Bathymetry Data Collection for Subaqueous Soil Mapping

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Rhode Island

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Overview of Method

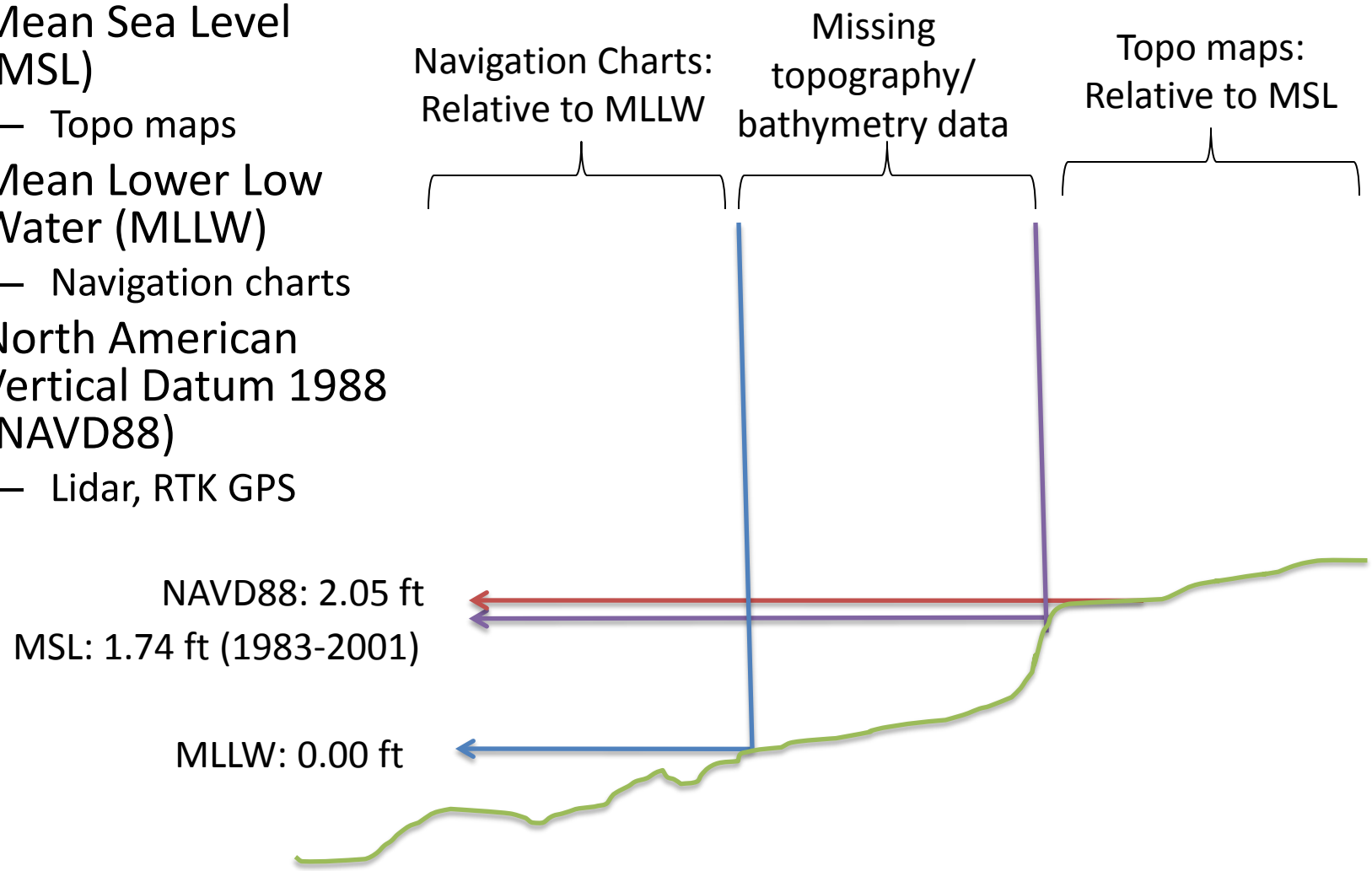
- Collect tide data
- Collect bathymetry data in tracks
- Correct to a vertical datum (NAVD88)
- Correct bathymetry data to tides
- Export as a point file (x,y,z data)

Tidal Datums

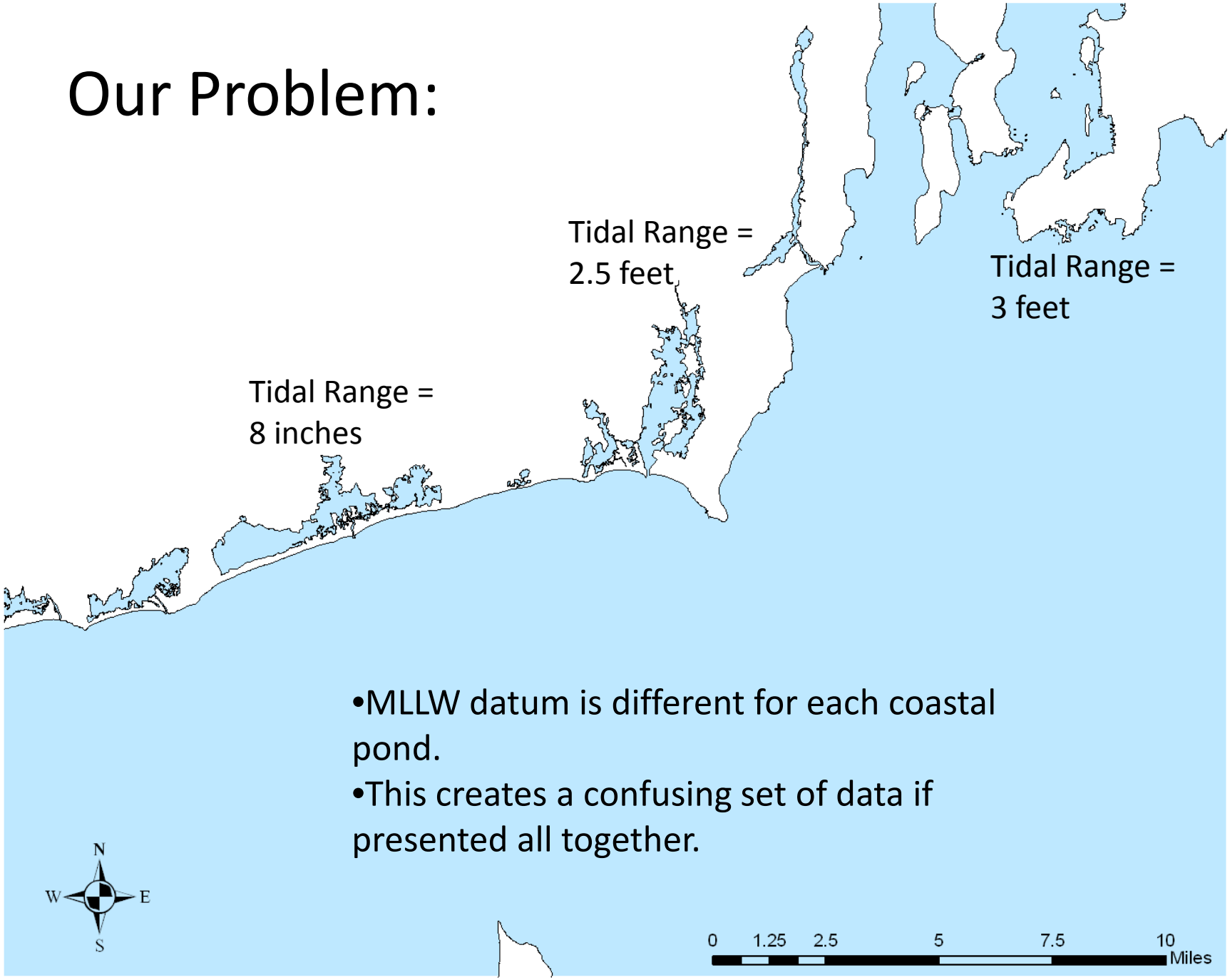
- Mean Sea Level (MSL)
  - The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch (19 yrs).
    - Shorter series are specified in the name; e.g. monthly mean sea level and yearly mean sea level.
- Mean Lower Low Water (MLLW)
  - The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch.

Elevation Datums

- Mean Sea Level (MSL)
  - Topo maps
- Mean Lower Low Water (MLLW)
  - Navigation charts
- North American Vertical Datum 1988 (NAVD88)
  - Lidar, RTK GPS



Our Problem:



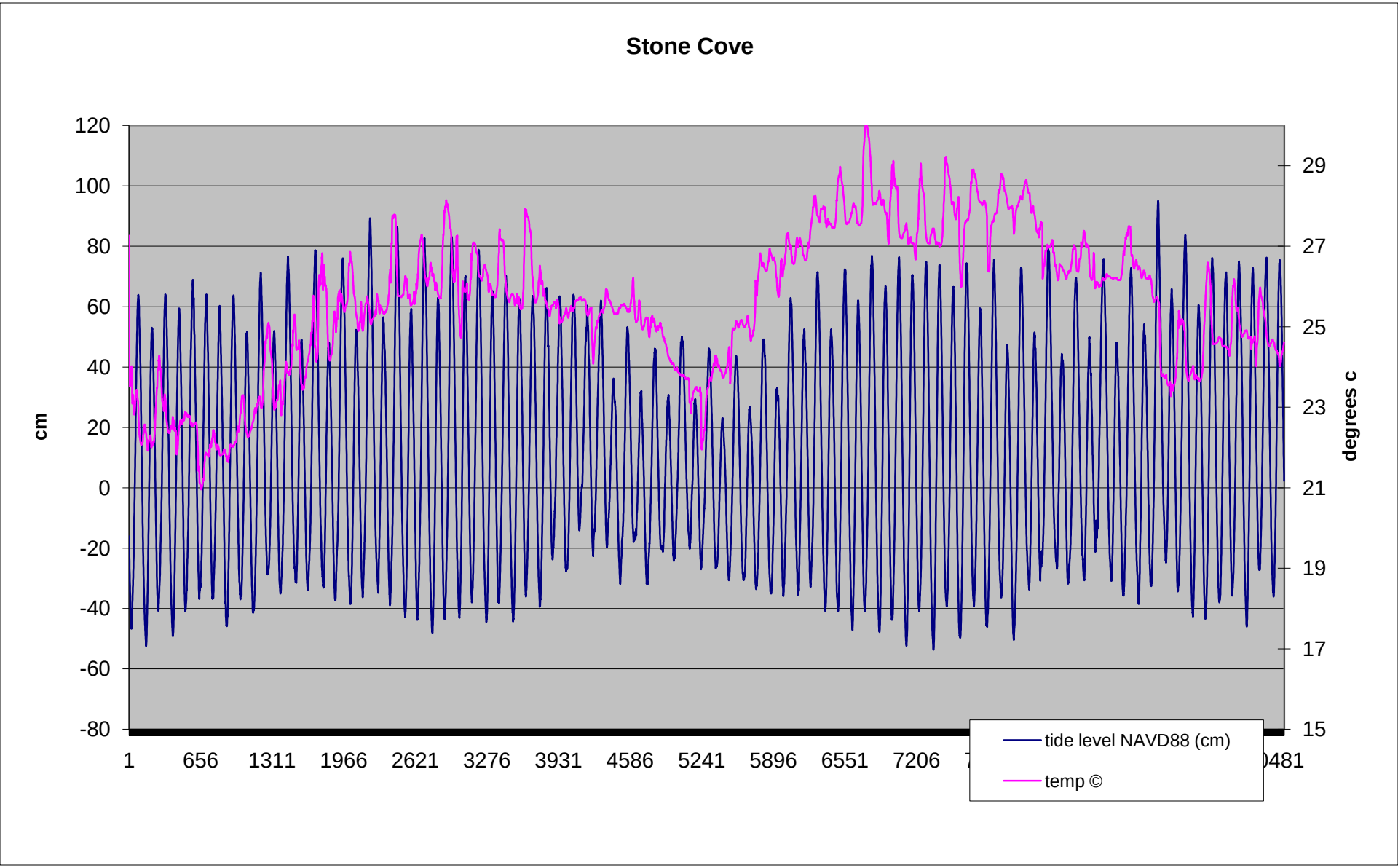
- MLLW datum is different for each coastal pond.
- This creates a confusing set of data if presented all together.

NAVD88

- Seamless topo/bathy
- Same datum from one water body to the next
- BUT
  - Maps NOT used for navigation
  - 0 feet NAVD88 ≠ 0 feet MSL
    - Does not necessarily indicate intertidal above 0 ft.
  - The general public does not understand NAVD88, most understand mean sea level
    - Depending on your user you may want to provide a map in MSL or MLLW as well
- Inland and freshwater areas will need to be tied to an average water level

1. Tides

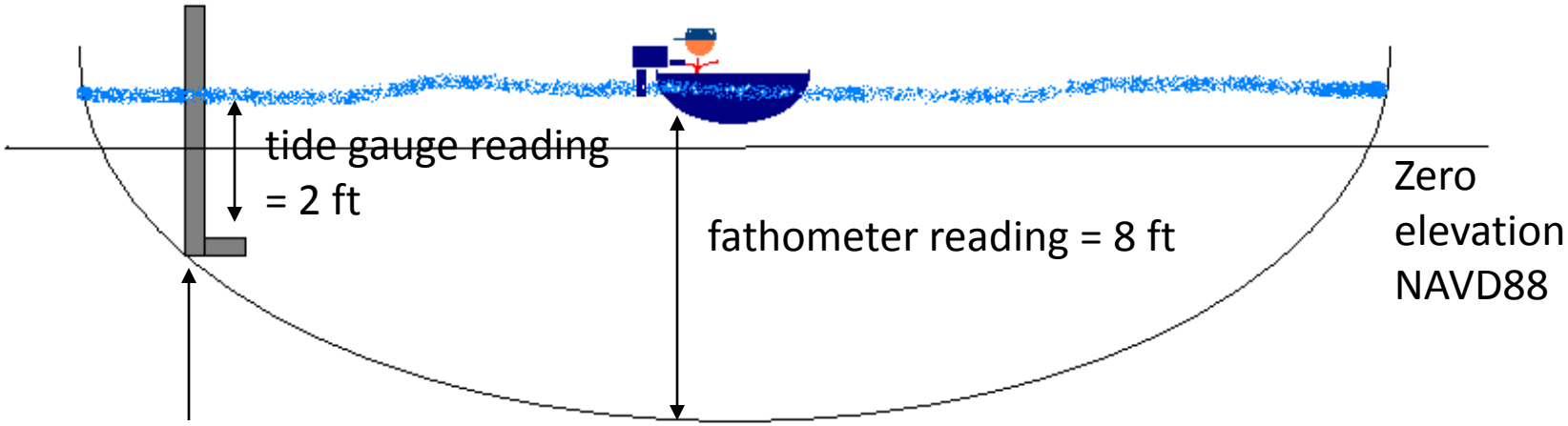
- Set tide gauges during the time of bathymetry data collection
- Be sure gauge will be underwater through the entire tidal cycle
- Measure elevation of tide gauges to tie into NAVD88 datum
- Multiple tide gauges may be necessary depending on size and shape of water body
  - No more than 1 mile apart
- One month of tidal data is beneficial to determine MSL and MLLW for the area
- Some tide gauges require barometric pressure correction


Stone Cove
cm
degrees c
120
100
80
60
40
20
0
-20
-40
-60
-80
29
27
25
23
21
19
17
15
1
656
1311
1966
2621
3276
3931
4586
5241
5896
6551
7206
tide level NAVD88 (cm)
temp ©

Tide elevation above zero NAVD88 = 2+(-1) = 1

At 10:00, water depth beneath boat = 8 – 1 = 7 feet below zero NAVD88

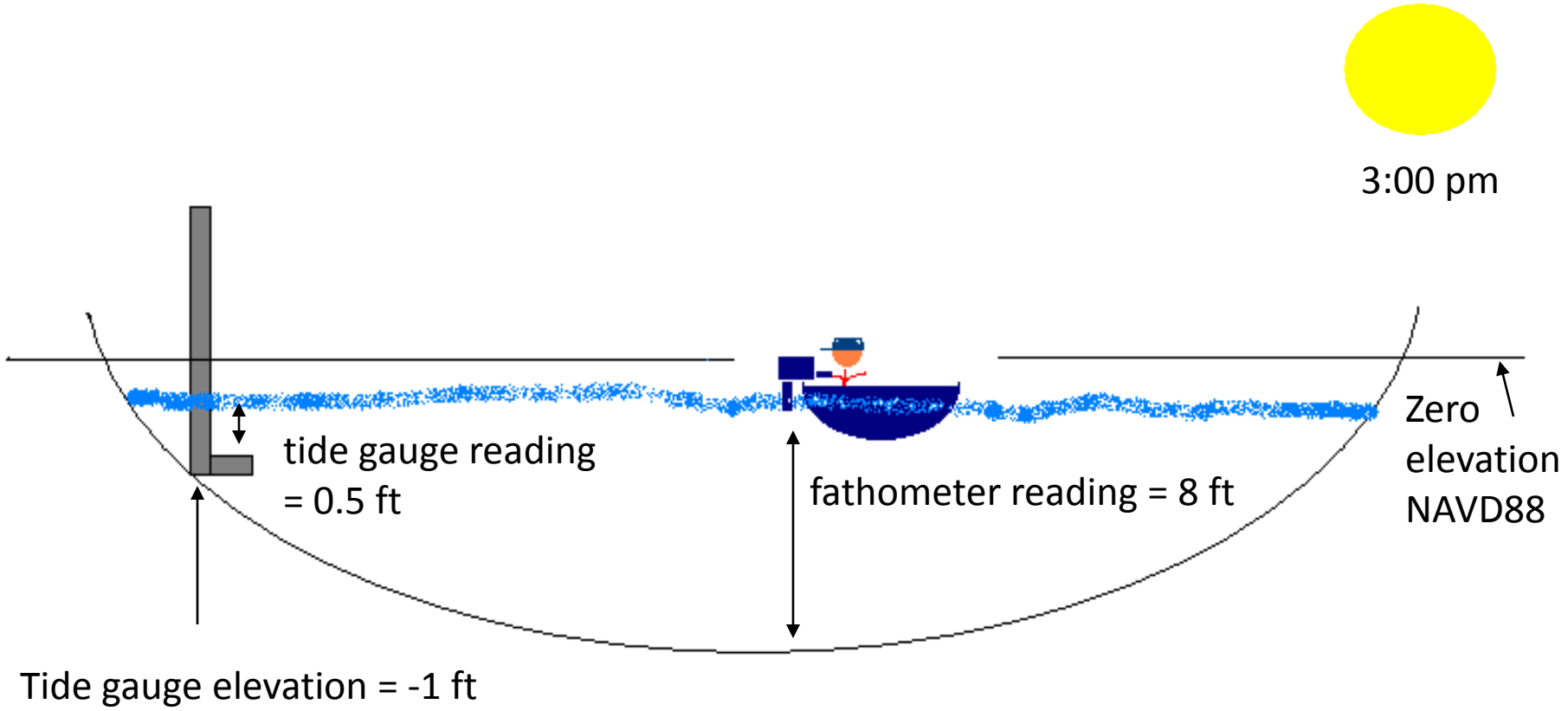
10:00 am



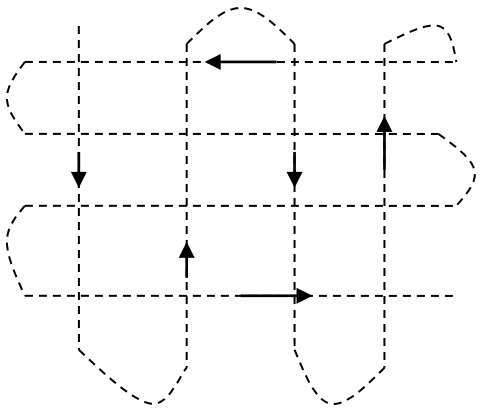
Tide gauge elevation = -1 ft

Tide elevation below zero NAVD88 = 0.5+(-1) = -0.5

At 3:00, water depth beneath boat = 8 – (-0.5) = 8.5 feet below zero NAVD88



2. Bathymetry data collection



- Sounder or Chartplotter with GPS and data recording/transferring capabilities
- Record depth every 5 - 10 seconds
- Travel at 4-6 mph
- Criss-cross pattern


N
0
250
500
1,000
Meters

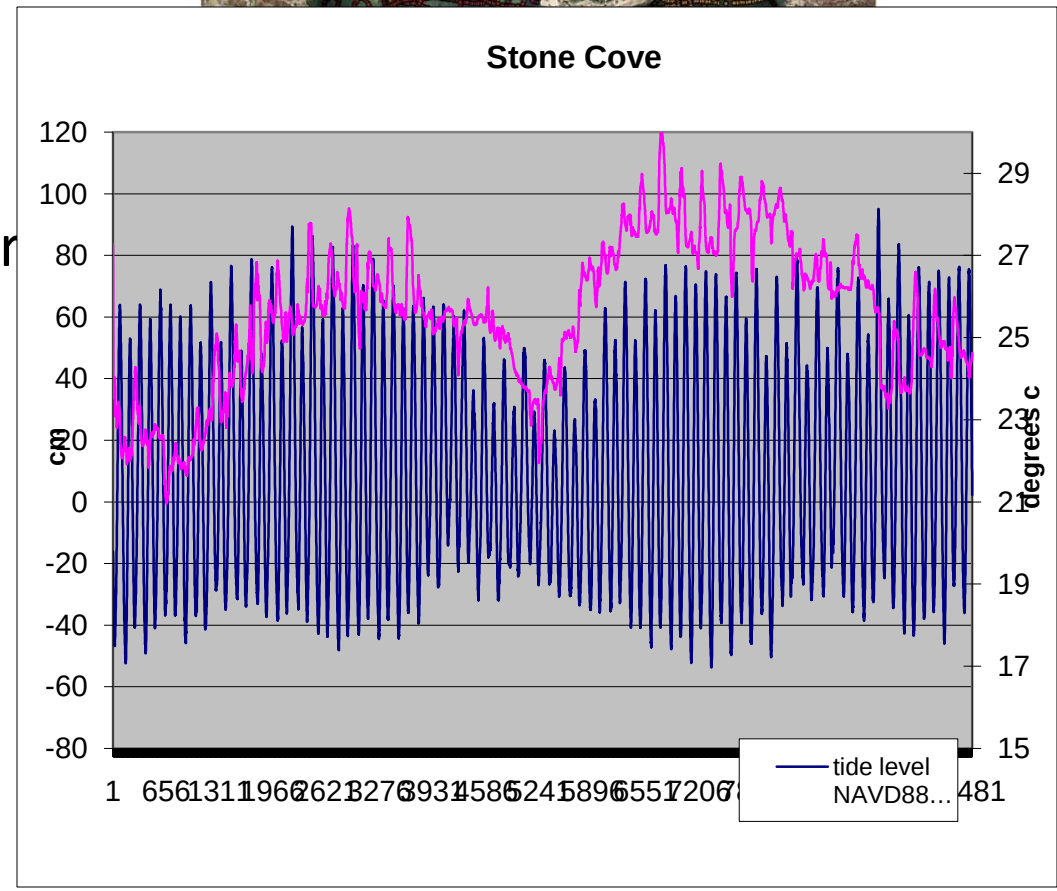
- Verify water depth manually and determine draft or offset
  - Preferably at data collection speed and weighted with the data collection personnel

Vegetation

- Submerged aquatic vegetation (SAV) interferes with acoustic depth measurements
  - If annual vegetation, perform data collection in winter months when growth is minimal
  - If persistent, manual measurements are necessary

Data Download

- Bathymetry track lines
  - Mapsource software for Garmin
- Tide gauge data
  - Levelogger software for Levelogger and barrologger
- Tide gauge elevation
  - RTK download



Correct tide data to NAVD88

time	tide gauge reading (ft)	decimal time	RTK tide gauge elevation	total tide elevation (NAVD88)
11:19:03	2.31	11.32	-0.693	1.617
11:25:03	2.47	11.42	-0.693	1.777
11:31:03	2.5	11.52	-0.693	1.807
11:37:03	2.5	11.62	-0.693	1.807
11:43:03	2.56	11.72	-0.693	1.867
11:49:03	2.51	11.82	-0.693	1.817
11:55:03	2.49	11.92	-0.693	1.797
12:01:03	2.51	12.02	-0.693	1.817
12:07:03	2.51	12.12	-0.693	1.817
12:13:03	2.49	12.22	-0.693	1.797

time	tide gauge reading (ft)	decimal time	RTK tide gauge elevation	total tide elevation (NAVD88)
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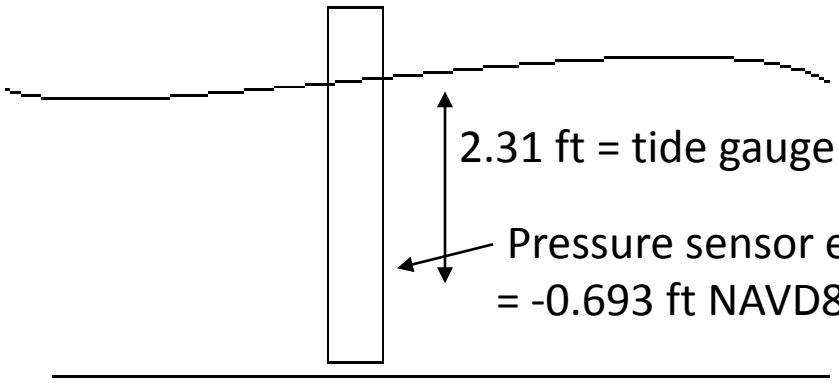
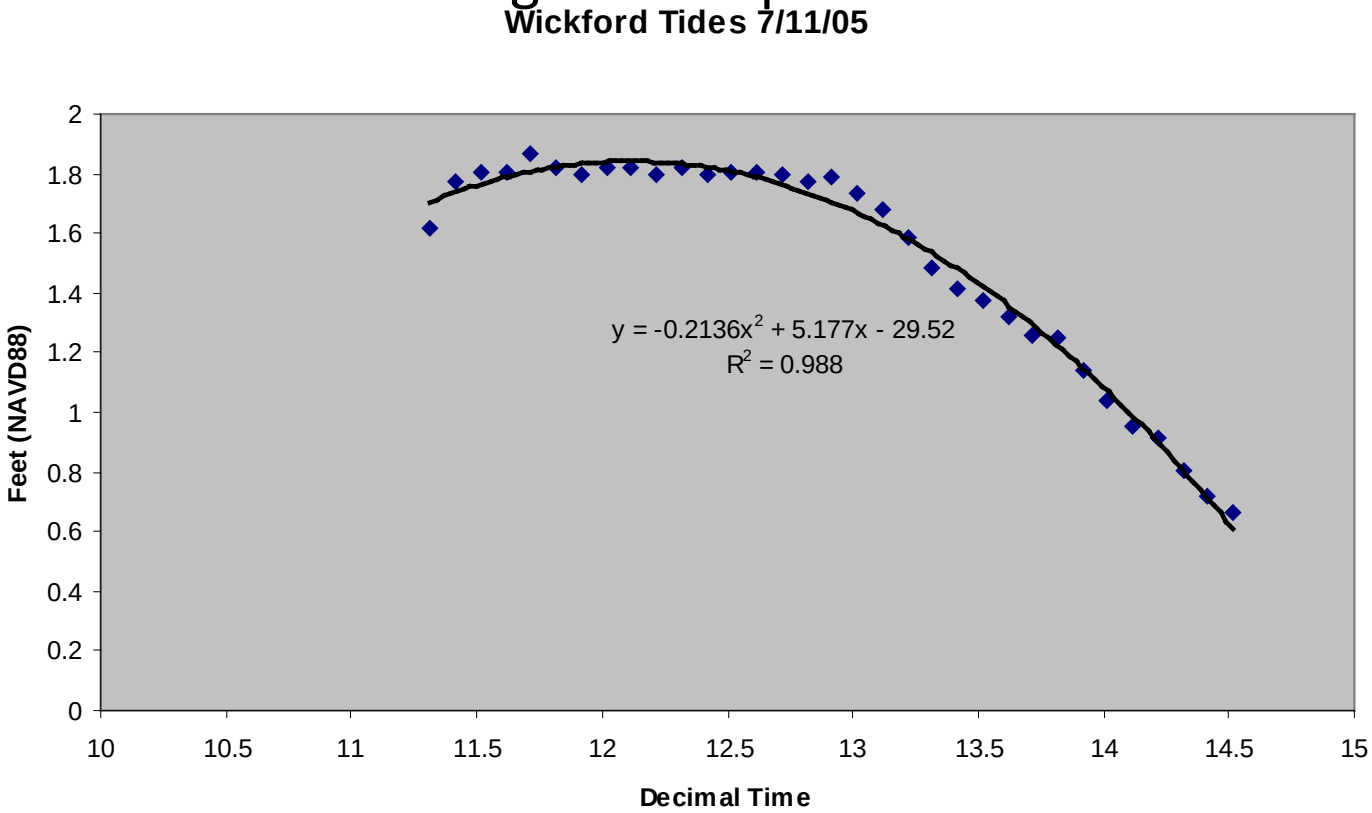
11:25:03	2.47	11.42		
11:31:03	2.5	11.52		
11:37:03	2.5	11.62		
11:43:03	2.56	11.72		
11:49:03	2.51	11.82		
11:55:03	2.49	11.92		
12:01:03	2.51	12.02		
12:07:03	2.51	12.12		
12:13:03	2.49	12.22	-0.693	1.797

Tide elevation = 1.617 ft NAVD88 (2.31 + -0.693)



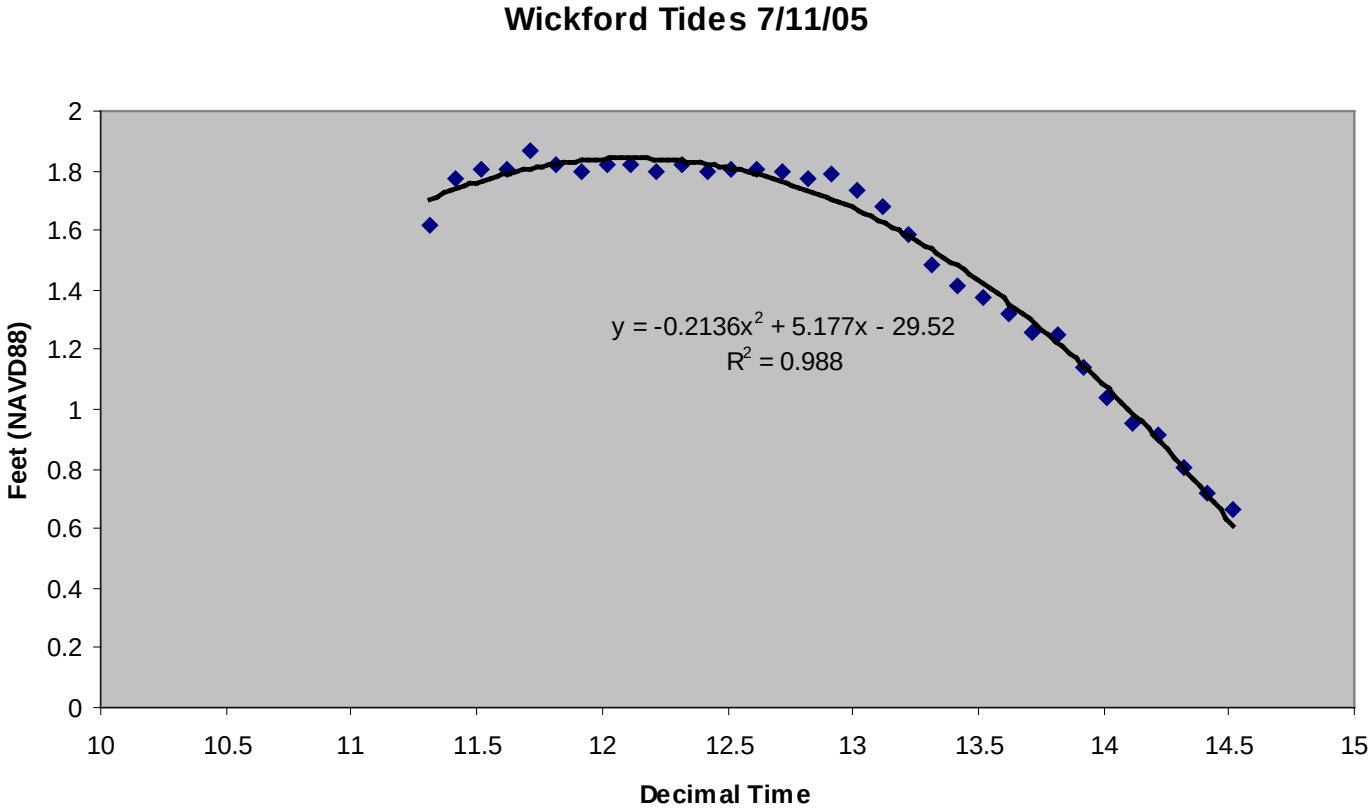
Graph corrected tide data

- Convert times for tide gauges and mapping depths to decimal hours using equation (time-INT(time))*24=decimal time.
- Graph the decimal time and the water depth from the corrected tide gauge information as an x-y graph.
- Add a trendline and get the equation.

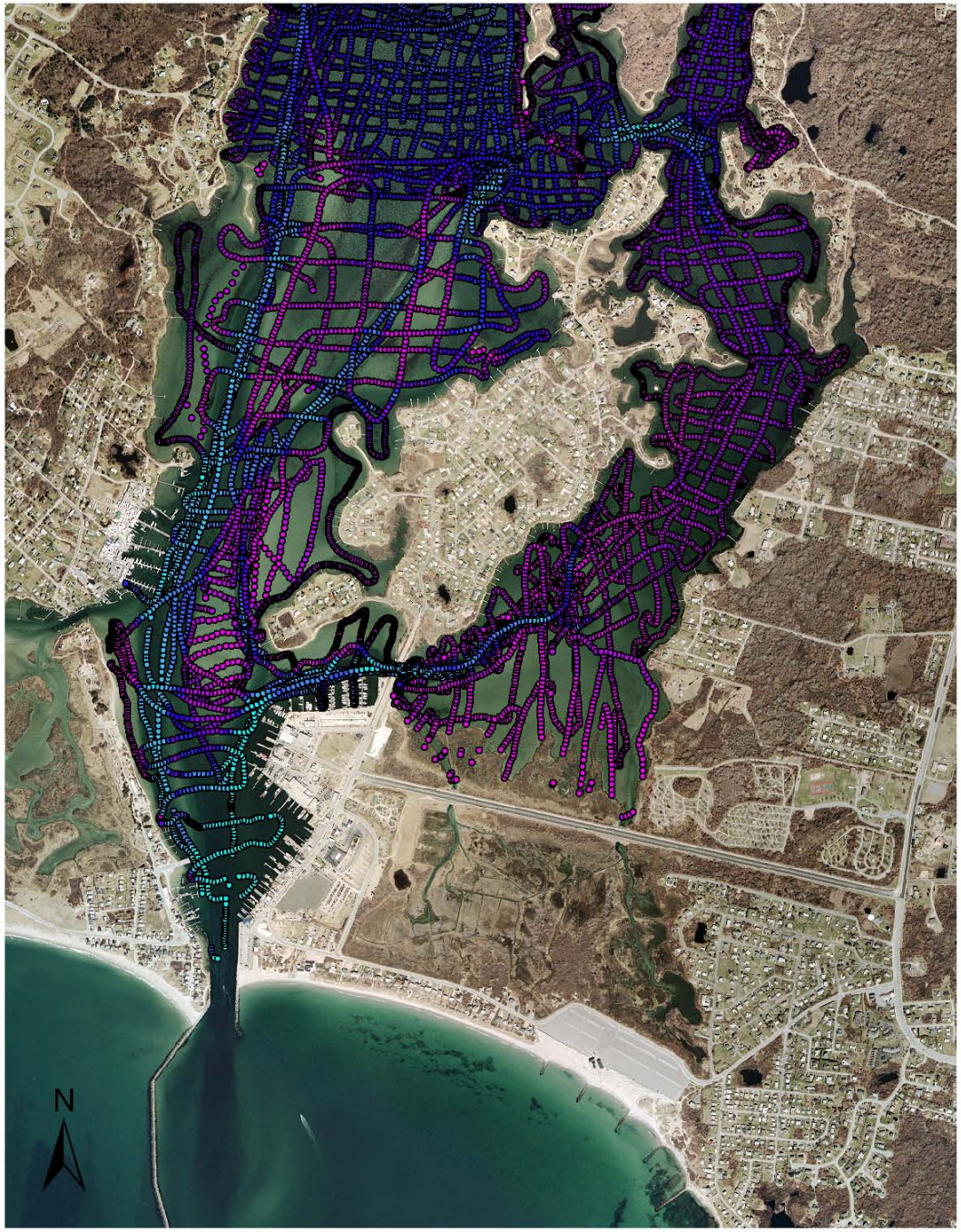


Correct tracklog data for tide

- Use the equation of the trendline and plug in decimal times of each depth reading from the Garmin. This will give you the approximate tide height above or below zero at that time.
- Subtract this correction number from the depth reading from the Garmin. This should give you the corrected depth readings.



Y_PROJ	X_PROJ	depth reading (ft)	Date	Decimal time	tide correction equation = tide elevation at each time	correct depth
					y = -0.2136x2 + 5.177x - 29.52	y = depth reading - tide correction
179313	343306	17.16	7/11/2005	11.11	1.630	15.53
179244	343355	17.78	7/11/2005	11.11	1.631	16.15
179173	343401	17.68	7/11/2005	11.11	1.633	16.05
179064	343433	16.63	7/11/2005	11.12	1.635	14.99
178412	342965	4.82	7/11/2005	11.50	1.768	3.05
178446	342960	5.48	7/11/2005	11.51	1.769	3.71
178474	342983	6.46	7/11/2005	11.51	1.770	4.69

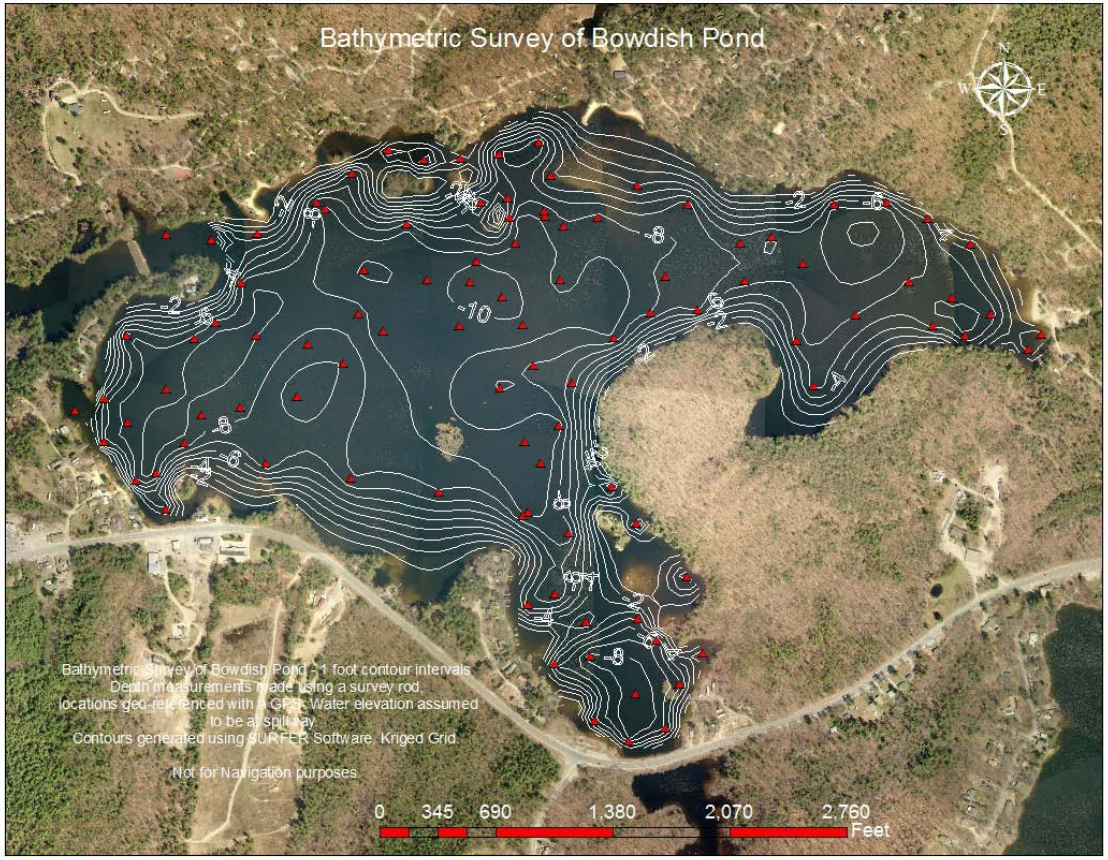

N
0
250
500
1,000
Meters

Other methods

- Hypack software
- Direct connection of fathometer to RTK
- Multibeam fathometer
- Survey using total station

Freshwater

- No tides, but be aware of water fluctuations seasonally
- Determine a vertical datum that would work for you
  - (NAVD88 might not be your answer)




Questions?