Tides vs Elevations - What's the Difference?

By Joe Burnett

Along the coastlines, everyone is familiar with tides and how they influence the water level. However, in inland situations along river systems and reservoirs, elevations are used to determine the water level or water surface. These Elevations are usually referenced to a height (elevation) above mean sea level (MSL). Mean sea level, depending on where you are located, is often the same as NGVD 29 (National Geodetic Vertical Datum of 1929).

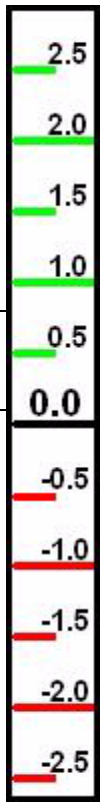
In HYPACK®, we give you the ability to apply either of these water level references to the collected depth data. we do this by creating tide files. Within HYPACK®, a tide file can either have tide information or elevation information. Just be aware of which type of water level information you are inputting into the tide file.

This article will begin a series of articles that will try to explain how HYPACK® applies these water levels, where we apply them, and how you can set up these tide files.

TIDES

Tides fluctuate above and below a zero point, that is usually referenced to the 0.0 of mean lower low water (MLLW). However, your vertical datum may differ from this value.

FIGURE 1. *Sample Tide Staff*

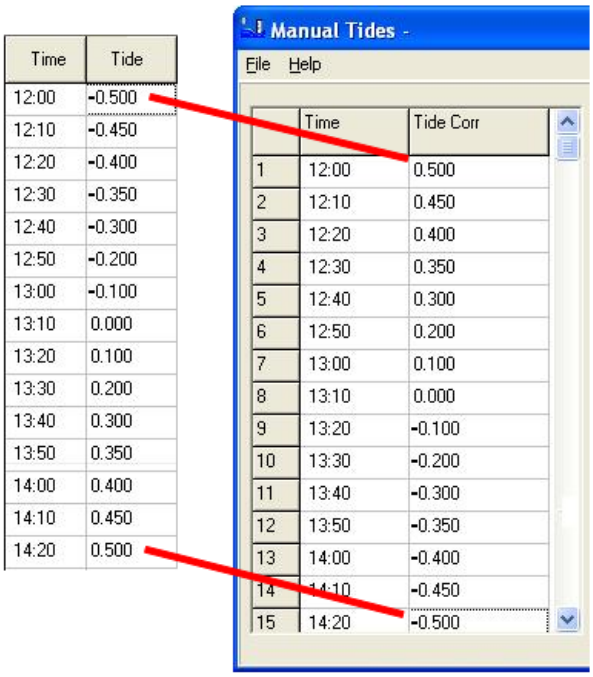


As you can see from the tide staff in Figure 1, the readings on a typical tide staff are marked as positive above 0.0 and negative below 0.0. When the readings are recorded, they are recorded just as they were read from the tide staff. Tide readings are usually required each time the water level changes by 0.1. This could be every few minutes, or an hour or more apart. Most electronic tide gauges record the tide values at rates of every 1 minute, 6 minutes, 10 minutes, or on the hour.

Note: It may be necessary to record tide levels at multiple locations, depending upon the extent of the area being surveyed, and the distance offshore.

Here's where tides get tricky (at least, to me they do). When you create a tide file (for tides) in a HYPACK® tide program, you must invert the tide values by reversing the sign.

FIGURE 2. *Actual Tide Readings vs Tide Corrections in HYPACK®*



Time	Tide
12:00	-0.500
12:10	-0.450
12:20	-0.400
12:30	-0.350
12:40	-0.300
12:50	-0.200
13:00	-0.100
13:10	0.000
13:20	0.100
13:30	0.200
13:40	0.300
13:50	0.350
14:00	0.400
14:10	0.450
14:20	0.500

Manual Tides -

File Help

	Time	Tide Corr
1	12:00	0.500
2	12:10	0.450
3	12:20	0.400
4	12:30	0.350
5	12:40	0.300
6	12:50	0.200
7	13:00	0.100
8	13:10	0.000
9	13:20	-0.100
10	13:30	-0.200
11	13:40	-0.300
12	13:50	-0.350
13	14:00	-0.400
14	14:10	-0.450
15	14:20	-0.500

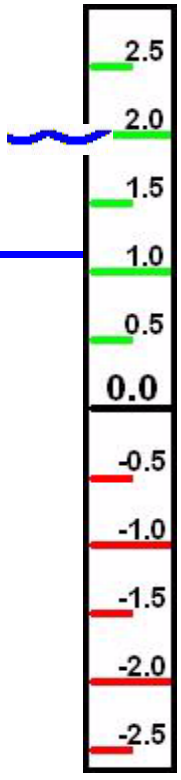
Notice the reversal of the signs for the HYPACK® Tide File.

This is done because, in HYPACK® we add corrections to the raw depths and you are trying to get the depths referenced to the zero point of MLLW (or Local Vertical Datum).

For example: If the water level on the tide staff read 2.0, and a depth of 10.0 was recorded, this would be equivalent to 8.0, if the gauge had read 0.0.

Water Depth with respect to 0.0 MLLW = Depth +Tide Correction

10.0 + (-2.0) = 8.0



ELEVATIONS

Water levels or water surfaces (as they are referred to on the inland river sytems), are usually based on their height above mean sea level (MSL, which could also be equal to NGVD 29). One of the main differences between tidal influenced waterways and elevation influenced waterways, especially on rivers, is that while tides cause the water level to rise and fall, the water surface of a river normally “slopes downward” linearly, as the river goes downstream. There is normally a “known” slope to a river, based upon the severity of the terrain that surrounds it and its location with respect to the nearest tidal basin.

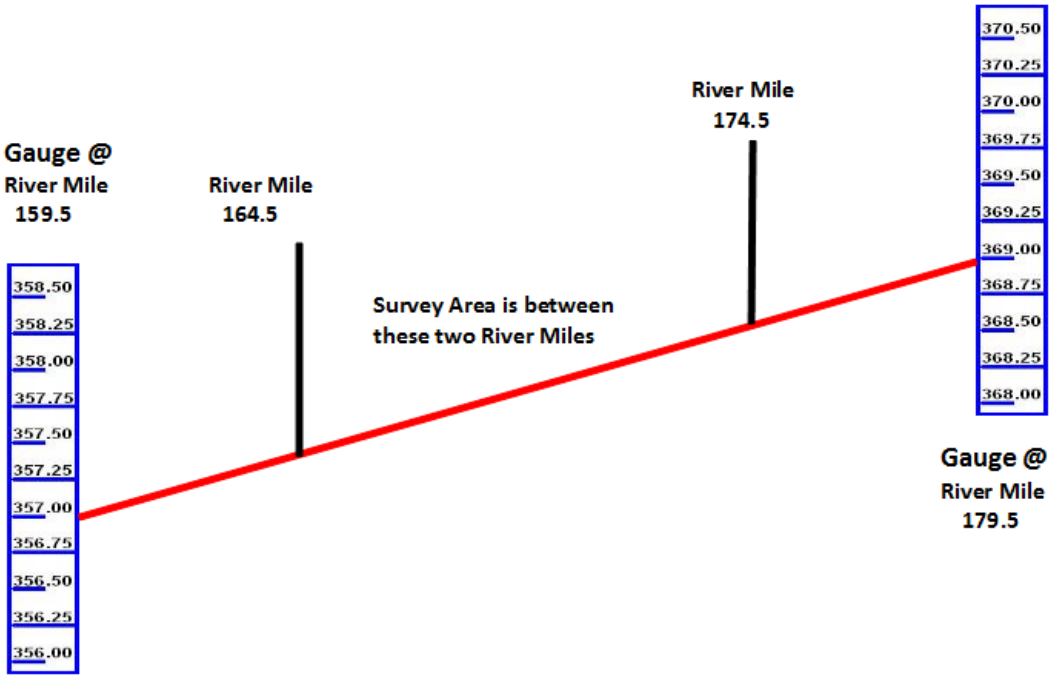
For example, on the Mississippi river (near St. Louis approximately 1150 miles from the Gulf of Mexico), the river “slopes” approximately 0.6' per mile as you go downstream. The water surface elevation is 379.23 MSL (or NGVD 29) when the gauge at St. Louis has a reading of 0.0.

However, once you get down near New Orleans (approximately 100 miles from the Gulf of Mexico), the river “slopes" less than 0.1' per mile as you go downstream, and 0.0 on the New Orleans gauge is the same as 0.0 MSL (or NGVD29). Even though it is 100 miles from the gulf, there can be a tidal influence that far up river. The slight slope of the water surface is

due to the slight slope of the surrounding terrain which causes the river to “level out” compared to the slope upriver.

When recording these water surfaces, it will be necessary to record multiple gauges--their readings, as well as their locations and times. Information from a minimum of two (2) gauges must be recorded, usually one upstream of your survey area and one downstream. This is required because of the slope of the river and your location between the upstream and downstream gauges. Both time and position are interpolated for accurate water levels.

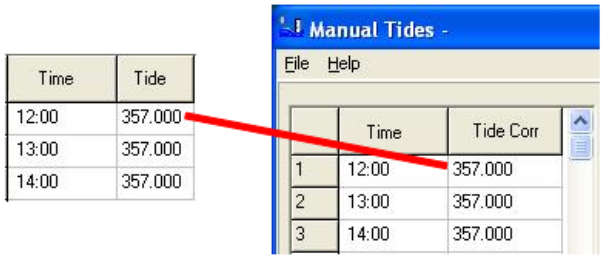
FIGURE 3. *Interpolating Tide Corrections Between Tide Gauges*



Record Gauge readings at both gauges during the time of the survey (from just before the survey started to just after) and create a tide file with the recorded elevations from each gauge, individually. Here's where tides and elevations differ.

Important! When creating the tide file for a project in elevations, *you do not “invert the signage” of the readings*, you enter them just as they were recorded.

FIGURE 4. *Creating a Tide Corrections File for a Project in Elevations*



You enter the water levels as a "positive" number, because in the SINGLE BEAM EDITOR and HYSWEEP® EDITOR we *add* the correction to the raw depth.

If the water level on the gauge read 300.00, and a depth of 50.0 was recorded, because we *add*, we must now *invert the sign of the Depth* (instead of the tide value), in order to attain the final Z-value, in elevations.

Using the same equation as we used for the tidal-based tide file:

Water Depth with respect to 0.0 MSL (or Local Vertical Datum) = Depth + Tide Correction

-50.00 + 300.00 = 250.00 MSL

INVERTING THE SIGNS

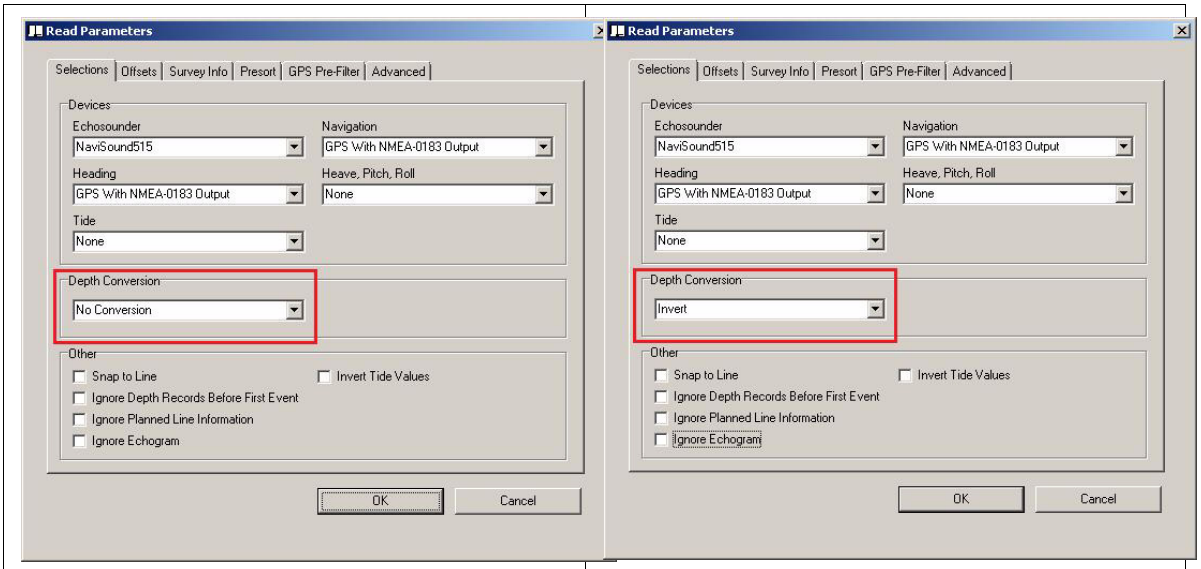
In order for HYPACK® to keep the same internal equation, we just "invert" the sign in either the depth or tide to accommodate for the vertical basis in which you want your Z-value to be represented. Where does this take place? And how do I set it up?

Once you have created your tide file (whether for tides or elevations), there is one more step to ensure that your Z-values end up with the correct final format (tides or elevations).

INVERTING THE SIGN IN THE SINGLE BEAM EDITOR

In the SINGLE BEAM EDITOR Read Parameters, the Selections tab includes a Depth Conversion option. Choose ‘Invert’ or ‘No Conversion’.

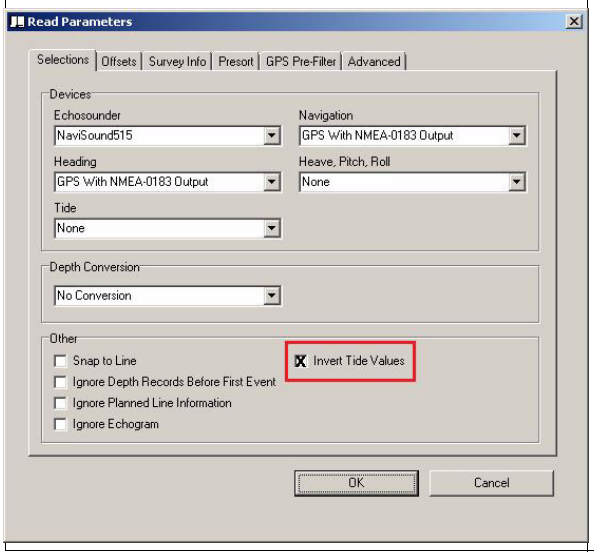
FIGURE 5. *Tidal-based Setup (left) vs Elevation-based Setup (right))*



If, by chance, when you entered your tide values, you forgot to invert the tide readings, you can check the "invert tide values" box and HYPACK® will invert them for you.

Instead of inverting the tide, this will invert the depth.

FIGURE 6. *Inverting the Tide Values in SBMax*



Now the 3 main SBMAX windows will appear on your screen.

Right-click on the Profile Window and select View Options (Figure 7). Select the correct way to display your depths:

- **Soundings as Depths** displays larger soundings toward the bottom of the graph.

- **Soundings as Elevations** inverts the graph (not the sounding values) so that the larger soundings are toward the top.

FIGURE 7. *Tidal-based Water Level vs Elevation-based Water Surface*

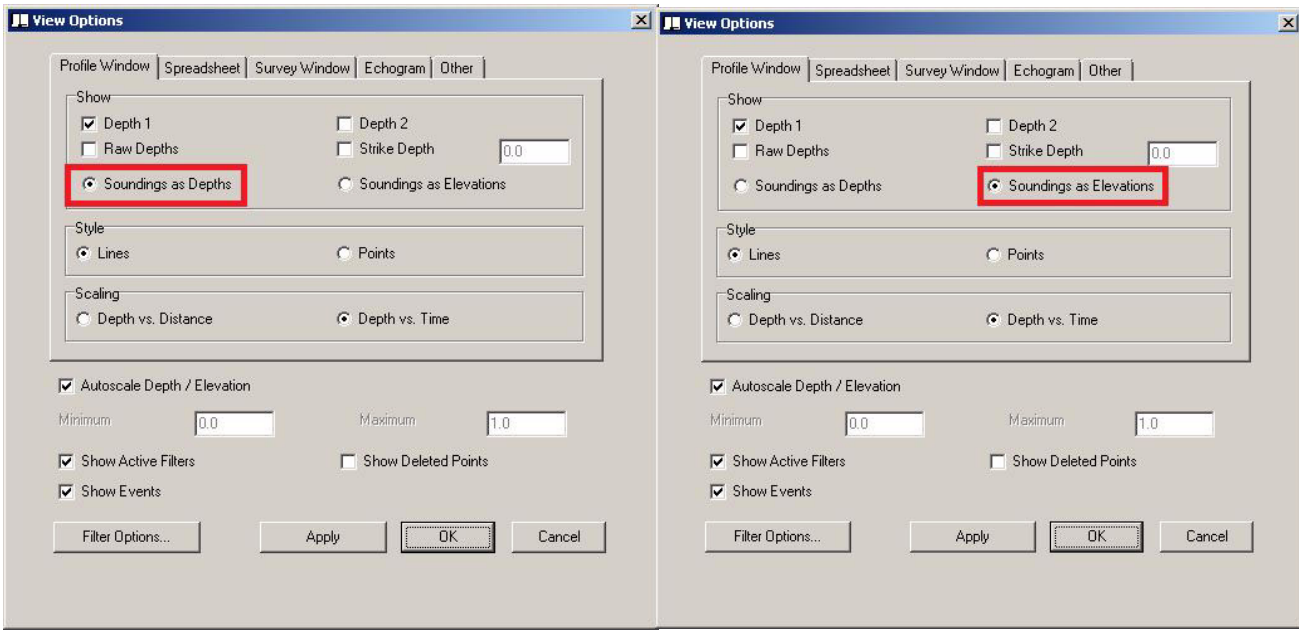


FIGURE 8. *Tidal-based Water Surface View*

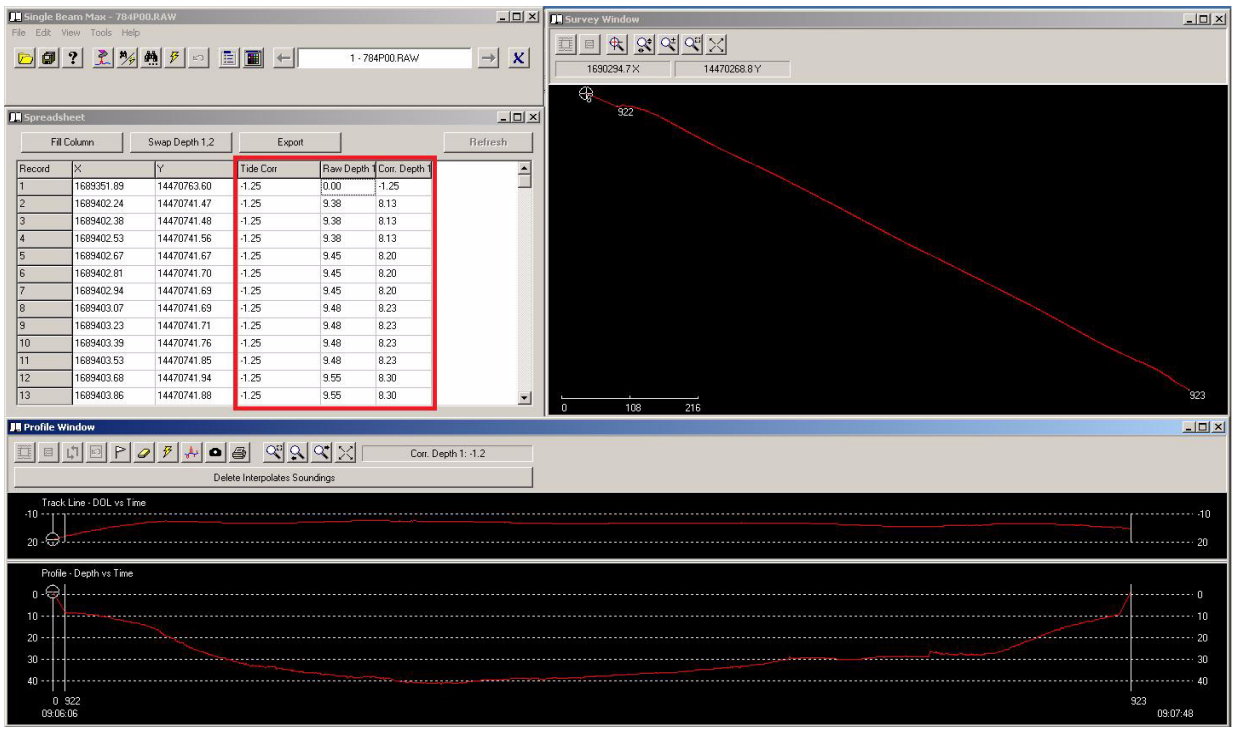
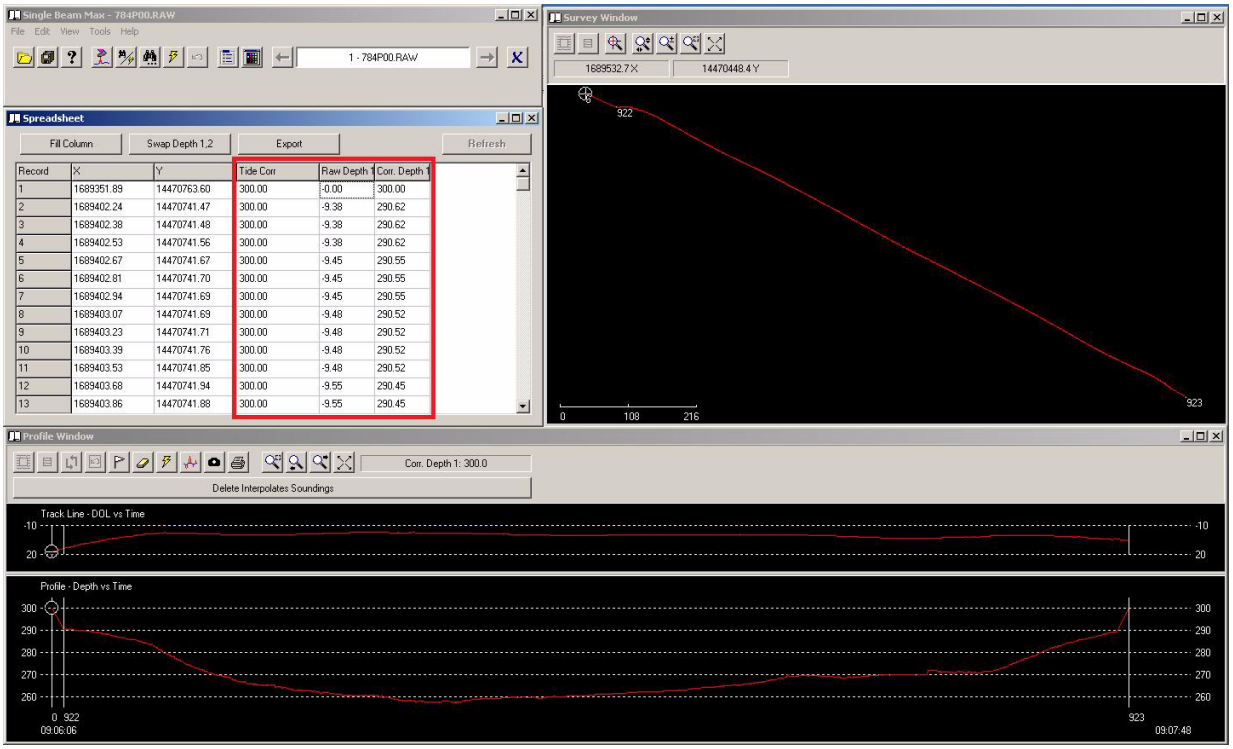


FIGURE 9. *Elevation-based Water Level View*

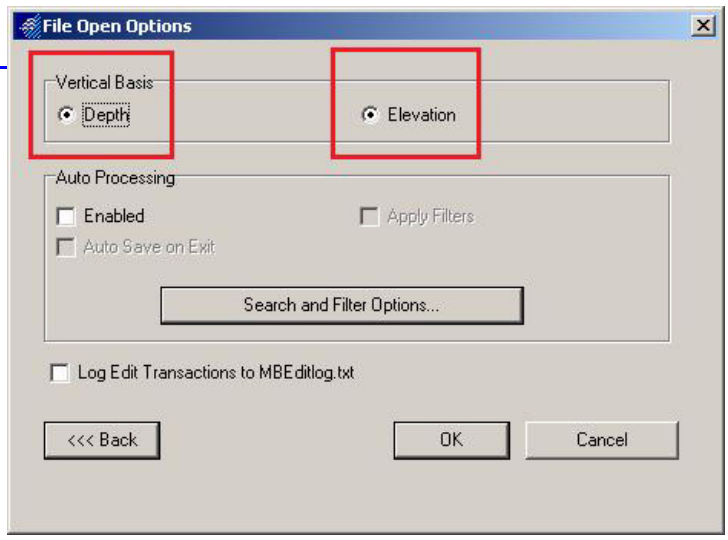


Notice in the spreadsheet, that if you add the tide correction to the raw depth, you will get the corrected depth. This works for both the tidal-based and elevation-based water levels. Pay close attention to the "signage" of the tide correction and raw depth values in each. That is where the differences between tides and elevations come in.

INVERTING THE SIGNAGE IN THE HYSWEEP® EDITOR

In MBMAX, the option is more straightforward. You either select depth or elevation when the file open options comes up.

FIGURE 10. *File Open Options in the HYSWEEP® EDITOR*



Here, "depth" refers to tidal-based water levels, where the depths will be kept as "positive" values and you will invert your tide values. "Elevation" refers to elevation-based water surfaces where the depths be inverted and the tide values will stay as they were entered in the tide program.

Again, HYPACK® keeps the same internal equation, we just either the depth or tide to accommodate for the vertical basis in which you want your Z-value represented.

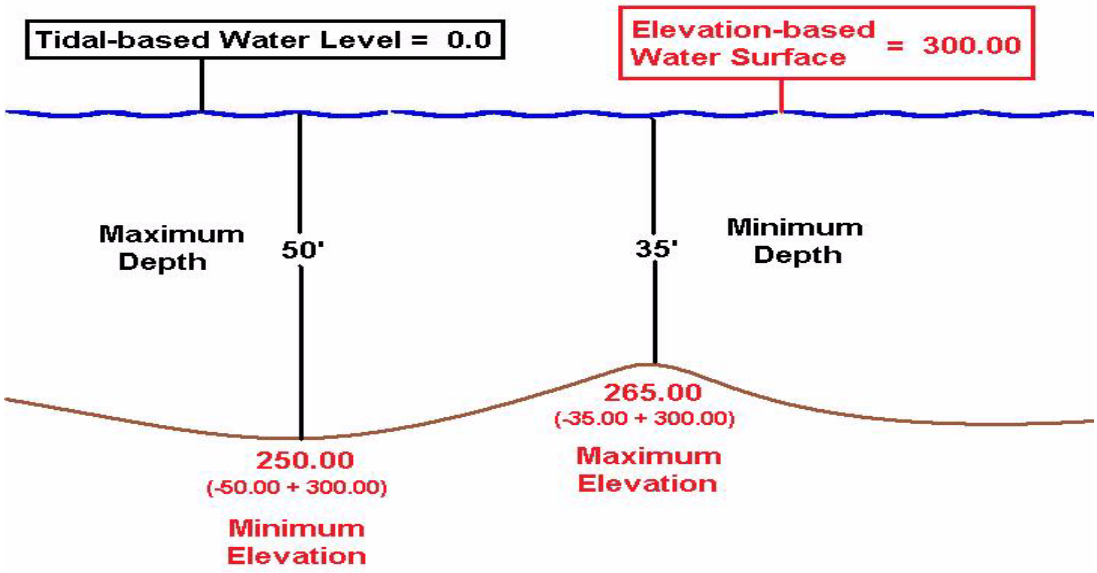
DATA THINNING

In the MAPPER program and in Phase 3 of the HYSWEEP® EDITOR, you can choose your Z-value type. This mainly focuses on whether you choose the minimum or maximum Z-value.

This is important because, depending on the water level type of your project--tide or elevation--minimum and maximum will have opposite meanings.

Tidal-based		Elevation-based
Minimum Depth (Shoal Depth)	equals	Maximum Elevation
Maximum Depth	equals	Minimum Elevation

FIGURE 11. *Tidal-based vs Elevation-based Water Surface*



The next article will deal with elevation-based water surfaces and the several different ways they can be setup and applied to your edited data.