

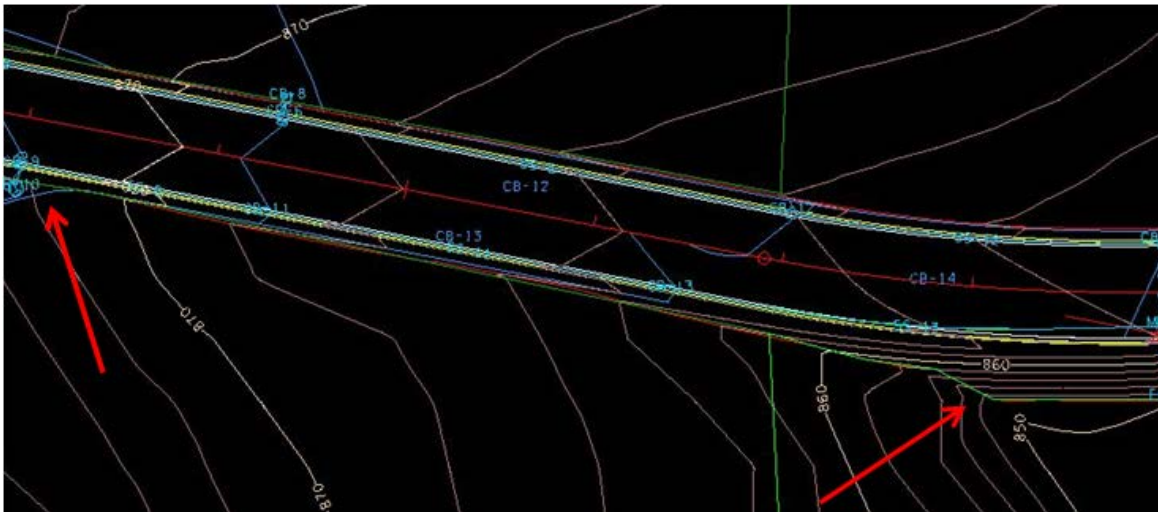
7. Ditch Nodes and Links

This exercise shows the user how to utilize the tools for nodes and links for ditch analysis. We will investigate the drainage flow along a fill slope with these settings and in a later chapter define a special ditch to manage it.

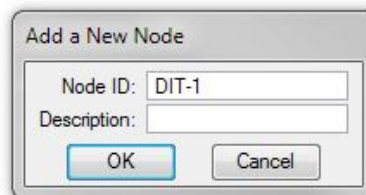
7.1 Ditch Node Design DIT-1

Begin Ditch

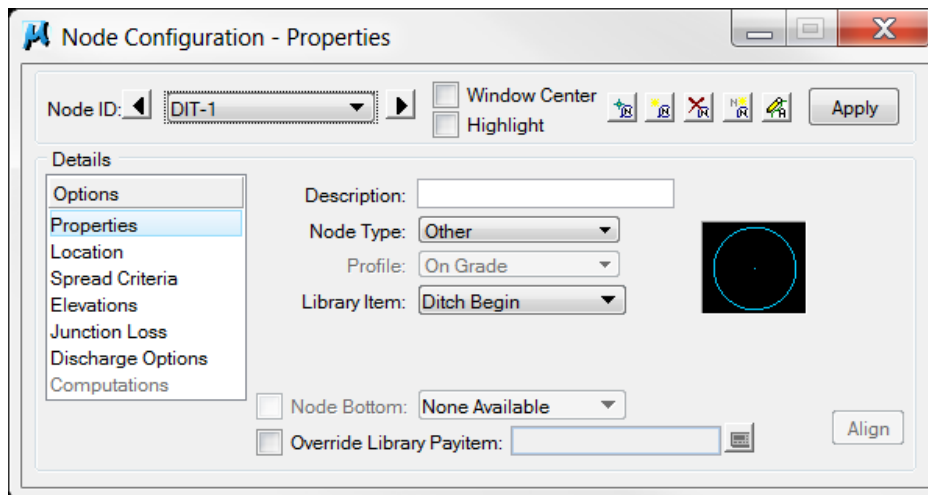
- a) Visually determine the tentative location of the beginning of the ditch. In this case a ditch is created along the south side of the roadway by the new fill slopes.



- b) Select from the Drainage Menu Bar: **Component > Node > Add** or from the main toolbar: **Add Drainage Node**.
- c) In the **New Node** window that appears, set the name **DIT-1** and click **OK**.



d) **Properties** > Set **Node Type** to Other and **Library Item** to Ditch Begin.

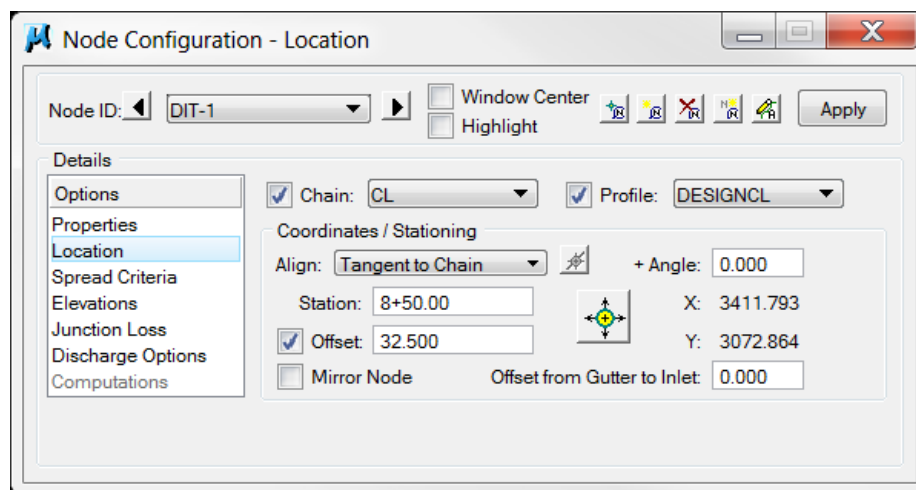


e) **Location** > All settings should have carried over from the last Node input. Review and make the following changes:

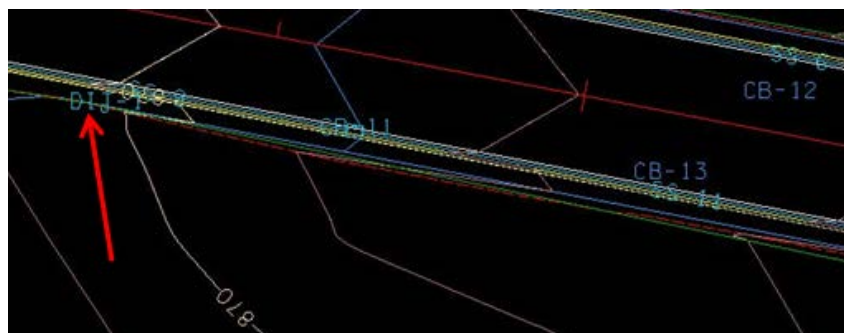
Station: 8+50.00

Offset: 32.50

+Angle: 0.00



This will approximate the beginning of the ditch as shown below:



Exercise 7

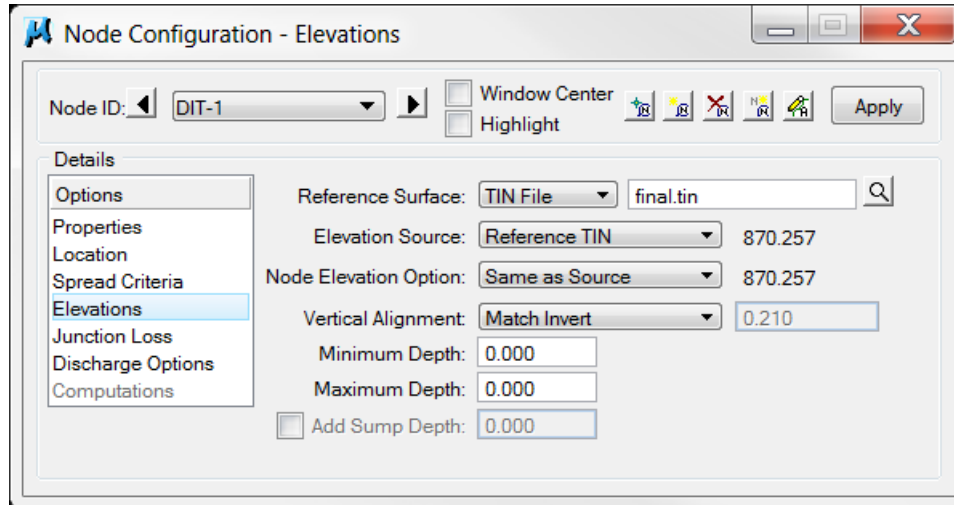
NOTE: The **Spread Criteria** configuration is not required for **Other** node types such as are used by ditches.

- f) **Elevations** > All settings should have carried over from the last Node input. Review and make the following changes:

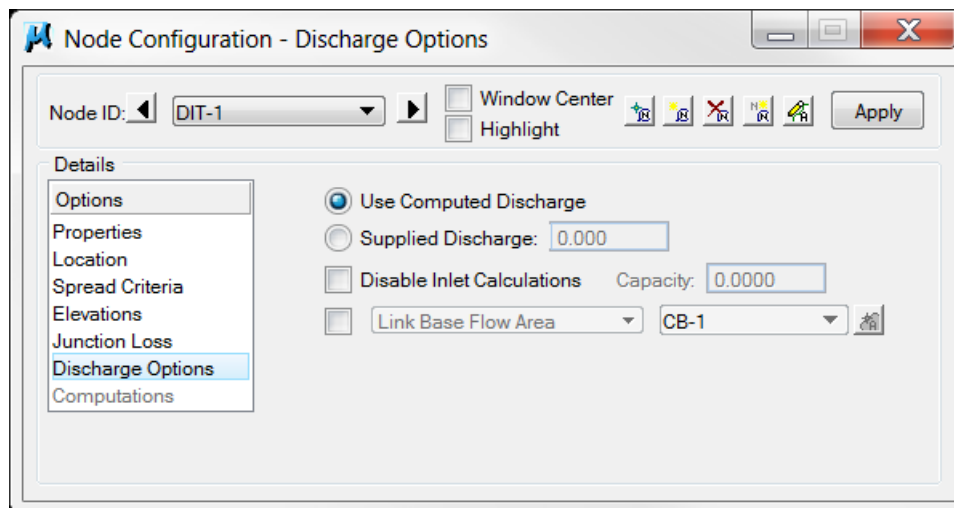
Vertical Alignment: Match Invert

Minimum Depth: 0.00

Maximum Depth: 0.00



- g) **Discharge Options** > Leave **Use Computed Discharge** selected and click **Apply** to save all settings.



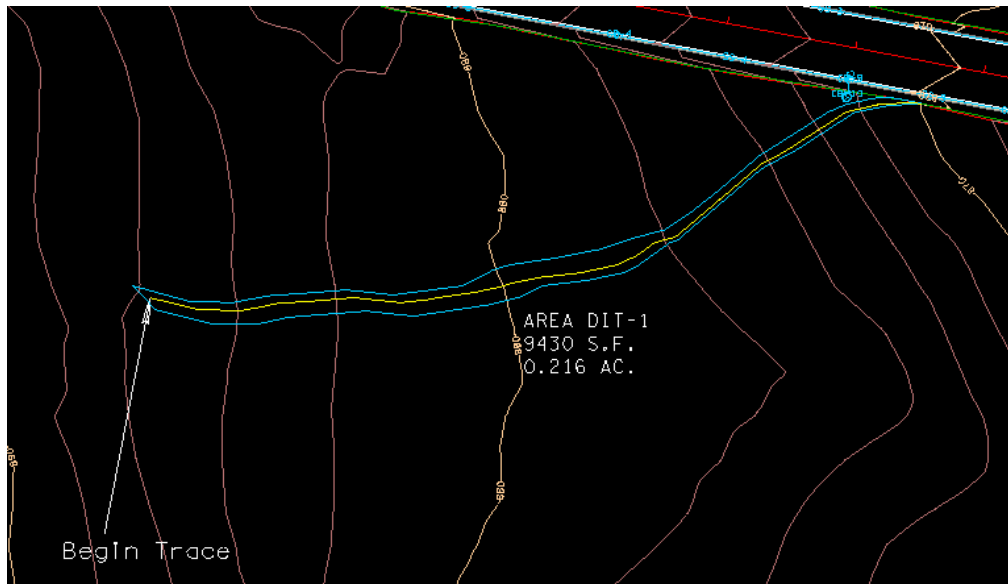
NOTE: For short ditches where only a single drainage area is utilized, the **Link Base Flow Area** option should be toggled ON and set to add the discharge for that area. It is then toggled off at the ditch outlet. If this is not toggled OFF at other nodes beyond the beginning, the discharge will accumulate at each node and not accurately represent the area's discharge.

7.2 Delineate Drainage Area DIT-1

Begin Ditch Drainage Area

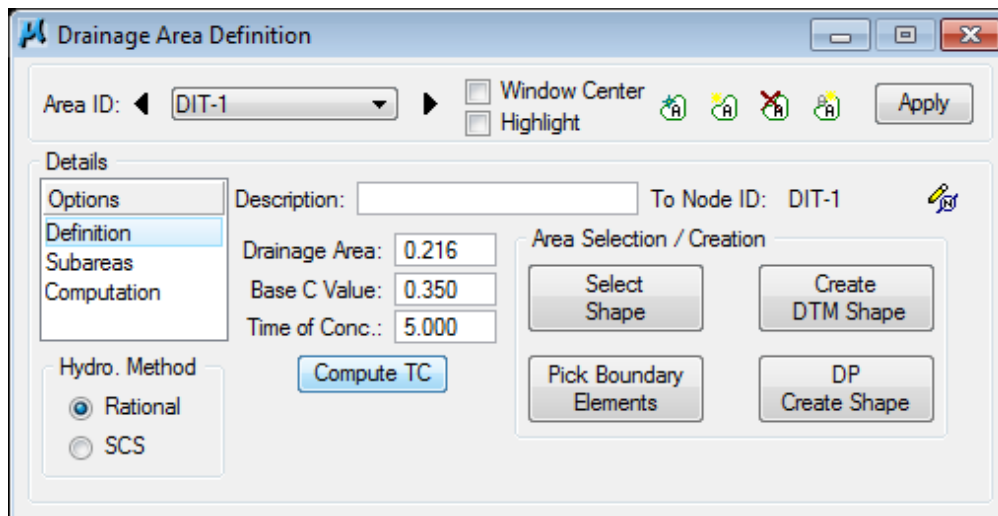
- a) From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **DIT-1** should automatically appear, click **OK**.
- b) Follow the steps in Exercise 4.1 to delineate and define the drainage area for the begin ditch location. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA_DIT-1. **You may want to turn off the level SURVEY – DRAINAGE – Area Shapes** to see the ditch easier.

Delineate Drainage Area:

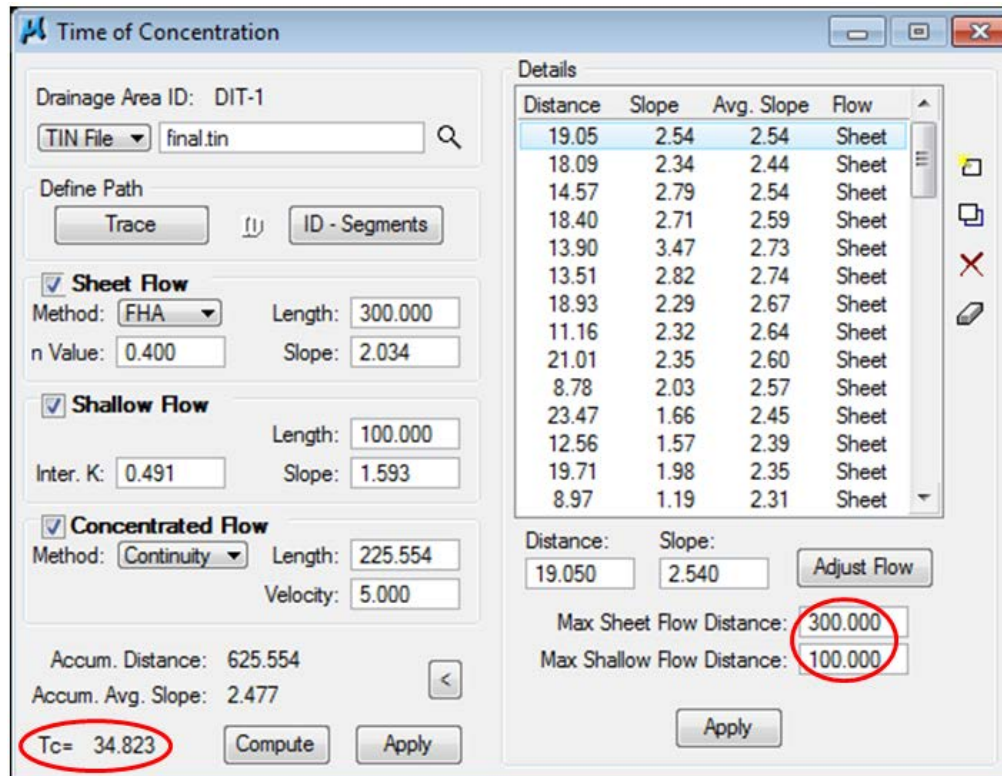


NOTE: The drainage area should be broken into sections for long ditches, however, for short ditches; determine the area from the most downstream point (i.e. the stream outlet).

- c) Define Drainage Area:



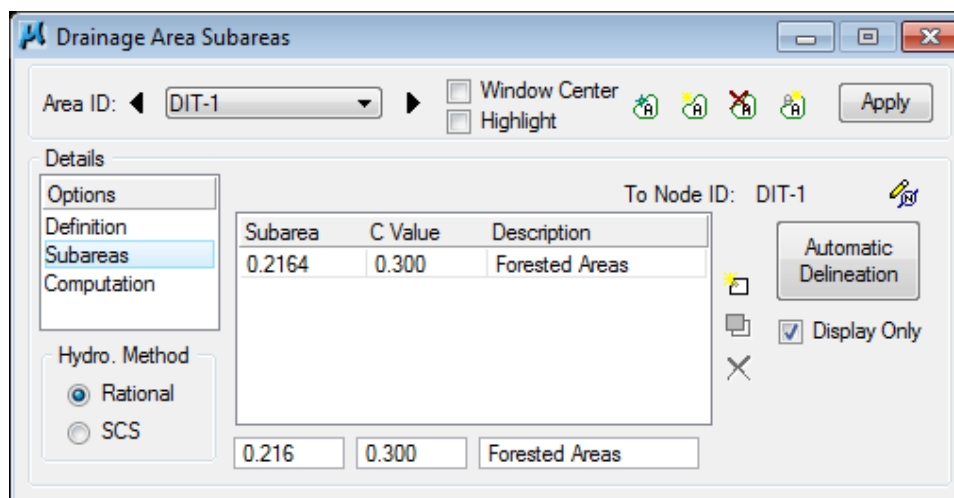
d) Calculate Time of Concentration:



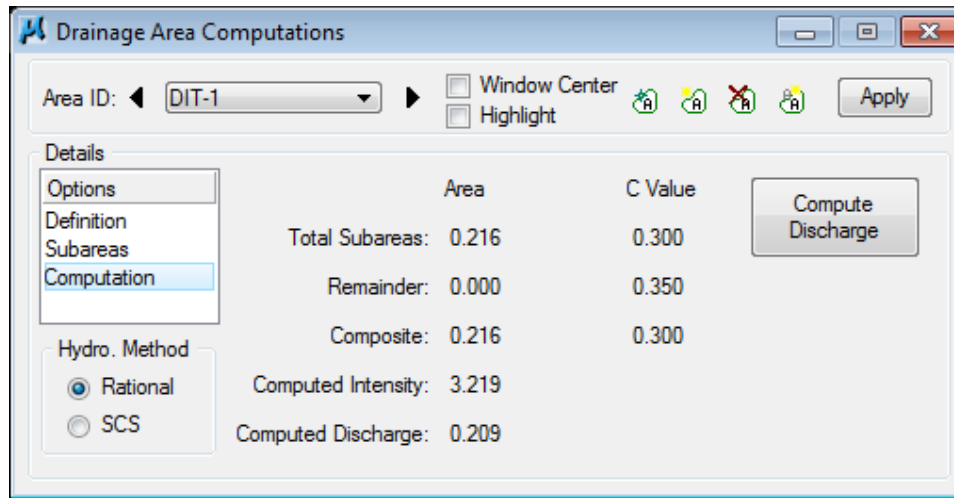
Make settings as shown for Max Sheet Flow and Max Shallow Flow. We will use these settings for all the ditch areas.

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with **NO** further steps required

e) Delineate Subareas utilizing the Land Use DGN:



f) **Compute Discharge and Apply:**



7.3 Ditch Node Design DIT-2

- a) Visually determine the location of any major ditch change; such as a change in horizontal or vertical alignment or a change in cross section.

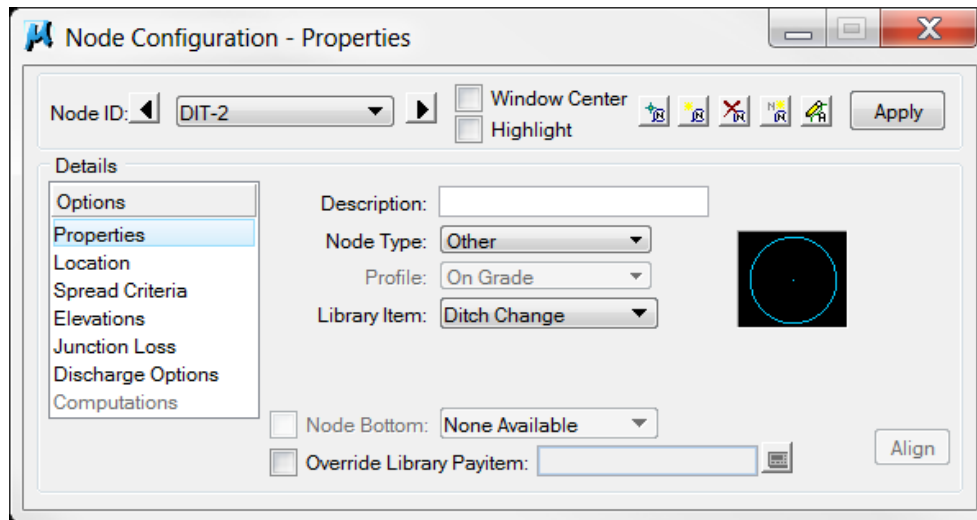
In this initial set up we are analyzing the flow along the fill slope and will set them as shown.



- b) Select from the Drainage Menu Bar: **Component > Node > Add** or from the main toolbar: **Add Drainage Node**.
- c) In the **New Node** window that appears, set the name **DIT-2** and click **OK**.

Exercise 7

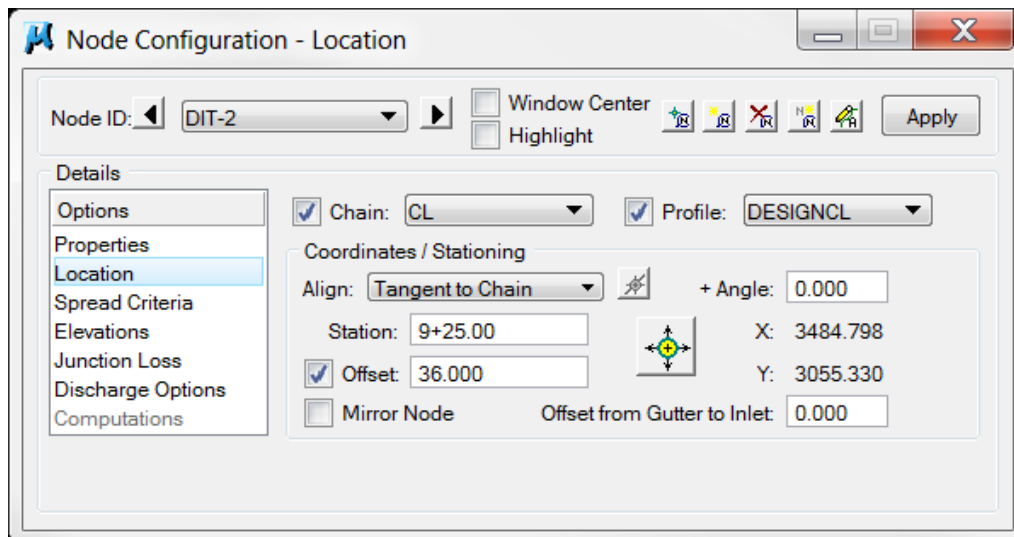
d) **Properties** > Set **Node Type** to Other and **Library Item** to Ditch Change.



e) **Location** > All settings should have carried over from DIT-1. Review and make the following changes (estimated change locations):

Station: 9+25.00

Offset: 36.00

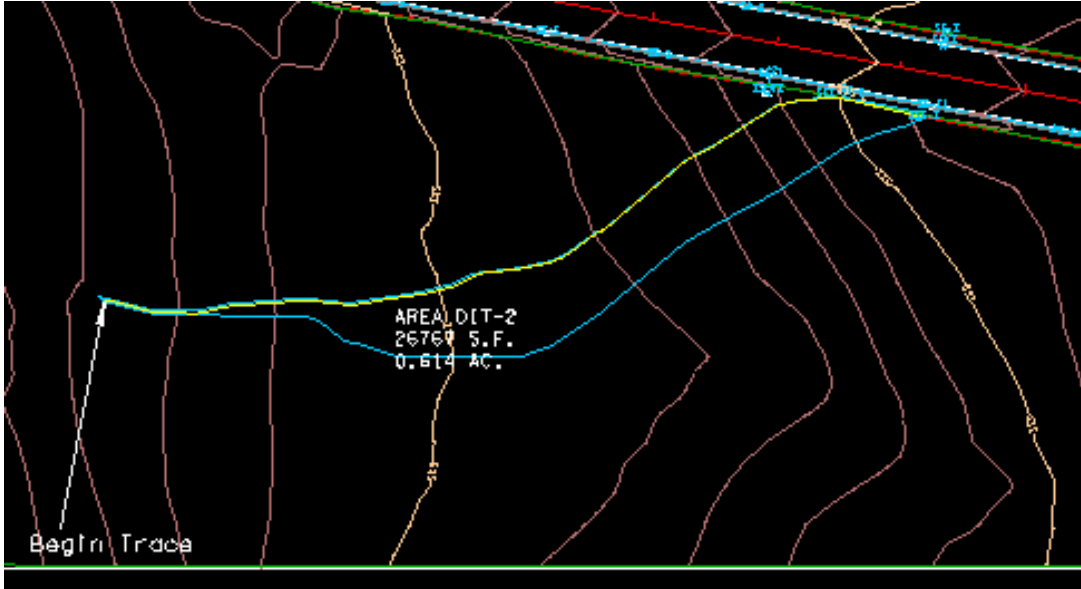


f) Click **Apply**.

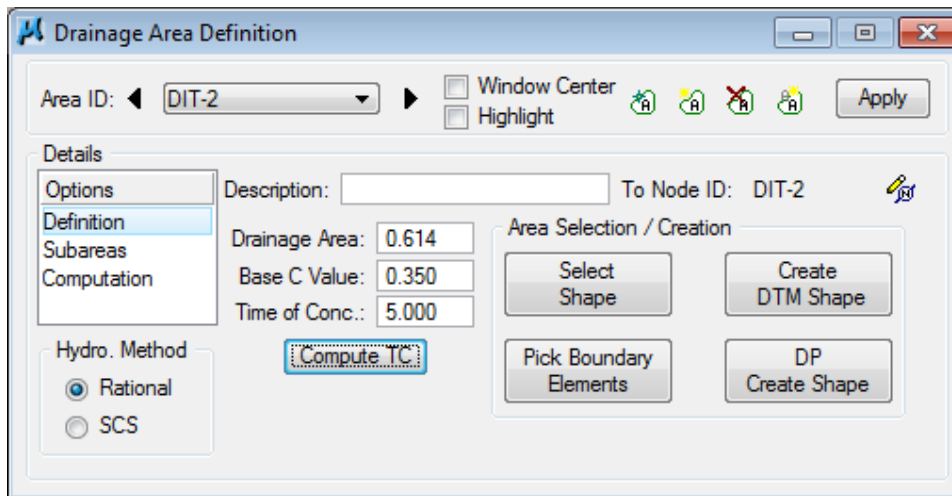
7.4 Delineate Drainage Area DIT-2

- a) From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **DIT-2** should automatically appear, click **OK**.
- b) Follow the steps in Exercise 4.1 to delineate and define the drainage area for this ditch change location. Attach reference file DA_DIT-2 and turn off DA_DIT-1.

Delineate Drainage Area:



- c) Define Drainage Area:



d) Calculate Time of Concentration:

Drainage Area ID: DIT-2
 TIN File: final.tin

Define Path
 Trace ID - Segments

Sheet Flow
 Method: FHA Length: 300.000
 n Value: 0.400 Slope: 1.963

Shallow Flow
 Length: 100.000
 Inter. K: 0.491 Slope: 1.573

Concentrated Flow
 Method: Continuity Length: 296.435
 Velocity: 5.000

Accum. Distance: 696.435
 Accum. Avg. Slope: 2.566

Tc= 35.542 Compute Apply

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required

e) Delineate Subareas utilizing the Land Use DGN:

Area ID: DIT-2 Window Center Highlight Apply

Details
 Options Definition Subareas Computation

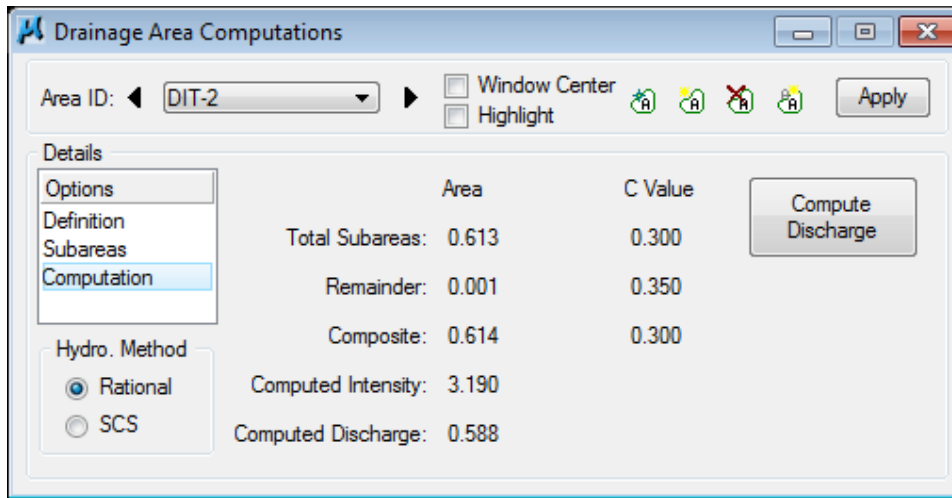
Hydro. Method
 Rational
 SCS

To Node ID: DIT-2 Automatic Delineation Display Only

Subarea	C Value	Description
0.6132	0.300	Forested Areas

0.613 0.300 Forested Areas

f) **Compute Discharge and Apply:**



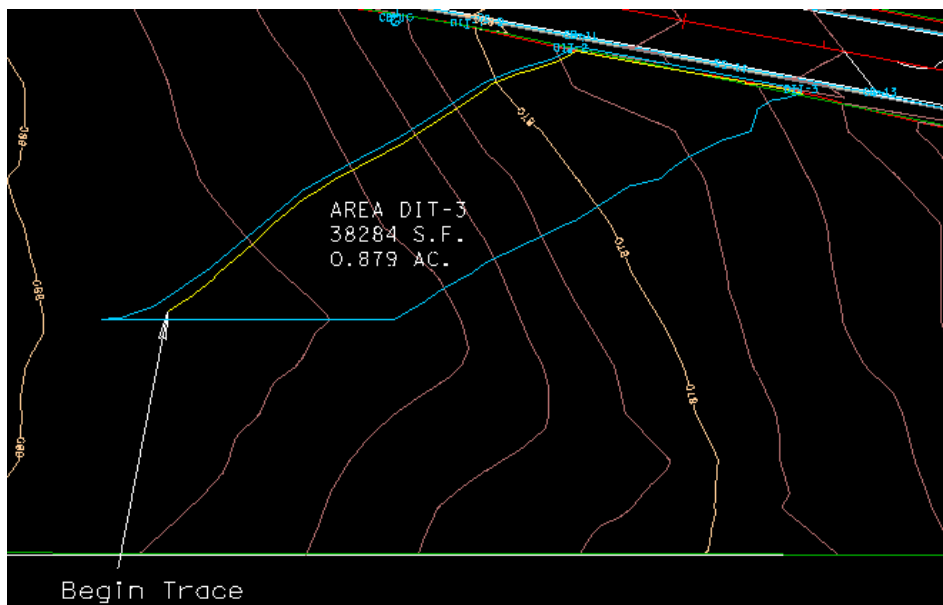
7.5 Ditch Node Design DIT-3

Repeat previous steps on pages 7-7 & 7-8 creating ditch change Node **DIT-3** at **Station: 10+90.00** and **Offset: 34.00**. All other information should remain unchanged.

7.6 Delineate Drainage Area DIT-3

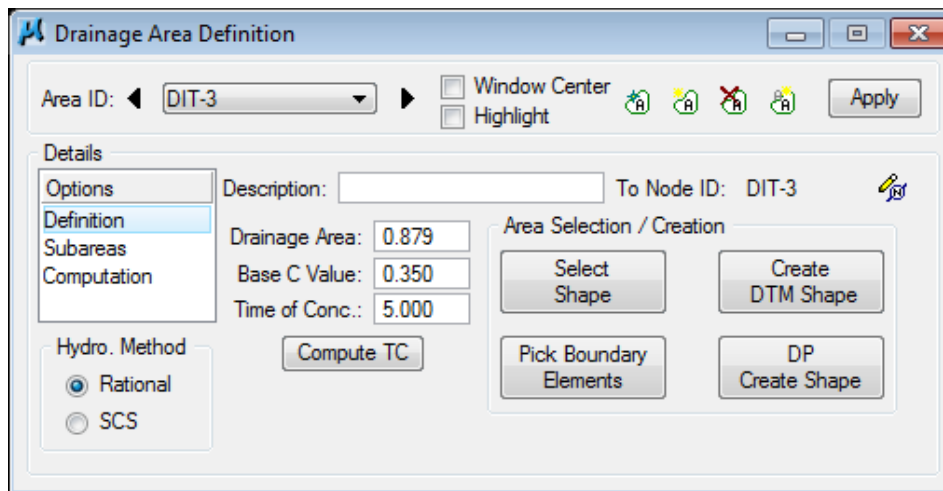
- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **DIT-3** should automatically appear, click **OK**.
- Follow the steps in Exercise 4.1 to delineate and define the drainage area for this ditch change location.

Delineate Drainage Area:

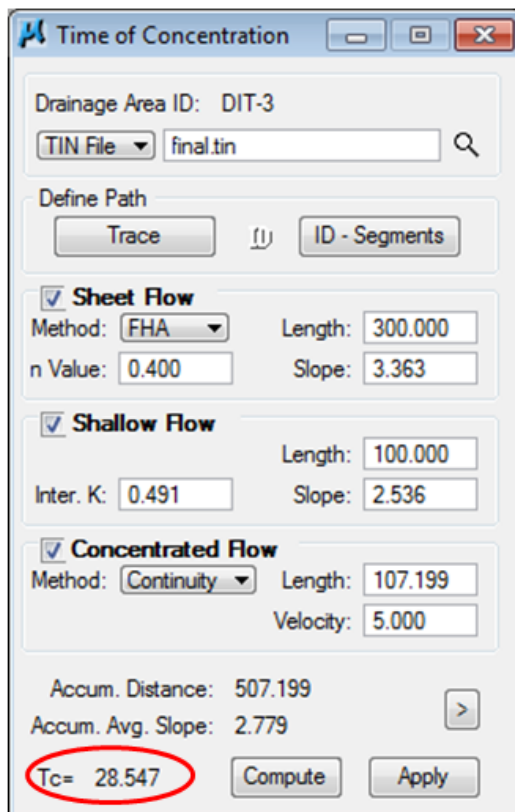


Exercise 7

c) Define Drainage Area:

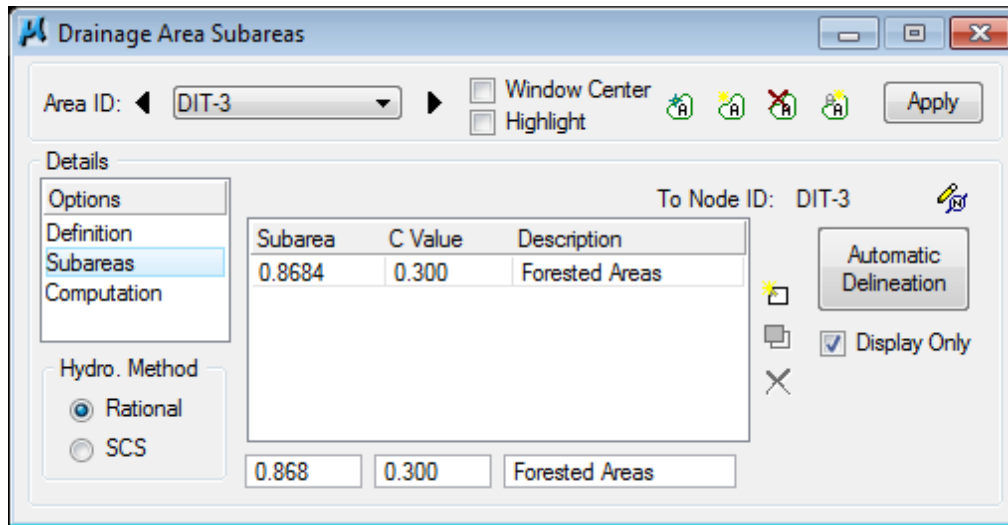


d) Calculate Time of Concentration:

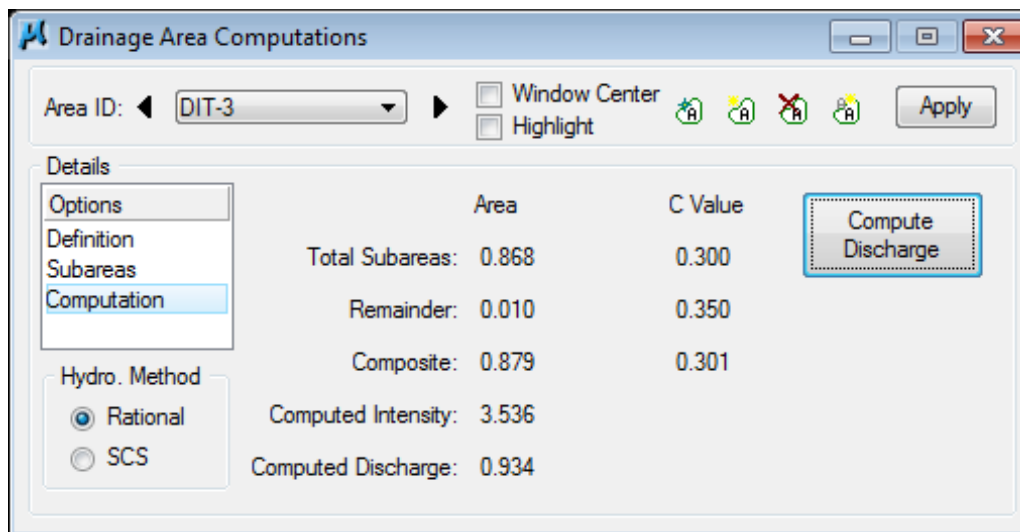


The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required

e) Delineate Subareas utilizing the Land Use DGN:

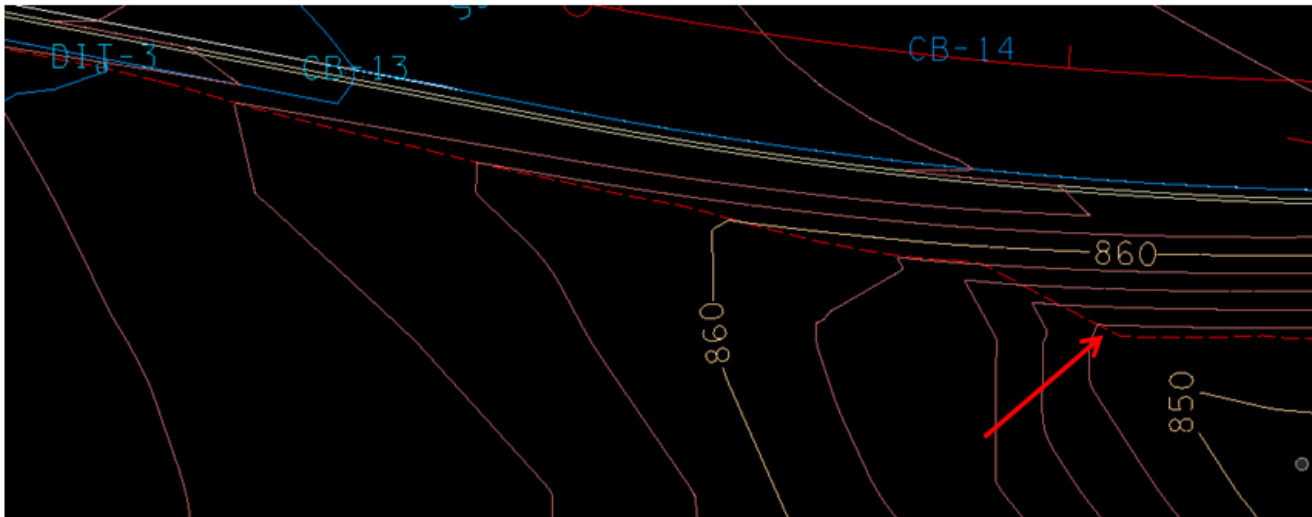


f) Compute Discharge and Apply:

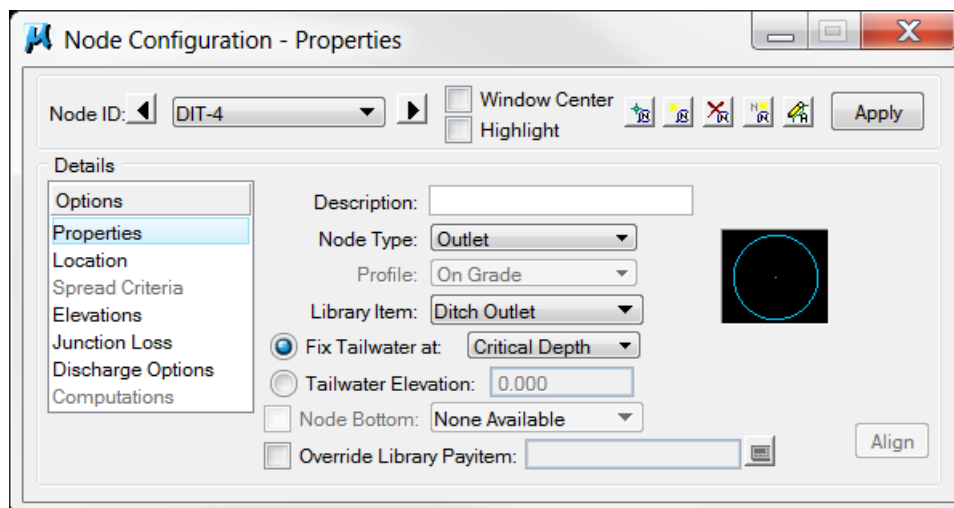


7.7 Ditch Node Design DIT-4

- a) Visually determine the location of the ditch outlet.



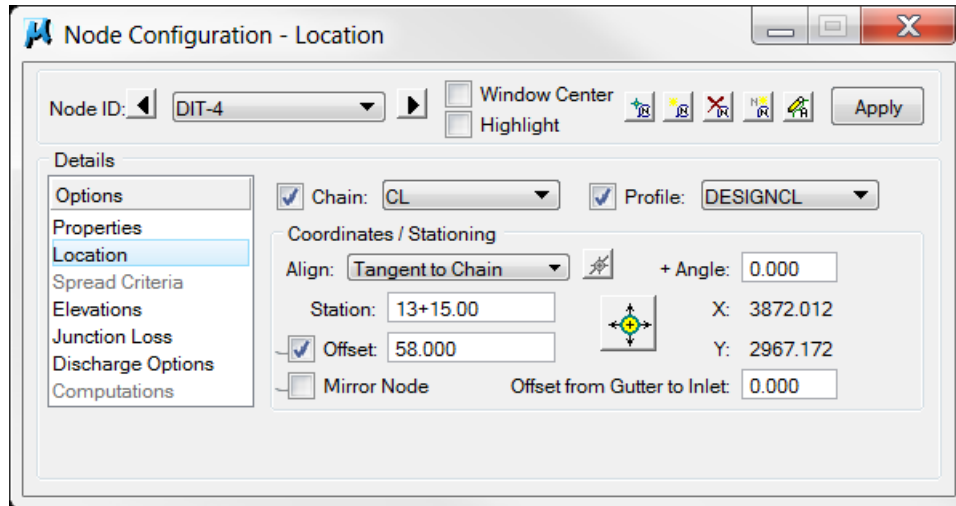
- b) Select from the Drainage Menu Bar: **Component > Node > Add** or from the main toolbar: **Add Drainage Node**.
- c) In the **New Node** window that appears, set the name **DIT-4** and click **OK**.
- d) **Properties >** Set **Node Type** to Outlet, **Library Item** to Ditch Outlet and **Fix Tailwater at Critical Depth**



- e) **Location** > All settings should have carried over from DIT-3. Review and make the following changes:

Station: 13+15.00

Offset: 58.00

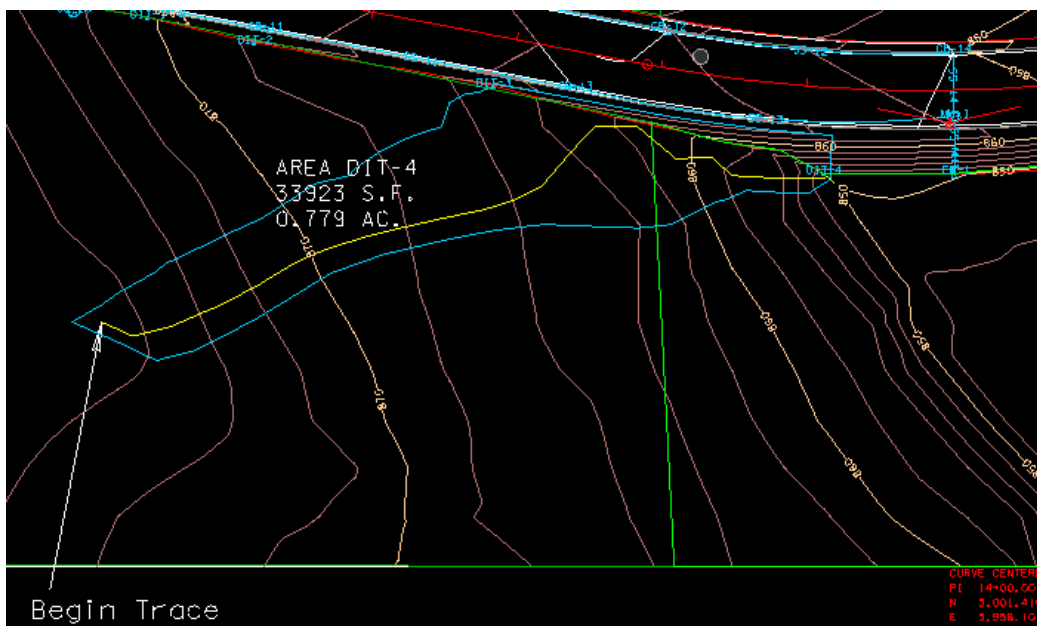


- f) All other options should be set from previous nodes, click **Apply**.

7.8 Delineate Drainage Area DIT-4

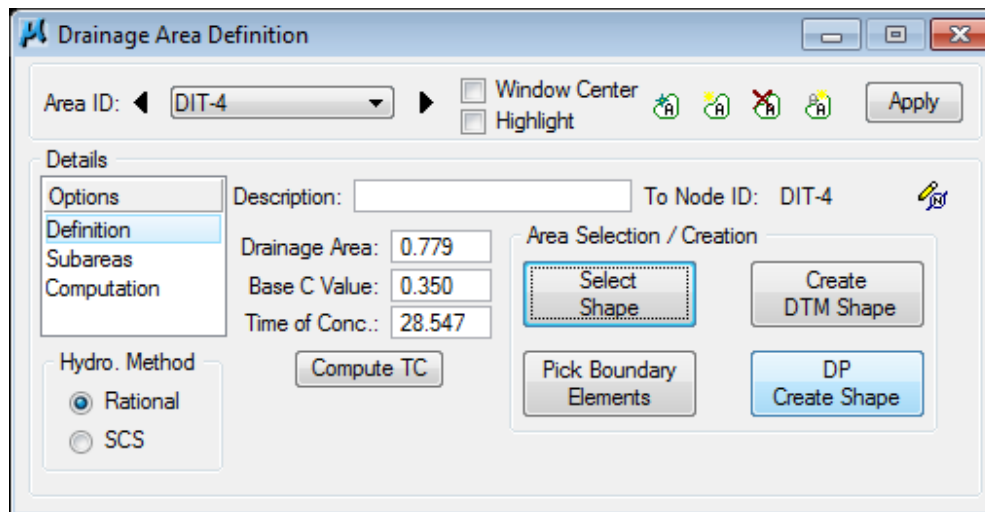
- a) From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **DIT-4** should automatically appear, click **OK**.
- b) Follow the steps in Exercise 4.1 to delineate and define the drainage area for this ditch outlet location.

Delineate Drainage Area:

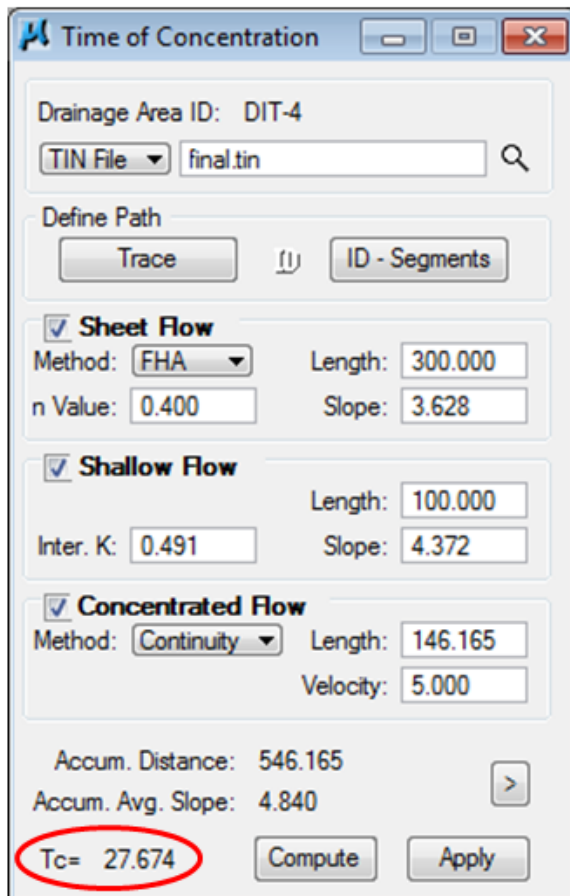


Exercise 7

c) Define Drainage Area:

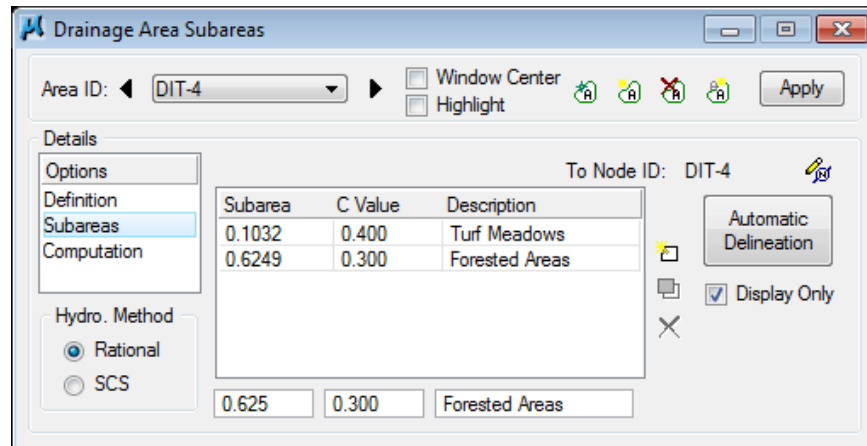


d) Calculate Time of Concentration:

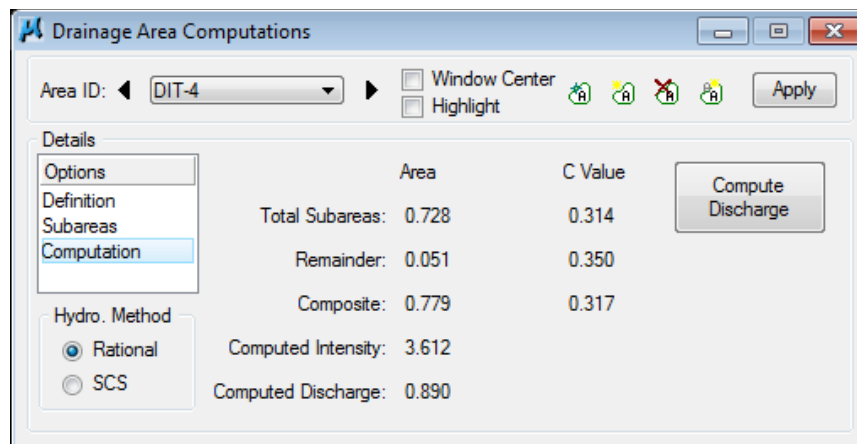


The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required

e) Delineate Subareas utilizing the Land Use DGN:

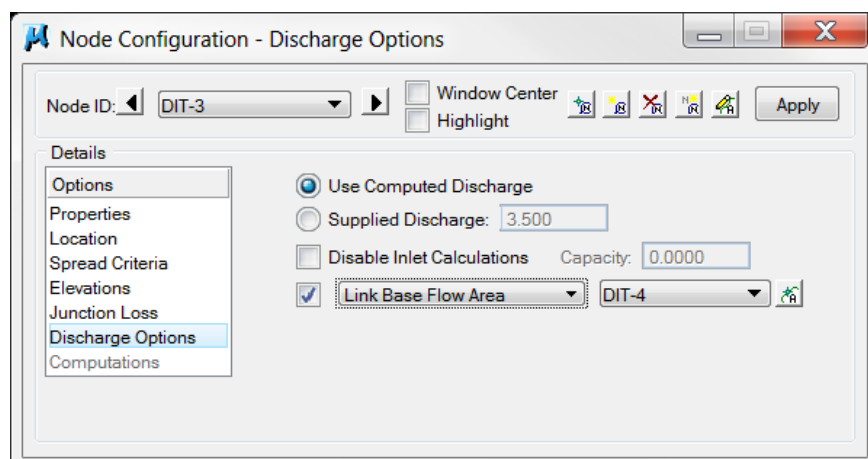


f) Compute Discharge and Apply:



g) Since Node DIT-4 is an outlet type, it will **not** consider the drainage area developed for it. In order to ensure the final ditch link, will be adequate for the capacity at the end we will need to link the DIT-4 drainage area to Node DIT-3.

Go to **Component> Node> Edit** and select node DIT-3. Under Discharge Options click on the option to **Link Base Flow Area** and set to include the DIT-4 drainage area.



7.9 Ditch Link DIT-1

We are checking the drainage flow along a fill slope so all links are set up as cross section based. The surface is read for the ditch shape and capacity is calculated at each cross section that is cut along the links.

Cross Section Based Link DIT-1

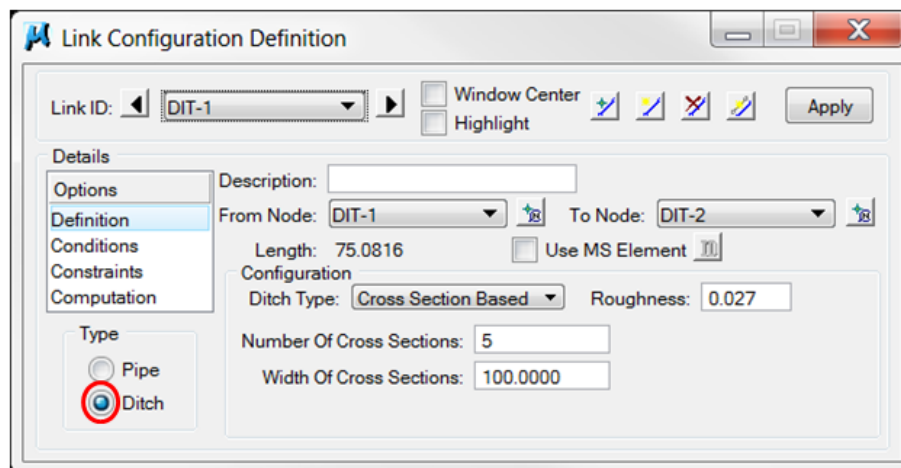
- Select from the Drainage Menu Bar: **Component > Link > Add** or from the main toolbar: **Add Drainage Link**
- Set the Name to **DIT-1** and click **OK**.
- Set the **From Node** as **DIT-1** and the **To Node** as **DIT-2** via the dropdown list or by clicking the **Node ID** button and selecting the appropriate node.
- In the *Details* portion of the dialog change **Type** to **Ditch**.
- In the *Configuration* portion of the dialog set the following:

Ditch Type: Cross Section Based

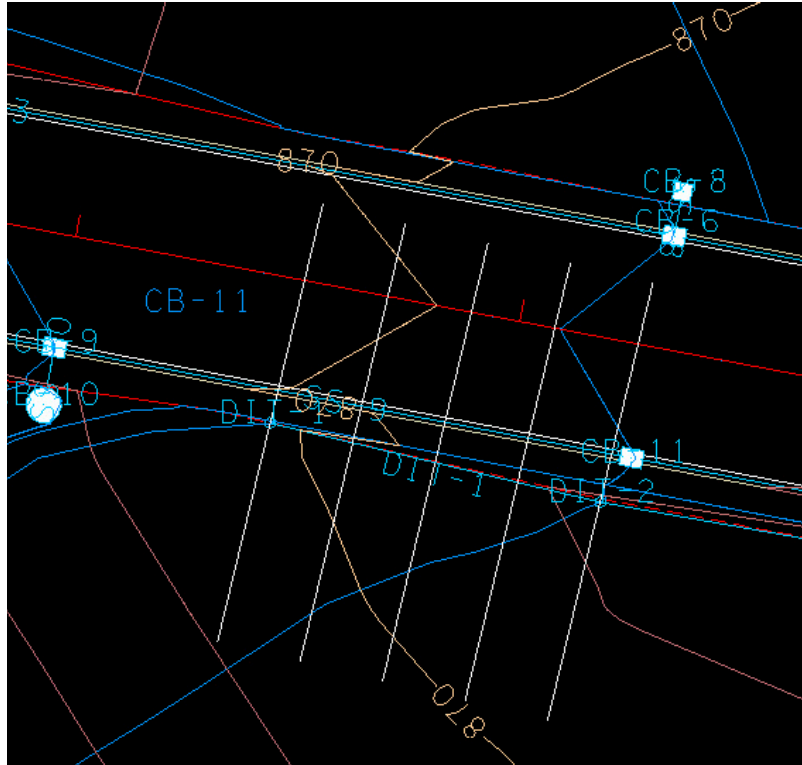
Roughness: 0.027 (See [TDOT Drainage Manual Chapter 5](#) Table 5A-1 for typical values)

Number of Cross Sections: 5 (Typically one cross section every 5 feet to a maximum of every 50 feet for long ditches)

Width of Cross Sections: 100 (Ensure top of bank on both sides is captured)



- Click **Apply** and review the cross section lines displayed in the plan view (shown on next page) to determine if adjustments should be made.



NOTES:

Since we are using the Cross Section Based ditch type to analyze existing conditions, the **Conditions** and **Constraints** require no special settings. In the system modification chapter, we will use those to control the proposed ditch that is to be designed.

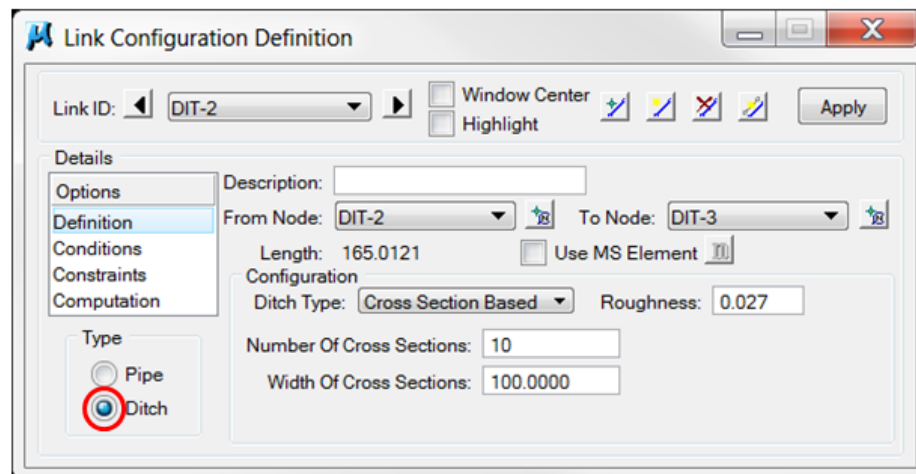
Computation will not show any information until a drainage network is built from the nodes and links in this ditch system.

This same set up using the **Cross Section Based** ditch type can be used to analyze long proposed roadway ditches for capacity and function.

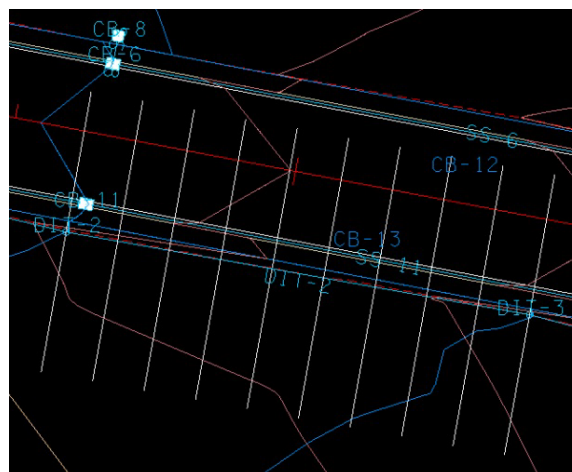
7.10 Ditch Link DIT-2

Cross Section Based Link DIT-2

- Select from the Drainage Menu Bar: **Component > Link > Add** or from the main toolbar: **Add Drainage Link**
- Set the Name to **DIT-2** and click **OK**.
- Set the **From Node** as **DIT-2** and the **To Node** as **DIT-3** via the dropdown list or by clicking the **Node ID** button and selecting the appropriate node.
- In the *Details* portion of the dialog change **Type** to **Ditch**.
- In the *Configuration* portion of the dialog set the following:
 - Ditch Type:** Cross Section Based
 - Roughness:** 0.027 (See [TDOT Drainage Manual Chapter 5](#) Table 5A-1 for typical values)
 - Number of Cross Sections:** 10 (Typically one cross section every 5 feet to a maximum of every 50 feet for long ditches)
 - Width of Cross Sections:** 100 (Ensure top of bank on both sides is captured)



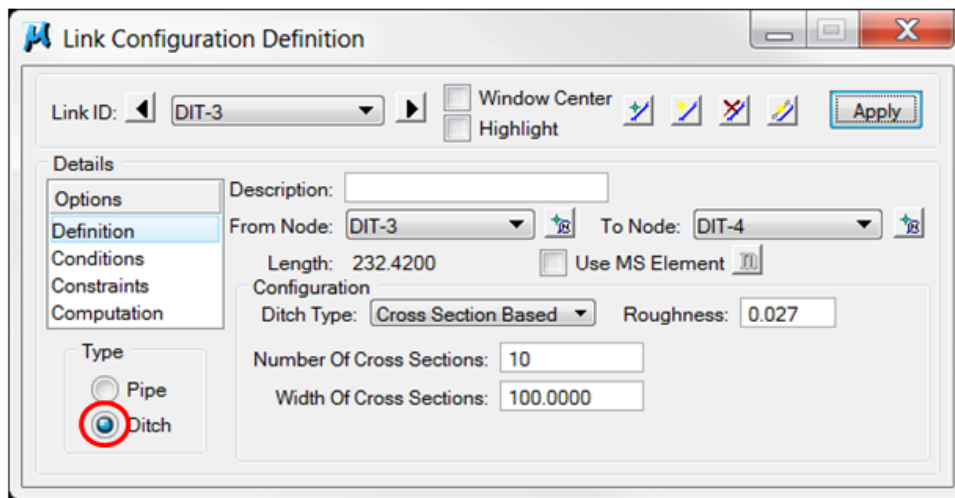
- Click **Apply**.



7.11 Ditch Link DIT-3

Cross Section Based Link DIT-3

- a) Select from the Drainage Menu Bar: **Component > Link > Add** or from the main toolbar: **Add Drainage Link**
- b) Set the Name to **DIT-3** and click **OK**.
- c) Set the **From Node** as **DIT-3** and the **To Node** as **DIT-4** via the dropdown list or by clicking the **Node ID** button and selecting the appropriate node.
- d) In the *Details* portion of the dialog change **Type** to **Ditch**.
- e) In the *Configuration* portion of the dialog set the following:
Ditch Type: Cross Section Based
Roughness: 0.027 (See [TDOT Drainage Manual Chapter 5](#) Table 5A-1 for typical values)
Number of Cross Sections: 10 (Typically one cross section every 5 feet to a maximum of every 50 feet for long ditches)
Width of Cross Sections: 100 (Ensure top of bank on both sides is captured)



- f) Click **Apply**.

