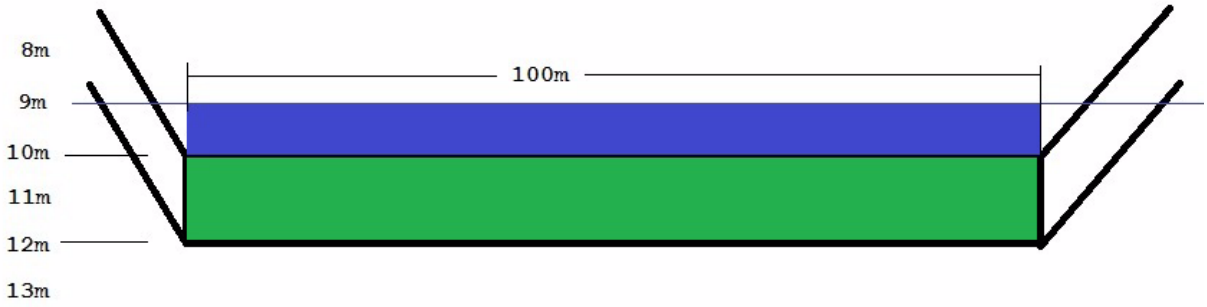
Contour Volumes of Allowable Overdepth in CROSS SECTIONS AND VOLUMES

By Volume Boy (a pseudonym…)

It's time for my annual article on 'Contour Overdepth'. In both the CROSS SECTIONS AND VOLUMES program and the TIN MODEL program, there are options to compute the Allowable Overdepth material in 'Contour' mode. When using this mode, material is only included for consideration in the Allowable Overdepth region if the surveyed bottom is above the channel design depth. In the Philadelphia Methods, this is called 'Contour' dredging. In the Standard HYPACK method, we refer to it as 'Smart' mode. In the AEA2 and AEA3 methods, it subdivides the Allowable Overdepth material into V2P (Contour) and V2NP (Non-Contour – Contour)

Let's start off by taking a look at the section below. We're only going to be looking at the center channel material.

FIGURE 1. *Section A.*

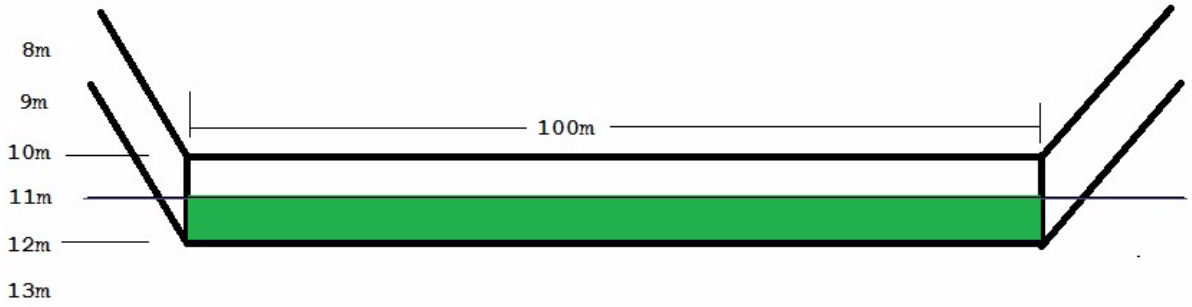


In Section A, the survey bottom is at 9m, all the way across the section. Since the surveyed depth is above the channel design depth, all of the Allowable Overdepth material (green) is included when we compute the volume using the 'Contour' method. If we had 100m between sections, the volume of Allowable Overdepth material between this and the next section would be:

$$V = 100 * 2 * 100 = 20{,}000\ m^3 \qquad \textbf{(EQ 1)}$$

Now, let's take a look at another section.

FIGURE 2. *Section B.*



In Section B, all of the surveyed bottom is beneath the channel design depth. If you were computing volume quantities using the Non-Contour method (all of the Allowable Overdepth material is included), the volume for our example would be:

$$V_{non\text{-}contour} = 100 * 1 * 100 = 10{,}000m^3 \quad \textbf{(EQ 2)}$$

If you were computing the Allowable Overdepth material using the Contour method, the Allowable Overdepth would be equal to 0m3. This is because the surveyed bottom is entirely beneath the channel design depth. Remember, when computing the Allowable Overdepth using the Contour method, only material where the bottom is above the channel design depth is included.

$$V_{contour} = 0m^3 \quad \textbf{(EQ 3)}$$

If we consider Section A our pre-dredge section and Section B our post-dredge section, you might think the amount of Allowable Overdepth removed would be the difference between the two results, as shown below:

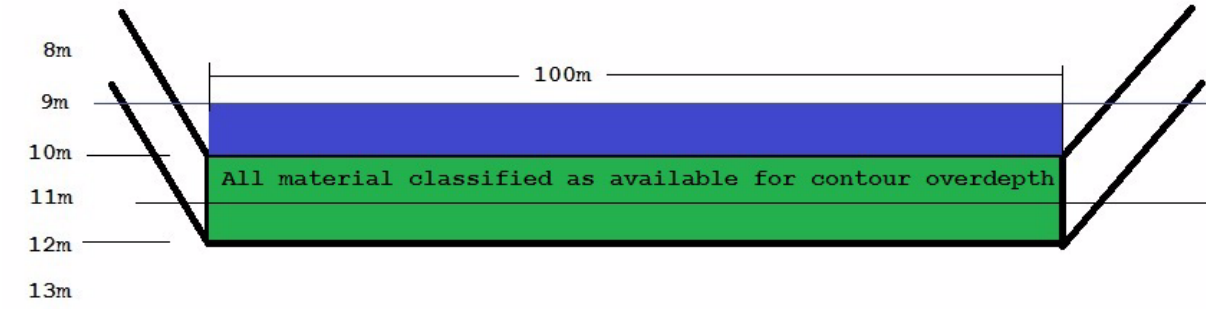
TABLE 1. *Hypothetical Post-dredge Volumes*

	Non-Contour	Contour
PreDredge Allowable Overdepth	20,000	20,000
PostDredge Allowable Overdepth	10,000	0
Allowable Overdepth Material Credited as Removed:	10,000	20,000

You would be VERY wrong!

All material is classified as available Allowable Overdepth or Non-Available Overdepth *based on the results of the pre-dredge survey*. This is an important point that a lot of people miss.

FIGURE 3. *Pre-dredge (blie) and Post-dredge (green)*



In the composite section above (both pre-dredge and post-dredge), the material in the Allowable Overdepth region is classified as either Available or Not-Available based on the pre-dredge survey. Since we are using the 'Contour' option, and since the surveyed bottom in the pre-dredge survey was above the channel design depth, all of the material in the Allowable Overdepth region is classified as 'Available'

The post-dredge survey finds that 10,000m^3 of the Allowable Overdepth was removed. If you look at the report from CROSS SECTIONS AND VOLUMES, you'll see the following:

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Dredging Quantities Summary
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Materials	Gross Material	Infill	Net Material
Total Removed To Project Depth	10300.0	0.0	10300.0
Total Pay Removed In Overdepth	**10000.0**	**0.0**	**10000.0**
Total Pay Removed	20300.0	0.0	20300.0
Total Removed	29900.0	0.0	29900.0
Total Remaining Above Project Depth .	0.0		0.0
Total Overdredged Material	9600.0	0.0	9600.0
Total Infill Material		0.0	

The 'Total Pay Removed in Overdepth' is correct at 10,000m^3.

When using the contour method and computing the volumes between a pre-dredge and post-dredge survey, you need to remember:

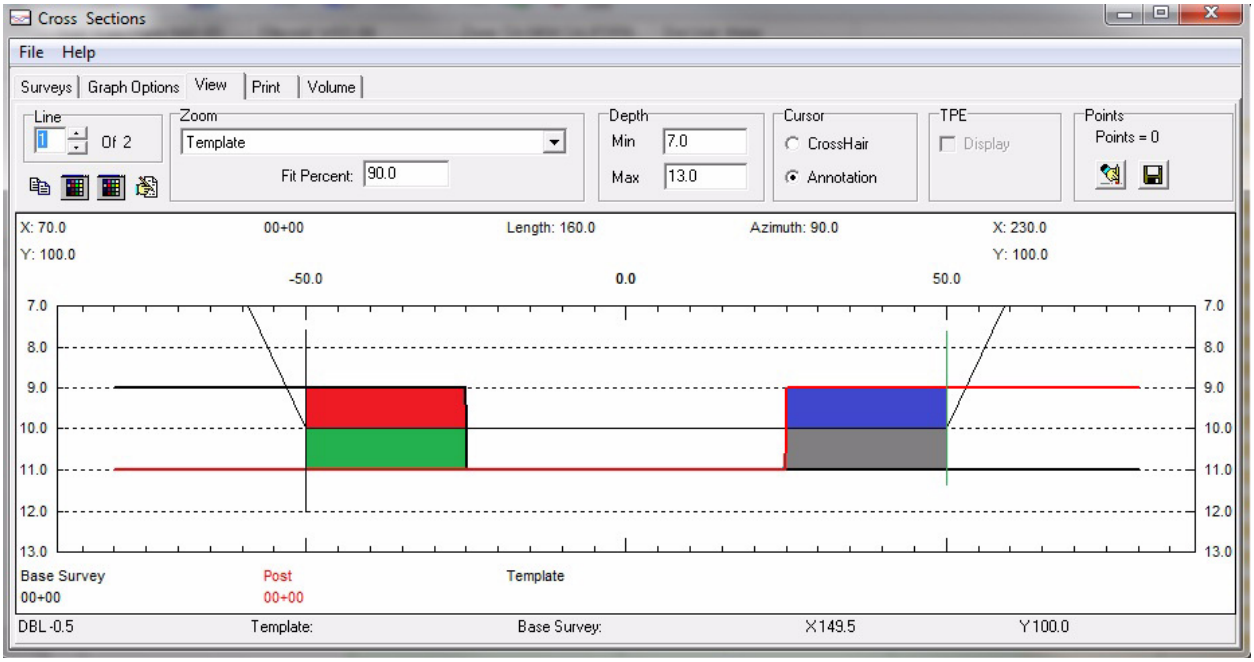
The classification of material is based upon the pre-dredge survey.

You cannot just take the results from the pre-dredge survey and subtract the results from the post-dredge survey.

Advanced Example:

You can see how even in a simple example, you need to put on your thinking cap. Now, let's see how good you are!

FIGURE 4.



My pre-dredge survey starts at 9m on the left side of the channel. It is 9m until it gets to 25m inside the left toe, when it drops down to 11m. It is then 11m all of the way across the right toe.

My post-dredge survey starts at 11m on the left side of the channel. It is 11m until it gets to within 25m of the right toe, when it rises to 9m. It is then 9m all the way across the right toe.

So, if we just look at the center channel, we haven't removed any material. We just took the material that was available in the pre-dredge survey (on the left side) and moved it over (to the right side).

Let's first look at the Non-contour result for the Allowable Overdepth material. Based on my pre-dredge survey, the material in the Allowable Overdepth region from DBL = -50 to DBL = -25 is considered as Allowable Overdepth. That material is:

$$V_{non\text{-}contour} = 25 * 2 * 100 = 2500m^3 \quad \textbf{(EQ 4)}$$

Based on my post-dredge survey, there is new infill that is equal to:

$$V_{infill} = 25 * 2 * 100 = 2500m^3 \quad \textbf{(EQ 5)}$$

So, our Net Material should be:

$$V_{non\text{-}contour} \text{ minus } V_{infill} = 0m^3. \quad \textbf{(EQ 6)}$$

If I run the data into CROSS SECTIONS AND VOLUMES, use the Philadelphia Post-dredge method and run the example, I get:

Dredging Quantities Summary

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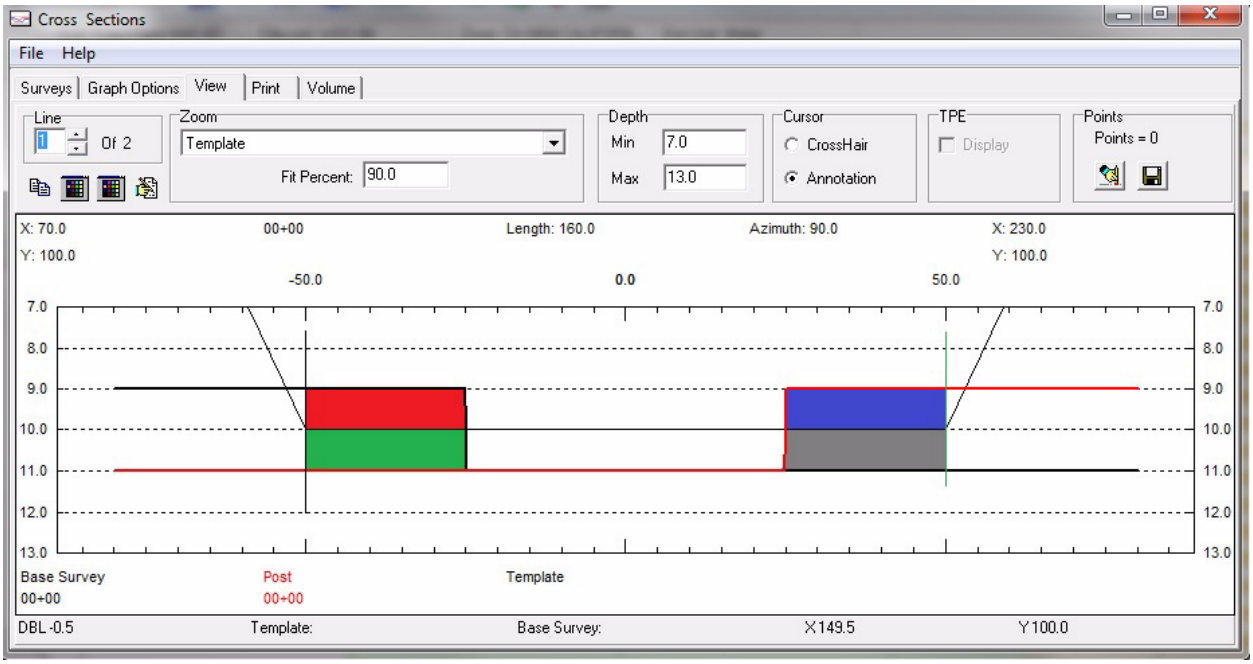
Materials	Gross Material	Infill	Net Material
Total Removed To Project Depth	2645.0	2645.0	0.0
Total Pay Removed In Overdepth	***2505.0***	***2505.0***	***0.0***
Total Pay Removed	5150.0	5150.0	0.0
Total Removed	9950.0	9950.0	0.0
Total Remaining Above Project Depth .	2645.0		2645.0
Total Overdredged Material	4800.0	4800.0	0.0
Total Infill Material		9950.0	

The Total Pay Removed in Overdepth shows the gross material at $2505m^3$, with $2505m^3$ of infill, resulting in a Net Material of $0m^3$! (The extra $5m^3$ of material results from my sloppy model making. I can't make a vertical wall at the transitions from 9 to 11m, so the result is a little sloppy.)

Now, let's look at the 'Contour' result for the same section.

Materials	Gross Material	Infill	Net Material
Total Removed To Project Depth	2645.0	2645.0	0.0
Total Pay Removed In Overdepth	5005.0	2505.0	2500.0
Total Pay Removed	7650.0	5150.0	2500.0
Total Removed	12450.0	9950.0	2500.0
Total Remaining Above Project Depth .	2645.0		2645.0
Total Overdredged Material	4800.0	4800.0	0.0
Total Infill Material		9950.0	



I repeat the drawing above, because you're going to have to stare at it for a while.

Based on our rules for Contour Overdepth, only the material from DBL = -50 to DBL = -25 is considered available, based upon the pre-dredge survey. The region from DBL = -25 to DBL = 50 is ignored.

Based on the post-dredge survey, 2,500m^3 of material from DBL = -50 to DBL = -25 has been removed. The CROSS SECTIONS AND VOLUMES (CSV) report is going to report a Net Material of 2,500m^3 as being removed. It next goes on to compute the infill in the Overdepth region. The rules for classification based upon the pre-dredge survey are not applied to the Infill calculation. CSV finds 2,500m^3 of infill material (from DBL = 25 to DBL = 50) and reports it in the Fill Column.

In the report for CROSS SECTIONS AND VOLUMES, Gross Material minus Infill is equal to the Net Material. This is sacrosanct and must be obeyed. In order for things to work out, we add the Net Material and the Infill to get the Gross Material. This is a little hard to understand,

but it is necessary due to the conflicting rules on how Contour Allowable Overdepth and Infill are computed. Our report now shows Allowable Overdepth results as:

Gross Material =	5,005
Infill =	2,505
Net Material =	2,500

This example is pretty extreme, but it illustrates some of the problems involved when computing the Contour overdepth in regions where you have infill due to natural sedimentation in areas where you may not be digging.