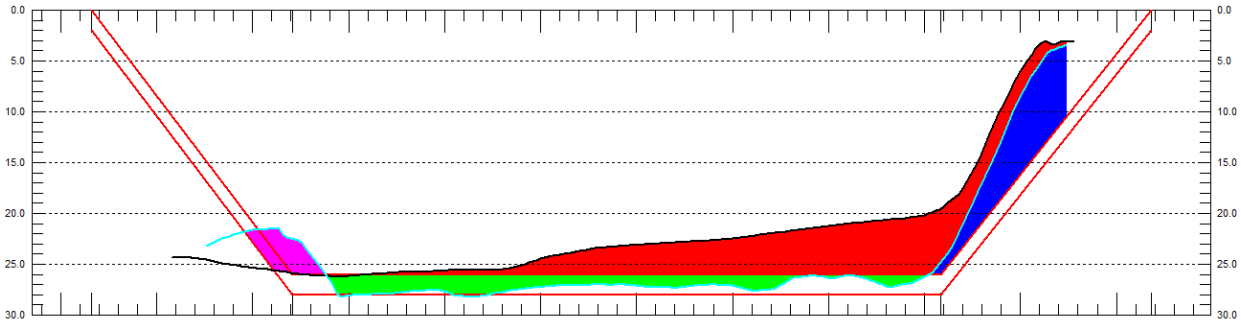
# Trends in Volume Calculations for Dredging Projects

by Pat Sanders

As the Chief Volume Guru at HYPACK, I get to talk with a lot of different hydrographers who are computing volume quantities in support of dredging projects. Based on these conversations, I wanted to write about some of the trends that I have seen happening over the last couple of years. So, here we go…!

## 1. The Move Away from Volumes by Sections to Volumes by Surface Models



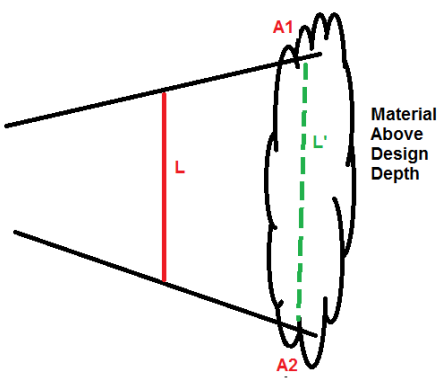

We have been computing volume quantities using a TIN MODEL for almost 20 years, but industry has been slow to move away from volumes by sections, using an Average End Area (AEA) method. When hydrographers started using multibeam systems in their everyday work, I thought it would be the end of Average End Area! I was wrong. We soon were getting calls from end-users wanting to cut slices through multibeam data in order to compute volume quantities by sections using AEA. The reasons given were:

- The engineers are used to reports by sections and we need to give them what they want.
- The contractor has a MB boat and the contracting authority has a single beam boat (or vice versa) and we need to compare sections.

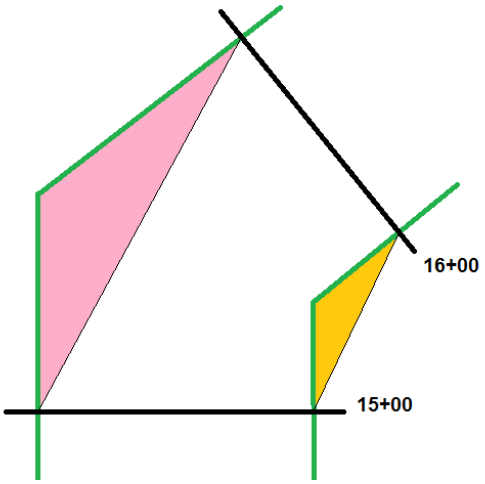
More agencies acquired MB systems and became comfortable with the results by doing statistical comparisons with their single beam systems. In addition, software packages adapted to be able to generate reports for MB volumes that listed quantities by sections.

When people ask me why I prefer volumes by TIN MODEL, I give them a couple of good reasons….

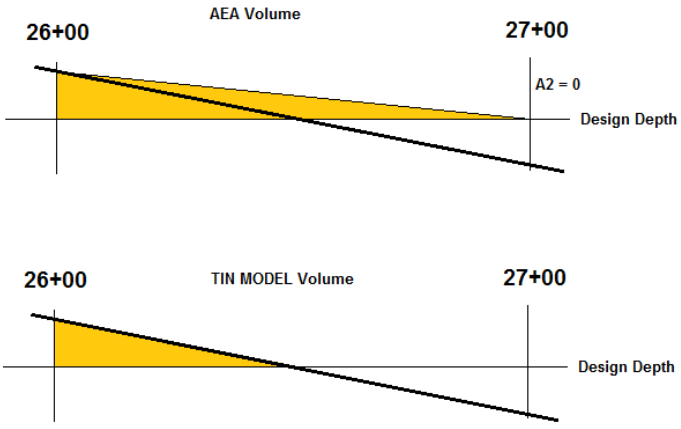
- **AEA can overstate or understate the amount of material if it is piled up along the inside or outside of a turn.** TIN MODEL will give a much more accurate number. In the graphic, AEA uses a distance between lines based on the geometry of the lines (L), and not based on where the material exists (L'). In this case AEA would understate the amount of available material.



- **AEA doesn't know anything about what happens to the channel outside the two sections.** If we just have two sections (15+00 and 16+00) and run the AEA volumes, you will be ignoring the pink area and adding material in the yellow area. Not good! The TIN MODEL can be configured so it knows the exact 3-D geometry of your channel and give you a more accurate result in areas that are complex.



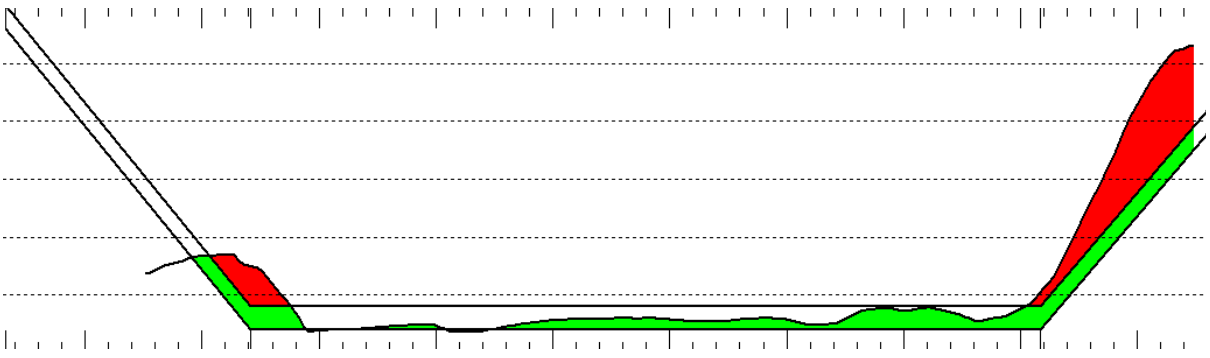

- **In AEA, you aren't going to get credit for the bottom dropping below the design surface.** In the plan view shown, the surveyed bottom passes through the design depth midway between the two sections. AEA is going to compute the area at section 27+00 as = 0. The resulting volume is shown in yellow. TIN MODEL knows exactly where the bottom passes through the design depth and gives the more accurate results.




## 2. More Usage of Contour Overdepth

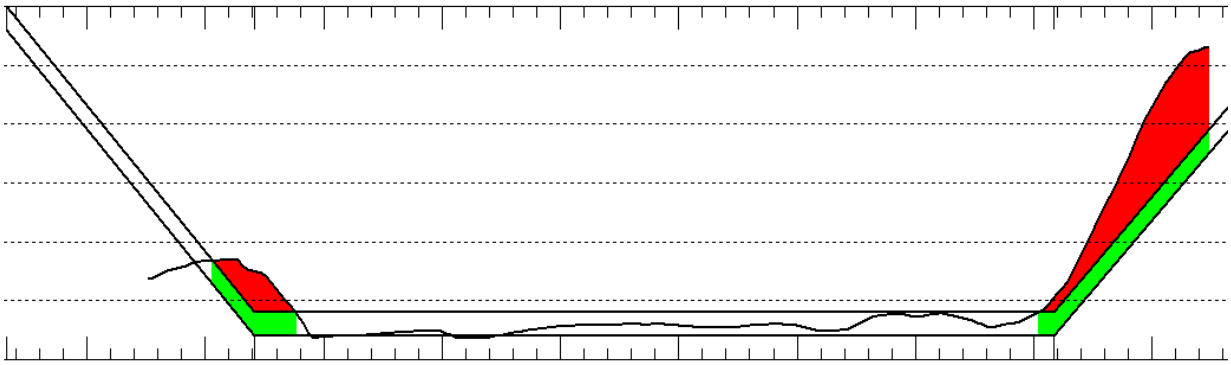
Another trend I have noticed is that more and more projects are computing the overdepth material using a technique named "Contour Overdepth". In "Non-Contour", all of the material overdepth material is computed. This is shown by the green in the following section.

***FIGURE 1.*** *Non-contour Overdepth*



Using “Contour Overdepth”, the computation of overdepth material is limited to areas where the bottom is above the design template.

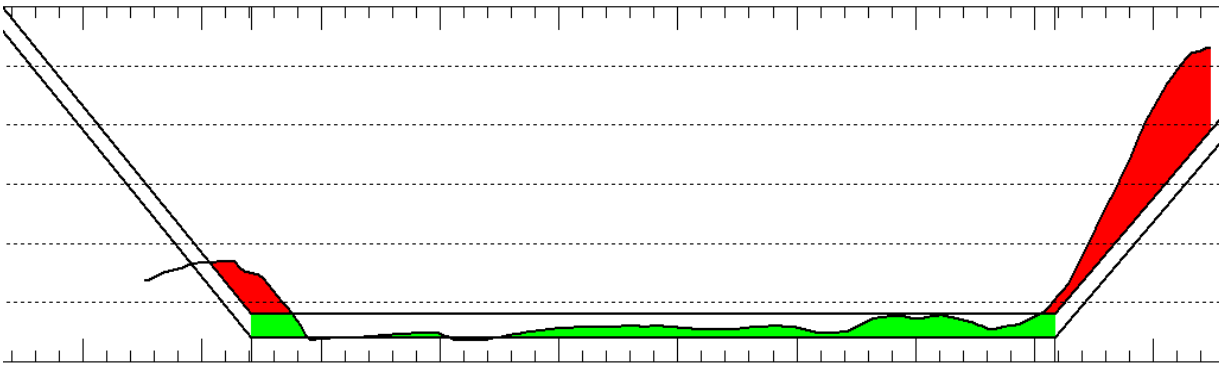
***FIGURE 2.*** *Contour Overdepth*



From the contracting agency’s point of view, I want you to remove the material above design (red). In order to ensure you have removed the material to the project depth, you’ll have to take some of the overdepth material (green) and will be paid for it. However, I want to maximize the ‘bang for my buck’, and I don’t want you removing overdepth material where it doesn’t impact the design depth.

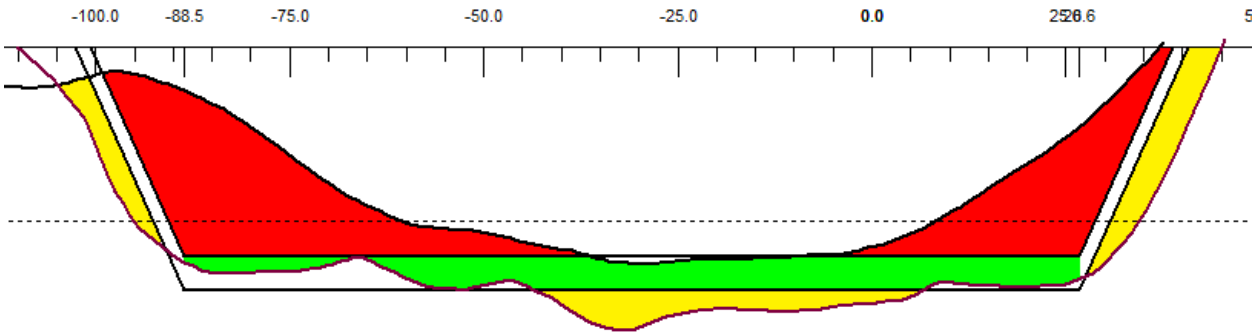
This can be a *very* large difference in the computed overdepth material. However, most contractors recognize this and make adjustments to their bids to reflect the method used to compute the overdepth.

## 3. No Overdepth Material Computed on the Side Slopes



This one has started to “pop up” more and more. We have changed a couple of the volume methods in HYPACK® to ignore the side slope overdepth material. I’m at a loss to the reasoning. The contractor has to remove the material above design on the side slopes. To guarantee they have the side slope below design, they are going to have to take some of the overdepth. Why aren’t they getting paid for it?

## 4. Penalties for Overdredged Material




Overdredged material is material that was removed beneath the allowable overdepth template (yellow). We have seen recent projects (mainly environmental dredging) where there were substantial penalties for overdredged material. The reasons are twofold:

- We have an environmental permit to dredge to a certain depth. Dredging deeper is going to stir up PCBs or other contaminants and is to be avoided.
- It took me 3 years to get a disposal area and permit. I don't want you filling up my disposal area with non-essential material.

## Conclusions

Go over the bid documents with a fine-toothed comb and make sure you understand exactly how volume quantities are going to be calculated!

*After spending a couple of hours sorting out a particular volume problem, I find myself fantasizing about a world where every channel is straight (no turns) and every design profile is a simple channel, and everybody is using a TIN MODEL for volumes…*