

# Topsoil Calculations



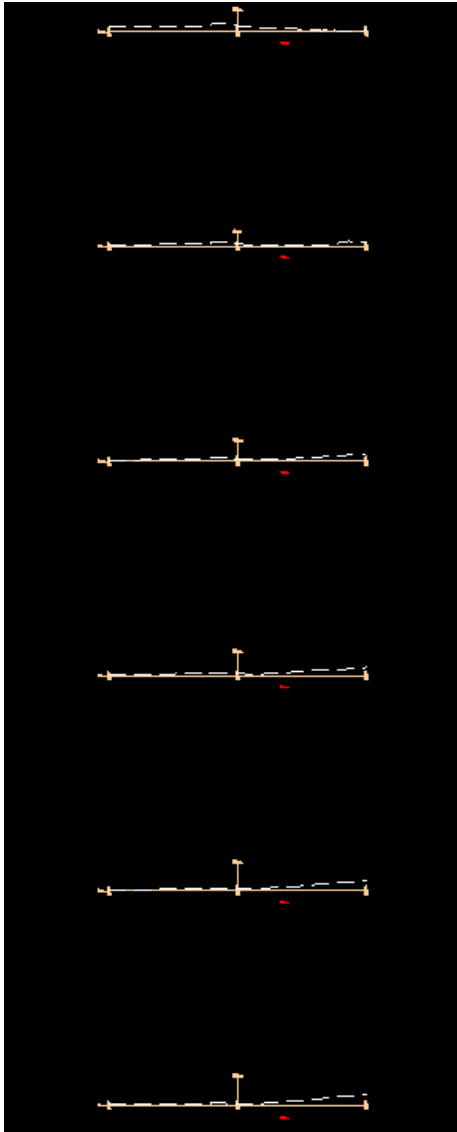
**Roadway Design Division**

Website [www.tn.gov/tdot/roadway-design/training.html](http://www.tn.gov/tdot/roadway-design/training.html)

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The purpose of this tutorial is to outline the method for using Geopak to calculate Topsoil quantities and how they are included in Earthwork Balances.

1) Run Existing Cross Sections on project



This example is SR 95 from 287+00 to 289+50 (6 sections):

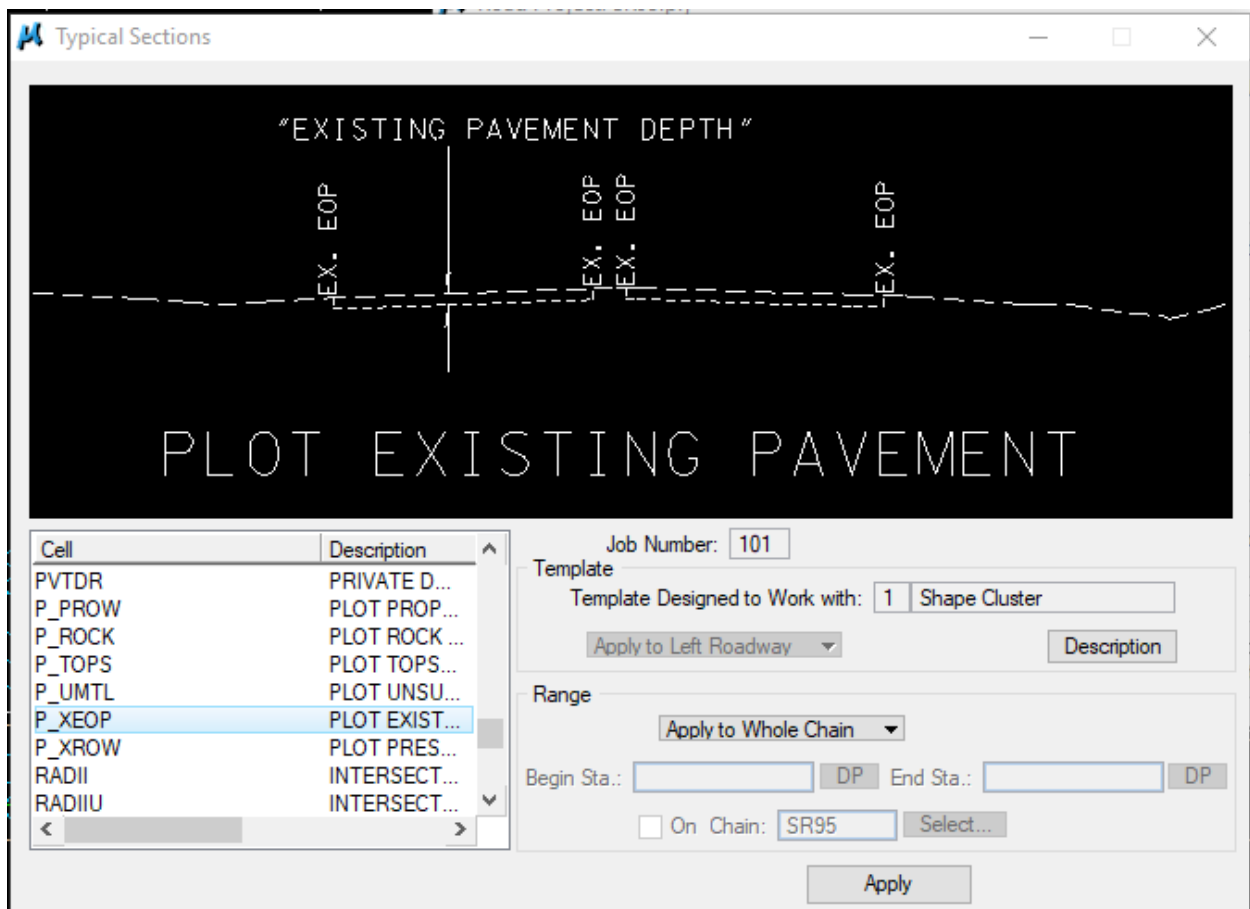
**2) Plot existing pavement on cross sections**

GEOPAK Project Manager>Proposed Cross Sections

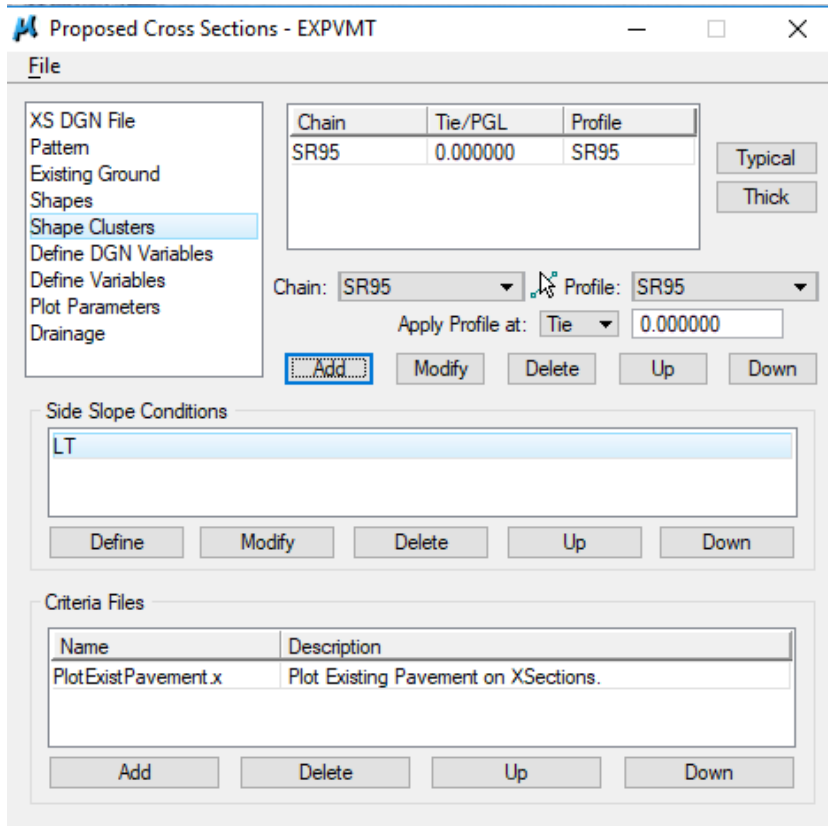
Create Run "EXPVMT"

Shape Clusters:

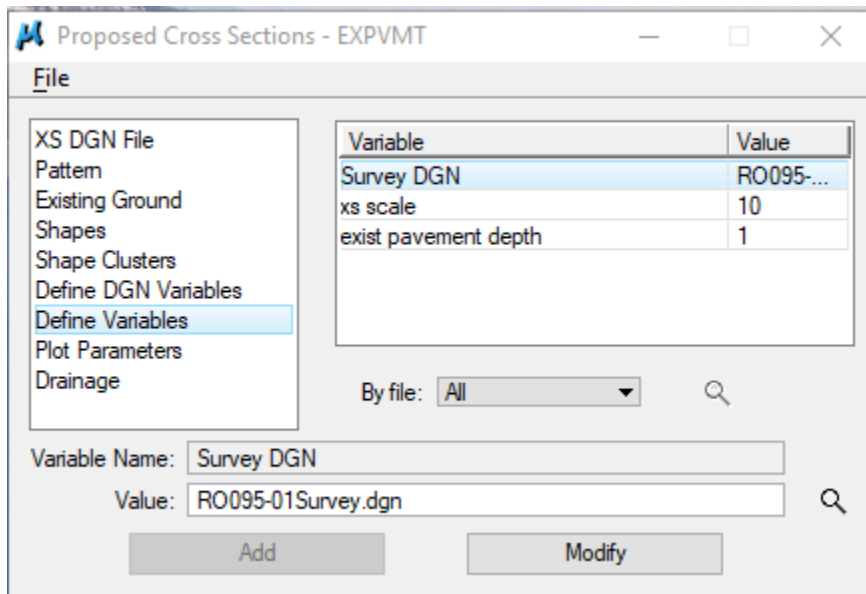
Select template "P\_XEOP"



# Topsoil Calculations



Define Variables:

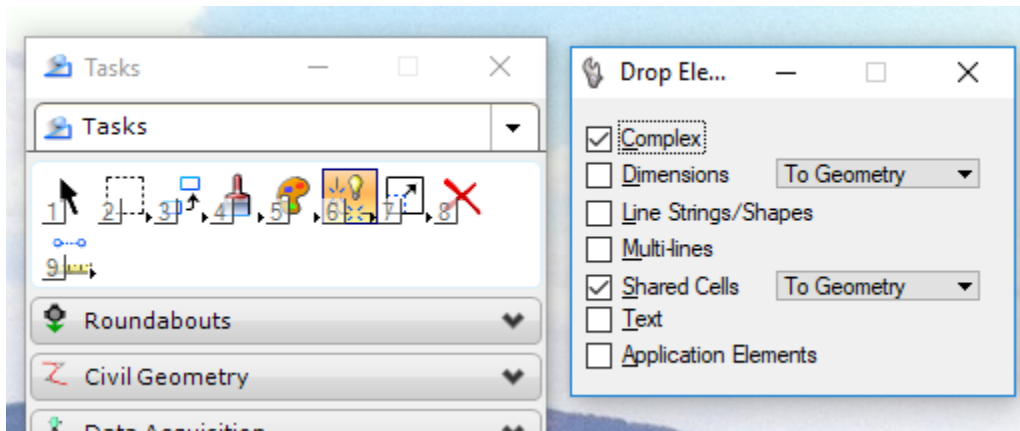


Change the Survey DGN name to the file for your project

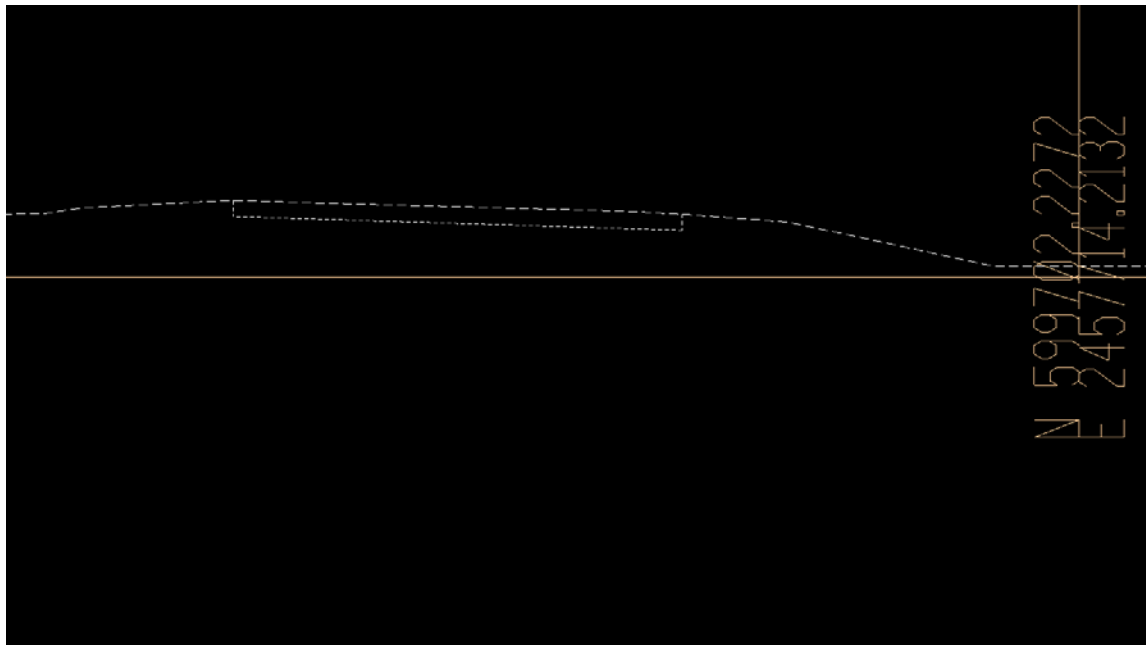
## Topsoil Calculations

All other settings can stay the same as for other cross section runs

Before running the sections, go into your survey DGN file and drop status on the edge of pavement lines. The program will not run for complex elements.

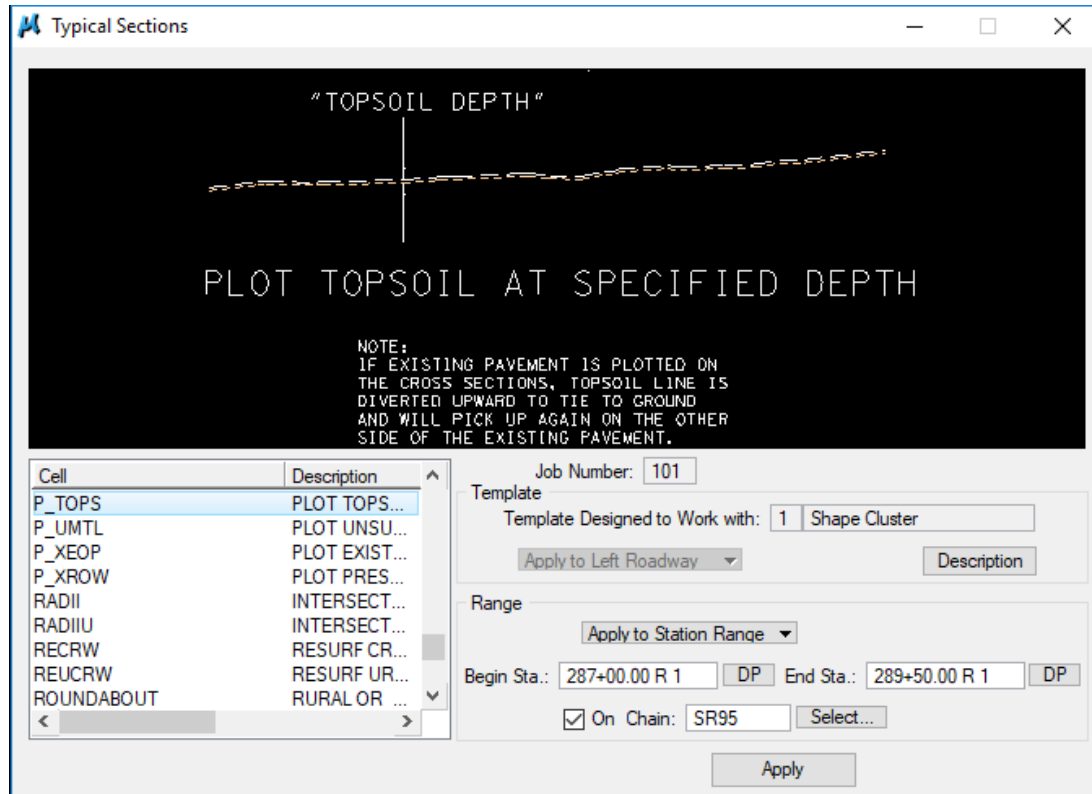


Then run cross sections:

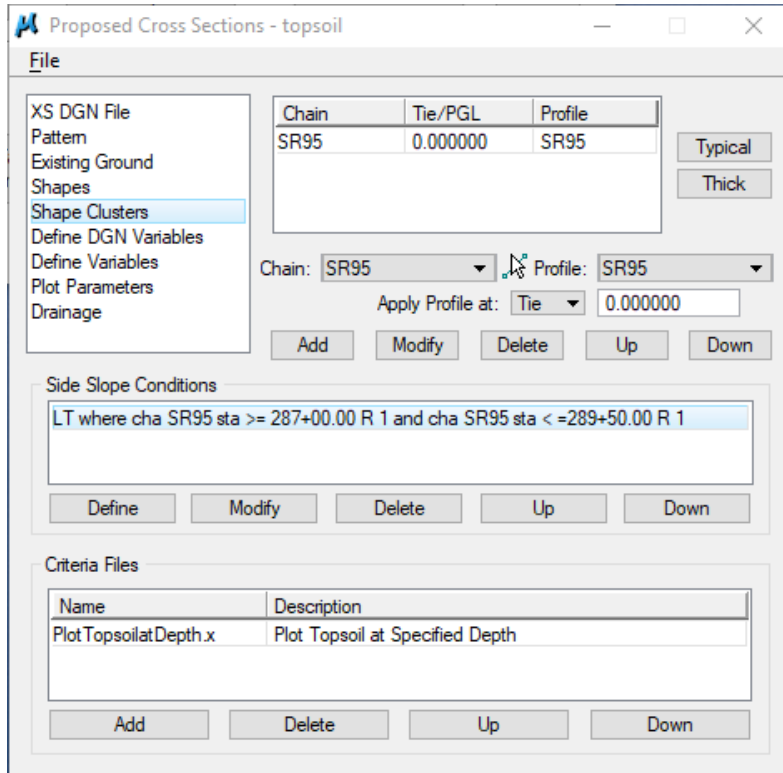


## 3) Plot Existing Topsoil Layer

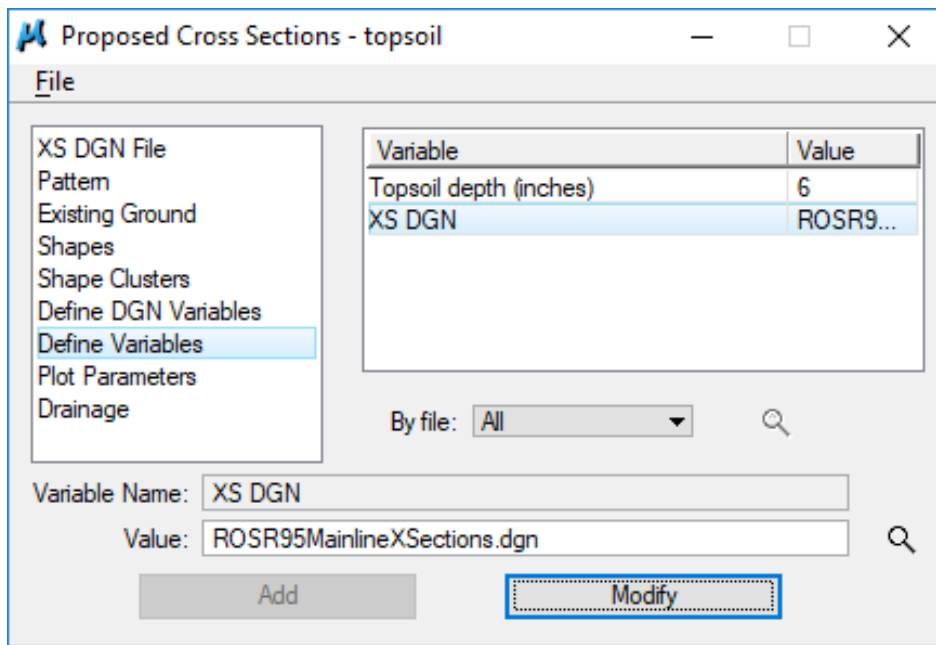
Open GEOPAK Project Manager. Go to Proposed Cross Sections. Create a new run “topsoil”, or copy the Proposed cross section run, and use the same settings with the exception of “Shape Clusters”. Delete the previous clusters, add new cluster using the template P\_TOPS



# Topsoil Calculations



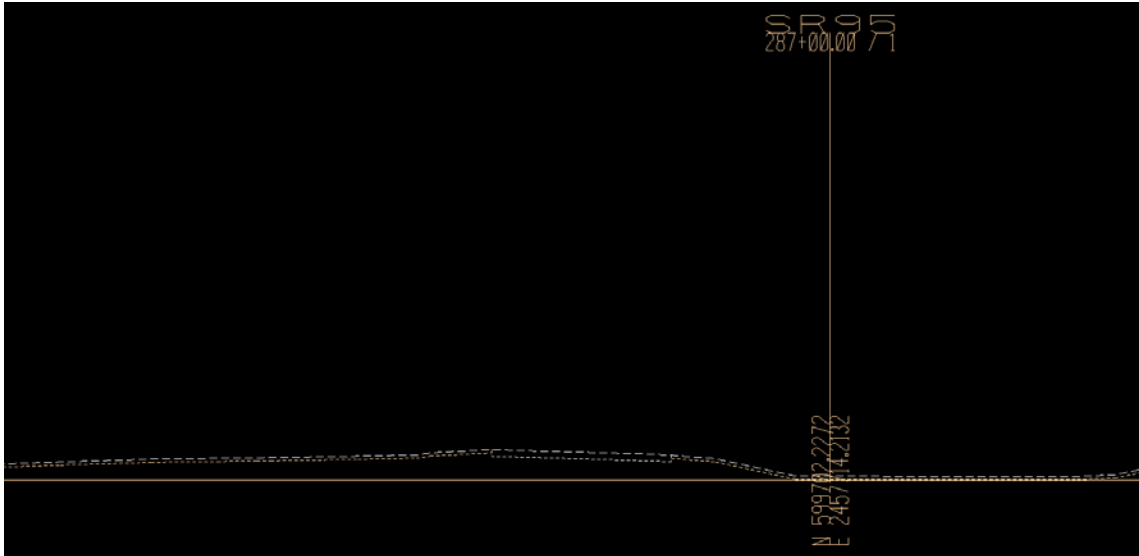
In "Define Variables" edit the "XS DGN" file:



Then, select "Run"



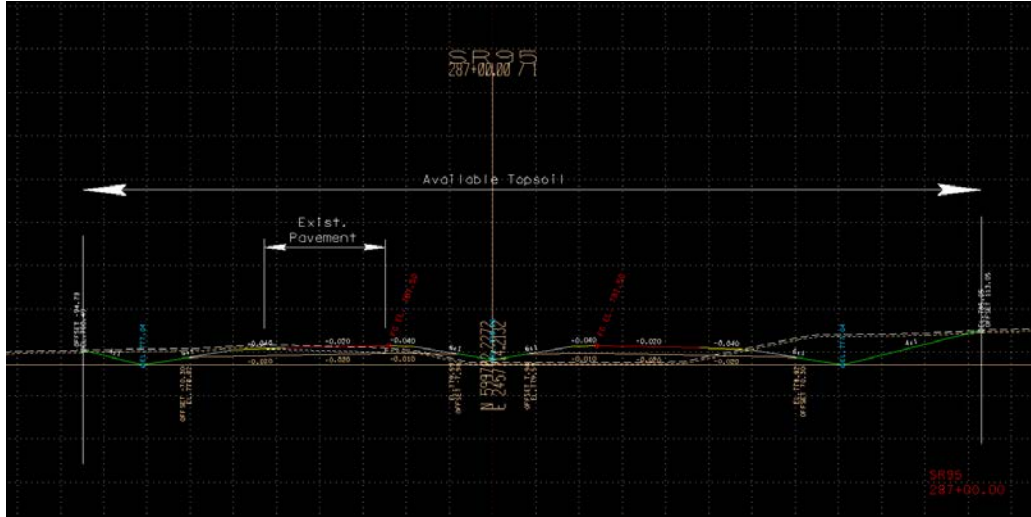
## Topsoil Calculations



The topsoil layer is plotted on the cross sections at a default depth of 6 inches. This is to allow for 100% Shrinkage. Notice it excludes the existing pavement but plots along the entire ground line of the cross sections.

The available topsoil is the ground line (dashed) between the excavation limit lines , excluding the existing pavement area.

4) Run Proposed Cross Sections

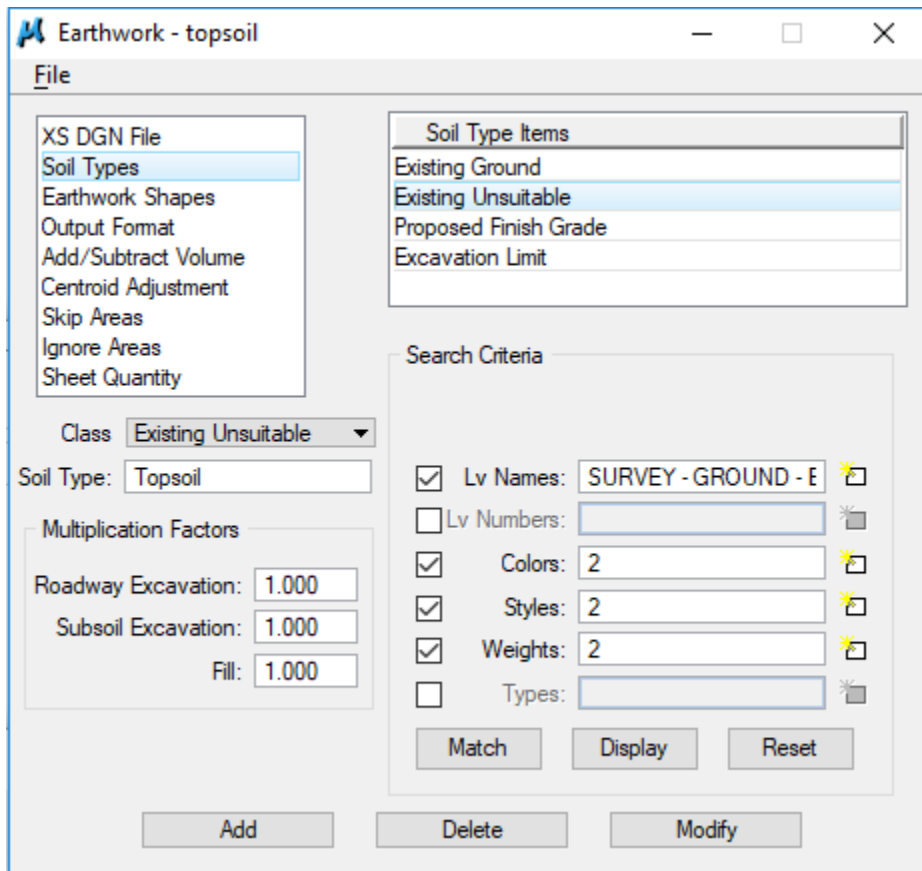


### 5) Run Earthwork

Create run “Topsoil”

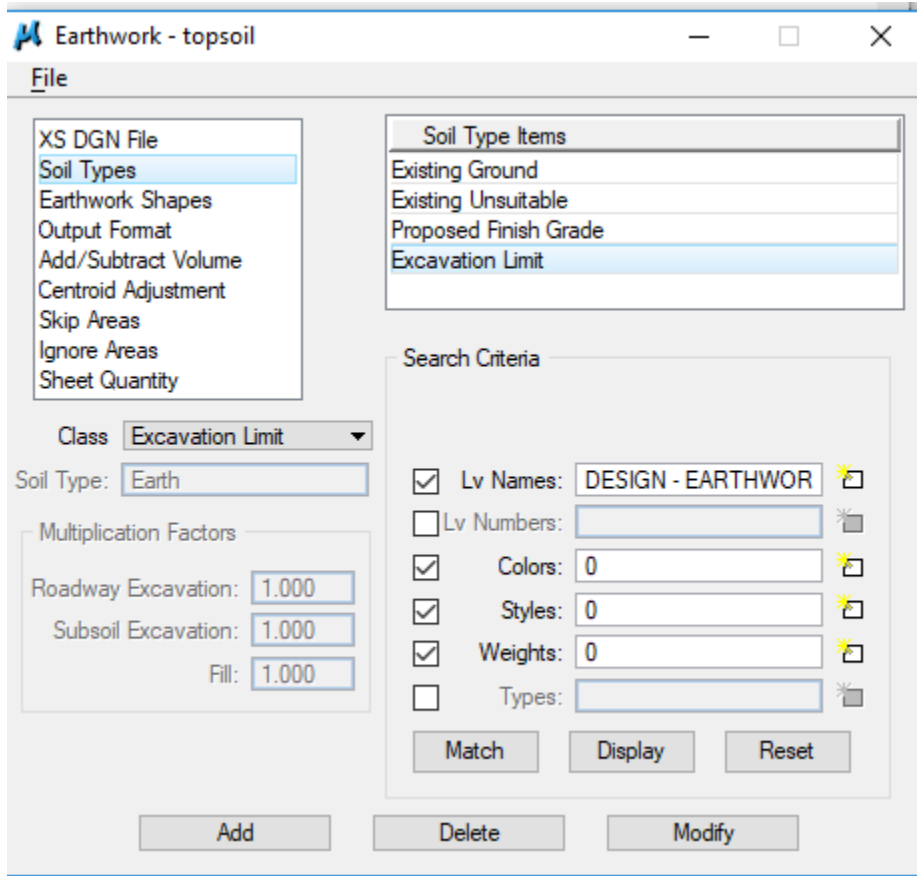
Make settings as shown in GEOPAK Road Manual Exercise 15. In Soil Types, add settings for Topsoil and Excavation Limit as shown-

#### Topsoil Settings:



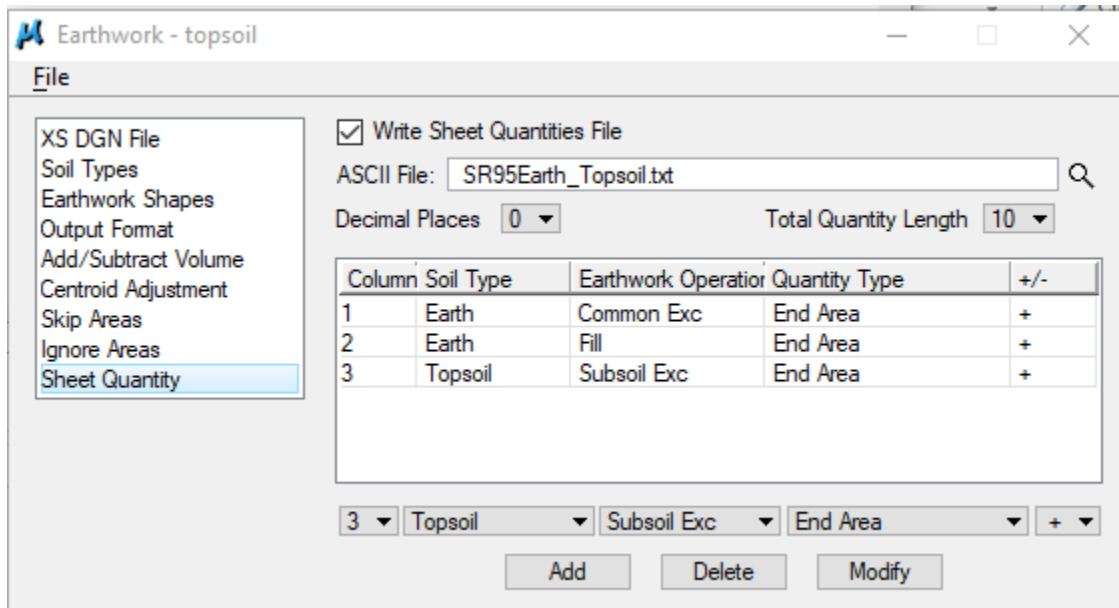
Level- SURVEY-GROUND- Bottom of Topsoil Layer

Excavation Settings:



Level- DESIGN-EARTHWORK- Excavation Limit Lines

## Sheet Quantity – add column for Topsoil



When all settings are made, then Run

# Topsoil Calculations

Output file SR95Earth\_Topsoil.txt:

SR95Earth\_Topsoil - Notepad  
File Edit Format View Help

Station		Volumes (sq. ft.)	Volumes (cu. yd.)	Volumes (cu. yd.)	Factor	Ordinate
287+00.00	EARTH					
	Common Exc	319.2	0	0	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	132.6	0	0	1.00	0
	TOPSOIL					
	Common Exc	55.0	0	0	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	34.9	0	0	1.00	
	Fill	0.0	0	0	1.00	0
	Mass ordinate for TOPSOIL = 0					
287+50.00	EARTH					
	Common Exc	244.9	522	522	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	82.8	199	199	1.00	323
	TOPSOIL					
	Common Exc	61.4	108	108	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	26.6	57	57	1.00	
	Fill	0.0	0	0	1.00	323
	Mass ordinate for TOPSOIL = 165					
288+00.00	EARTH					
	Common Exc	125.6	343	343	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	139.4	206	206	1.00	460
	TOPSOIL					
	Common Exc	42.2	96	96	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	39.9	62	62	1.00	
	Fill	0.0	0	0	1.00	460
	Mass ordinate for TOPSOIL = 323					

# Topsoil Calculations

Continued:

SR95Earth\_Topsoil - Notepad

File Edit Format View Help

288+50.00 EARTH						
Common Exc	55.7	168	168	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	0.0	0	0	1.00		
Fill	309.8	416	416	1.00		212
TOPSOIL						
Common Exc	22.8	60	60	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	52.6	86	86	1.00		
Fill	0.0	0	0	1.00		212
Mass ordinate for TOPSOIL = 469						
289+00.00 EARTH						
Common Exc	40.6	89	89	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	0.0	0	0	1.00		
Fill	429.7	685	685	1.00		-384
TOPSOIL						
Common Exc	12.4	33	33	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	57.8	102	102	1.00		
Fill	0.0	0	0	1.00		-384
Mass ordinate for TOPSOIL = 604						
289+50.00 EARTH						
Common Exc	35.6	71	71	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	0.0	0	0	1.00		
Fill	669.0	1017	1017	1.00		-1330
TOPSOIL						
Common Exc	9.5	20	20	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	66.3	115	115	1.00		
Fill	0.0	0	0	1.00		-1330
Mass ordinate for TOPSOIL = 739						
290+00.00 EARTH						
Common Exc	0.0	33	33	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	0.0	0	0	1.00		
Fill	0.0	619	619	1.00		-1916
TOPSOIL						
Common Exc	0.0	9	9	1.00		
Subgrade Exc	0.0	0	0	1.00		
Subsoil Exc	0.0	61	61	1.00		
Fill	0.0	0	0	1.00		-1916
Mass ordinate for TOPSOIL = 809						
XS-NOELEM No cross-section elements found at						

# Topsoil Calculations

Continued:

SR95Earth\_Topsoil - Notepad

File Edit Format View Help

Material Name	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor		
-----					
EARTH					
Common Exc	1226	1226	1.00		
Subgrade Exc	0	0	1.00		
Subsoil Exc	0	0	1.00		
Fill	3142	3142	1.00		
TOPSOIL					
Common Exc	326	326	1.00		
Subgrade Exc	0	0	1.00		
Subsoil Exc	483	483	1.00		
Fill	0	0	1.00		
S P L I T     S U M M A R Y     T O T A L S					
Material Name	XS Quant Unadjusted Volume (cu. yd.)	XS Quant Adjusted Volume (cu. yd.)	Add/Sub Quant Unadjusted Volume (cu. yd.)	Add/Sub Quant Adjusted Volume (cu. yd.)	Mult Factor
-----					
EARTH					
Common Exc	1226	1226	0	0	1.00
Subgrade Exc	0	0	0	0	1.00
Subsoil Exc	0	0	0	0	1.00
Fill	3142	3142	0	0	1.00
TOPSOIL					
Common Exc	326	326	0	0	1.00
Subgrade Exc	0	0	0	0	1.00
Subsoil Exc	483	483	0	0	1.00
Fill	0	0	0	0	1.00
B A L A N C E   P O I N T   S U M M A R Y					
Material Name	Cumulative		Incremental		Mult Factor
	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	
-----					

Earth (Common Exc. ) = 1226 c.y.

Emb. = 3142 c.y.

Available Topsoil = 326 c.y. + 483 c.y. = 809 c.y.



## Required Topsoil

Since topsoil will be required on all slopes, calculate the surface of the proposed fill and cut slopes and multiply by the thickness of the required topsoil (3")

In GEOPAK, reference Exercise 17 (Cross Section Reports) to calculate the surface area (seeding and sodding). In step 5 of Exercise 17, use the setting **Even at 50** for the Subtotal option. For the ASCII File name, use TopsoilReqd.txt.

The screenshot shows the 'Seeding Report' dialog box in GEOPAK. The window title is 'Seeding Report'. The 'Job' field is '101' and 'Current Station' is '298+50.00 R 1'. The 'Chain' is 'SR95'. The 'Begin Station' is '287+00.00 R 1' and the 'End Station' is '347+50.00 R 1'. There are three 'Search Criteria' sections: 'Existing Ground Line', 'Proposed Finish Grade', and 'Candidate Seeding Elements', each with a small graph icon and a 'Display' button. The 'Max Allowable Slope' is set to '1.0000 : 6.0000' with a 'Rise:Run' dropdown. The 'Subtotal Split Slope' is '0.0000 : 0.0000'. The 'Even' dropdown is selected, 'Sub Every' is '.000000', and 'First Sub at' is '+00.00 R 1'. The 'Scale Factor' is '1.00000' and the 'Label' is 'SF'. There are buttons for 'ByPass Segments', 'Additional Distance via Station', and 'Additional Distance ...'. The 'Report Decimal' is '2'. There is a 'Pause on Each XS' checkbox. The 'ASCII File' is 'TopsoilReqd.txt'. An 'Apply' button is at the bottom.

# Topsoil Calculations

Output file TopsoilReqd.tx :

```

-----
SUBTOTALS EVERY 50.0000 Ft BEGINNING AT STATION 287+00.00 R 1 METHOD INCR
SCALING FACTOR = 1.00000 WITH LABEL [ SF ]
-----

```

STATION	SLOPE DISTANCE		AVERAGE SLOPE DIST		A R E A		SF BOTH	SUBTOTAL LT	A R E A		SF BOTH
	LT	RT	LT	RT	LT	RT			RT		
287+00.00 R 1	33.15	51.98						0	0	0	
	( 85.13)		32.54	51.16	1627	2558	4185				
287+50.00 R 1	31.93	50.33						1627	2558	4185	
	( 82.26)		30.70	44.03	1535	2202	3737				
288+00.00 R 1	29.46	37.72						1535	2202	3736	
	( 67.18)		28.26	31.16	1413	1558	2971				
288+50.00 R 1	27.06	24.60						1413	1558	2971	
	( 51.66)		20.27	26.39	1014	1320	2334				
289+00.00 R 1	13.48	28.17						1014	1320	2333	
	( 41.65)		14.83	34.30	741	1715	2456				
289+50.00 R 1	16.18	40.43						741	1715	2456	
	( 56.61)										
TOTAL	LEFT	RIGHT			BOTH						
SF=	6330.0000	9353.0000			15681.0000						
ACRES=	0.1453	0.2147			0.3600						

Multiply the proposed slope area by the required thickness:

$$15681 \text{ s.f.} \times 3 \text{ in} \times 1\text{ft}/12 \text{ in} = 3920 \text{ c.f.}$$

$$3920 \text{ c.f.} \times 1 \text{ c.y.}/27 \text{ c.f.} = \underline{145.19 \text{ c.y.}}$$

This is the required topsoil

## Topsoil Calculations

Refer to section 3-315.15 in [Roadway Design Guidelines](#) for the relationship of topsoil to total earthwork.

$$\text{Topsoil} = \text{Avail.} - \text{Req'd.} = 809\text{c.y.}^* - 146\text{ c.y.}^{**} = 663\text{ c.y.}$$

### Earthwork Balances:

30% Shrinkage

$$\text{Road \& Drainage Exc (Uncl.) (Item 203-01)} = (1226\text{ c.y.}^* - 663\text{ c.y.})/1.30 = \underline{433\text{ c.y.}}$$

$$\text{Borrow Exc (Uncl.)(Item 203-03)} = (3142^* - 433) \times 1.30 = \underline{3522\text{ c.y.}}$$

\*calculated on Page 14

\*\* calculated on Page 16