

14. Proposed Cross Sections – Final

Now that we have adjusted our profile, added edge of pavement lines to control pavement widths and set up superelevation shapes to apply superelevation to the pavement and shoulders, we are closer to producing finalized cross sections.

In this exercise, we will apply our superelevation shapes and take this one step further by setting up some special controls for side slopes as well as the application of a special ditch ultimately leading to the final cross sections for S.R. 95.

I.) Initial Set up

- 1) Open the MicroStation file

C:\Projects\Roane\SR95PoplarCr\ROSR95MainlineXSections.dgn

- 2) Prior to beginning the process of the final proposed cross section design, we need to delete our preliminary sections but we want to leave on our cross section grids so they will not have to be placed again.

From the Menu Bar in MicroStation, use the following pull down tool to remove your proposed cross sections:

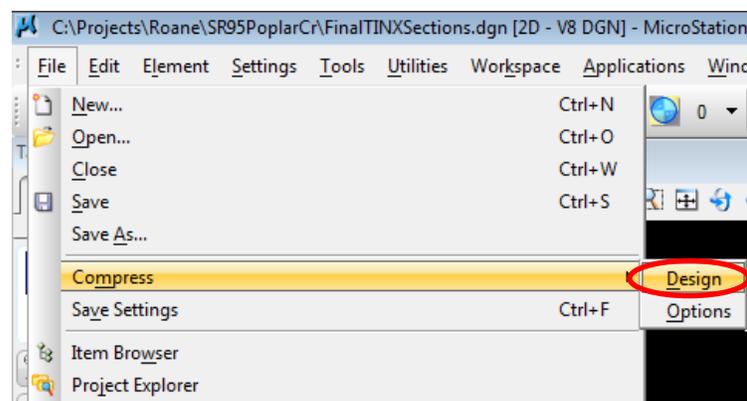
T.D.O.T. → Cross Sections → Delete ALL Prop. XS Graphics

NOTE:

This tool is also available from D&C Manager at

Drafting **Standards** → **Cross Sections** → **Delete XSs**

After deleting proposed cross section graphics, compress the file as shown below.



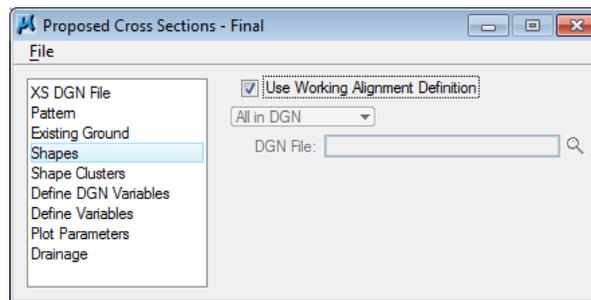
- 3) Access Project Manager.

- 4) Choose Proposed Cross Sections from the Project Manager workflow dialog.

Since most of settings we made in the preliminary run will still be valid for our final cross sections, in the Select Run dialog go to Run → Copy → Run and make a copy of the run Prelim and call it Final.

Open run Final.

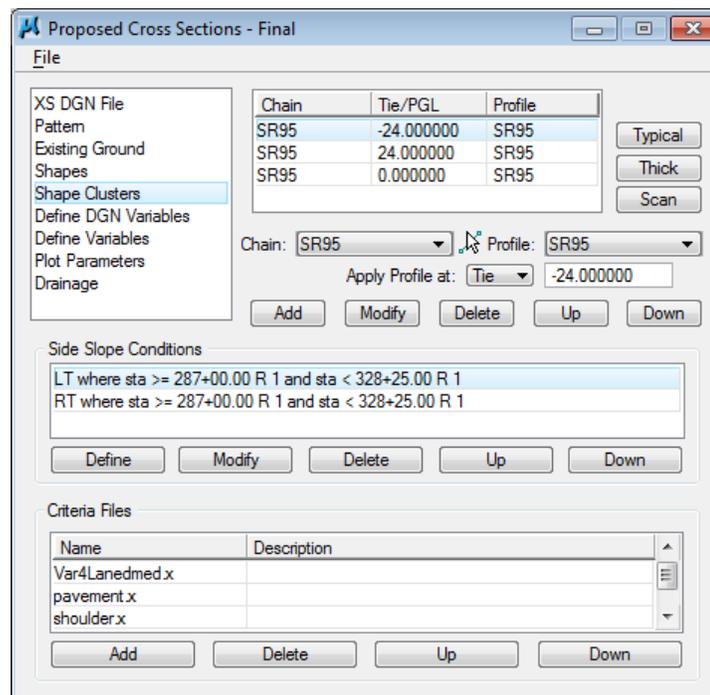
- 5) In the Proposed Cross Section dialog, go to Shapes. First set the control button to All in DGN and then click on Use Working Alignment Definition.



II.) Define Roadway/Shape Clusters

a) Add Shape Clusters

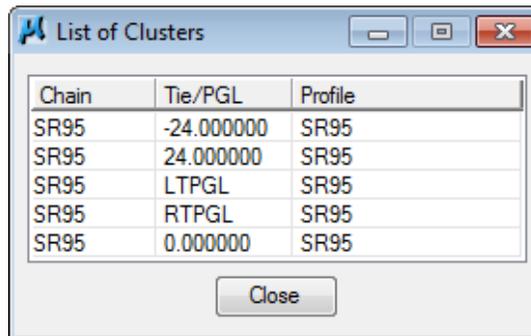
- 1) Next, select the Shape Clusters item.



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We can now see the clusters as we set them up originally in the Prelim run. Notice that since we have activated superelevation shapes in the previous step, a Scan button has been added to the upper right of the dialog to search for shape clusters.

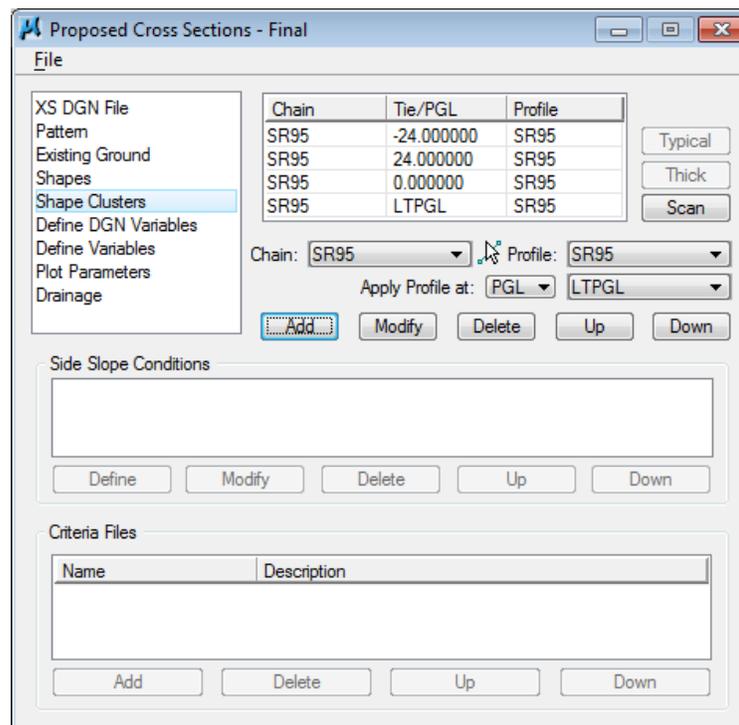
- 2) Press the Scan button to invoke the following dialog. This list reflects all of the superelevation shape clusters specified by our working alignment definition.



We can see that some of the clusters correspond with what we have already set up for Prelim but we do need to add the clusters for the transition area which utilize the special PGL chains.

- 3) Highlight the cluster, Chain = SR95, Tie/PGL = LTPGL, Profile = SR95 in the list. When you do this, it will be used to fill in the Chain, Tie and Profile fields in the main dialog.

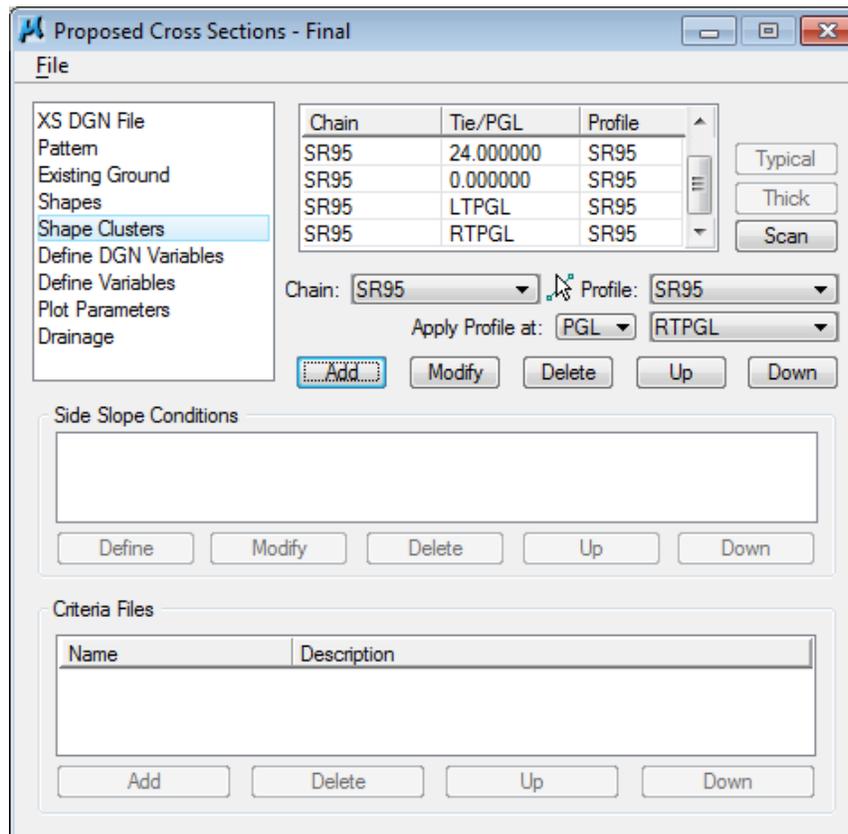
Press the Add button to add the cluster to the processing list.



- 4) Repeat Step 3 to add shape cluster Chain = SR95, Tie/PGL = RTPGL, Profile = SR95 clusters.

Press the Close button on the List of Clusters dialog to dismiss it when done.

Your main dialog should now appear as shown.



NOTE:

The order of the shape clusters does not matter so you do not have to use the Up button to re-organize them.

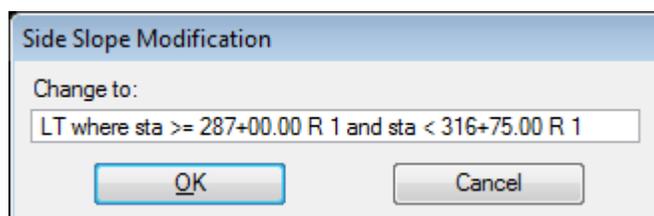
One important concept to remember is that **you should never have more than one shape cluster specified in this list with the same set of parameters**. If you do this, all but the last one will be ignored and not processed. Instead, under the Side Slope Conditions, you will have multiple station ranges.

b) Shape Cluster Station Adjustment

- 5) Highlight shape cluster Chain = SR95, Tie/PGL = -24, Profile = SR95

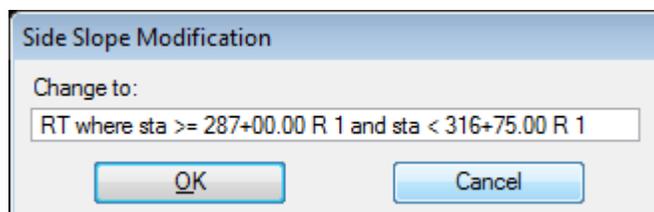
Originally we set this cluster up to go all of the way to the beginning of the urban section at station 328+25. Now that we have special shape clusters for the transition area, we need to edit the final station given for this cluster and its corresponding right roadway cluster at the Tie of 24.

In the Side Slope Condition area, highlight the Side Slope LT condition ending at 328+25 and press the Modify button to access the Side Slope Modification dialog. Change the ending station to 316+75 (beginning of our PGL transition):



Click OK to save the change and return to the main dialog.

- 6) Repeat step 5 for the Side Slope RT condition.



- 7) Highlight shape cluster Chain = SR95, Tie/PGL = 24, Profile = SR95. Repeat steps 5 & 6 for its LT & RT side slope conditions.

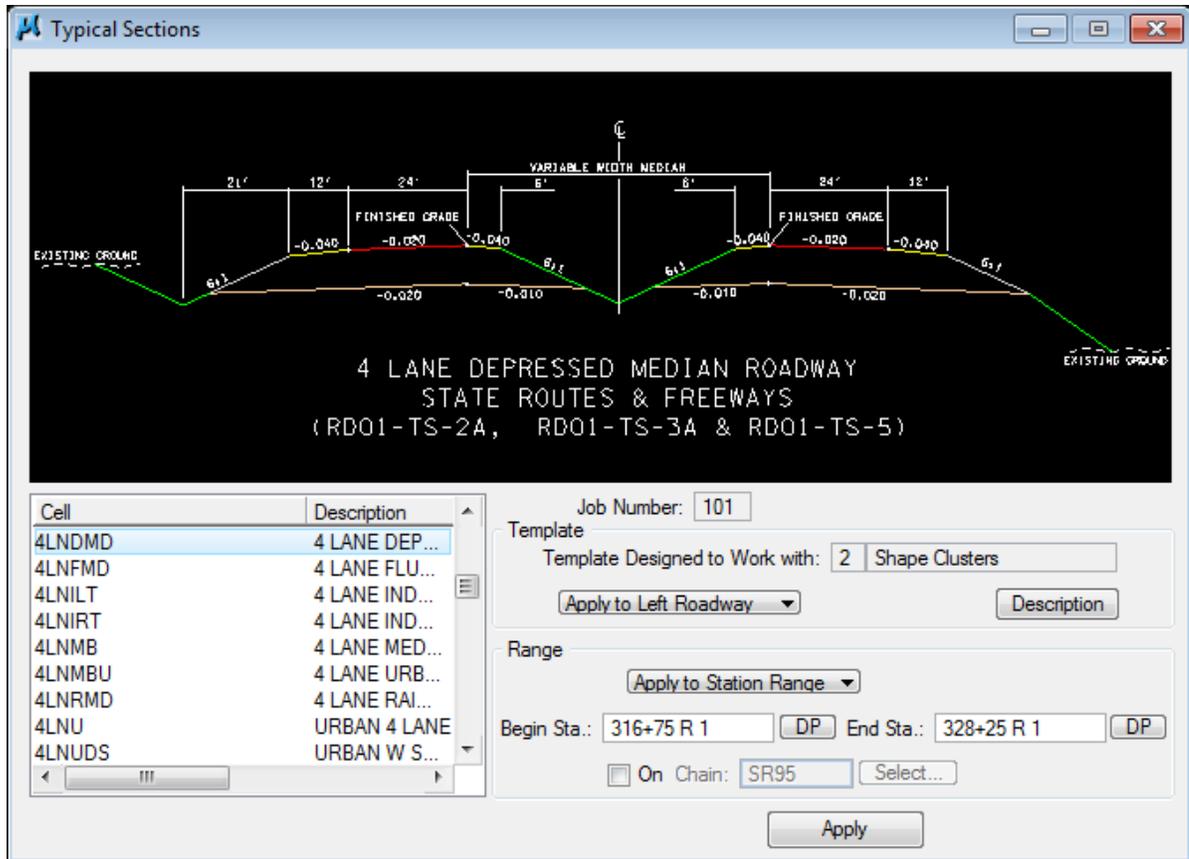
c) Shape Cluster: Chain=SR95, Tie/PGL=LTPGL, Profile=SR95

- 8) This cluster represents the left side transition area of our lane divided roadway section. Highlight the cluster in the list box and press the Typical button

NOTE:

Even though we are transitioning down from the full 4 lane divided roadway section, we will continue to use the same typical. Its criteria files are set up to recognize transition areas and to alter medians, etc. as needed.

- 9) From the typical section List, select the Typical Section "4LNDMD - 4 LANE DEPRESSED MEDIAN".

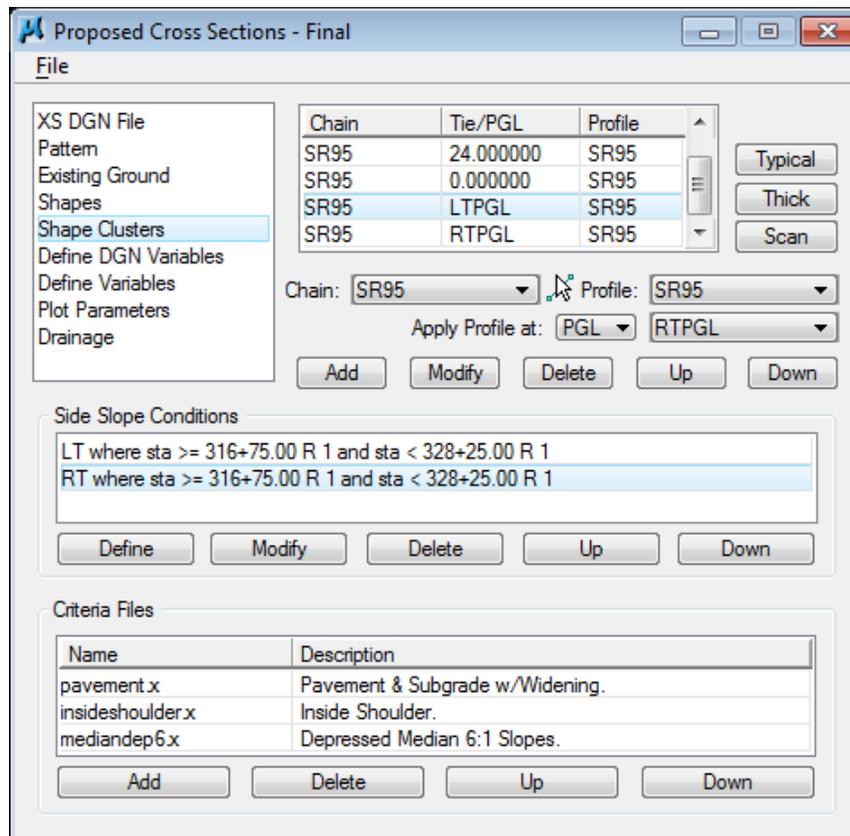


10) Since this shape cluster represents the left side of our transition, we need to apply the Typical Section to the left roadway. Set the toggle as shown above.

Also, since our shape cluster runs from Station 316+75 to Station 328+25, we need to apply the Typical Section to that station range.

Once station range is set, press Apply.

The Typical Section Generator will then populate the main dialog with the required Side Slope conditions and associated criteria files.



d) Shape Cluster: Chain=SR95, Tie/PGL=RTPGL, Profile=SR95

- 11) This cluster represents the right side transition area of our lane divided roadway section. Repeat steps 8-10. Apply the Typical Section to the Right Roadway and use a station range of 316+75 to 328+25.

III.) Define Variables

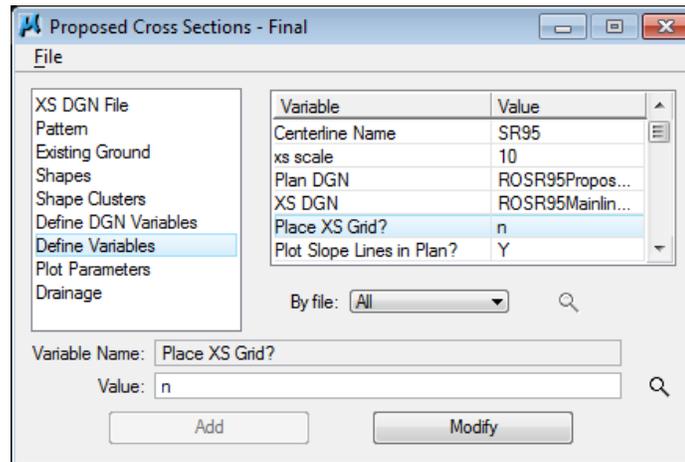
Next, we'll need to re-define our variables as needed. Variables allow us to customize our cross sections. For example, on one project our "Subgrade Depth" may be 1.5', while on another it may be 1.75'. Or we may want to set up different runs on the same project where each run reflects differing variable values.

NOTE:

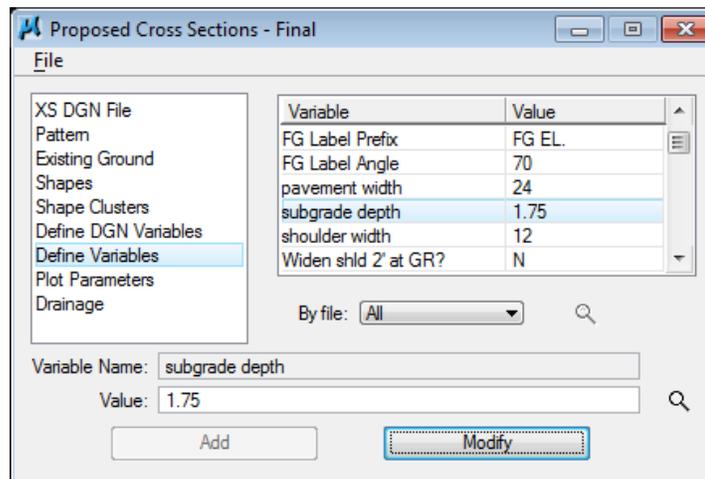
Once a value is set, that value controls the entire cross section run. For example, if we set the "Subgrade Depth" to a value of 1.5', our subgrade depth will be plotted at 1.5' for all of the cross sections.

- 1) Select the Define Variables item from the Proposed Cross Section dialog list box. Most of our variables are already set but we want to make a couple of changes.

- 2) Select the Variable "Place XS Grid?" and set the Value to "N". To do this, enter the change in the Value field and **press the Modify button**.



- 3) Select the Variable "subgrade depth" and set the Value to "1.75".



IV.) Variable Criteria Files

All of the rest of the settings in our run Final are set so we could run our cross sections to see what effects our changes have made but instead let's take this fine tuning of our roadway one step further.

By default, our side slopes are variable and are based on Case I or Case II slope criteria as specified on T.D.O.T. standard roadway drawing RD01-S-11. In certain situations, we may be required to adjust this in certain areas with fixed slopes, special ditches or benching.

We will illustrate how to address some of these in this section by setting up some special re-definable variables in our variable criteria files. Re-definable variables are variables which are set up so that we can vary their values by station range.

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Re-definable controls are available for:

Fixed Fill or Cut Slopes on left or right

Maximum cut or fill slope control to limit maximum slopes applied using normal variable slopes application

Median slopes in guardrail areas for bridge pier or bridge end protection

Special ditch application area:

- along roadway
- at the toe of fill slopes
- at the top of cut slopes

Special ditch defined by:

- centerline & profile (channel changes)
- profile and foreslope
- minimum depth and foreslope

Berm control for top of cut special ditches

Low water keyhole for channel change special ditches

Benching in earth or rock cuts and earth fills

Bench formation defined as:

- single slope to top of rock
- repeating by height
- up to 6 defined elevations

Benching Rock- Earth interface area defined as:

- bench at rock
- trace rock
- single slope

Rules for Variable Criteria File Editing

The following guidelines should be observed when setting up the variable criteria file to alter cross sections to reflect design needs for special areas along the roadway:

1. Comment lines are lines used for explanation only and are not processed as commands. They should begin with */** and end with **/*.
2. If statements are statements that define an area, station to station, within which the commands that follow it will be processed.
3. The begin bracket { and end bracket } signify the beginning and end of variable settings. The settings should follow if statements.

For Alternate Side Slopes, Special Ditches or Benching along Roadway:

1. Copy the lines of text between the lines that contain the “begin” comment and the “end” comment. The copying should begin with the line containing the “if statement” and end with the line containing the end bracket “}”. Make a copy for each “station to station” area needed.
2. Paste these copies at the end of the file after the comment “/* Add all changes below this line */”
3. For each area with different settings,
 - a. Change the station ranges (and region #'s if needed) in the “if statement” text line.
 - b. Set the variables as needed for that area on the LT or RT.
 - c. If it's for the left only, then delete the lines of text for the RT. If it's for the right only, then delete the lines of text for the LT.

When a variable file (Var***.x) is modified for use by a specific roadway it will be necessary to rename it (Example: VarMainline.x). That way it will not be overwritten or used on the wrong roadway. Once this file is modified and re-named, replace the original variable criteria file associated with your roadway in the GEOPAK Proposed Cross Section dialog with this new one.

Any values which need to be applied on the entire roadway can be set in the Define Variables section of the GEOPAK Proposed Cross Section dialog.

a) Special Design Case 1 – Rural Fixed Slopes

To limit the length of box culvert required at Poplar Cr., we need to steepen slopes behind the guardrail on the left side of the roadway from Station 289+00 to Station 292+00.

Fixed Fill Slope Left: 2:1

We need to pull slopes inside present R.O.W. on the right side of the roadway from Station 293+00 to Station 297+00.

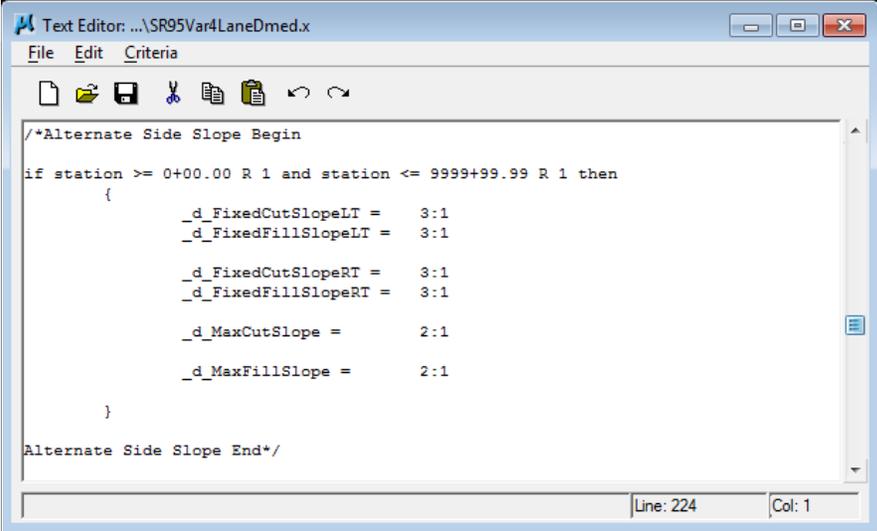
Fixed Fill Slope Right: 3:1

- 1) Access the GEOPAK Text Editor from the Road Tools task group.



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- 2) Using the File drop down, open the variable file Var4LaneDmed.x located in your project directory. Scroll down until you see the section for Alternate Side Slopes as shown below:



```
Text Editor: ...\\SR95Var4LaneDmed.x
File Edit Criteria

/*Alternate Side Slope Begin
if station >= 0+00.00 R 1 and station <= 9999+99.99 R 1 then
{
    _d_FixedCutSlopeLT = 3:1
    _d_FixedFillSlopeLT = 3:1
    _d_FixedCutSlopeRT = 3:1
    _d_FixedFillSlopeRT = 3:1
    _d_MaxCutSlope = 2:1
    _d_MaxFillSlope = 2:1
}
Alternate Side Slope End*/
```

The instructions for editing variable criteria files shown on the previous page are also given in each variable criteria file.

- 3) Following the rules stated for editing this file, copy the alternate side slope section twice to the bottom of the file and edit this area of the variable file so that it looks as follows:

```
if station >= 289+00.00 R 1 and station <= 292+00.00 R 1 then
{
    _d_FixedFillSlopeLT = 2:1
}
```

```
if station >= 293+00.00 R 1 and station <= 297+00.00 R 1 then
{
    _d_FixedFillSlopeRT = 3:1
}
```

b) Special Design Case 2 – Special Ditch

A special trapezoidal ditch is needed on the left side of the road from Station 300+00 to Station 309+00 to handle a buildup in the volume of water coming down the hill.

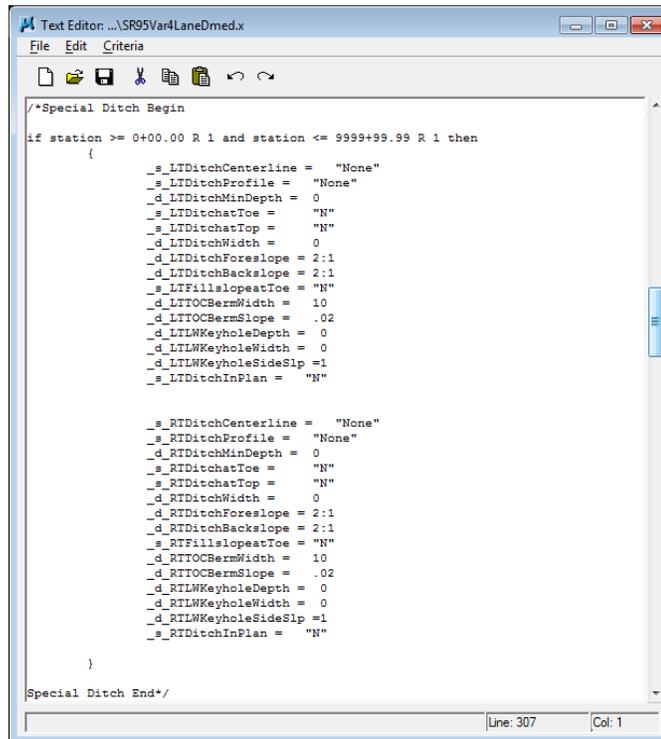
Elevation Control: Minimum Depth of 4'

Ditch Width: 6'

Foreslope: 6:1

Backslope: 2:1

- 1) Access the GEOPAK Text Editor from the Road Tools task group.
- 2) Scroll back up until you see the section for Special Ditches as shown below:



```
Text Editor: ...SR95Var4LaneDmed.x
File Edit Criteria

/*Special Ditch Begin
if station >= 0+00.00 R 1 and station <= 9999+99.99 R 1 then
{
    _s_LTDitchCenterline = "None"
    _s_LTDitchProfile = "None"
    _d_LTDitchMinDepth = 0
    _s_LTDitchatToe = "N"
    _s_LTDitchatTop = "N"
    _d_LTDitchWidth = 0
    _d_LTDitchForeslope = 2:1
    _d_LTDitchBackslope = 2:1
    _s_LTDitchFillSlopeToe = "N"
    _d_LTDitchBermWidth = 10
    _d_LTDitchBermSlope = .02
    _d_LTDitchKeyholeDepth = 0
    _d_LTDitchKeyholeWidth = 0
    _d_LTDitchKeyholeSideSlp = 1
    _s_LTDitchInPlan = "N"

    _s_RTDitchCenterline = "None"
    _s_RTDitchProfile = "None"
    _d_RTDitchMinDepth = 0
    _s_RTDitchatToe = "N"
    _s_RTDitchatTop = "N"
    _d_RTDitchWidth = 0
    _d_RTDitchForeslope = 2:1
    _d_RTDitchBackslope = 2:1
    _s_RTDitchFillSlopeToe = "N"
    _d_RTDitchBermWidth = 10
    _d_RTDitchBermSlope = .02
    _d_RTDitchKeyholeDepth = 0
    _d_RTDitchKeyholeWidth = 0
    _d_RTDitchKeyholeSideSlp = 1
    _s_RTDitchInPlan = "N"
}
Special Ditch End*/
Line: 307 Col: 1
```

- 3) Following the rules stated for editing this file, copy the special ditch section to the bottom of the file and edit this area so that it looks as follows:

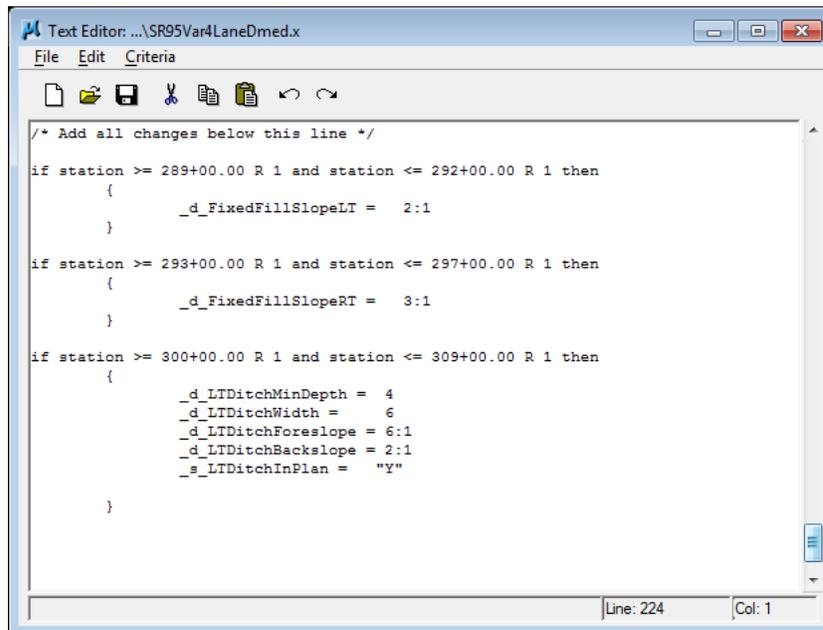
if station >= 300+00.00 R 1 and station <= 309+00.00 R 1 then

```
{
    _d_LTDitchMinDepth = 4
    _d_LTDitchWidth = 6
    _d_LTDitchForeslope = 6:1
    _d_LTDitchBackslope = 2:1
    _s_LTDitchInPlan = "Y"
}
```

- 4) Sometimes, GEOPAK has trouble reading the last line of a criteria file so add a few blank lines at the end of the file to ensure processing without errors.

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- 5) Using the File drop down in GEOPAK text editor, use Save As to save your changes as SR95Var4LaneDmed.x.



```
Text Editor: ...SR95Var4LaneDmed.x
File Edit Criteria

/* Add all changes below this line */
if station >= 289+00.00 R 1 and station <= 292+00.00 R 1 then
{
    _d_FixedFillSlopeLT = 2:1
}
if station >= 293+00.00 R 1 and station <= 297+00.00 R 1 then
{
    _d_FixedFillSlopeRT = 3:1
}
if station >= 300+00.00 R 1 and station <= 309+00.00 R 1 then
{
    _d_LTDitchMinDepth = 4
    _d_LTDitchWidth = 6
    _d_LTDitchForeslope = 6:1
    _d_LTDitchBackslope = 2:1
    _s_LTDitchInPlan = "Y"
}
}

Line: 224 Col: 1
```

c) Special Design Case 3 – Urban Fixed Slopes

To minimize encroachment on properties in the urban section, it has been stipulated that we may use 3:1 slopes instead of normal variable slopes in that area from Station 328+25 to Station 347+50.

Fixed Cut Slope Left: 3:1

Fixed Fill Slope Left: 3:1

Fixed Cut Slope Right: 3:1

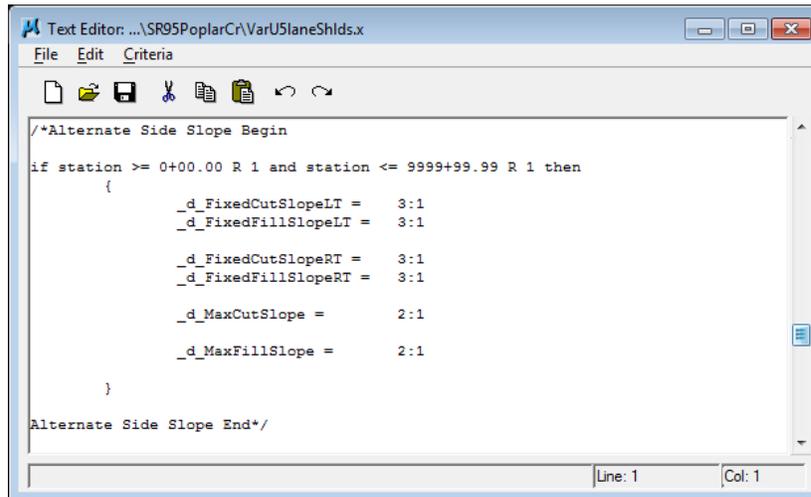
Fixed Fill Slope Right: 3:1

To handle each of these situations, we'll need to edit the appropriate variable criteria file. Each Typical Section has its own variable file. It can be determined by looking at the first criteria file name listed for the left side slope set up for any given roadway shape cluster. On this project they are as follows:

| Typical Section | Variable Filename |
|---------------------------------------|-------------------|
| 4LNDMD (4 Lane with Depressed Median) | Var4LaneDmed.x |
| 5LNUS (5 Lane Urban with Shoulders) | Varu5LaneShlds.x |

- 1) Since this scenario is in a section of our project covered by the typical 5LNUS, we'll need to use the appropriate variable file to make our changes.

Using the File pull drop down in GEOPAK text editor, open the variable file Varu5LaneShlds.x located in your project directory. Scroll down until you see the section for Side Slopes as shown below:



```
Text Editor: ...SR95PoplarCr\Varu5laneShlds.x
File Edit Criteria
[*Alternate Side Slope Begin
if station >= 0+00.00 R 1 and station <= 9999+99.99 R 1 then
{
    _d_FixedCutSlopeLT = 3:1
    _d_FixedFillSlopeLT = 3:1
    _d_FixedCutSlopeRT = 3:1
    _d_FixedFillSlopeRT = 3:1
    _d_MaxCutSlope = 2:1
    _d_MaxFillSlope = 2:1
}
Alternate Side Slope End*/
```

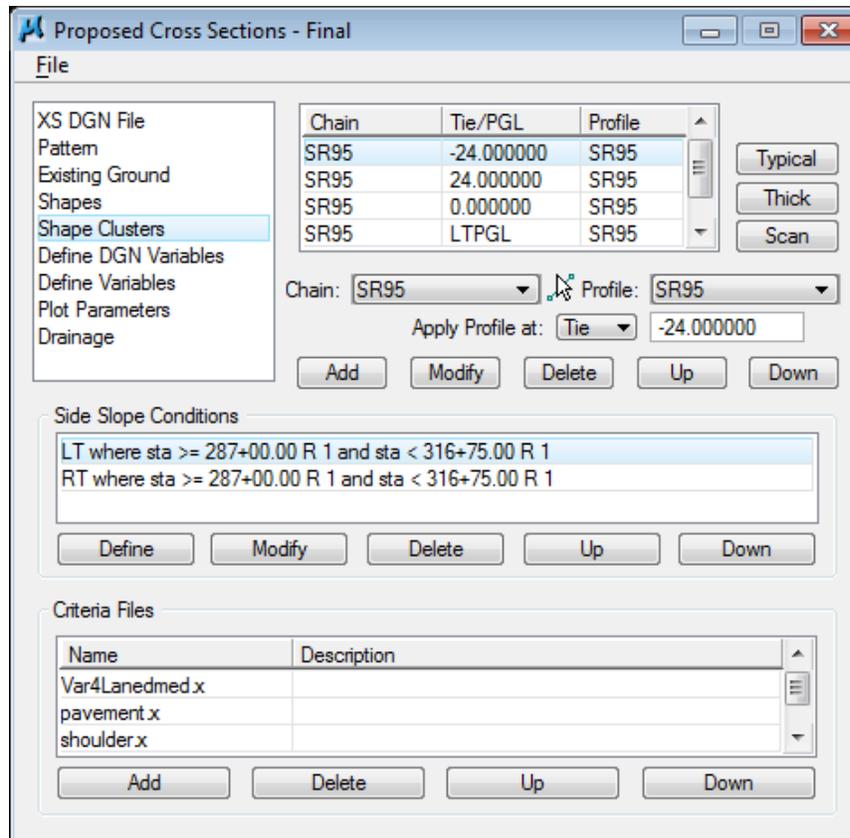
- 2) Copy this section to the bottom of the file and edit this area of the variable file so that it looks as follows:

```
if station >= 328+25.00 R 1 and station <= 347+50.00 R 1 then
{
    _d_FixedCutSlopeLT = 3:1
    _d_FixedFillSlopeLT = 3:1
    _d_FixedCutSlopeRT = 3:1
    _d_FixedFillSlopeRT = 3:1
}
```

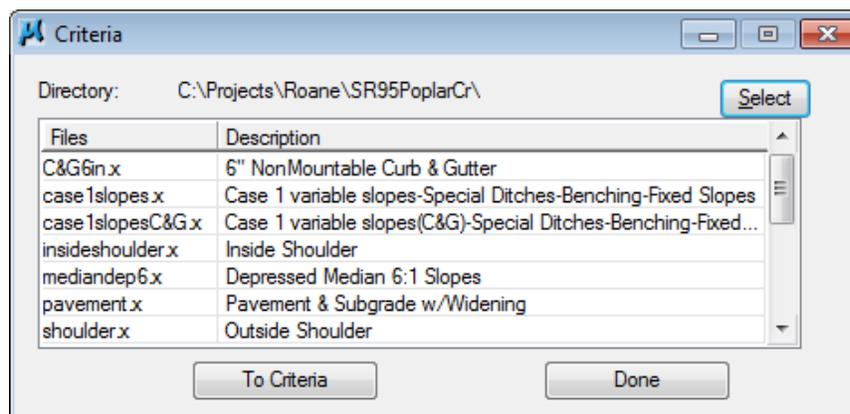
- 3) Using the File drop down in GEOPAK text editor, use **Save As** to save your changes as SR95Varu5LaneShlds.x.
- 4) Exit the GEOPAK text editor.

V.) Re-Assigning Variable Criteria Files

- 1) Return to the Proposed Cross Section dialog and under Shape Clusters select the Shape Cluster identified by Chain=SR95, Tie/PGL=-24 and Profile=SR95.



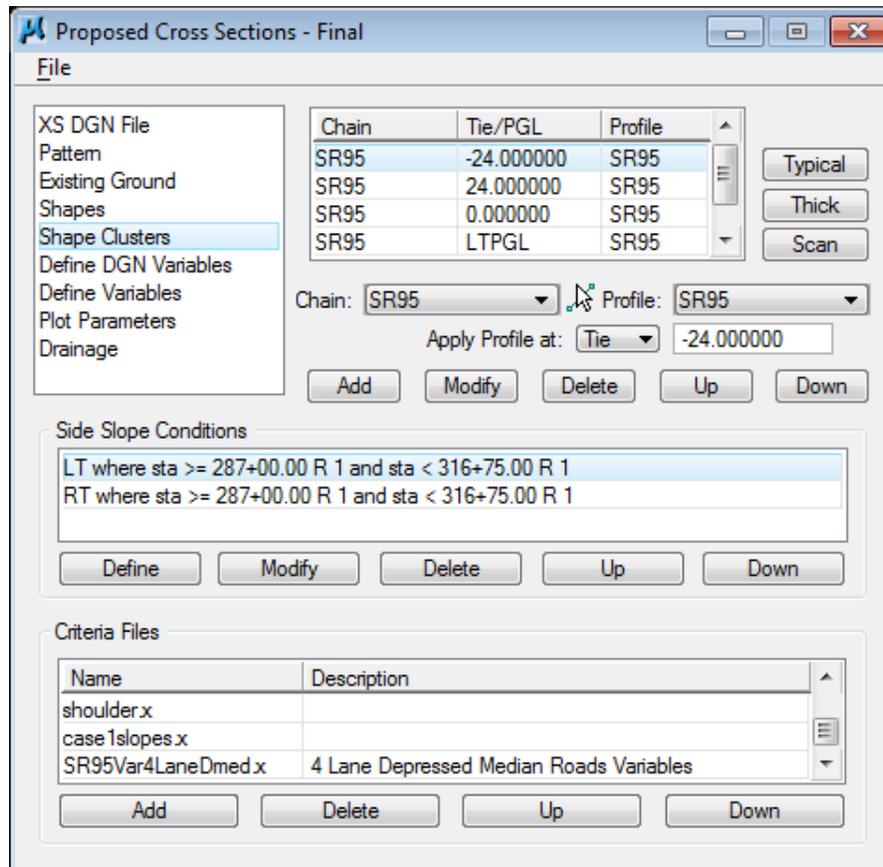
- 2) At the bottom of the dialog below the Criteria File list, press Add and the following dialog will appear.



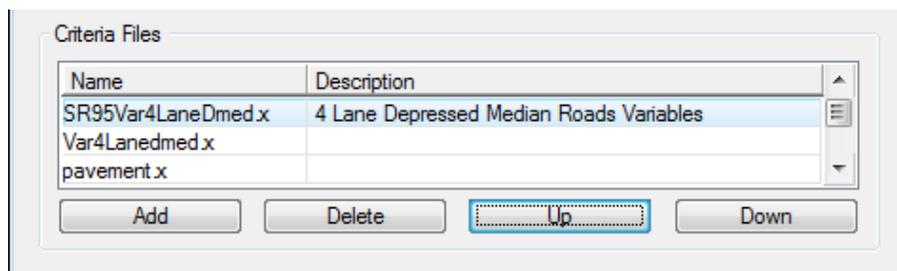
NOTE:

Use the Select button at the upper right of the dialog if you need to change paths to your project working directory.

- 3) Highlight the new variable file SR95Var4LaneDmed.x and then press the To Criteria button or double-click on the file to add the file to the Proposed Cross Section Criteria File list.



- 4) Highlight the new variable file and press the Up as many times as needed to move the file to the top of the Criteria File list.



NOTE:

Since cross sections process from left to right and variables must be defined before other criteria files can be processed, then the variable criteria file must be first in the left slope condition or in some cases where there is no left slope condition, first in the right set up.

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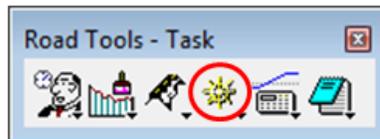
- 5) In the Criteria File area highlight the original variable file, Var4LaneDmed.x at the top of the list and press Delete.
- 6) Answer Yes to delete the criteria file when prompted and the original variable file Var4LaneDmed.x will be removed from the list.
- 7) Select the Shape Cluster identified by Chain=SR95, Tie/PGL=LTPGL and Profile=SR95.
- 8) Repeat previous steps 2-6 to add the new variable file SR95Var4LaneDmed.x and delete the old variable file Var4LaneDmed.
- 9) Select the Shape Cluster identified by Chain=SR95, Tie/PGL=0 and Profile=SR95.
- 10) Repeat previous steps 2-6 to add the new variable file SR95Varu5LaneShlds.x and delete the old variable file Varu5LaneShlds.x.
- 11) We are now finished adding criteria files so can click on the Done button on the Add Criteria dialog.

NOTE:

When replacing variable files, never delete the original file first. Values that have been set under Define Variables will be re-initialized to their original default values so that you would have to set them again for your project.

VI.) Processing Final Proposed Cross Sections

- 1) At this point, we are ready to process our final proposed cross sections. From the Proposed Cross Sections dialog, select drop down option Files → Run.
- 2) Select Screen Only and de-activate the Pause on Each Section toggle.
Press Apply.
- 3) When cross sections finish processing, close the Proposed Cross Sections dialog box and click Yes to save your run when prompted.
- 4) Review your proposed cross sections using XS Navigator. Check the changes that have been made since we originally ran them including:



- (289+00 - 292+00) - 2:1 slopes behind the guardrail on the left
 - (292+00 – 293+50) - Type 38 guardrail terminal pad widening on left at 10:1 slope
 - (293+00 - 297+00) - 3:1 side slopes on the right
 - (300+00 - 309+00) - Special ditch on the left
 - (307+74 – 323+55), (330+66 – 337+95) - Superelevation on our 2 horizontal curves
 - (316+75 - 328+25) - Transition area from 4 lane divided to 5 lane undivided
 - (328+25 - 347+50) - 3:1 side slopes on left & right in the urban section
- 5) Open the Proposed DGN file ROSR95Proposed.dgn and review your slope lines in the following areas:
 - (293+00 - 297+00) - Slope ties pulled inside of existing R.O.W. on right
 - (300+00 - 309+00) - Special ditch on the left
 - (336+00 - 338+50) - Slope ties pulled outside of cemetery area on the right