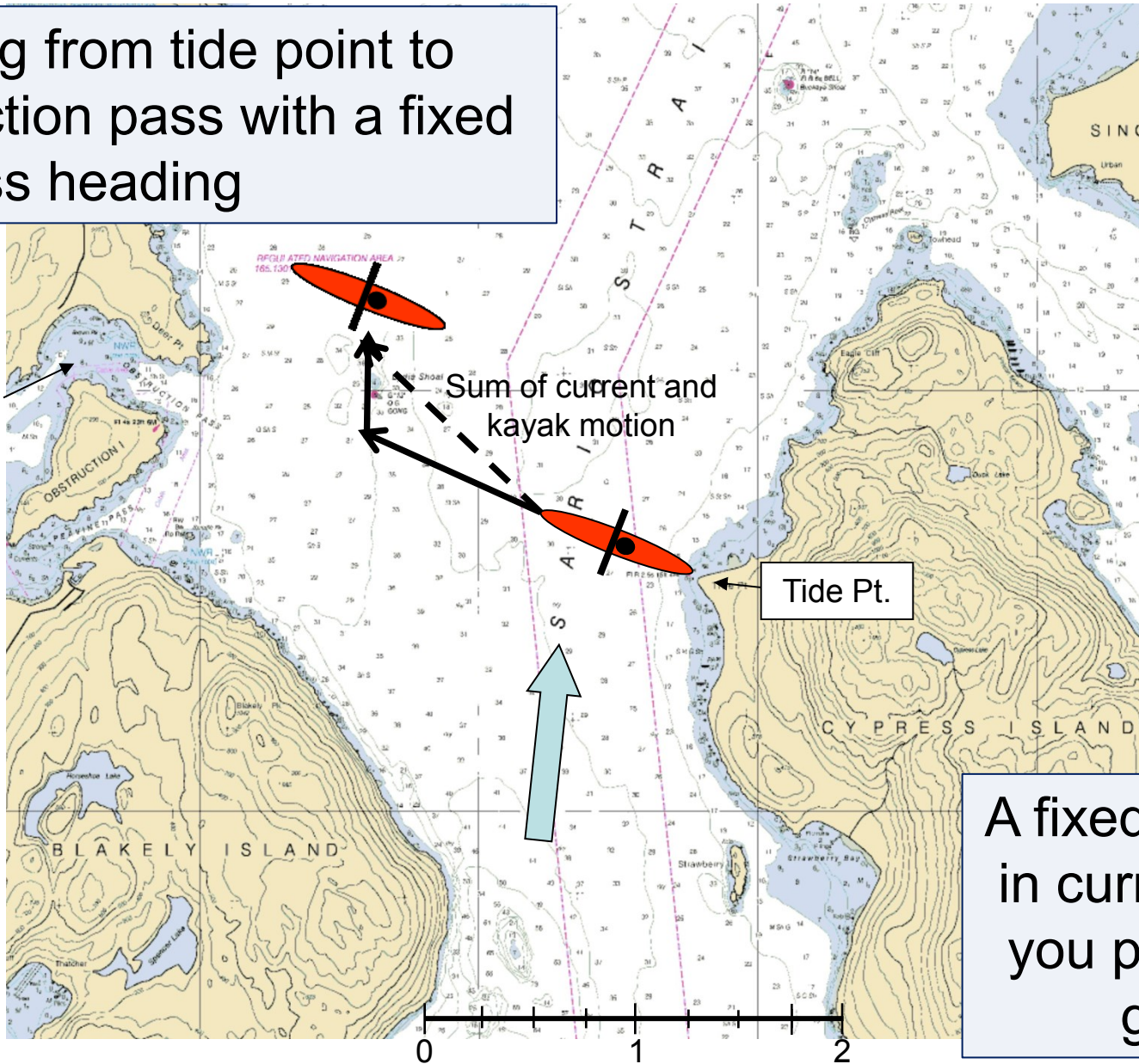


Nautical miles

Crossing in Current (fixed heading)

Crossing from tide point to Obstruction pass with a fixed compass heading

Obstruction Pass



Sum of current and kayak motion

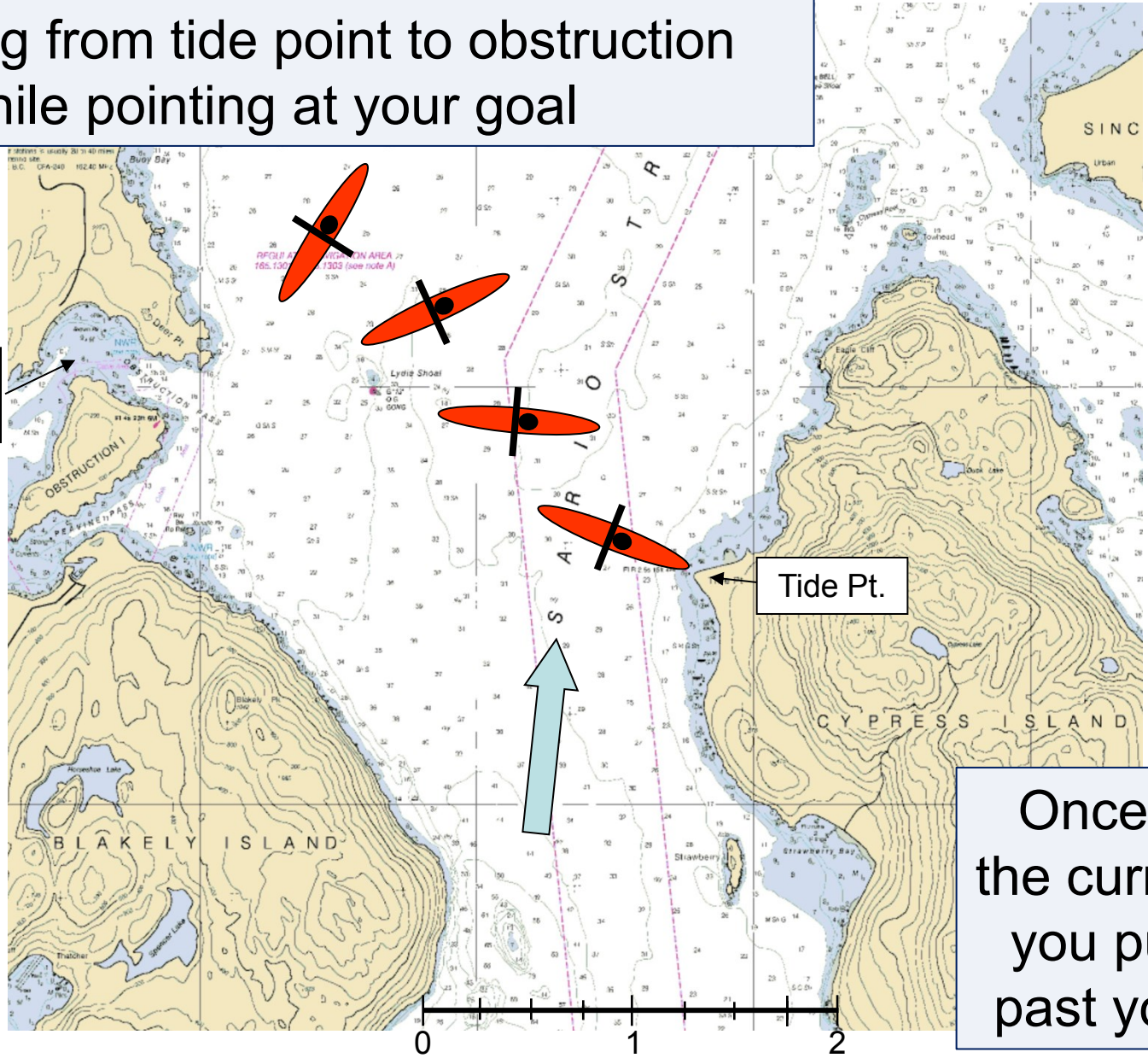
Tide Pt.

A fixed heading in current puts you past your goal

Nautical miles

Crossing in Current (always pointing at your goal)

Crossing from tide point to obstruction pass while pointing at your goal



Obstruction Pass

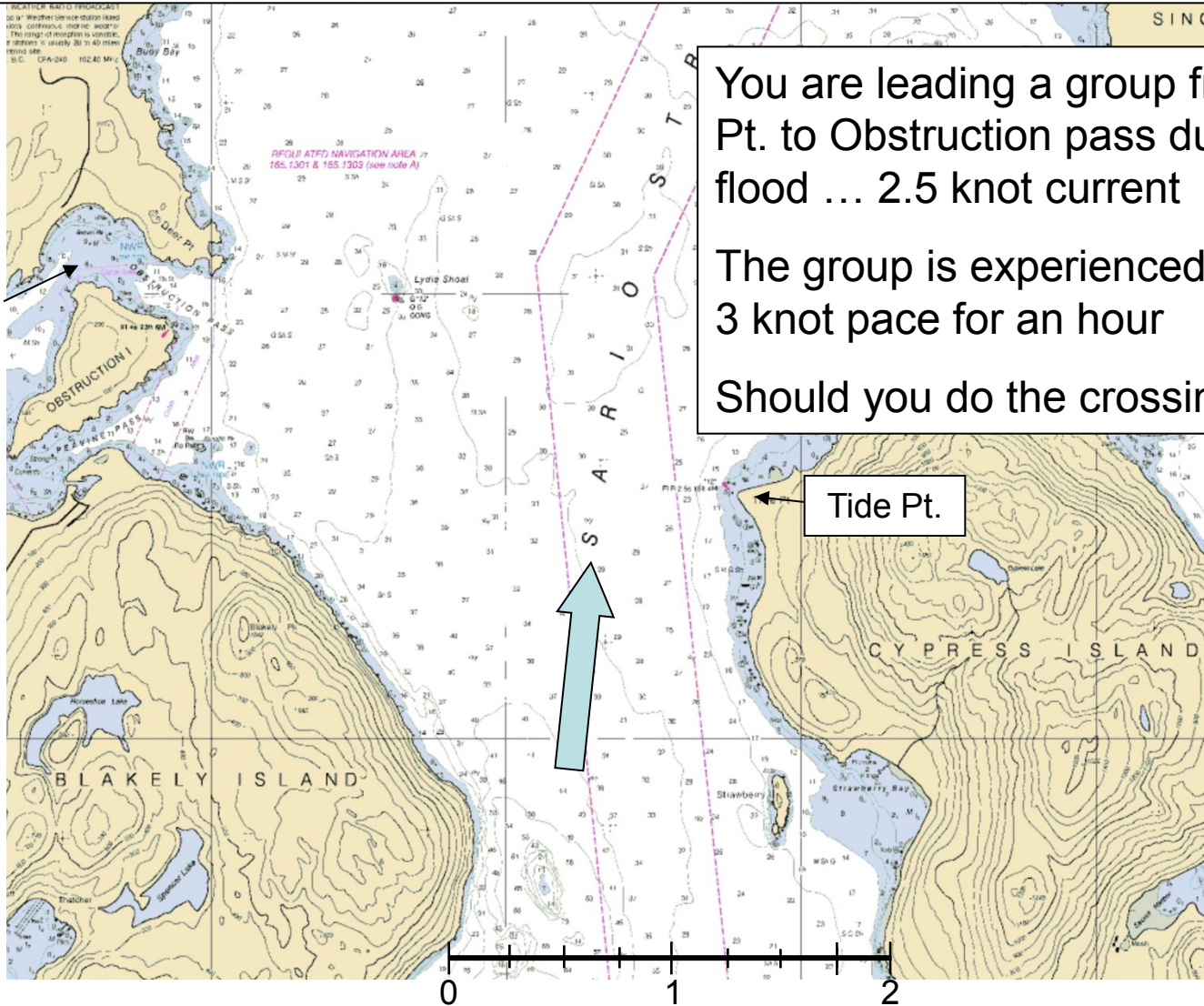
Tide Pt.

Once again, the current puts you past your goal

Nautical miles

Crossing in Current (Compensate for current)

How do you safely navigate a crossing when current (or high wind) are pushing you past your goal? Let's consider a specific example

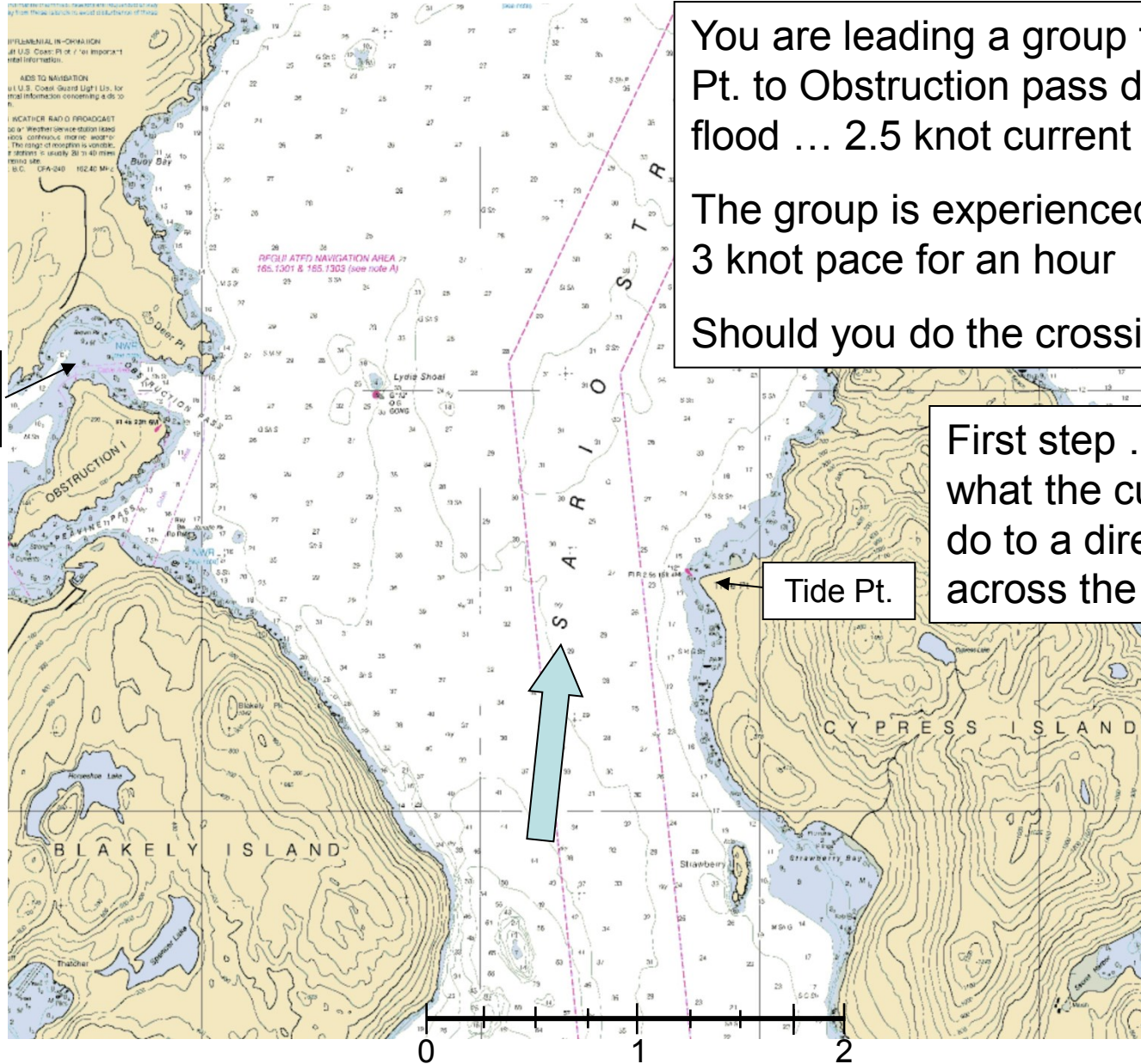


You are leading a group from Tide Pt. to Obstruction pass during peak flood ... 2.5 knot current

The group is experienced, can hold a 3 knot pace for an hour

Should you do the crossing now?

Crossing in Current (Compensate for current)



You are leading a group from Tide Pt. to Obstruction pass during peak flood ... 2.5 knot current

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Should you do the crossing now?

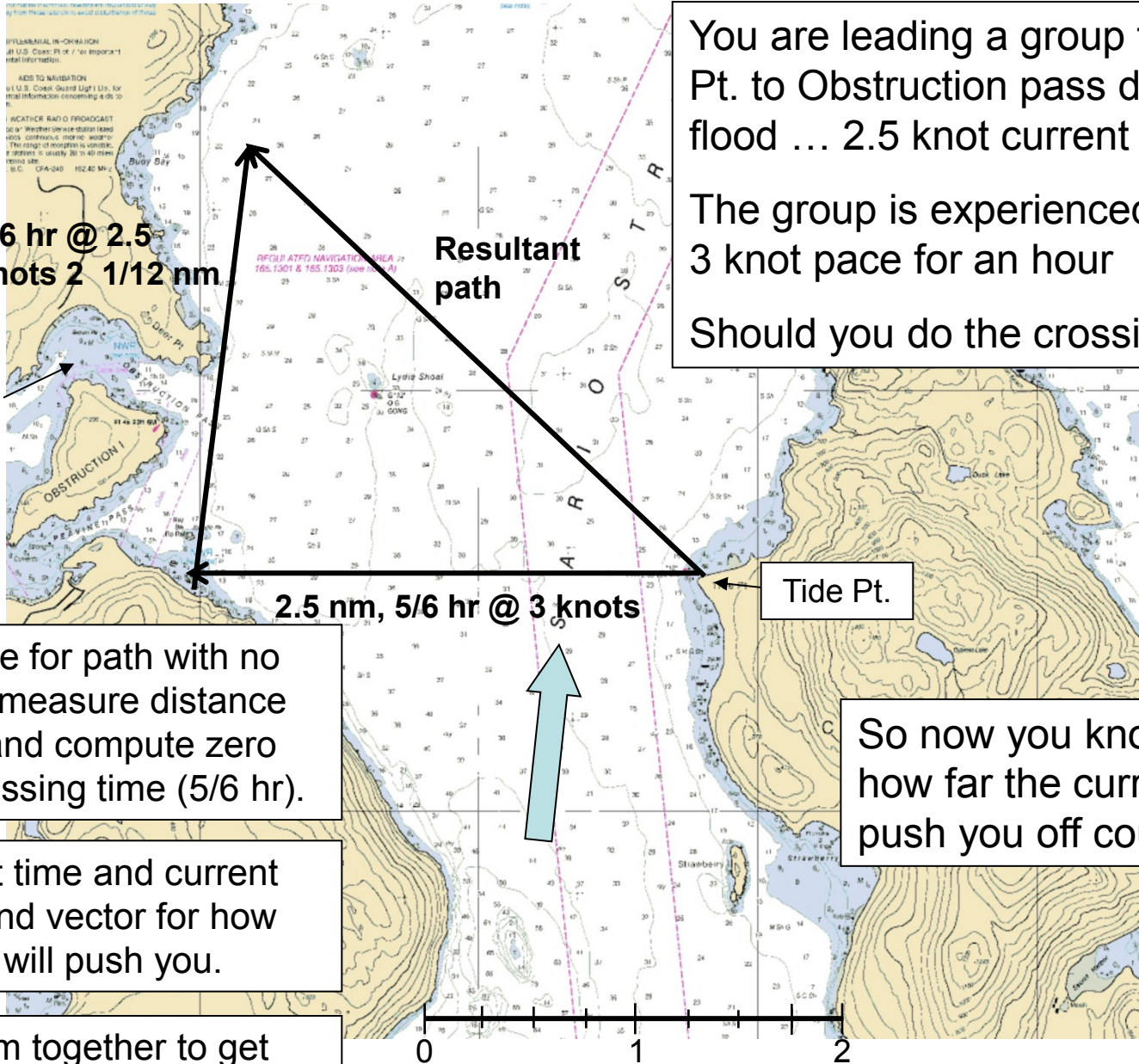
Obstruction Pass

First step ... figure out what the current would do to a direct path across the channel

Tide Pt.

Nautical miles

Crossing in Current (Compensate for current)



You are leading a group from Tide Pt. to Obstruction pass during peak flood ... 2.5 knot current

The group is experienced, can hold a 3 knot pace for an hour

Should you do the crossing now?

5/6 hr @ 2.5 knots = 2 1/12 nm

Resultant path

Obstruction Pass

Tide Pt.

2.5 nm, 5/6 hr @ 3 knots

1. Draw line for path with no current ... measure distance (2.5 nm) and compute zero current crossing time (5/6 hr).

2. Use that time and current speed to find vector for how far current will push you.

3. Add them together to get route.

So now you know just how far the current will push you off course.

Nautical miles

Crossing in Current (Get high. Stay high)

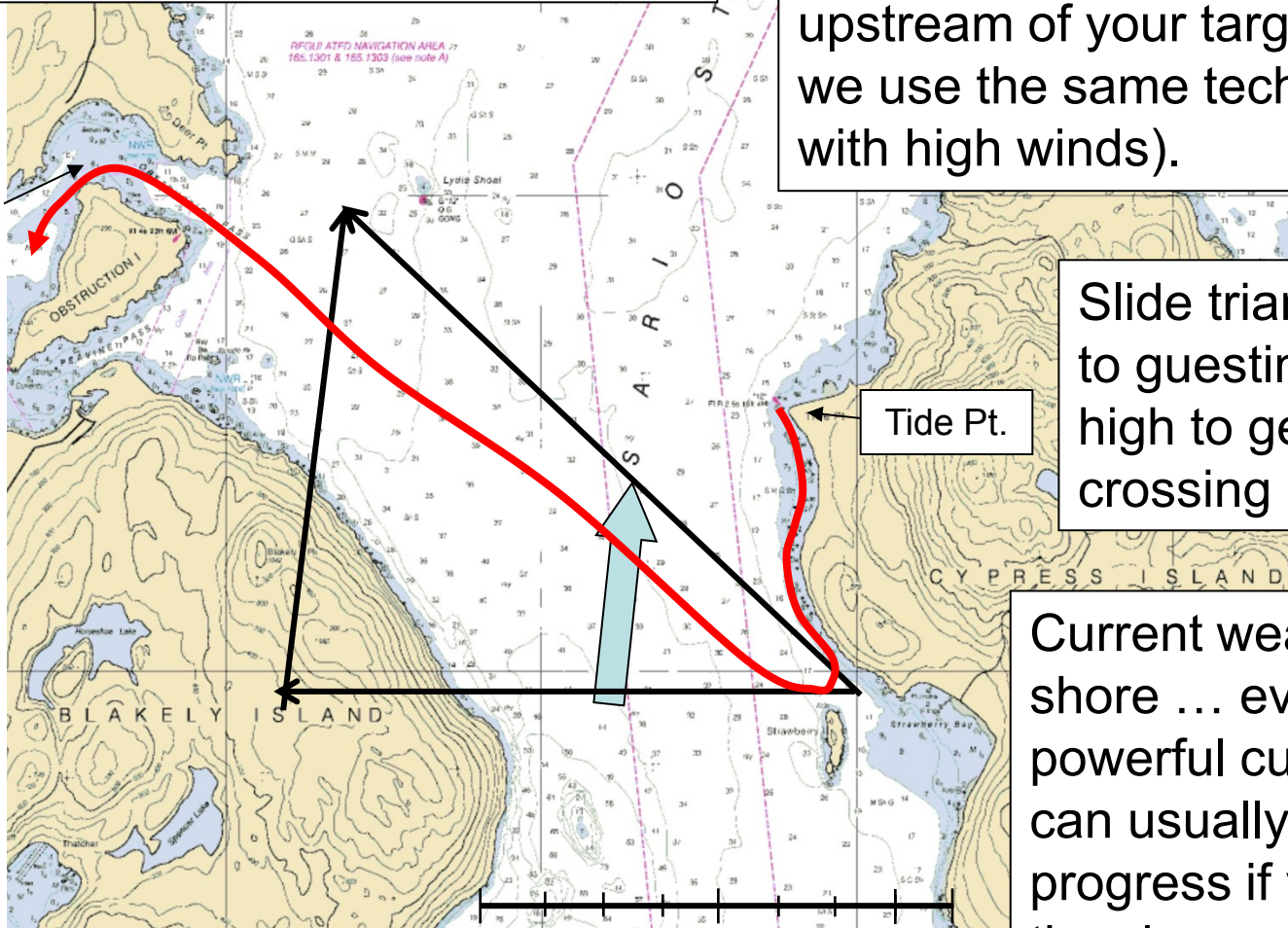
Solution: you have two options:

1. Don't cross now. Wait for less current
2. Go now, but "get high and stay high"

Get high ... i.e. head upstream before starting across.

Stay high ... plan to arrive upstream of your target (note: we use the same technique with high winds).

Obstruction Pass



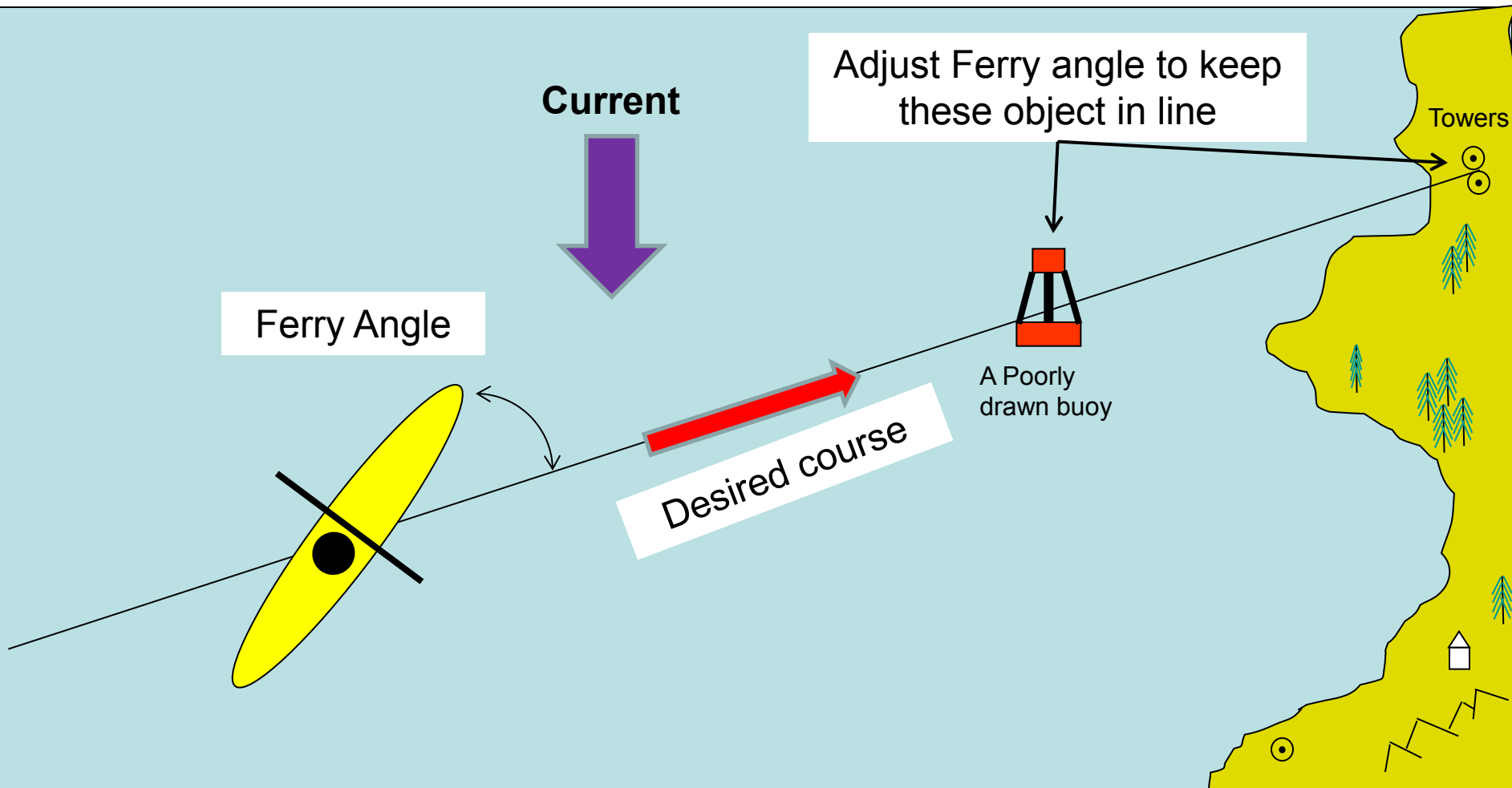
Slide triangle down to guesstimate how high to get before crossing

Current weakest along shore ... even in powerful current, you can usually make progress if you hug the shore

Nautical miles

Ranges and ferry angles

- **Ferry** ... modify your heading to face into current or wind to offset its effect on your course.
- Use ranges to set and verify your Ferry angle



Current Hazards ... tide races



Tim Mattson at Sechelt Narrows, B.C. (Skookumchuck), Aug. 2010. Video by Sterling Donaldson.

Working with Forecasts

- You must look up currents before you go on a trip so you can plan around them.

Remember: most paddlers can only hold a 3 knot pace over long distances so any current approaching 3 knots or more can get you into deep trouble!

weather and swell	http://www.wrh.noaa.gov/
tide height	http://tidesandcurrents.noaa.gov/tides11/
current information	http://tidesandcurrents.noaa.gov/currents11/

Current Definitions

- Set of the current – the direction towards which the current is flowing.
 - E.g. A current flowing from the north to the south is called a southerly current. Notice that this is opposite to the convention with wind for which direction indicates where it is blowing from.
- Drift of the current – its speed in knots.
- Flood – the current that occurs when the water flows from the sea towards shore and increases the level of the tide.
- Ebb – a current that occurs when water flows from shore towards sea and the level of the tide decreases.
- Slack – the state of relative calm when the current changes from an Ebb to a Flood or visa versa.
 - Notice: the more precise term now used on current forecasts is “**minimum before flood**” or “**minimum before ebb**” since in many cases the water never stops moving.

NOAA current entry page

select state

- [Alabama](#)
- [Alaska](#)
- [California](#)
- [Canada](#)
- [Central America](#)
- [Connecticut](#)
- [Delaware](#)
- [Florida](#)
- [Georgia](#)
- [Hawaii](#)
- [Louisiana](#)
- [Maine](#)
- [Maryland](#)
- [Massachusetts](#)
- [Mississippi](#)
- [New Hampshire](#)
- [New Jersey](#)
- [New York](#)
- [North Carolina](#)
- [Oregon](#)
- [Pennsylvania](#)
- [Puerto Rico](#)
- [Rhode Island](#)
- [South Carolina](#)
- [Texas](#)
- [Virginia](#)
- [Washington](#)
- [Washington DC](#)

2009 Tidal Current Predictions

NOTE: NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) has created a supplemental tidal current publication for the marine navigation community of Cook Inlet, Alaska for the last quarter of 2008 and all of 2009. The tidal current predictions in this publication are a reproduction of data that is published in the 2009 Tidal Current Tables, with the addition of two new stations near Nikiski. These two new stations, Tesoro Pier and Unocal Pier, S of. will be published in the 2010 Tidal Current Tables. Data collected at the two new sites in summer 2008 were gathered in response to user requests to provide more representative current velocity predictions aiding in the safe docking of large ships at these piers. In this supplemental publication of the Tidal Current Tables, Tesoro Pier is published as a Table 1 station to provide daily predictions at this critical location. The Forelands serves as the primary reference station for the Table 2 secondary stations in central Cook Inlet. Unocal Pier, S of. appears in Table 2 as a secondary station referenced to The Forelands. These updates provide improved tidal current predictions for safe marine navigation within central Cook Inlet.
Link: [Special Predictions for Central Cook Inlet \(PDF\)](#) ([Get PDF reader](#))

This system will allow you to obtain tidal current predictions computed by CO-OPS for more than 2,700 tidal current locations along the U.S. coastline. The publication of full daily predictions is limited to a select number of "reference stations." The remaining stations are referred to as "subordinate stations." Tidal predictions for subordinate stations are obtained by applying specific differences to the times and speeds of the predicted tidal currents for the specified reference stations.

These pages provide a listing of the 2,700 plus reference stations and subordinate stations. Selecting the "predictions" link beside a station listing will provide tidal current predictions for the location with the differences already applied.

Unlike tide stations, which are normally located along the shoreline, most tidal current stations are located offshore in channels, rivers, and bays. Tidal current stations are often named for the channel, river, or bay in which they are located or for a nearby navigational reference point. A map or some personal knowledge of the area may be necessary to help identify stations in the area you are interested in.

The list of subordinate stations has been broken down into states and other areas where tidal current stations are located. Each state is further broken down into regions. Each region presents a list of the tidal current stations in the area. The stations are listed geographically; thus, stations that are near each other along the shoreline appear together in the listing. This assists the user in locating a station of interest.

Current Regions in Oregon and Washington



The screenshot shows a Microsoft Internet Explorer browser window titled "Tidal Current Tables - Microsoft Internet Explorer". The address bar displays the URL: <http://tidesandcurrents.noaa.gov/currents09/cpred2.html#OR>. The main content area is titled "OREGON and WASHINGTON" and lists the following regions:

- [Oregon Coast](#)
- [Columbia River](#)
- [Washington Outer Coast](#)
- [Strait of Juan de Fuca](#)
- [Admiralty Inlet](#)
- [Hood Canal](#)
- [Puget Sound, north of The Narrows](#)
- [Puget Sound, south of The Narrows](#)
- [Possession Sound to Skagit Bay](#)
- [Rosario Strait](#)
- [San Juan Channel](#)
- [Haro Strait and Boundary Pass](#)

Below the list, there is a link: [select a different state](#)

The section is titled "ALASKA" and lists the following regions:

- [Dixon Entrance, Pierce & Portland Canals](#)
- [Revillagigedo Channel & Carrol Inlet](#)
- [Tongass Narrows & Felice Strait](#)
- [Nichols Passage & Behm Canal](#)
- [Clarence Strait](#)
- [Cordova Bay & Tlevak Strait](#)
- [Meares Passage to El Capitan Passage](#)
- [Sumner & Keku Strait](#)
- [Wrangell Narrows & Fredrick Sound](#)
- [Stephens Passage](#)
- [Lynn Canal & Chatham Strait](#)
- [Sitka Sound to Salisbury Sound](#)
- [Peril Strait to Cross Sound](#)
- [Glacier Bay to Icy Bay](#)
- [Prince William Sound](#)

Columbia river current stations

Current Station Locations and Ranges - Microsoft Internet Explorer

Address: <http://tidesandcurrents.noaa.gov/currents09/tab2pc2.html#112>

COLUMBIA RIVER and APPROACHES

Station	Depth	Latitude	Longitude	Average Speed and Direction					
				Min Before Flood		Flood		Min Before Ebb	
				Spd	Dir	Spd	Dir	Spd	Dir
Predictions Sand Island Tower, 1nm SE of (midchannel)	15	46° 15.17'	123°59.45'	0.1	016	3.0	107	0.3	191
Predictions Sand Island Tower, 0.9nm SE of (north channel)	15	46° 15.47'	123°59.67'	0.2	015	2.1	092	0.1	184
Predictions Baker Bay entrance, E of Sand Island Tower	23	46° 15.72'	123°59.88'	-	-	1.2	008	-	-
Predictions Clatsop Spits, NNE of	15	46° 14.77'	123°59.65'	0.1	032	2.6	114	0.2	205
Predictions Sand Island, SSE of	12	46° 15.33'	123°58.08'	-	-	0.6	097	-	-
Predictions Youngs Bay Entrance	17	46° 11.18'	123°53.27'	0.2	172	1.7	093	0.1	006
Predictions Youngs Bay Bridge	9	46° 10.67'	123°52.10'	-	-	0.8	135	0.1	222
Predictions Hammond, northeast of ship channel	15	46° 12.67'	123°56.07'	0.1	219	0.8	134	0.1	230
Predictions McGowan, SSW of						1.7	107	-	-
Predictions Point Ellice, east of						1.6	065	0.1	336
Predictions Point Adams, NNE OF						1.6	139	0.4	210
Predictions Chinook Point, WSW of						2.2	117	0.4	199
Predictions Tongue Point, northw						0.8	077	-	-
Predictions Woody Island Channel						1.0	118	-	-
Predictions Woody Island Channel (off Sand Island)						0.5	081	0.1	358
Predictions Quinn Island, Prairie Channel	8	46° 14.23'	123°30.20'	-	-	0.5	097	-	-
Predictions Clifton Channel	10	46° 13.07'	123°27.92'	-	-	0.5	118	-	-
Predictions Hunting Island, south of	20	46° 12.43'	123°24.25'	0.1	206	0.3	125	-	-
Predictions Cathlamet Channel, SE of Nassa Point	19	46° 09.37'	123°18.90'	0.1	221	0.2	103	-	-
Predictions Walker Island, south of	12	46° 08.47'	123°02.75'	-	-	0.4	148	-	-

There are so many of them ... I focus on the worst case scenario and pick the station with the greatest current swings

Sand Island, 1nm SE of (midchannel)

Tidal Current Predictions - Microsoft Internet Explorer

Address: [http://tidesandcurrents.noaa.gov/get_predc.shtml?year=2009&stn=6255+Grays+Harbor+Entrance&secstn=Sand+Island+Tower,+1nm+SE+of+\(midchannel\)+&sbftm=%2B18sbftm=12&](http://tidesandcurrents.noaa.gov/get_predc.shtml?year=2009&stn=6255+Grays+Harbor+Entrance&secstn=Sand+Island+Tower,+1nm+SE+of+(midchannel)+&sbftm=%2B18sbftm=12&)

Sand Island Tower, 1nm SE of (midchannel)

Predicted Tidal Current October, 2009

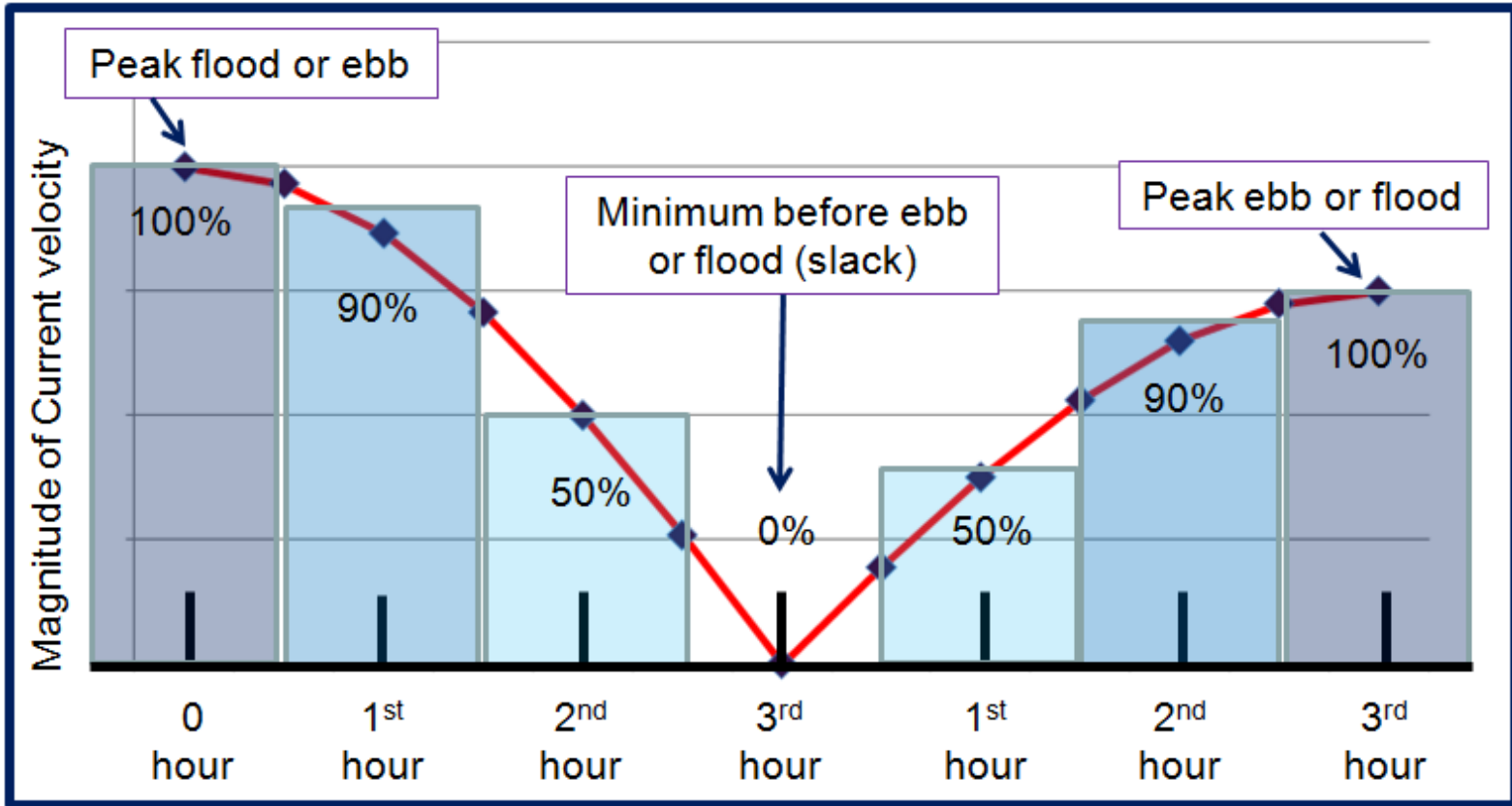
Flood Direction, 107 True. Ebb (-)Direction, 275 True.

NOAA, National Ocean Service

Day	Slack Water			Maximum Current			Slack Water			Maximum Current			Slack Water			Maximum Current			
	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	
1	0021	0320	-4.3	0736	1057	+3.2	1302	1549	-4.2	2003	2310	+2.7							
2	0109	0401	-4.5	0808	1118	+3.4	1334	1625	-4.8	2038	2337	+3.2							
3	0153	0438	-4.5	0839	1132	+3.5	1404	1657	-5.3	2112									
4		0002	+3.5	0235	0512	-4.5	0910	1151	+3.7	1433	1728	-5.6	2148						
5		0030	+3.7	0316	0545	-4.3	0942	1218	+3.7	1502	1758	-5.9	2226						
6		0103	+3.8	0358	0618	-4.0	1017	1249	+3.7	1533	1832	-6.1	2307						
7		0141	+3.8	0443	0655	-3.7	1055	1325	+3.7	1607	1910	-6.1	2352						

The 50/90 rule

- The NOAA tables provide times for slack and peak.
- Use the 50/90 rule to estimate current at other times:



Divide time from peak to slack into three equal segments (~1 hr)

- 90% of peak after 1st segment
- 50% of peak after 2nd segment
- 0% (slack) after 3rd segment

- Reverse process back to peak
- 50% of peak after 1st segment
 - 90% of peak after 2nd segment
 - 100% (peak) after 3rd segment

Weather

- Dealing with weather is simple ... always check forecasts and know your limits.
- It's the wind that matters most. Key issues for understanding wind:
 - **Direction:** Stated in terms of where the wind comes from (opposite of the convention with current).
 - **Fetch:** the span of water the wind blows over.
 - **Time:** How long has the wind been blowing?

Anything over 25 knots is very tough! Only advanced paddlers working in well practiced teams should choose to paddle beyond 30 knots ... and even then, you better hope you're heading downwind!

Weather underground .. Ilwaco WA Oct 16, 2009

The screenshot shows the Weather Underground website for Ilwaco, WA. The browser address bar shows www.wunderground.com. A callout box points to the 'Recent Cities' list on the left sidebar, which includes Ilwaco, WA. Another callout box points to the 'Marine Forecast' link in the bottom navigation menu. The main content area displays current conditions (58.9°F, Light Rain Mist) and a 5-day forecast.

www.wunderground.com

Select a city near your coastal destination

and it's all over your city.

Ilwaco, Washington

Local Time: 1:14 PM PDT (GMT -07) — [Set My Timezone](#) Lat/Lon: 46.3° N 124.0° W ([Google Map](#))

Tropical Weather: [Hurricane Rick](#) (East Pacific) [Invest 94](#) (East Pacific) [Typhoon Lupit](#) (Western Pacific)

Active Advisory: [Special Weather Statement \(US Severe Weather\)](#)

Current Conditions

Sandridge Rd near Pioneer Rd, Long Beach, Washington (PWS)
Updated: 2 sec ago

58.9 °F
Light Rain Mist

Humidity: 97%
Dew Point: 58 °F
Wind: 7.9 mph from the SSW
Wind Gust: 12.7 mph
Pressure: 30.05 in (Falling)
Visibility: 3.0 miles
UV: 1.2 out of 16
Clouds: Few 1700 ft
Overcast 2200 ft (Above Ground Level)
Elevation: 15 ft
Rapid Fire Updates: Enable Disable

Source for Current Conditions:

[Local Radar](#)
[WunderMap](#)
[Regional Radar](#)
[Local Satelite](#)
[Marine Forecast](#)
[Snow Depth](#)
[Trip Planner](#)
[Weather Stations](#)

5-Day Forecast for ZIP Code 98624

Friday	Saturday	Sunday	Monday	Tuesday
65° F 52° F Rain 90% chance of precipitation Hourly	59° F 47° F Rain 90% chance of precipitation Hourly	58° F 47° F Rain 30% chance of precipitation Hourly	58° F 47° F Rain 60% chance of precipitation Hourly	56° F 45° F Chance of Rain 40% chance of precipitation Hourly

Today is forecast to be nearly the same temperature as yesterday.

84 DEGREES +
100% FUN

Join the CLEAR™ generation.
TELL ME MORE!

Marine Forecast, Ilwaco WA Oct 16, 2009

Marine Forecast : Weather Underground - Microsoft Internet Explorer

Address <http://www.wunderground.com/MAR/PZ/210.html>

Denain, WA
Stevenson, WA
Hood River, OR

Zip Code: Search

Forecast as of 12:14 PM PDT on October 16, 2009

Synopsis For Southern Washington And Northern Oregon Coast
A cold front will move across the coastal waters today...then stall along the coast before moving onshore Sat as a second low moves through the coastal waters Sat afternoon and evening. Another frontal system will move into the waters Sun night and Mon...with yet another Tue night and Wed.
Small Craft Advisory for rough Columbia River bar in effect until 11 PM PDT this evening

Forecast as of 12:14 PM PDT on October 16, 2009
Columbia River Bar-

In The Main Channel
Combined seas 9 ft building to 10 ft this afternoon and tonight and 8 ft Sat. However...seas will temporarily build to 13 ft with breakers during the strong Ebb current around 415 PM this afternoon...and to 11 ft during the very strong Ebb around 330 am Sat morning.

Coastal Water Temperature

Place:	Temperature
Astoria, OR	57.9 °F
Toke Point, WA	55.0 °F
Tacoma, WA	52.0 °F
South Beach, OR	52.0 °F
Seattle, WA	54.0 °F

Open Sea Buoy Information

Place:	Station ID:	Water Temp:	Wave Height
COL RIVER BAR - 78NM South Southwest of Aberdeen, WA	46029	56 °F	9.84 ft
CAPE ELIZABETH- 45NM Northwest of Aberdeen, WA	46041	52 °F	10.17 ft
STONEWALL BANKS - 20NM West of Newport, OR	46050	58 °F	7.55 ft

Click the Station ID for daily observations and history.

C-MAN Station Information

Place:	Station ID:	Water Temp:	Wave Height:
Destruction Is., WA	DESW1	-	-
Newport, OR	NWPO3	-	-
West Point, WA	WPOW1	-	-

Marine Map

- Buoy / Water Temps
- [Wave Heights](#)

12 PM PDT Fri Oct 16

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Scroll down for more forecast options

Buoy data to see current action off-shore

Columbia Bar forecast is most relevant for Ilwaco, WA

Marine forecast options OR/WA coasts

Marine Forecast : Weather Underground - Microsoft Internet Explorer

Address: <http://www.wunderground.com/MAR/PZ/210.html>

Sea Surface Temperature

Wind Barbs 1kt = 1.15mph

35 40 45 50 55 60 65 70 75 80 85 90 F
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 C

◇ CMAN Station □ Moored Buoy ○ Ship or Land Station

Click any area for a Zone forecast. Click the Station ID for station data.

Global Marine Zone Map

Marine Links

Marine links for Washington and Northern Oregon marine forecasts

- [Grays Harbor Bar](#)
- [West Entrance U.S. waters of Strait of Juan de Fuca](#)
- [Central U.S. waters of Strait of Juan de Fuca](#)
- [East Entrance U.S. waters of Strait of Juan de Fuca](#)
- [Northern inland waters including San Juan Islands](#)
- [Admiralty Inlet](#)
- [Puget Sound and Hood Canal](#)
- [Coastal waters from Cape Flattery to James Island, out 20 nm](#)
- [Coastal waters from James Island to Point Grenville, out 20 nm](#)
- [Coastal waters from Point Grenville to Cape Shoalwater, out 20 nm](#)
- [Coastal waters from Cape Flattery to James Island 20 to 60 nm](#)
- [Coastal waters James Island to Point Grenville 20 to 60 nm](#)
- [Coastal waters from Point Grenville to Cape Shoalwater 20 to 60 nm](#)
- [Columbia River Bar](#)
- [Coastal waters Cascade Head, OR to Cape Shoalwater, WA westward 20 nm](#)
- [Waters from Cascade Head, OR to Cape Shoalwater, WA 20 to 60 nm offshore](#)

Marine links for Canadian Pacific waters

- [Canadian portions of the Pacific](#)

<http://www.wunderground.com/MAR/PZ/081.html> Internet

Columbia Bar is nice, but you need to know what's happening further out so you can anticipate how things will change over the course of the day.

Marine forecast Oct. 16, 2009 cascade head to cape shoalwater westward 20 nm

PZ 250
Enter a coastal zip code to search for marine weather.
Zip Code: Search

Forecast as of 12:14 PM PDT on October 16, 2009

Synopsis For Southern Washington And Northern Oregon Coast
A cold front will move across the coastal waters today...then stall along the coast before moving onshore Sat as a second low moves through the coastal waters Sat afternoon and evening. Another frontal system will move into the waters Sun night and Mon...with yet another Tue night and Wed.

Small Craft Advisory for winds in effect until 8 PM PDT this evening
Small Craft Advisory for hazardous seas in effect through late tonight

Forecast as of 12:14 PM PDT on October 16, 2009

Today
S wind 20 to 25 kt. Isolated gusts up to 30 kt. Wind waves 6 ft. SW swell 12 ft at 9 seconds. Rain.

Tonight
S wind 10 to 15 kt. Gusts up to 25 kt in the evening. Wind waves 3 ft. SW swell 11 ft at 10 seconds. Rain.

Marine Map

- o Buoy / Water Level
- o Wave Height

Richland, WA
Belfair, WA
Stevenson, WA
Hood River, OR
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Developer's Blog

Sun
N wind 5 to 10 kt. foot...building to

Sun Night
S wind 10 to 15 kt. 4 ft. W swell 6 ft.

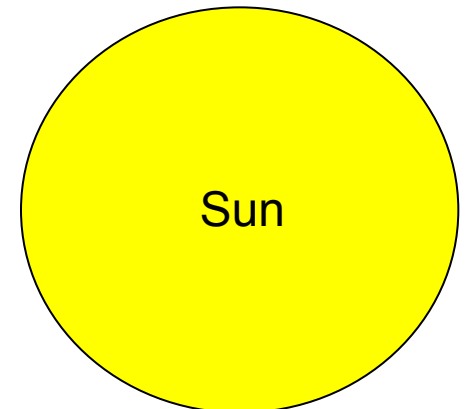
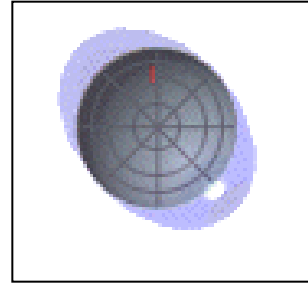
Mon
S wind 15 to 20 kt.

Tue
S wind 25 to 30 kt.

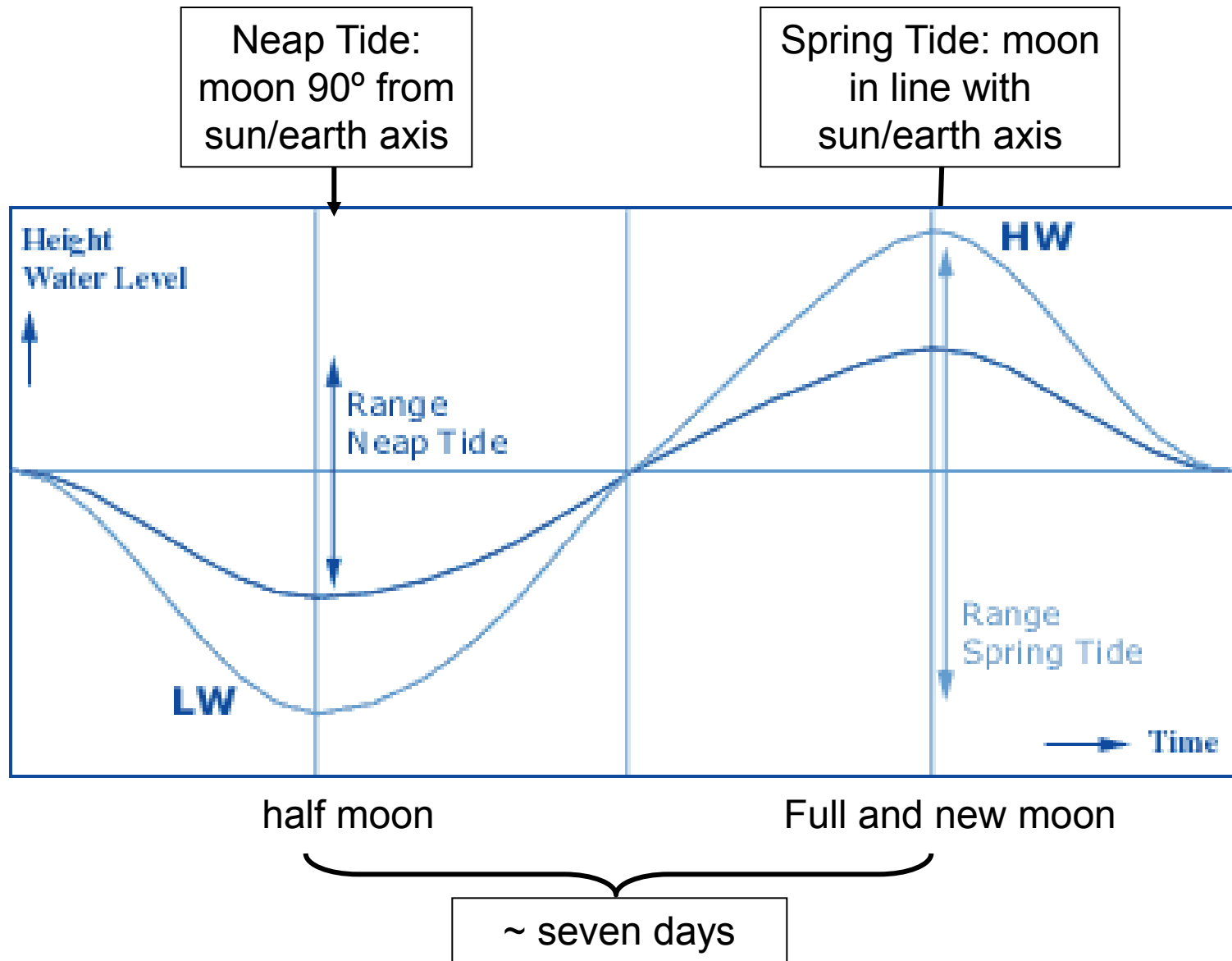
This is bad ... you should probably stay on shore

Origins of tides

- Tides come from oceans bulges due to gravitational forces from the sun and the moon.
- Biggest bulges when the sun, earth and moon are lined up



Spring and Neap Tides

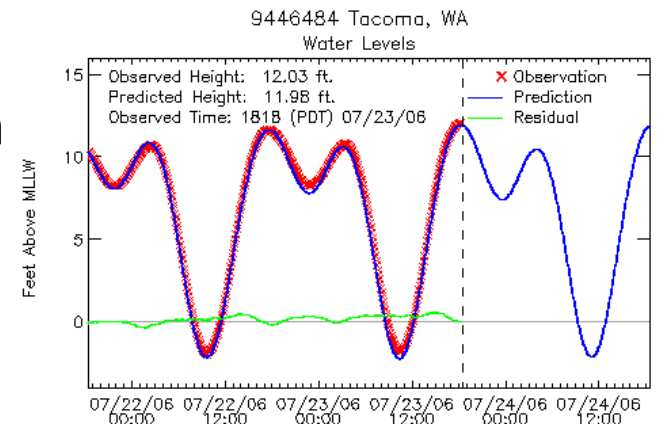
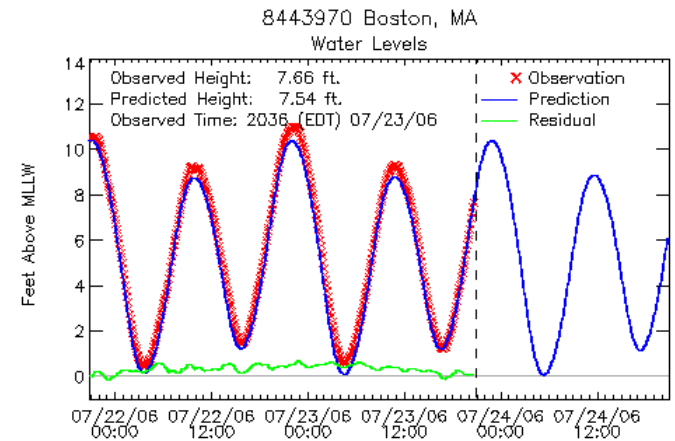
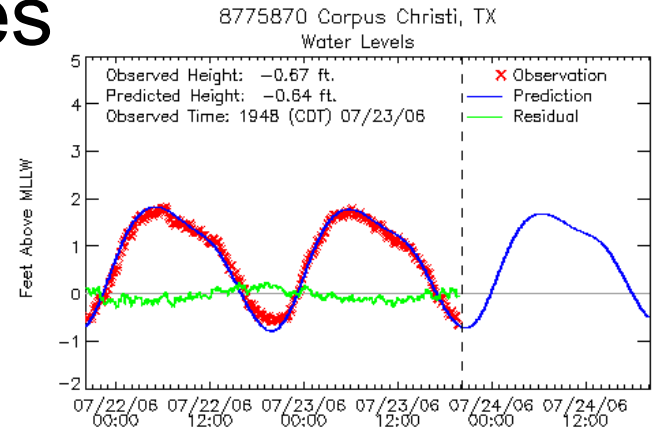


3 Types of Tides

Tides depend on many factors:

- Shape of the water basin
- Frictional forces
- Coriolis effect
- Weather

- Diurnal: one high and one low (e.g. Corpus Cristi, TX)
- Semidiurnal tide: two highs, two lows per tidal day. Roughly equal magnitude (e.g. Boston, MA)
- Mixed: wide variation in highs and lows with longer tidal cycles than a diurnal tide (e.g. Tacoma, WA).



NOAA tide web page

NOAA TIDES & CURRENTS

Home | Products | Programs | Partnerships | Education | Help

select state

- [Alabama](#)
- [Alaska](#)
- [California](#)
- [Caribbean Islands](#)
- [Connecticut](#)
- [Delaware](#)
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- [North Carolina](#)
- [Oregon](#)
- [Pacific Islands](#)
- [Panama Canal](#)
- [Pennsylvania](#)
- [Rhode Island](#)
- [South Carolina](#)
- [Texas](#)
- [Virginia](#)
- [Washington DC](#)

2009 Water Level Tidal Predictions

This system will allow you to obtain tidal predictions computed by CO-OPS for more than 3,000 water-level stations. The publication of full daily predictions is limited to fewer stations. These stations with full daily predictions are referred to as "reference stations." The remaining stations are referred to as "subordinate stations." Tidal predictions for subordinate stations can be obtained by applying specific differences to the times and heights of tides of the specified reference stations.

These pages provide a listing of the 3,000-plus subordinate stations with the differences already applied. These differences are located in the prediction header. The list of subordinate stations has been broken down into states and other areas where water-level stations are located. Each state is further broken down into regions. Each region presents a list of the water-level stations in the area. The stations are listed geographically; thus, stations that are near each other along the shoreline are near each other in the listing. This simplifies locating a station of interest.

A description of the information provided in this section can be found by clicking on the symbol found throughout the listing of subordinate stations.

Bookmarks/Links:
Bookmarks/links may be created to the daily predictions for specific stations using the URL listed when the predictions for that station are displayed. Bookmarks/links may also be created to the station listings for a region. However, that bookmark/link will only provide access to the predictions for the year available when the bookmark/link was created. Each successive year of predictions will use a different URL, and thus any bookmarks/links must be updated to access each new year of predictions.

Information on t
Click [HERE](#) for
Tide table chang

Click the link for your state
(Washington in this case)

[home](#) | [products](#) | [programs](#) | [partnerships](#) | [education](#) | [help](#)

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Washington/Oregon tide stations

Make a Tide Prediction, State and Region Listing - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://tidesandcurrents.noaa.gov/tides09/tpred2.html#OR> Go Links >>

OREGON and WASHINGTON

- [Washington Coast](#)
- [Strait of Juan de Fuca and Admiralty Inlet](#)
- [Hood Canal](#)
- **Puget Sound**
 - [Edmonds, Seattle, Des Moines area](#)
 - [Tacoma, Arcadia, Olympia area](#)
 - [Possession Sound, Port Susan, Skagit Bay area](#)
- [Rosario Strait](#)

ALASKA

- [Dixon Entrance and Portland Canal](#)
- [Revillagigedo Channel and Tongass Narrows](#)
- [Behm Canal](#)
- [Clarence Strait](#)
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- [Gulf of Alaska](#)
- [Prince William Sound](#)
- [Kenai Peninsula and Cook Inlet](#)
- [Kodiak and Afgonak Islands](#)
- [Alaska Peninsula](#)
- **Aleutian Islands**
 - [Unimak and Unalaska Islands](#)
 - [Umnak, Yunaska, Atka Islands](#)
 - [Adak, Kanaga, Tanaga, Rat and Attu Islands](#)
- [Bristol Bay](#)
- [Kusokwim Bay and Bering Sea](#)
- [Norton Sound, Bering Strait, and Arctic Ocean](#)

Pacific Islands

- [Marianas Islands](#)
- [Federated States of Micronesia](#)
- [Marshall Islands](#)
- [Hawaiian Islands](#)
- [French Polynesia](#)
- [Cook Islands, Samoa Islands, Tonga Islands](#)
- [Fiji, Tuvalu and Kiribati](#)

Revised: 4 October, 2008

Internet

Choose your region of interest (Columbia River)

Tide Stations along Columbia river

OREGON and WASHINGTON
Columbia River

Predictions	Station	Latitude	Longitude	Mean Range (ft)	Spring Range (ft)	Mean Tide Level (ft)
Predictions	ASTORIA (Tongue Point), Oreg.	46° 12.5'	123° 5'	5.2	6.4	--
Predictions	Knappa, Knappa Slough	46° 11'	123° 5'	5.2	6.3	--
Predictions	Settlers Point, Oreg.	46° 10'	123° 41'	6.3	8.0	4.1
Predictions	Harrington Point, Wash.	46° 16'	123° 39'	6.1	7.7	3.9
Predictions	Skamokawa, Steamboat Slough, Wash.	46° 16'	123° 27'	5.6	6.9	--
Predictions	Cathlamet, Wash.	46° 12'	123° 23'	5.2	6.4	--
Predictions	Wauna, Oreg.	46° 10'	123° 24'	5.2	6.3	--
Predictions	Eagle Cliff, Wash.	46° 10'	123° 14'	4.5	5.5	--
Predictions	Stella, Wash.	46° 11'	123° 7'	4.0	4.9	--
Predictions	Longview, Wash.	46° 6'	122° 57'	3.3	4.0	--
Predictions	Kalama, Wash.	46° 0'	122° 51'	2.6	3.2	--
Predictions	Saint Helens, Oreg.	45° 52'	122° 48'	2.0	2.5	--
Predictions	Knapp Landing, Wash.	45° 44'	122° 45'	1.5	2.0	--
Predictions	Kelley Point, Oreg.	45° 39'	122° 46'	1.4	2.0	--
Predictions	St. Johns, Willamette River, Oreg.	45° 35'	122° 46'	1.7	2.2	--
Predictions	Portland, Willamette River, Oreg.	45° 31'	122° 40'	1.8	2.4	--
Predictions	Vancouver, Wash.	45° 37'	122° 40'	1.3	1.8	--
Predictions	Ellsworth, Wash.	45° 36'	122° 33'	1.0	1.4	--

WASHINGTON

Predictions	Station	Latitude	Longitude	Mean Range (ft)	Spring Range (ft)	Mean Tide Level (ft)
Predictions	Willapa Bay					
Predictions	Nahcotta	46° 30.1'	124° 01.8'	7.89	10.03	5.33
Predictions	Tarlatt Slough	46° 22.2'	124° 00.3'	7.9	9.4	4.6
Predictions	Paradise Point, Long Island	46° 28.1'	123° 56.7'	8.0	10.2	5.4
Predictions	Naselle River, swing bridge	46° 25.8'	123° 54.2'	8.48	10.72	5.72
Predictions	Naselle River, 4 miles above swing bridge	46° 23.3'	123° 50.4'	8.68	10.75	5.62
Predictions	Bay Center, Palix River	46° 37.4'	123° 56.7'	7.07	9.21	4.94
Predictions	Palix River, south fork	46° 35.2'	123° 54.6'	7.17	9.28	4.90
Predictions	TOKE POINT	46° 42.5'	123° 57.9'	6.81	8.92	4.78
Predictions	Mailboat Slough, Willapa River	46° 41.3'	123° 49.0'	7.36	9.52	5.08
Predictions	South Bend, Willapa River	46° 39.8'	123° 47.9'	7.66	9.82	5.27

Baker Bay (a-jetty) tides

Tide Tables - Microsoft Internet Explorer
Address: http://tidesandcurrents.noaa.gov/get_predictions.shtml?year=2009&stn=1038+Astoria&secstn=Ilwaco,+Baker+Bay,+Wash.&thh=%2D0&thm=13&tlh=%2B0&tlm=1&hh=%2D0.8&hl=%2D0.1 Go Links >>

October - Ilwaco, Baker Bay, Wash.

Date	Day	Time	Height		Time	Height		Time	Height		Time	Height	
10/01/2009	Thu	06:16AM	LDT	0.4	L	12:22PM	LDT	6.9	H	06:39PM	LDT	1.0	L
10/02/2009	Fri	12:21AM	LDT	6.7	H	06:50AM	LDT	0.5	L	12:51PM	LDT	7.3	H
10/03/2009	Sat	01:05AM	LDT	6.9	H	07:22AM	LDT	0.8	L	01:18PM	LDT	7.7	H
10/04/2009	Sun	01:48AM	LDT	7.0	H	07:54AM	LDT	1.1	L	01:43PM	LDT	8.0	H
10/05/2009	Mon	02:31AM	LDT	6.9	H	08:26AM	LDT	1.5	L	02:09PM	LDT	8.3	H
10/06/2009	Tue	03:15AM	LDT	6.8	H	09:00AM	LDT	1.9	L	02:38PM	LDT	8.5	H
10/07/2009	Wed	04:01AM	LDT	6.5	H	09:36AM	LDT	2.3	L	03:11PM	LDT	8.5	H
10/08/2009	Thu	04:51AM	LDT	6.2	H	10:17AM	LDT	2.6	L	03:51PM	LDT	8.4	H
10/09/2009	Fri	05:48AM	LDT	5.8	H	11:05AM	LDT	3.0	L	04:38PM	LDT	8.0	H
10/10/2009	Sat	12:19AM	LDT	-0.3	L	06:55AM	LDT	5.5	H	12:07PM	LDT	3.2	L
10/11/2009	Sun	01:29AM	LDT	-0.1	L	08:08AM	LDT	5.5	H	01:28PM	LDT	3.2	L
10/12/2009	Mon	02:44AM	LDT	0.0	L	09:16AM	LDT	5.8	H	02:58PM	LDT	2.9	L
10/13/2009	Tue	03:53AM	LDT	0.0	L	10:13AM	LDT	6.4	H	04:13PM	LDT	2.1	L
10/13/2009	Fri	04:03AM	LST	1.2	L	10:06AM	LST	8.4	H	05:01PM	LST	-0.2	L
10/14/2009	Sat	04:50AM	LST	1.6	L	10:46AM	LST	8.8	H	05:50PM	LST	-0.8	L
10/15/2009	Sun	05:35AM	LST	2.0	L	11:24AM	LST	9.0	H	06:35PM	LST	-1.1	L
10/16/2009	Mon	12:39AM	LST	7.0	H	06:18AM	LST	2.5	L	12:01PM	LST	9.0	H
10/17/2009	Tue	01:27AM	LST	7.0	H	07:00AM	LST	2.9	L	12:36PM	LST	8.8	H

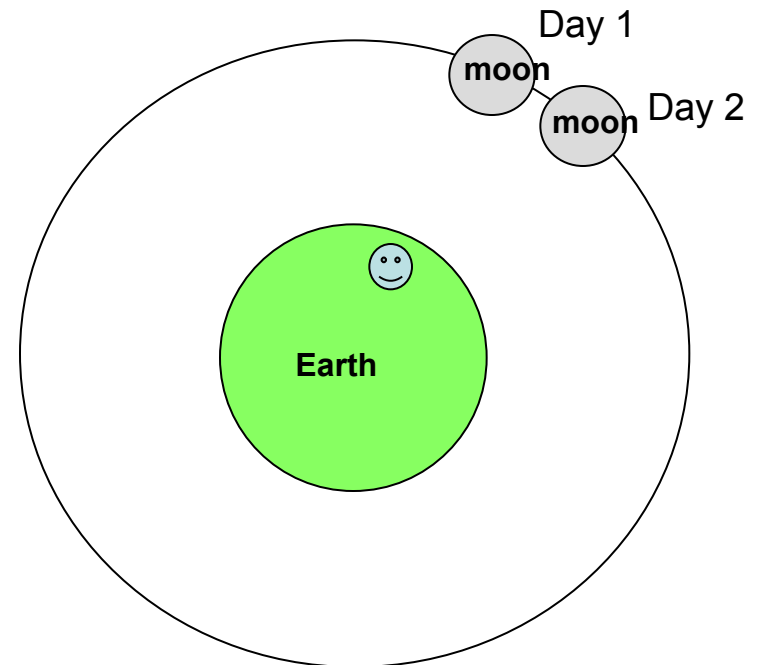
October - Ilwaco, Baker Bay, Wash.

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11/13/2009	Fri	04:03AM	LST	1.2	L	10:06AM	LST	8.4	H	05:01PM	LST	-0.2	L
11/14/2009	Sat	04:50AM	LST	1.6	L	10:46AM	LST	8.8	H	05:50PM	LST	-0.8	L
11/15/2009	Sun	05:35AM	LST	2.0	L	11:24AM	LST	9.0	H	06:35PM	LST	-1.1	L
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11/17/2009	Tue	01:27AM	LST	7.0	H	07:00AM	LST	2.9	L	12:36PM	LST	8.8	H

Done Internet

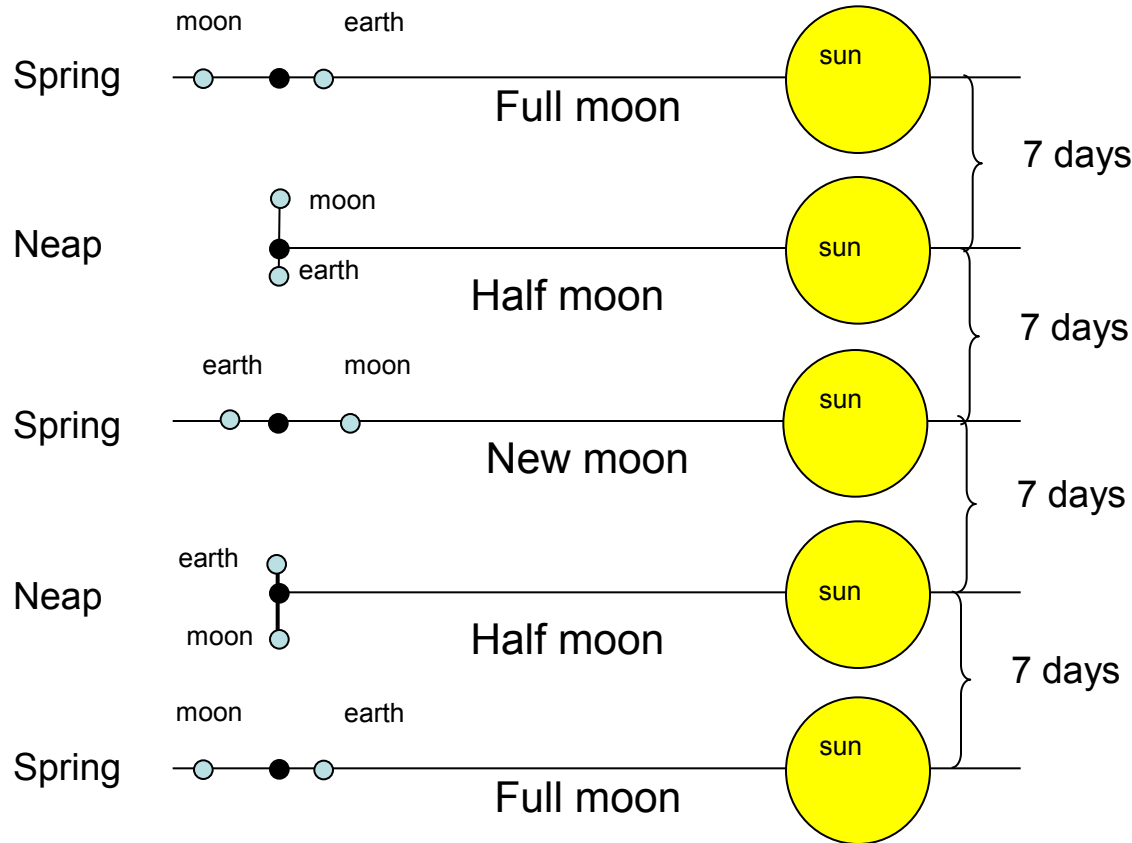
Tidal variation from day to day

- Basic facts:
 - Earth rotates once per 24 hours.
 - Moon orbits earth in 28 days.
- Moon position at same time from one day to another
 - When you finish a full rotation, the moon has moved $1/28$ of an orbit ahead of the previous day's position
- Impact on tide:
 - Tidal bulge follows the moon's position.
 - Hence tide moves “forward” by $1/28^{\text{th}}$ of a cycle or ...
 - Tide is shifted $24/28 * 60 = 51$ minutes later.



Estimating tidal variation from day to day

Rule of sevenths

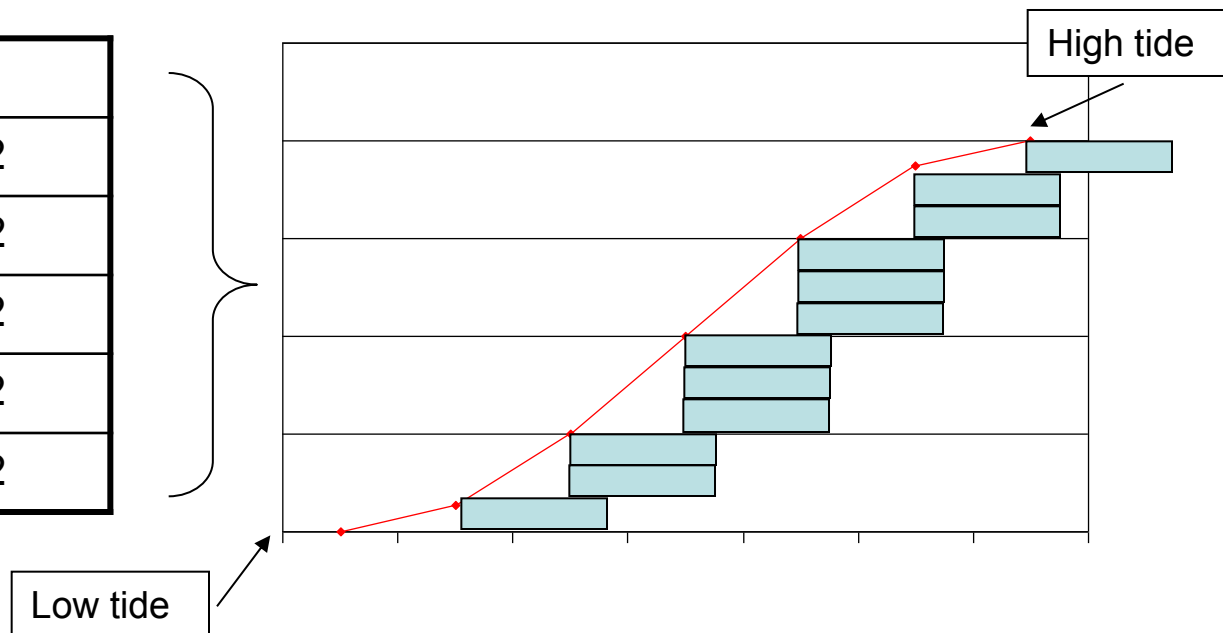


- 7 days from spring to neap.
- Assume a linear variation, i.e.:
 - Each day tidal range changes by $1/7$ spring/neap change.
- Example:
 - Spring range 12 feet
 - Neap range 6 feet
 - 3 days after full moon, tidal range will be:
 $12 - 3 * (12 - 6) / 7 = 9.4$ feet

Estimating Tides: The rule of 12ths

- Tide varies from low to high (and back again) according to a smooth curve called a sine wave.
- The rule of 12th's approximates a quarter sine wave
 - Divide time from low to high tide into six segments (~ one hour segments).
 - The change after each segment (hour) expressed as a fraction of 12:

First hour	1/12
Second hour	+2/12
Third hour	+3/12
Fourth hour	+3/12
Fifth hour	+2/12
Sixth hour	+1/12



Summary

- You should always know:
 1. Where are we?
 2. How are we moving (direction and speed)?
 3. When will we get there?
 4. What risks are we taking?
- Kayak Navigation: the tools to answer those questions:
 - Orientation
 - Locations and Directions
 - Moving consciously across the water
 - Dealing with the environment

Next Steps

- You can not learn navigation by listening to a lecture. You must go out and practice.

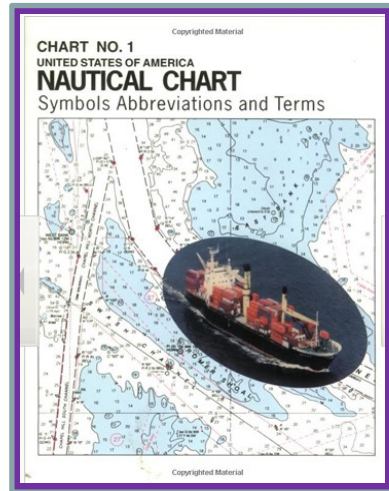
- Get a chart for local waters you enjoy ... make sure its big open waters with lots of interesting features.
- Study the chart with a copy of “chart 1” in hand and learn the symbols.

- Get a compass and play with it until its use is second nature.
 - Setting and holding a heading
 - Moving between true and magnetic bearings
 - Triangulation

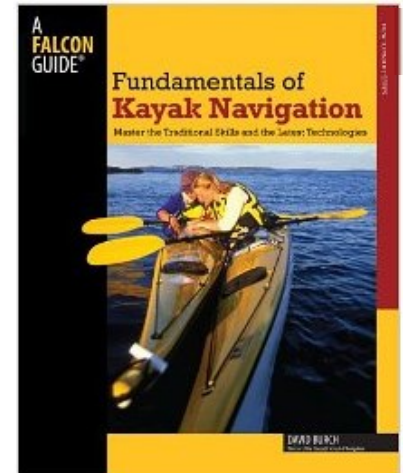
- Routinely track weather, current, and tide forecasts for interesting areas ... get familiar with the jargon

References

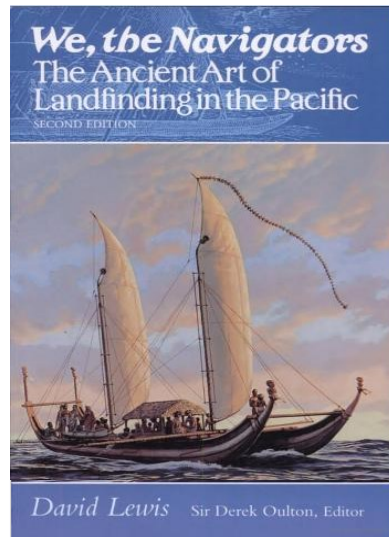
Chart 1 ... all the symbols found on a NOAA nautical chart. PDF available online from NOAA.



David Burch's classic reference book on kayak navigation



We the navigators by David Lewis ... A study of the greatest navigators in human history



How to read a nautical chart Annotated Chart 1 for U.S. and Canada plus fascinating background on Charts

