

## **CUT AND FILL TUTORIAL**

TEDDS calculation version 1.0.0

There are three methods for defining Existing and Proposed Cross Sections:

1. Manually input the coordinates from the user interface.
2. Import the coordinates from a text file.
3. Use a predefined template.

This tutorial shows you how to create a cut and fill calculation using the following coordinate information.

Cross section 1 at chainage – 0m

	<b>Existing cross section</b>		<b>Proposed cross section</b>	
Ref.	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-4.000	100.500	-4.000	100.500
2	-2.000	100.650	-3.000	100.200
3	0.000	100.500	3.500	100.200
4	2.000	100.400	4.000	100.700
5	4.000	100.700		

Cross section 2 at chainage – 10m

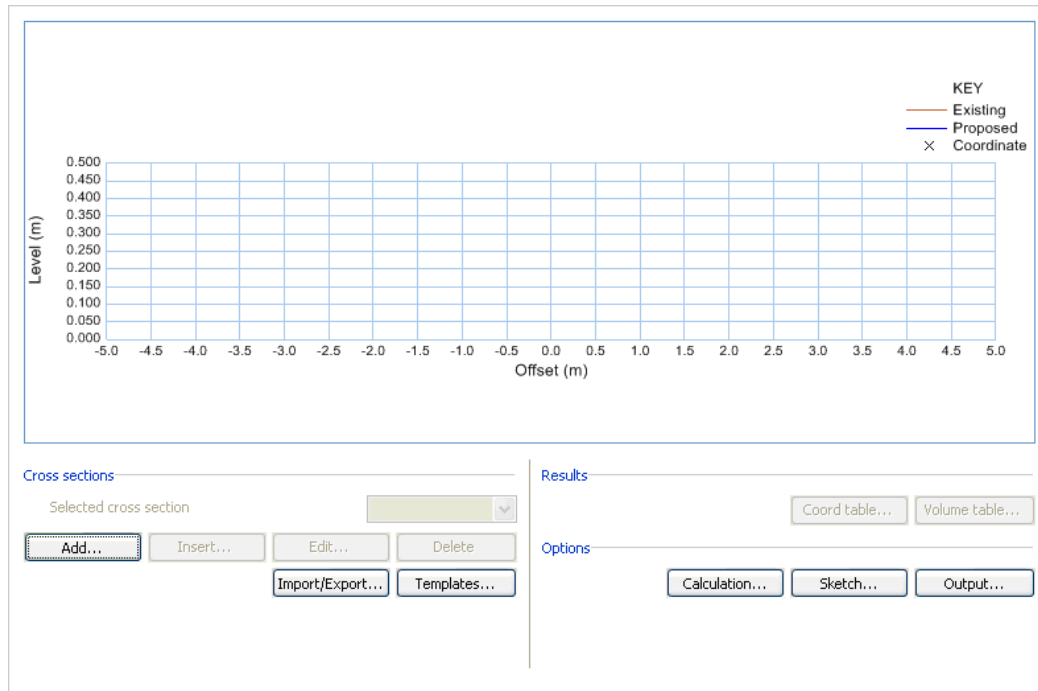
	<b>Existing cross section</b>		<b>Proposed cross section</b>	
Ref.	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-4.000	100.500	-4.000	100.500
2	-2.000	100.600	-3.000	100.300
3	0.000	100.750	3.500	100.300
4	2.000	100.550	4.000	100.600
5	4.000	100.600		

Cross section 3 at chainage – 20m

	<b>Existing cross section</b>		<b>Proposed cross section</b>	
Ref.	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-4.000	100.500	-4.000	100.500
2	-2.000	100.400	-3.000	100.650
3	0.000	100.450	3.500	100.650
4	2.000	100.550	4.000	100.600
5	4.000	100.600		

## 1. Manually input coordinates – Example 1

1.1. Start a new Cut and fill calculation. You should now be looking at the main page of the user interface from where you can access all the different parts of the calculation and review any information you have entered already.



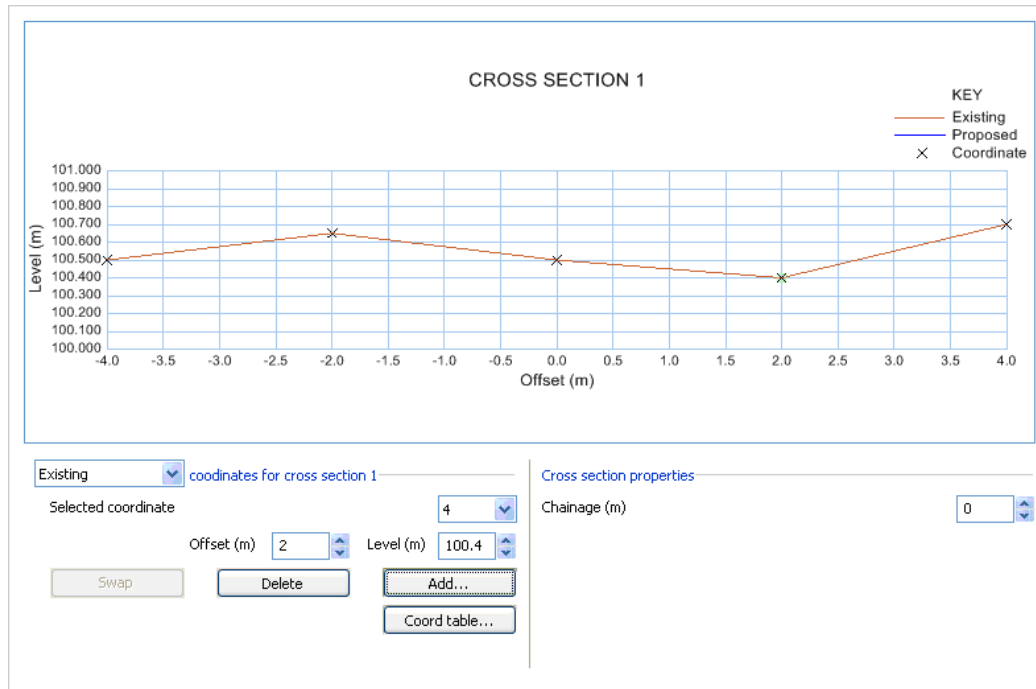
1.2. You now need to enter the coordinates for cross section 1. Click the **Add...** button to add a new cross section.

1.3. You should now be looking at the **Edit coordinates** page. This page lets you add, edit and delete coordinates for the selected cross section. Enter an Offset of -4.000m and a Level of 100.500m for coordinate 1. To create the second coordinate click the **Add...** button and enter an Offset of 4.000m and a Level of 100.700m then click **OK** to return to the edit coordinates page. A line will be drawn between the two coordinates you have defined.

1.4. To edit an existing coordinate select the coordinate to edit using the droplist and amend the Offset and Level values as appropriate. To add further coordinates click **Add...** and enter the Offset and Level values. You can enter coordinates in any order and the calculation will automatically order them according to the Offset value. If you enter two coordinates at the same Offset, for example to define a kerb, you can use the **Swap...** button to reorder the coordinates as required.

1.5. Add the remaining coordinates for cross section 1. Offset -2.000m, Level 100.650m Offset 0.000m, Level 100.500m Offset 2.000m, Level 100.400m.

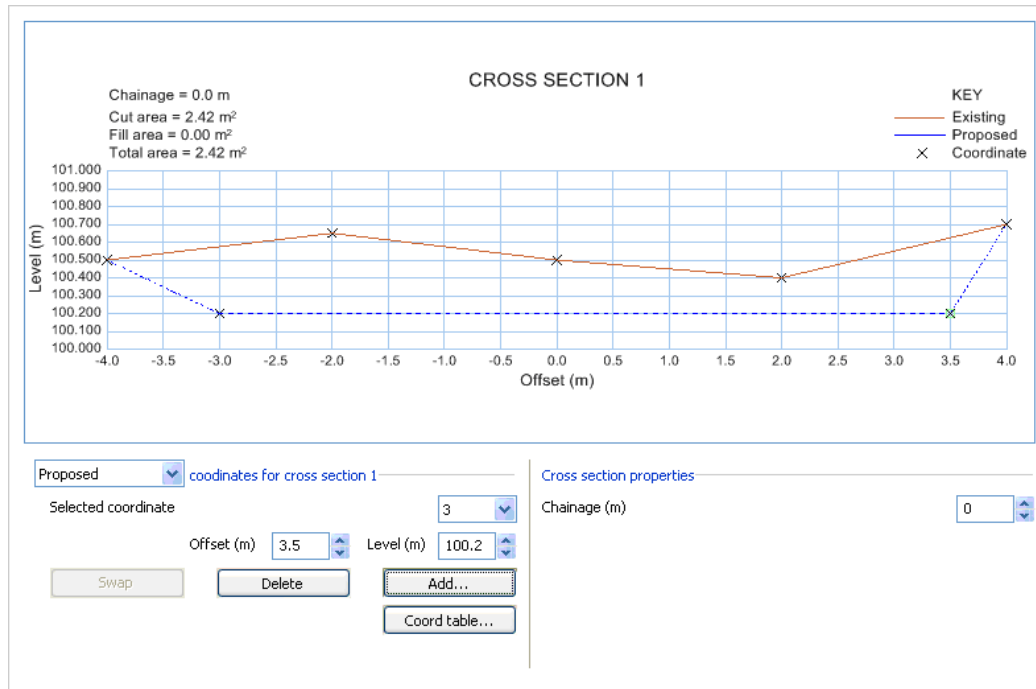
1.6. Your cross section should now look similar to the following:



1.7. Use the droplist to switch from editing the **Existing** coordinates to editing the **Proposed** coordinates. Now add the proposed coordinates for cross section 1. Offset -4.000m, Level 100.500m Offset 4.000m, Level 100.700m

1.8. Once you have entered all of the coordinates for the proposed cross section you will notice that the cut and fill areas are included in the diagram. This is because the start and end Offset values of the Existing and Proposed cross section are equal.

1.9. Try changing the Level of Proposed coordinate 1, note that because the Offset is still the same as existing coordinate 1 the calculation will continue to calculate the cut and fill areas. This can be useful if you want to incorporate a retaining wall or similar to the edges. Change the value back to its original position and add the remaining proposed coordinates. Offset -3.000m, Level 100.200m Offset 3.500m, Level 100.200m. When you have finished entering the coordinates click **OK** to return to the main page of the user interface.



1.10. The main page will now show you the cross section diagram and the calculated cut and fill areas. If you need to review the coordinates for this section click the **Coord table...** button.

1.11. To define the next cross section click the **Add...** button. The chainage of the section will default to 10m which you can amend as required. The shrinkage factor of the soil can also now be amended. These values are used to calculate the volume of soil for all the cross sections as the soil will either shrink when compacting or bulk when excavating. Typical values are shown in the information box. For this example enter a shrinkage factor of 0.9.

1.12. Continue to enter the cross section coordinates for cross section 2 and click **OK** to return to the main page.

1.13. Select section 2 and the buttons to **Add** or **Insert** a new cross section will be enabled. Clicking **Add...** will create a new section after all the currently defined sections and clicking **Insert...** will insert a new cross section before the selected cross section.

1.14. Click **Add...** to add a third cross section and enter the coordinates for cross section 3. Also enter a shrinkage factor of 0.9 and then return to the main page.

1.15. You have now completed your design and can view any of the cross sections and the associated results. You can also view the table of cumulative volume (the Quantity Distribution Table) of soil for all the cross sections by clicking the **Volume table...** button. The volume is calculated using the 'Volumes by end areas' method. This can be expressed as the average of two cross sectional areas multiplied by the distance between them.

1.16. Note that even though you entered a shrinkage factor of 0.9 for cross sections 2 and 3 it is only applied to cut areas. The existing and proposed levels are taken at an offset of 0m, which can be changed in the **Options** page.

## 2. Import from a text file – Example 2

2.1. In the first example you entered the cross sections manually. You will now produce the same information by importing a text file. When you write a text file to be imported by the Cut and fill calculation you must ensure that it is formatted correctly so all the variables are imported.

To import cross sections the data must be formatted as coordinate pairs in a comma separated list that includes the appropriate units. For example a proposed cross section has the following format:

Proposed\_{m} = "x<sub>1</sub>,y<sub>1</sub>,x<sub>2</sub>,y<sub>2</sub>,...x<sub>n</sub>,y<sub>n</sub>"

Where m is the section number, x<sub>1</sub> and y<sub>1</sub> are the first coordinate pair and x<sub>n</sub> and y<sub>n</sub> are the n'th coordinate pair, each with the appropriate units.

2.2. Using the format described above create a text file which defines the profiles for all three sections in the previous exercise and save the file to disk noting its location. You should end up with something like the following:

```

Existing_{1}="-4.000m,100.500m,-2.000m,100.650m,0.000m,100.500m,2.000m,100.400m,4.000m,100.700m"
Proposed_{1}="-4.000m,100.500m,-3.000m,100.200m,3.500m,100.200m,4.000m,100.700m"
Existing_{2}="-4.000m,100.500m,-2.000m,100.600m,0.000m,100.750m,2.000m,100.550m,4.000m,100.600m"
Proposed_{2}="-4.000m,100.500m,-3.000m,100.300m,3.000m,100.300m,4.000m,100.600m"
Existing_{3}="-4.000m,100.500m,-2.000m,100.400m,0.000m,100.450m,2.000m,100.550m,4.000m,100.600m"
Proposed_{3}="-4.000m,100.500m,-3.000m,100.650m,3.000m,100.650m,4.000m,100.600m"

```

2.3. Start a new Cut and fill calculation. From the main page click the **Import/Export...** button.

2.4. To import the text file you created enter the file name including the full path and file extension and click **Import**. The file path can be copied and pasted into the edit box from Windows Explorer.

2.5. Once the file has been imported the option to set the chainage will be enabled. Enter a Section interval of 10m from chainage 0m and click **Apply**. You should now have a page that looks like this

Section	Chainage	Existing coordinates	Proposed coordinates	Cut area	Fill area
Section 1	0.0 m	Coords at 100.500 m	Coords at 100.200 m	Not yet calculated	Not yet calculated
Section 2	10.0 m	Coords at 100.750 m	Coords at 100.300 m	Not yet calculated	Not yet calculated
Section 3	20.0 m	Coords at 100.450 m	Coords at 100.650 m	Not yet calculated	Not yet calculated

2.6. Click the **Calculate** button to calculate the cut and fill areas which will then be shown under the appropriate headings. You will notice that a warning message appears telling you that the calculation may take sometime. The TEDDS Progress Log will show which section is being calculated and the results for each section once it has completed its calculations.

2.7. Click **OK** to return to the main page.

2.8. Review all the cross sections and the tables which should be the same as the previous exercise.

2.9. You can also export data from the calculation. Click **Import/Export...** In the Export group enter the file name including the full path and file extension where you want to export your data. Click **Export** to save the file.

2.10. Using Windows Explorer locate the file you have exported and open it using Windows Notepad. You should notice the text file includes a few more lines which specify the chainage and the cut and fill areas.

The export button can be used at any time, for example if you have entered your coordinates manually and want to

change the offset values for all your cross sections from 3m to 2m you may find it quicker to export the coordinates amend them using an external text editor such as Notepad and then import the coordinates back into your calculation.

### 3. Defining a template – Example 3

3.1. The final method for defining cross sections is to use a template. A template can only be defined for a proposed cross section so the existing cross section must be defined using one of the methods described in the previous examples. In this example you will use the text file you exported in example 2.

3.2. Open the text file you created in example 2 and delete all the information apart from the existing profile data. Save the file with a new file name.

3.3. Start a new Cut and fill calculation, import the file you saved in the previous step and then return to the main interface page.

3.4. Click **Templates...** to show the template page.

The screenshot displays a software interface for defining cross sections. On the left, a table lists data for three sections:

Section 1	
Chainage	0.0 m
Existing coordinates	Coords at 100.500 m
Proposed coordinates	Not yet defined
Cut area	Not yet calculated
Fill area	Not yet calculated
Section 2	
Chainage	10.0 m
Existing coordinates	Coords at 100.750 m
Proposed coordinates	Not yet defined
Cut area	Not yet calculated
Fill area	Not yet calculated
Section 3	
Chainage	20.0 m
Existing coordinates	Coords at 100.450 m
Proposed coordinates	Not yet defined
Cut area	Not yet calculated
Fill area	Not yet calculated

On the right, there are controls for deleting sections and setting up proposed cross sections:

- Buttons: "Delete all existing cross sections" (with "Delete existing" sub-button), "Delete all proposed cross sections" (with "Delete proposed" sub-button).
- Section: "Proposed cross sections".
- Template: "Template - Not yet selected" (with "Template..." button).
- Number of sections: 3 (spinners).
- Section interval (m): 10 (spinners), from chainage: 0 (spinners), m.
- Longitud. fall/rise of: 0 (spinners), at start level: 0 (spinners), m.
- Offset distance: 0 (spinners), m.
- Button: "Apply template".

3.5. Now click **Template...** which will show the page where you can select a predefined template for a single carriageway, dual carriageway, cutting/embankment or a trench.

Using the carriageway and cutting/embankment templates you can define the appropriate widths and the gradient of the left and right slopes. These slopes are used by the calculation to determine intersection coordinates with the existing ground level. These gradients should be entered as positive values because the calculation will determine if the slopes are positive or negative. The extents of the existing coordinates must lie beyond or at the start of the slopes in order for the sections to be valid because the calculation does not allow any overhangs. If this does happen the calculation will warn you so that you can amend the design appropriately. However if the extents are beyond the start of the slopes the point at which the slope intersects the existing ground will be determined and the area calculated on that basis. If the existing ground does not extend as far as the intersection points the slope will finish with the same offset as the existing profile mimicking a retaining wall or similar.

In the case of the trench the existing profile must be beyond the width of the trench.

3.6. For this example select a cutting/embankment with a base width of 3000mm and left and right slopes to a gradient of 1 to 1. Click **OK** to return to the template page.

3.7. Once you have selected the template to use you need to enter the level. You can specify a longitudinal fall or rise and an offset distance. In this example enter a 1/100 longitudinal rise starting from a level of 100.500m.

3.8. Finally click **Apply** to create the proposed cross sections based on the template parameters you have defined.

3.9. You can now review the cross sections by returning to the main page. Once you have done this return to the template page, click **Calculate** and wait for the calculations to complete. If all the sections are valid the cut and fill areas will be shown in the preview window. You can now return to the main page and see each of the sections in detail.

3.10. The calculation has automatically determined the direction of the slopes at either end. Now you can view all the calculation results as per normal.

3.11. Click **Edit...** to change the level or offset for cross section 1. Select the **Proposed** cross section and click the **Template...** button. You can now amend the template level to 100.300m and an offset of 0.5m. Return to the main page and the calculation will automatically reapply the template and determine the new areas.

3.12. To change the shrinkage factor globally click the **Options...** button and enter a shrinkage value of 0.9.

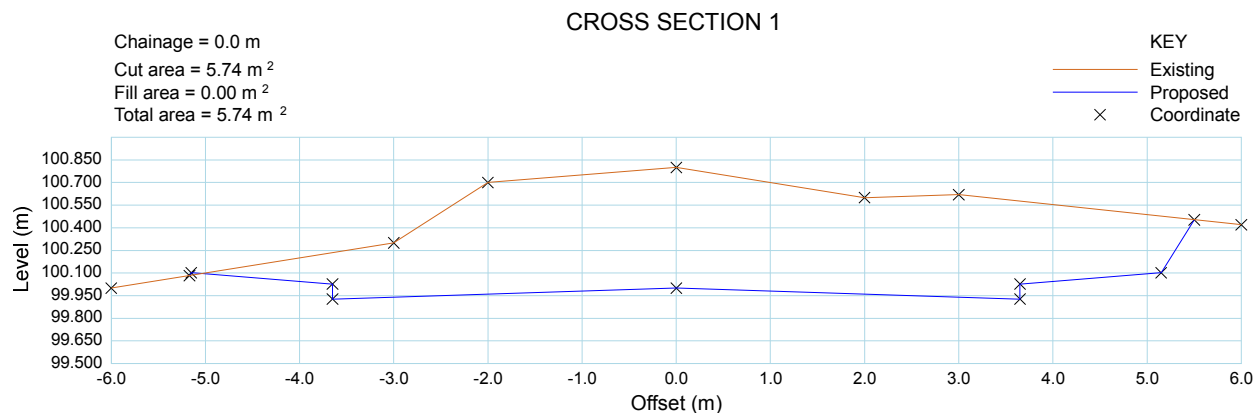
Review and output the calculation to your document when you are happy with the results.

## CUT AND FILL EXAMPLE

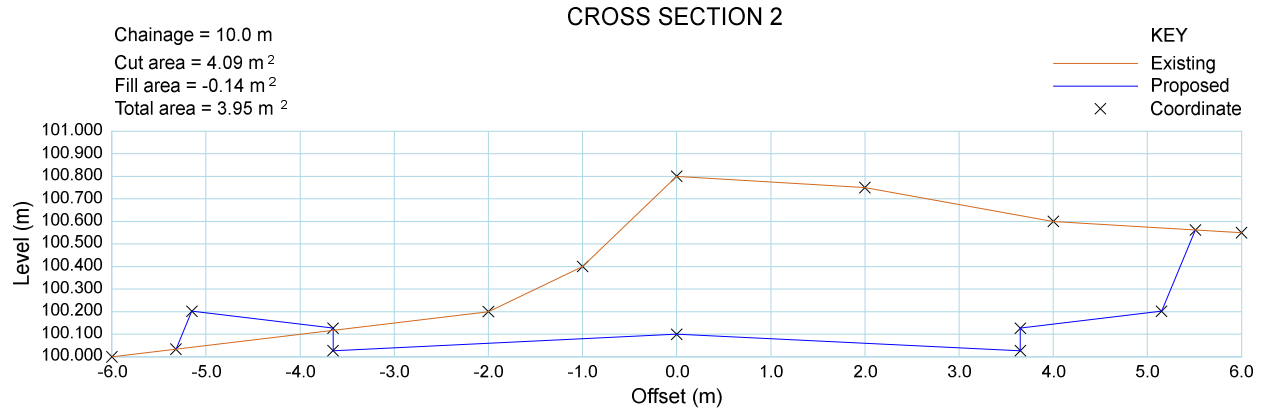
TEDDS calculation version 1.0.00

Quantity distribution table

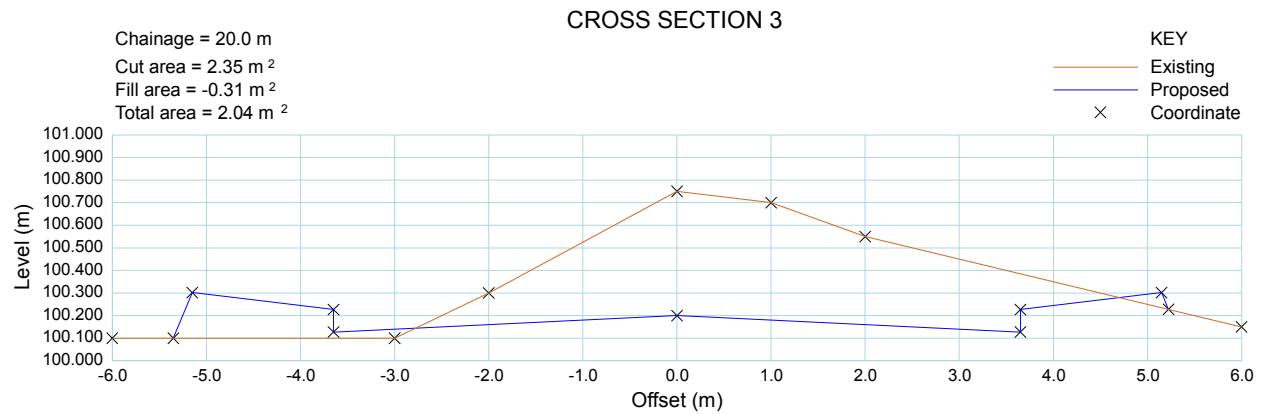
Chainage (m)	Exist. level (m)	Prop. level (m)	Cut area (m <sup>2</sup> )	Fill area (m <sup>2</sup> )	Shrinkage factor	Factored volume (m <sup>3</sup> )	Cumulative (m <sup>3</sup> )
0.0	100.800	100.000	5.74		1.0	0.0	0.0
10.0	100.800	100.100	3.95		1.0	48.5	48.5
20.0	100.750	100.200	2.04		1.0	30.0	78.4
30.0	100.638	100.300	1.07		1.0	15.5	94.0
40.0	100.200	100.400		-2.70		-8.2	85.8



Cross section 1 - Chainage 0.0 m				
Ref.	Existing		Proposed	
	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-6.000	100.000	-5.169	100.083
2	-3.000	100.300	-5.150	100.102
3	-2.000	100.700	-3.650	100.027
4	0.000	100.800	-3.650	99.927
5	2.000	100.600	0.000	100.000
6	3.000	100.620	3.650	99.927
7	6.000	100.420	3.650	100.027
8			5.150	100.102
9			5.501	100.453

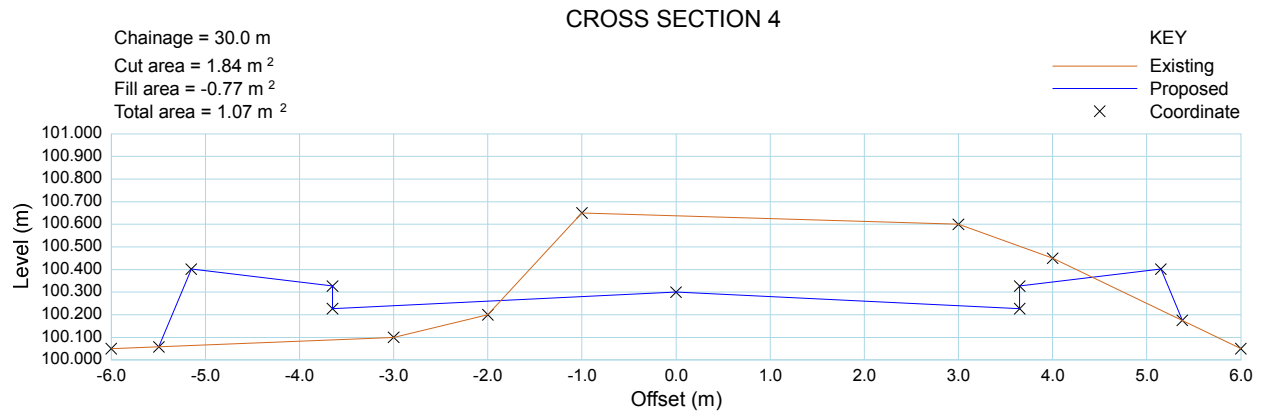


Cross section 2 - Chainage 10.0 m				
Ref.	Existing		Proposed	
	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-6.000	100.000	-5.318	100.034
2	-2.000	100.200	-5.150	100.202
3	-1.000	100.400	-3.650	100.127
4	0.000	100.800	-3.650	100.027
5	2.000	100.750	0.000	100.100
6	4.000	100.600	3.650	100.027
7	6.000	100.550	3.650	100.127
8			5.150	100.202
9			5.510	100.562

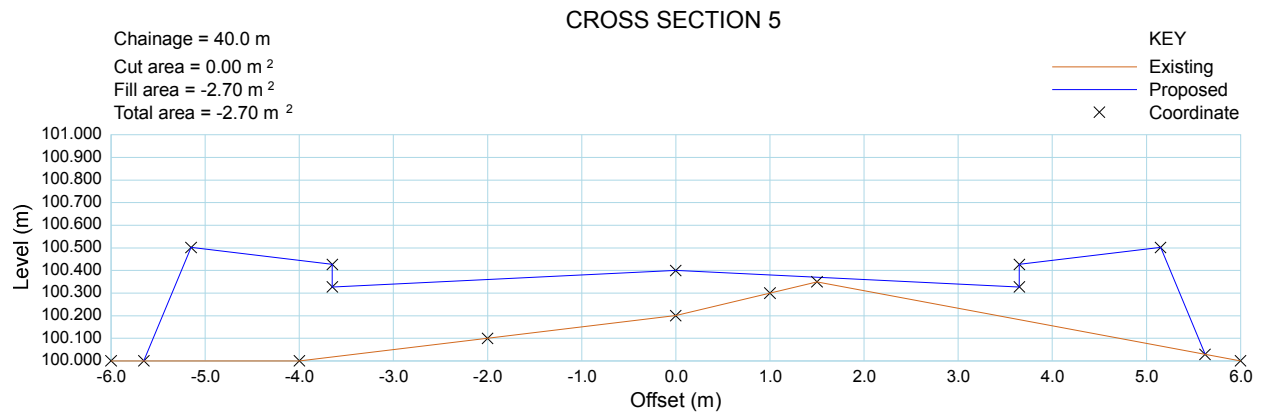


Cross section 3 - Chainage 20.0 m				
Ref.	Existing		Proposed	
	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-6.000	100.100	-5.352	100.100
2	-3.000	100.100	-5.150	100.302
3	-2.000	100.300	-3.650	100.227
4	0.000	100.750	-3.650	100.127
5	1.000	100.700	0.000	100.200
6	2.000	100.550	3.650	100.127
7	6.000	100.150	3.650	100.227
8			5.150	100.302
9			5.224	100.228





Cross section 4 - Chainage 30.0 m				
Ref.	Existing		Proposed	
	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-6.000	100.050	-5.494	100.058
2	-3.000	100.100	-5.150	100.402
3	-2.000	100.200	-3.650	100.327
4	-1.000	100.650	-3.650	100.227
5	3.000	100.600	0.000	100.300
6	4.000	100.450	3.650	100.227
7	6.000	100.050	3.650	100.327
8			5.150	100.402
9			5.378	100.175



Cross section 5 - Chainage 40.0 m				
Ref.	Existing		Proposed	
	Offset (m)	Level (m)	Offset (m)	Level (m)
1	-6.000	100.000	-5.652	100.000
2	-4.000	100.000	-5.150	100.502
3	-2.000	100.100	-3.650	100.427
4	0.000	100.200	-3.650	100.327
5	1.000	100.300	0.000	100.400
6	1.500	100.350	3.650	100.327
7	6.000	100.000	3.650	100.427
8			5.150	100.502
9			5.623	100.029