MIDUSS® Version 2

Tutorial Manual

Alan A. Smith Inc.

Published by:

Alan A. Smith Inc.

17 Lynndale Drive, Dundas, Ontario, Canada L9H 3L4

Tel: +1 (905) 628-4682

Fax: +1 (905) 628-1364

info@alanasmith.com

www.alanasmith.com

ISBN 0-921794-00-3

January 2004

Revised March 2004

Version 2.01 Rev318

A Detailed Example

This Tutorial presents a simple example that makes use of many of the commands presented in the User Manual.

The size of network is very small but the techniques illustrated are the same as you will use for the design of large complex drainage systems. You will find it useful to work through this example on your computer while reading this manual. As you compare the screen shots you see on your computer with the illustrations in this manual you will build up confidence that your use of MIDUSS is correct.

Three MIDUSS sessions will be described:

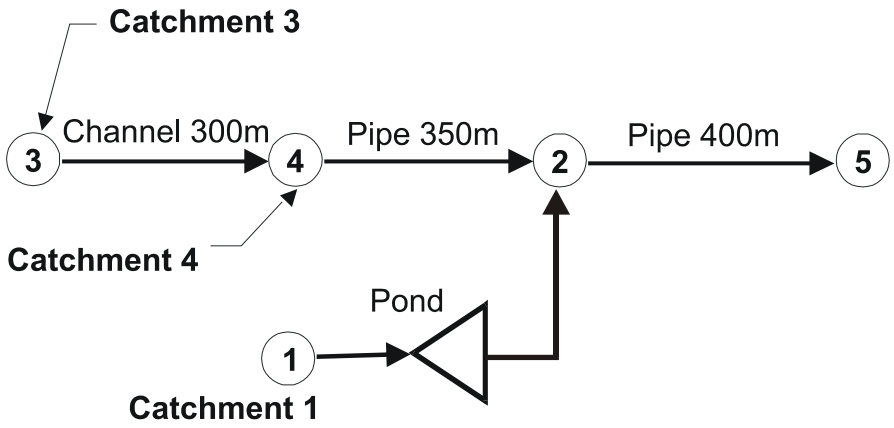
1. The first is in manual mode and will design the system for a 5-year storm.

2. The second session in automatic mode will test and refine the design under the action of a more severe storm.

3. A final section describes how to use the **Show / Graph** command to plot 2 or more hyetographs and/or hydrographs.

The MIDUSS CD and the MIDUSS web site (www.miduss.com) contains audio-visual lessons on the basic operations in MIDUSS. Many of these lessons have been based on the examples presented in this Tutorial.

A Manual Design for a 5-year Storm



The above diagram shows a network comprising 5 nodes and 4 links. Because only one outflow link exists for each node the link number is the same as the upstream node.

- Link #3 is intended to be an open channel
- Links #4 and #2 are to be pipes, and
- Link #1 is to be a detention storage pond.

The sub-catchments which generate overland flow enter the system at nodes (1), (3) and (4) and have the characteristics summarized in the table below.

Catchment data for the drainage network

Catchment number	1	3	4
Percent impervious	65	20	30
Area (ha)	5.0	3.5	2.5
Overland flow length (m)	85	125	90
Surface gradient (%)	2.0	1.5	2.5
Manning ‘n’	0.20	0.25	0.25
SCS Curve Number CN	84	76	76
Initial abstraction (mm)	5.0	7.5	7.5

The impervious fractions in the three contributing sub-catchments are assumed to have roughness and imperviousness values as indicated in the table below. The runoff from these catchment areas is to be computed using the SCS infiltration method and the triangular unit hydrograph method for overland flow.

Characteristics of impervious areas

Catchment number	1	3	4
Manning 'n'	0.015	0.020	0.020
SCS CN or Runoff coeff. C	0.9	98	98
Initial abstraction Ia – (mm)	1.5	2.0	2.0

Design Storms

We will design the drainage system for a 5-year design storm of the Chicago hyetograph type and then test it under a more severe historic storm. The 5-year synthetic storm will be based on the intensity-duration-frequency relation shown below with storm duration of 2 hours and a value of $r = 0.35$ (i.e. time to peak intensity divided by duration.)

$$i = \frac{a}{(t_d + b)^c} = \frac{1140}{(t_d + 6)^{0.84}}$$

A more severe historic storm is defined by the table of rainfall intensities in mm/hour at 5 minute intervals as shown in table below. We will use this data when we get to the MIDUSS Automatic feature.

3 hr historic storm hyetograph in mm/hour for 5 minute intervals.

12	12	14	15	21	19	18	15	14	12
11	10	12	16	20	24	38	42	75	77
96	105	102	89	65	56	54	38	35	20
17	13	9	6	4	3				

Setting the Initial Parameters

Three steps are required at the start of a MIDUSS design session. These define:

(1) The system of units to be used

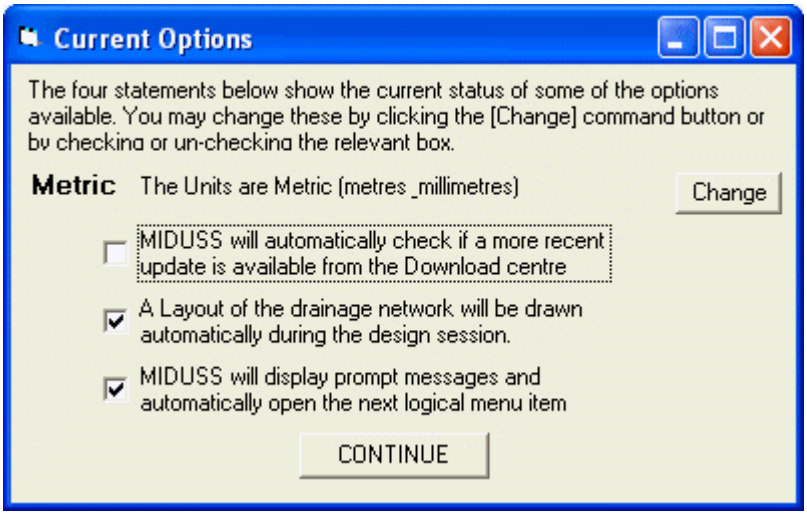
(2) The name of an output file be used, and

(3) The time step parameters.

These are detailed in the steps which follow.

Selecting the Units

When you launch MIDUSS you are presented with a dialog screen similar to the screen below.



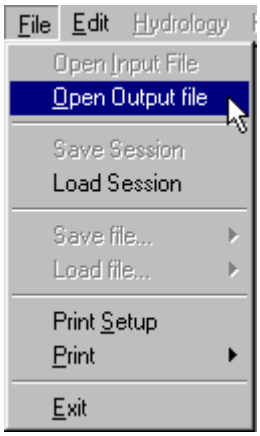
There are many other user options available in MIDUSS, but these are the 4 most important ones. You will see that the system of Units defaults to the one used in the last session. Simply click the Change button to toggle between Metric and Imperial units.

Specifying an Output File

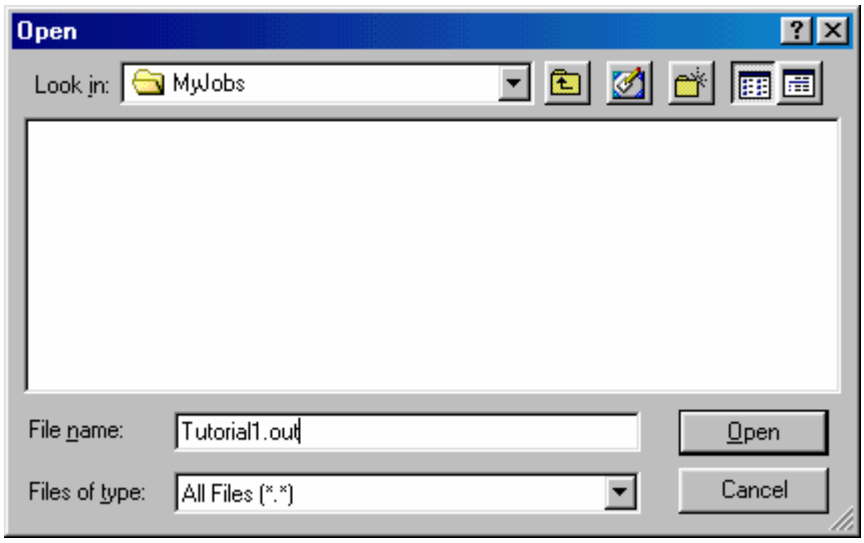
When you accept the units, the menu item **File / Open Output file** is opened automatically and the mouse pointer is positioned over this item. A job specific output file is not a requirement but it is strongly recommended. If you don't specify one, all output will be written to a default file in the MidussData folder.

It is good practice to specify a special sub-directory for the project that will contain all of the relevant files.

- Click on the **File / Open Output file** menu item.



- Create a new folder using the Windows dialog. Call it '**MyJobs**'.
- Click on the new folder to open it, then type the name of the output file in the File name text box. Use the filename '**Tutorial1.out'**.



When you click on the [Open] command button, the file dialogue box closes and a message is displayed. Typically, if a new file has been specified, MIDUSS will ask you to confirm that you want to create this file. If you select an existing file as the output file, the message will warn you that if you continue, the contents of the existing file will be lost.

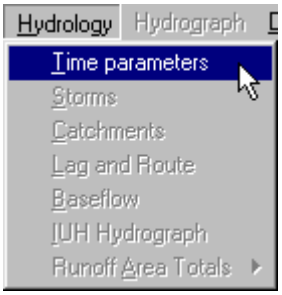
- Close the message box by clicking either [Yes] or [No]. If you press [No] the Open file dialogue box is re-opened until an acceptable output filename has been selected or defined.

The name of the output file will be displayed at the right-hand end of the bottom status bar.

Define the Time Parameters

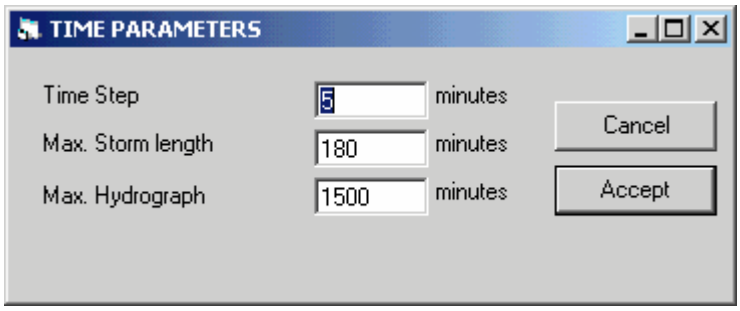
The third required step is to define the time parameters.

- Click on the **Hydrology / Time parameters** in the main menu.



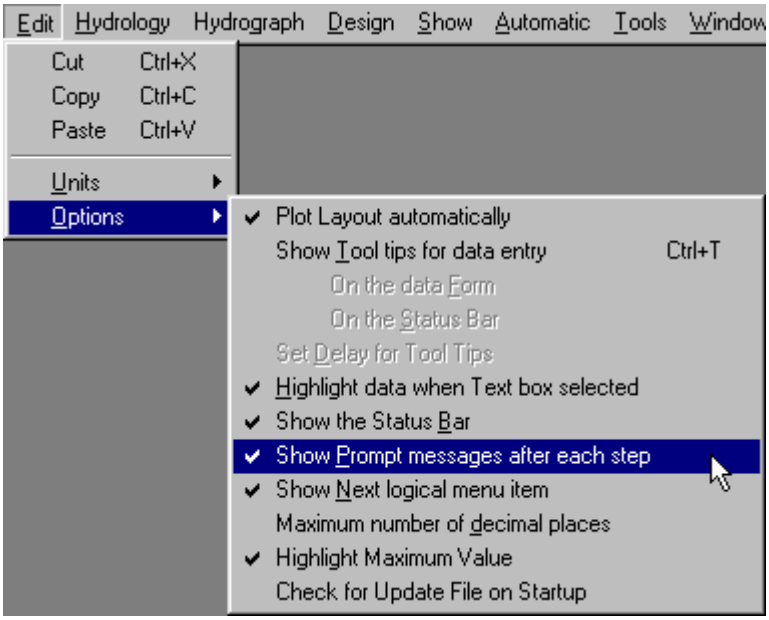
Notice that only the Time parameters item is enabled at this stage. Throughout your use of MIDUSS you will see many instances when menu items are greyed out. This indicates that prerequisite steps have not been completed or because choosing the item would not be a logical next step.

- Click on the command to open the Time Parameters dialogue box.



These are acceptable for the current example For other projects you can change these default values easily by clicking on a value to highlight it and then type in the desired value.

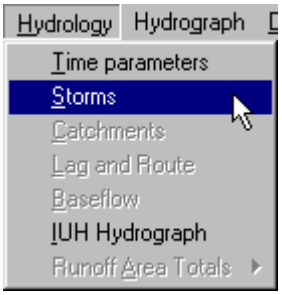
- Click [Ok] to acknowledge this message. Throughout MIDUSS there are automatic prompts which help you decide on the next step of the design. We will turn this notification system OFF for now.
- From the main menu select **Edit / Options**.
- Uncheck the **Prompt** option. The menu item will disappear immediately.



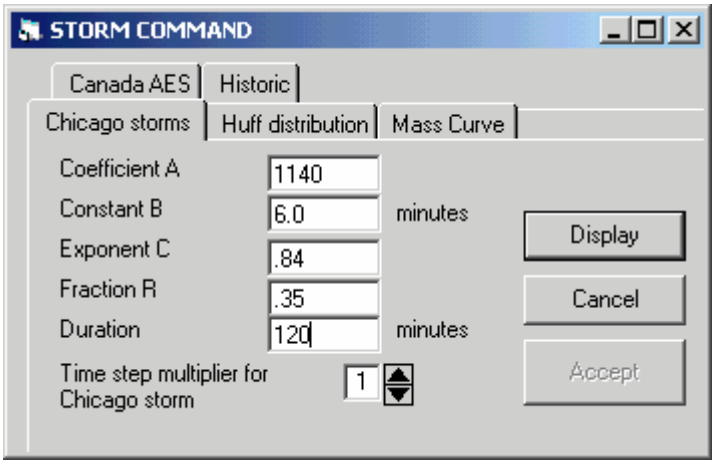
Specifying the Design Storm

In the **Hydrology** menu the **Hydrology/Storm** item is enabled only after the time parameters have been defined.

- Click the **Storm** command to open the Storm window.

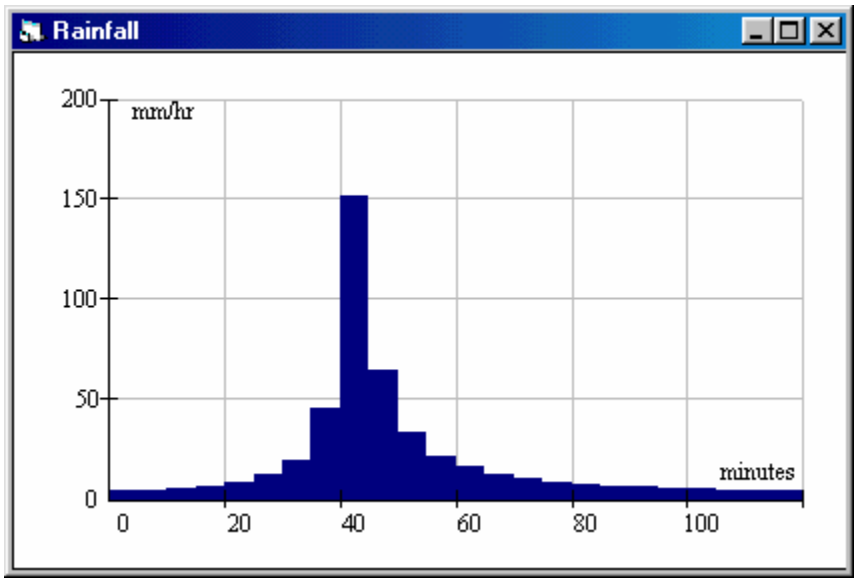


- Using the Chicago tab of the form, enter the parameters displayed below. These are the same as given in the 5-year storm equation above.

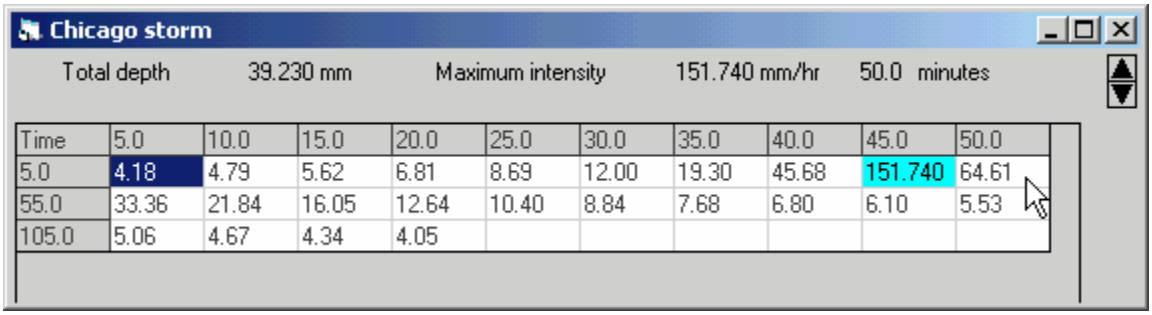


- Press [Display].

You should see the following hyetograph plot.



You should also see the storm plot represented in tabular form.



Time	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
5.0	4.18	4.79	5.62	6.81	8.69	12.00	19.30	45.68	151.740	64.61
55.0	33.36	21.84	16.05	12.64	10.40	8.84	7.68	6.80	6.10	5.53
105.0	5.06	4.67	4.34	4.05						

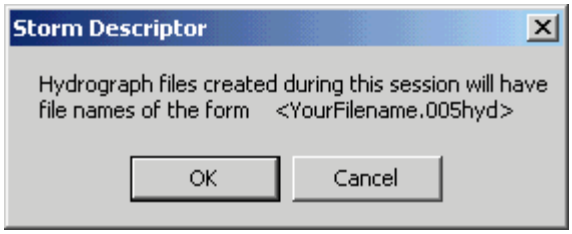
Note from the table that the peak intensity is 151.740 mm/hour at 45 minutes. Beside the maximum intensity is the value 50 minute. This only appears as you move your mouse over the cells in the table. At the moment the mouse is over the 50 minute time interval.

- On the Storm window, press the [Accept] button.

The storm descriptor window is opened as shown below.

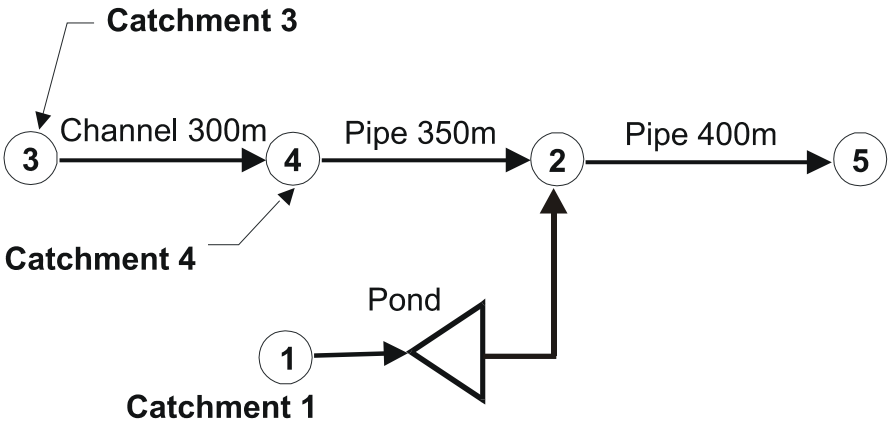
- The default string of '005' is for a 5-year storm. This is acceptable for the design storm so click on [Accept].

An acknowledgement message appears. It tells you that any hydrograph files saved during the session will have a default extension of '005hyd'. This helps you organize and keep track of hydrographs that are generated with this 5 year storm. Later we may save hydrographs at the same location but for a more severe storm. You could enter any other descriptive set of characters that would helps to identify this storm.



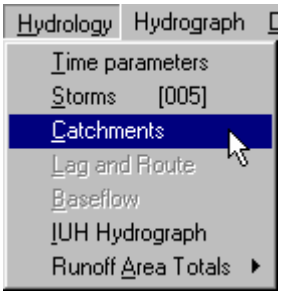
Runoff Analysis

The simulation and design does not need to follow the sequence of node numbers. You should first design the channel and pipe conveying the runoff from areas 3 and 4 to the junction node 2. For convenience, the small network we are designing is repeated below.

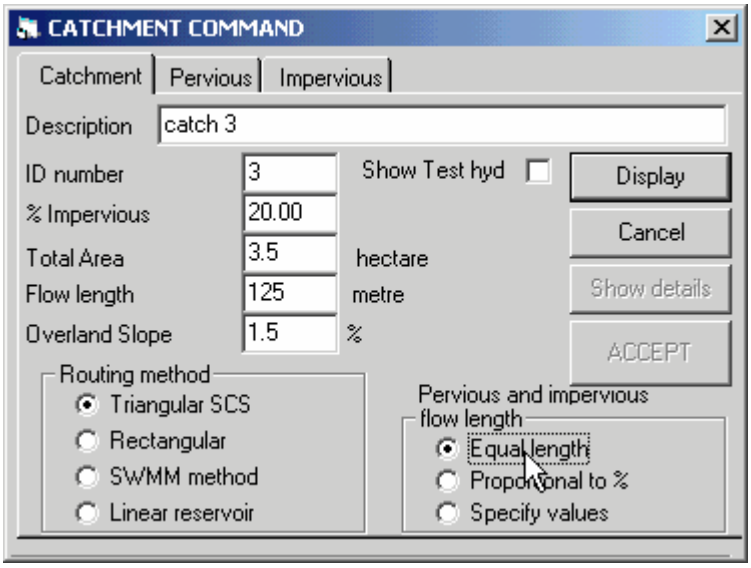


Now that a design storm has been defined the **Catchment** command is enabled. MIDUSS highlights menu items only when the necessary prerequisite actions have been carried out.

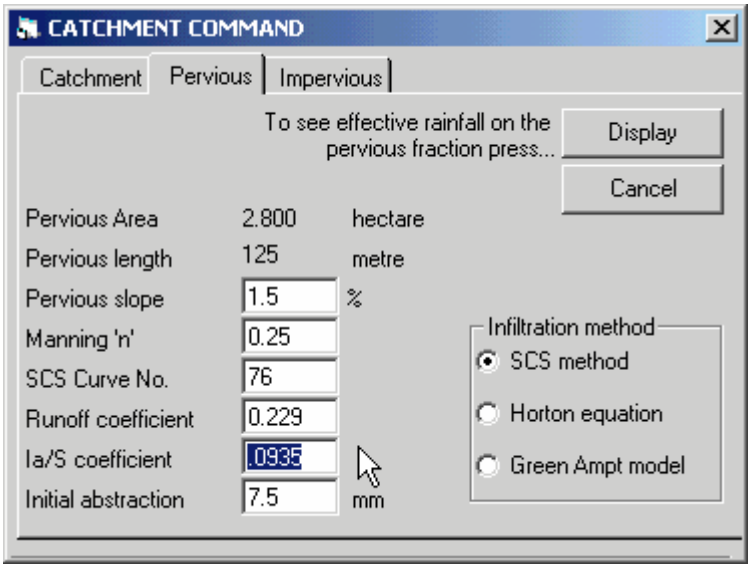
- Click the **Hydrology / Catchment** command to open the 3-tab Catchment form. Notice the [005] beside the Storms item. This is the short storm descriptor you entered above.



- On the Catchment tab, enter the first 5 items of data as displayed in the form shown below. This Catchment 3 data is from the summary of data presented at the beginning of this tutorial.
- Select the Triangular SCS response as the routing method. You will note that MIDUSS offers four routing choices and it will only present infiltration choices that are appropriate for your routing selection.
- Select the Equal Lengths option (this assumes that the overland flow lengths on the pervious and impervious fractions are equal.)

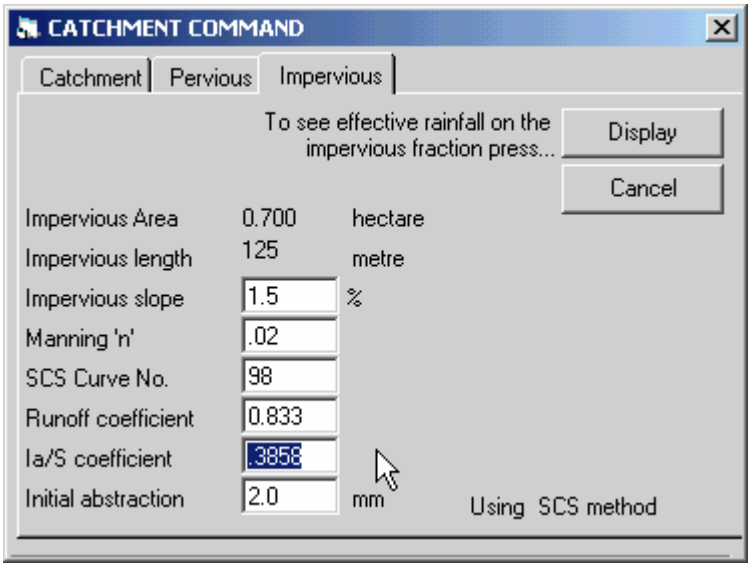


- Select the Pervious tab. The area and flow length are shown and cannot be changed.
- Leave the slope at 1.5%
- Select the SCS method as the infiltration method.
- Enter the SCS Curve Number of 76. As you enter a curve number of 76 you will see the runoff coefficient increases to 0.223.
- Enter the Initial Abstraction depth Ia as 7.5. You will see there is an automatic reduction of the ratio Ia/S to 0.0935 (from a default of 0.1.). The runoff coefficient increases to 0.229.

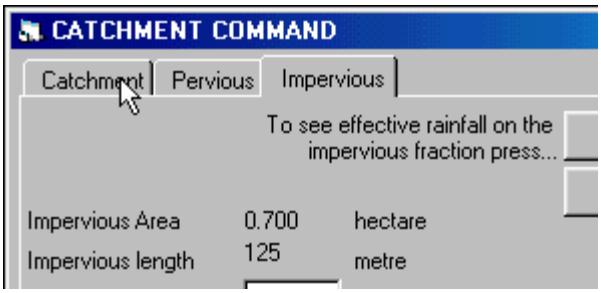


These changes are consistent with a less pervious soil type with significant vegetative cover to intercept rainfall.

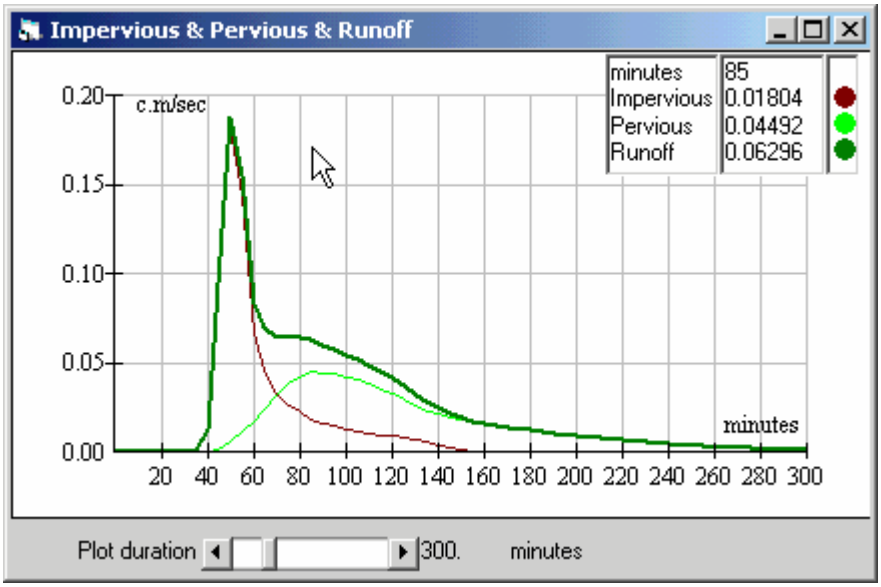
- Now select the Impervious tab. Note the area is a calculated as 0.7 ha because on the Catchment tab you specified an impervious fraction of 20% of 3.5 ha.
- The flow length stays at 125 m because you specified in the catchment tab that Pervious and Impervious flow lengths are equal length.
- Leave the slope at 1.5%.
- Enter Manning 'n' = 0.02
- Enter the SCS CN = 98.
- Enter the Initial Abstraction = 2.0 mm. You will see the ratio Ia/S increase to .3858.



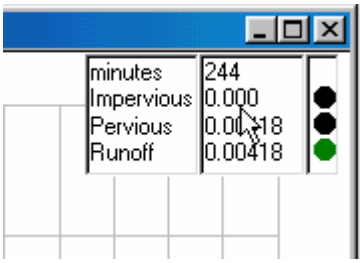
- Now return back to the Catchment tab and press the [Display] button.



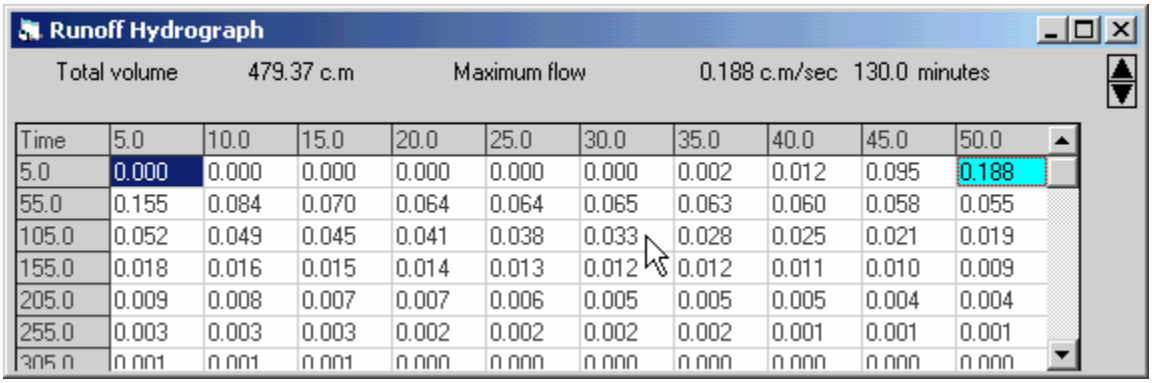
You should see the hydrograph plots displayed below.



These plots show the flow from the pervious, impervious and total areas. As you move the mouse pointer over the plot area three small data windows are shown at the top right of the graph window. As you move the mouse pointer the flow data changes. You can press and hold down the **right** mouse button to display cross hairs to assist you with the plot interpretation. You can also turn the grid on or off by clicking the mouse on the middle of the three small windows. The data windows are closed when the mouse pointer is outside the main graph window.



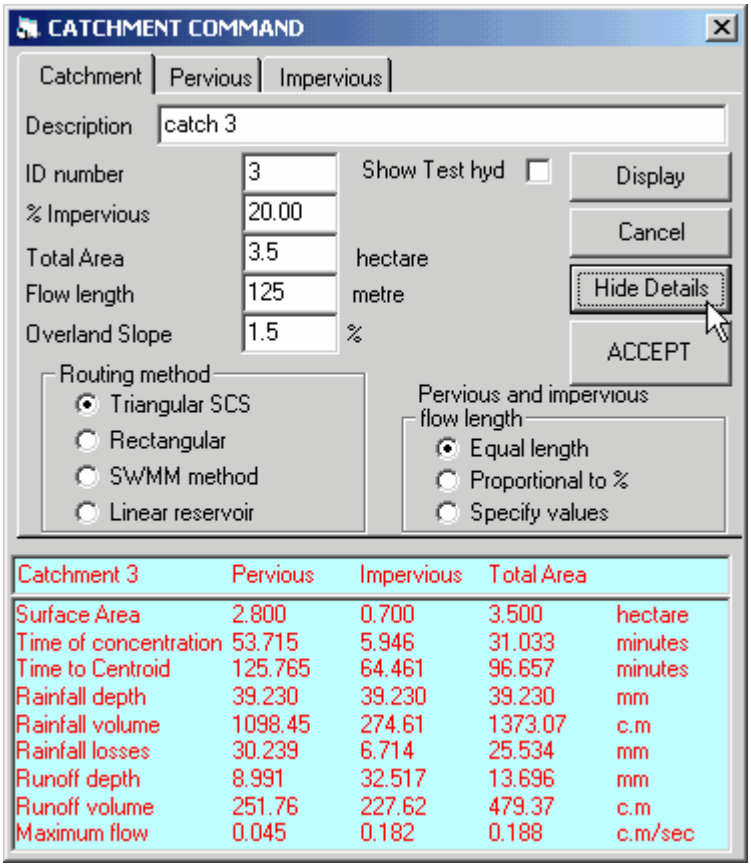
You should also see the Runoff Hydrograph table below. From this you can see that the peak flow is 0.188 c.m/s. As you move your mouse pointer over the table of flow rates, the corresponding time is displayed. In the snapshot below there is a flow of 0.033 at 130 minutes. The highlighting of the cell holding the maximum value can be turned off or on by using one of the Edit / Options labeled “Highlight Maximum Value.”



Time	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.012	0.095	0.188
55.0	0.155	0.084	0.070	0.064	0.064	0.065	0.063	0.060	0.058	0.055
105.0	0.052	0.049	0.045	0.041	0.038	0.033	0.028	0.025	0.021	0.019
155.0	0.018	0.016	0.015	0.014	0.013	0.012	0.012	0.011	0.010	0.009
205.0	0.009	0.008	0.007	0.007	0.006	0.005	0.005	0.005	0.004	0.004
255.0	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.001	0.001	0.001
305.0	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000

On the catchment window press the [Show Details] button. You will see a bluish coloured box appear which contains details about the runoff generated by this catchment.

You will see that the pervious fraction contributes more than half the volume of runoff. The table of runoff flows above shows zero runoff for the first 30 minutes; this is due to the relatively high initial abstraction of 7.5 mm.

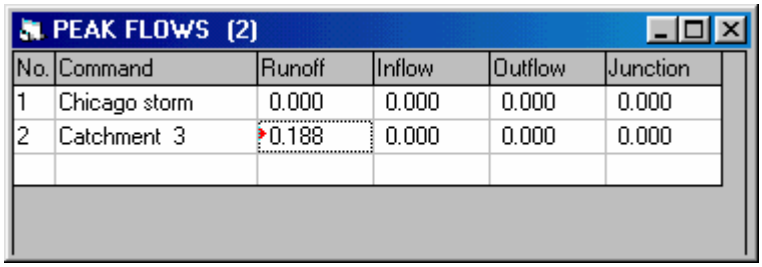


Catchment 3	Pervious	Impervious	Total Area	
Surface Area	2.800	0.700	3.500	hectare
Time of concentration	53.715	5.946	31.033	minutes
Time to Centroid	125.765	64.461	96.657	minutes
Rainfall depth	39.230	39.230	39.230	mm
Rainfall volume	1098.45	274.61	1373.07	c.m
Rainfall losses	30.239	6.714	25.534	mm
Runoff depth	8.991	32.517	13.696	mm
Runoff volume	251.76	227.62	479.37	c.m
Maximum flow	0.045	0.182	0.188	c.m/sec

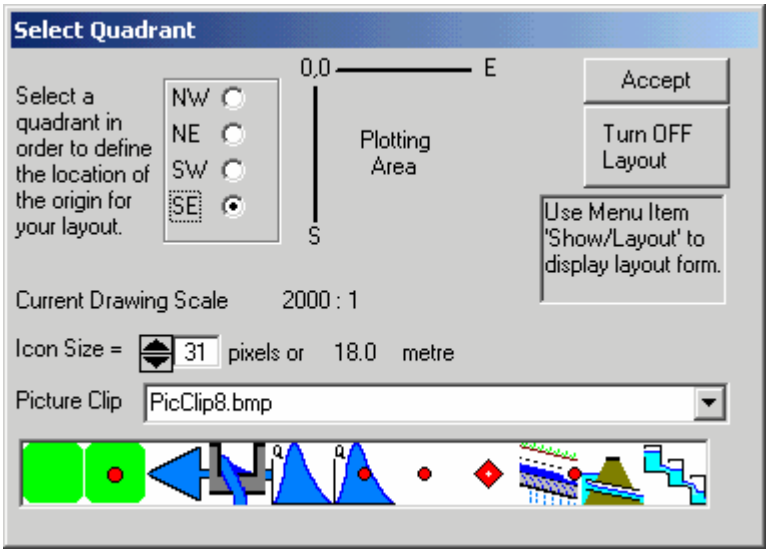
- The contribution of area 3 to the drainage network is completed. Now press the [Accept] button.

At the bottom right of your screen you will see the Peak Flows table. This table provides summary information about the network as you design it. From the table we see that Catchment 3 was designed and

the flow of 0.188 cm/s from this catchment was placed in the Runoff column. A small red arrow is placed in the cell where data was last updated.



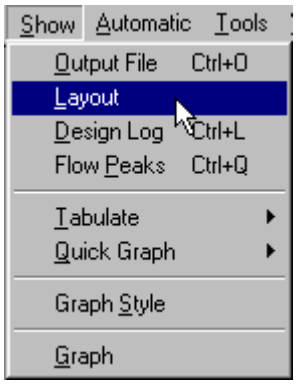
MIDUSS has a special feature which draws your drainage network in plan view. This is called the layout feature. If this is activated, which it is by default, then you need to tell MIDUSS what direction to plot the drainage elements. So to do this, a Select Quadrant window appears like the one below.



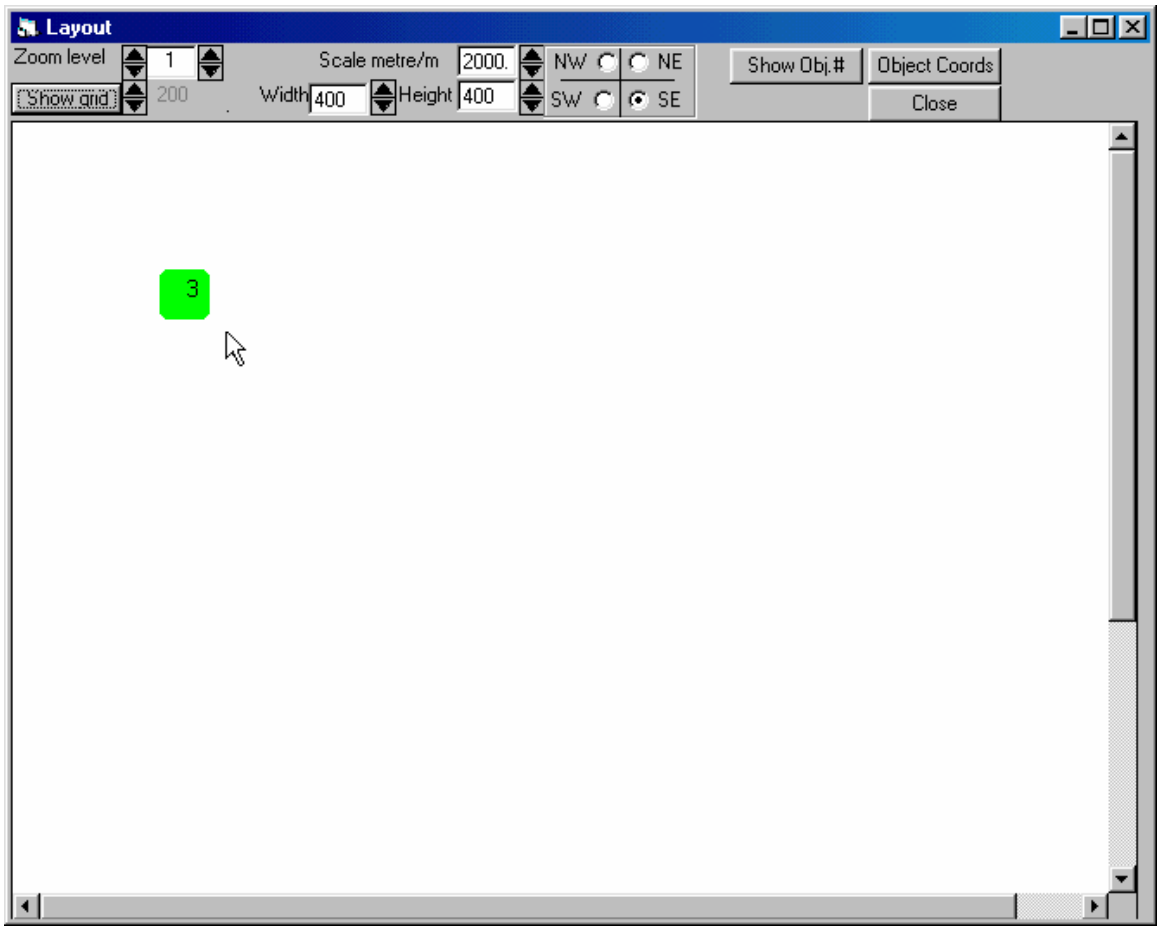
- We will plot in a South East direction, so leave the default SE. Now press the [Accept] button.

The Layout feature displays the drainage network as you design it.

- Select **Show / Layout** from the main menu.



A layout appear with only the icon for the one catchment we have designed so far.

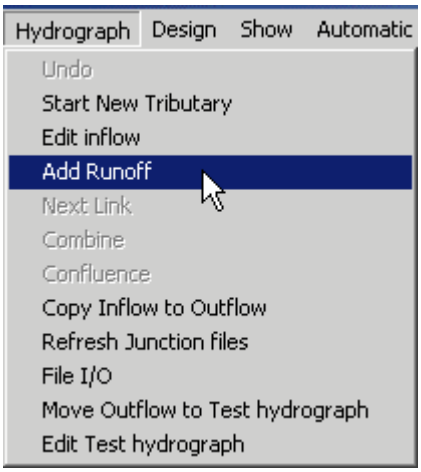


Leave this window open as we continue with the drainage network design. You will see how the drainage elements are added to the layout as your design proceeds.

So far we have created the runoff from catchment 3 above. We will be designing a channel to convey this flow so we need to copy the Runoff into the Inflow in preparation for this channel design. This is a one-click process.

Add Runoff is one of the main menu commands you will find yourself using over and over again. This command places the catchment flow (Runoff) into a hydrograph data 'holding bin' named **Inflow**. You can only design a network element such as a pipe, channel, pond etc if there is a hydrograph stored in the Inflow ready to use. So you need to move the hydrograph from the Runoff holding bin to the Inflow holding bin. **Add Runoff** does this.

- From the **Hydrograph** menu click the **Add Runoff** item. This causes the summary peak flow table to show a peak of 0.188 c.m/s in the Inflow.



PEAK FLOWS (3)

No.	Command	Runoff	Inflow	Outflow	Junction
1	Chicago storm	0.000	0.000	0.000	0.000
2	Catchment 3	0.188	0.000	0.000	0.000
3	Add Runoff	0.188	0.188	0.000	0.000

As implied above, the Peak Flows table is an important little table to understand. It helps you to keep organized as to what flows are being generated and where they are in the system. In our example so far, the table tells us that we have used the Chicago storm to generate rainfall. Then we produced a Runoff flow from Catchment 3 that had a peak of 0.188. Then we used the Add Runoff command to move this flow into the Inflow column. The small red arrow highlights the cell that has updated data in it.

We will repeat, because it is important: You cannot design a pipe, channel, culvert etc without having a positive flow placed in the Inflow. With a quick glance the Peak Flows table tells you that this step has been done. Actually, MIDUSS expects that you will copy the Runoff into the Inflow and it will provide reminders if you have not done so – as long as you have turned on the Prompt option.

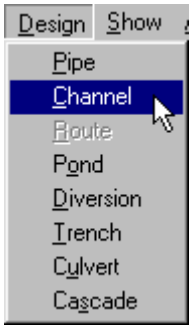
You will notice that the layout icon has been updated to indicate that the flow has moved to inflow ready for design. The Inflow point is represented by a small red ball that is added to the right of the catchment icon. These are two separate graphics objects that are connected by a wine-coloured link. This is a further visual verification that the catchment flow has been placed in the Inflow storage bin.

Designing the Channel

With an Inflow of 0.188 you are now ready to design a channel.

Rescue01.bin

- From the Design menu select Channel.



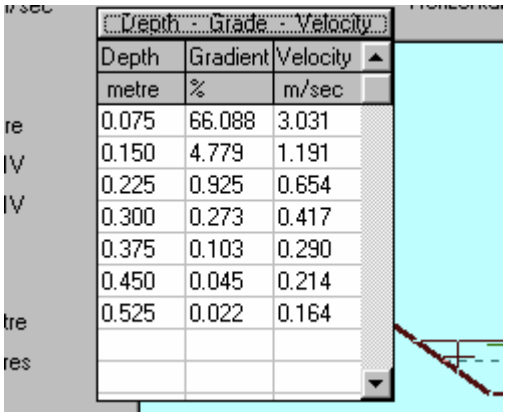
If your data so far does not match this tutorial then you can be 'rescued' from having to start again from the beginning. Use this file with the **Load Session** command to reset all the MIDUSS data to this point. The steps are:

- Close MIDUSS.
- Navigate to **… \ MIDUSS \ Tutorials \ Rescue01.**
- Copy all the files in this folder to your working folder.
- Re-start MIDUSS and use **File / Load Session.** Navigate to **Rescue01.bin** and Open it.

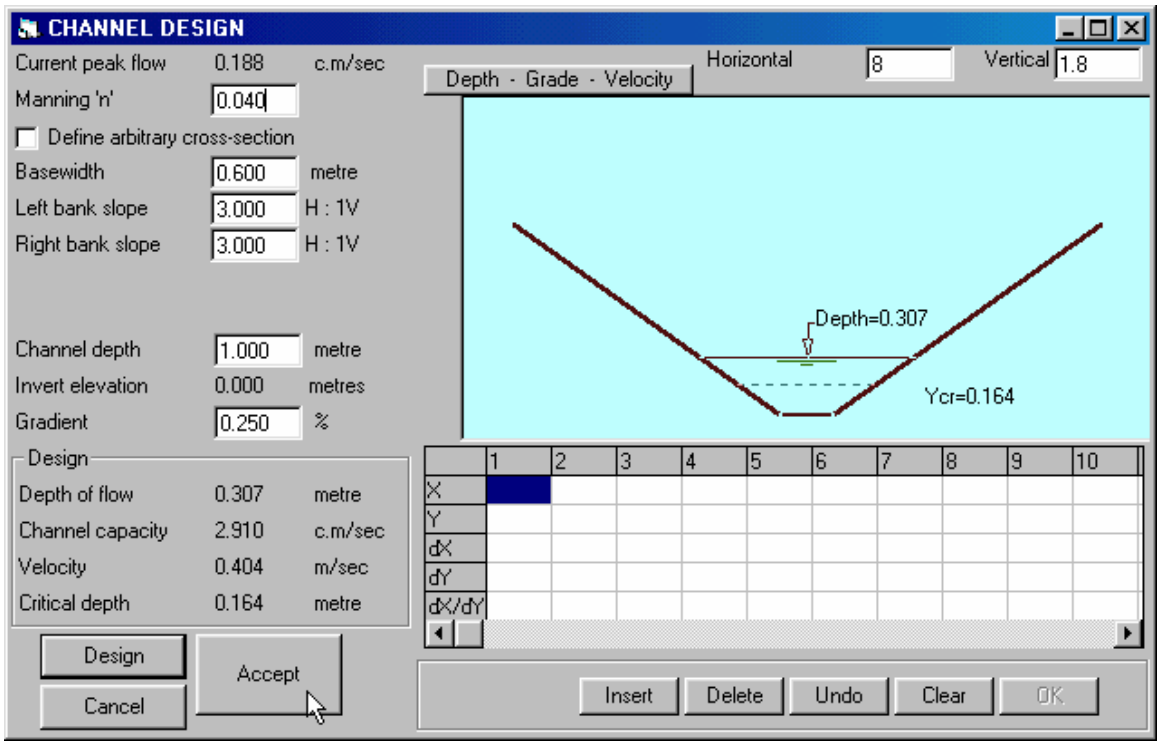
The Channel form opens with the default trapezoidal parameters of 3H:1V side-slopes, a base-width of 0.6 m and a roughness of n = 0.04. The default channel depth and slope is automatically estimated by MIDUSS. There is a 1.0m depth with a slope of 0.5%.

- To do a further refinement click the [Design] button. You are not yet accepting the channel design, just trying out different channel parameters. At this point you should see a depth of 0.260 m.

If you want to review alternative designs you can click on the [Depth Grade Velocity] button to display a table of feasible values of depth and gradient. Velocity is also shown for information. You can use any of these feasible designs by double clicking on the appropriate row of the grid. The gradient is rounded up to the nearest 0.05%.

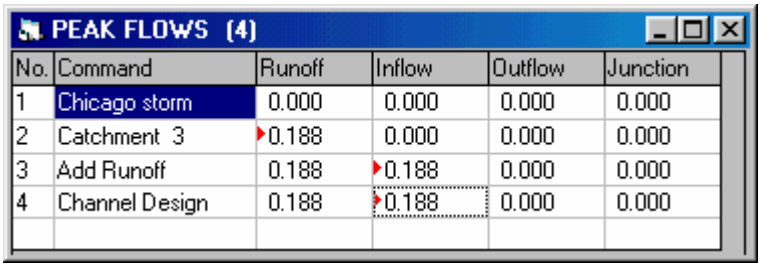


- Flatten the channel grade by entering a slope of 0.25%. Notice that any change to the design parameters causes the plot of water surface to be deleted and the [Accept] button is disabled until the [Design] button is pressed again.
- Press [Design] and the depth is increased to 0.306 m and the critical depth is 0.164, so the flow is tranquil or sub-critical.



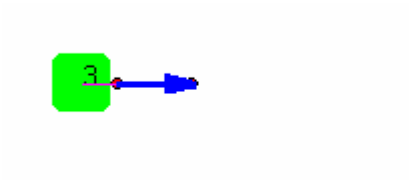
- Press the [Accept] button to close the form.

The peak flows in the summary table are unchanged but another record is added for information.



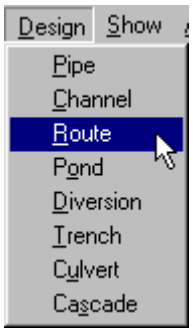
No.	Command	Runoff	Inflow	Outflow	Junction
1	Chicago storm	0.000	0.000	0.000	0.000
2	Catchment 3	0.188	0.000	0.000	0.000
3	Add Runoff	0.188	0.188	0.000	0.000
4	Channel Design	0.188	0.188	0.000	0.000

The layout is updated to show you a channel has been linked to the catchment. Channels are depicted as blue lines.

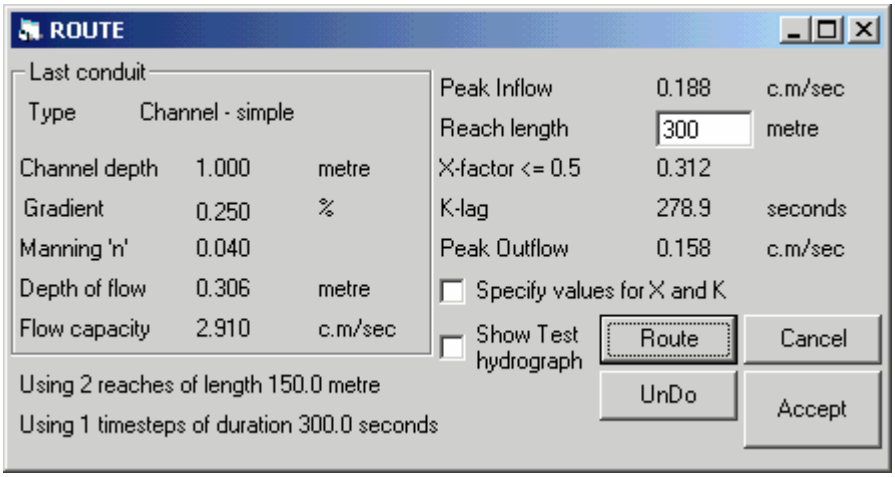


Now we have to Route the Inflow hydrograph through the channel.

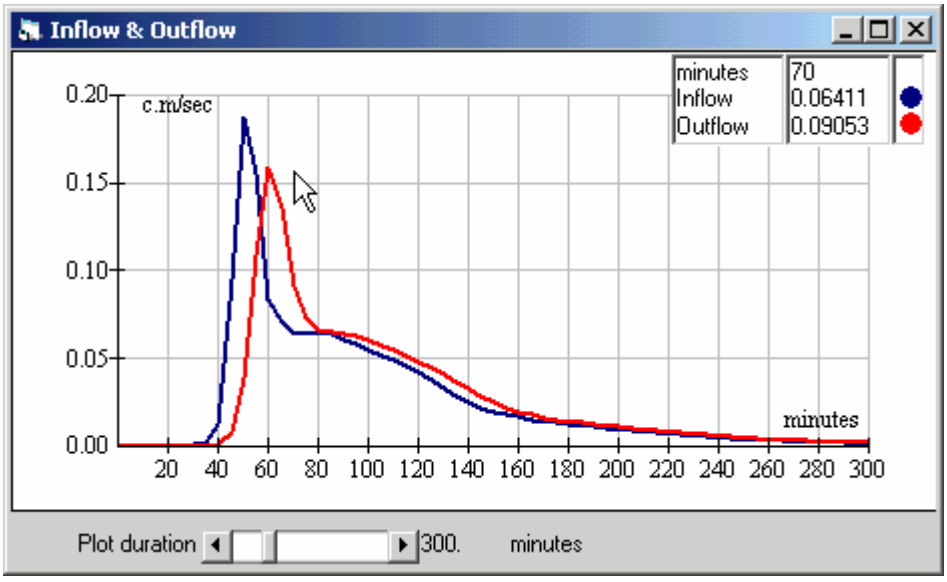
- Navigate to the **Design** menu and select the **Route** command.



The Route window will be displayed and the peak inflow is displayed as 0.188. On the left side of the form there is information about the channel we just designed.



- The default length (initially 120 m) is highlighted. Enter the actual reach length of 300 m. This will cause the values of the X-factor and K-lag to be increased which means more attenuation of the outflow hydrograph.
- Press the [Route] button and you should see the graphical comparison of the inflow and outflow hydrographs and also the tabular display of the outflow hydrograph.



Note the peak is reduced from 0.188 c.m/s to 0.158 c.m/s and lagged by about 10 minutes. Since the hydrographs are plotted at 5 minute increments, very 'peaky' hydrographs may sometimes show some truncation of the outflow.

- Press [Accept] to close the form. This causes another record to be added to the Peak Flow summary table showing the peak inflow and outflow. The outflow from the channel should be 0.158.

PEAK FLOWS (5)

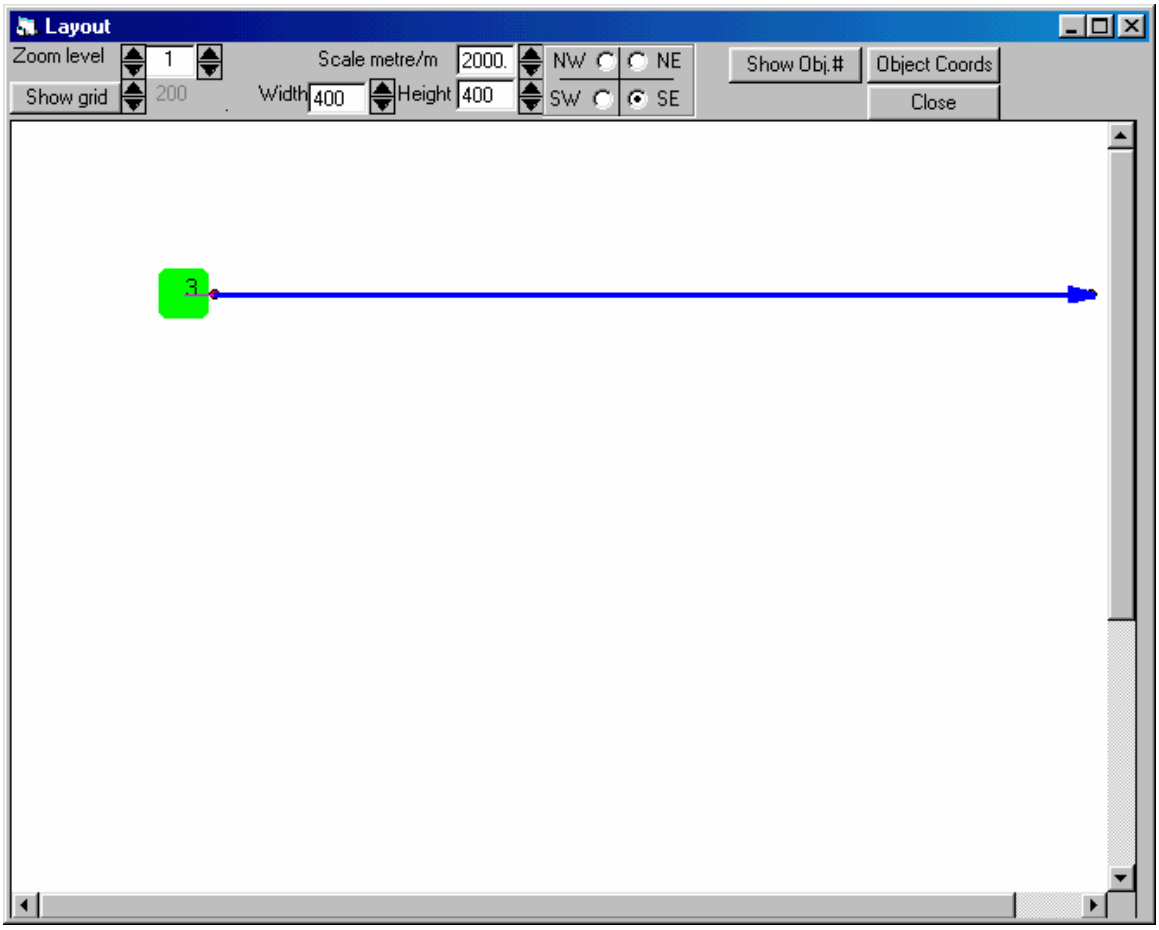
No.	Command	Runoff	Inflow	Outflow	Junction
1	Chicago storm	0.000	0.000	0.000	0.000
2	Catchment 3	0.188	0.000	0.000	0.000
3	Add Runoff	0.188	0.188	0.000	0.000
4	Channel Design	0.188	0.188	0.000	0.000
5	Channel Route 300	0.188	0.188	0.158	0.000

The hydrograph flow always has to be routed into the Outflow bin. After that you can store the flow at a junction or link it to the next drainage element.

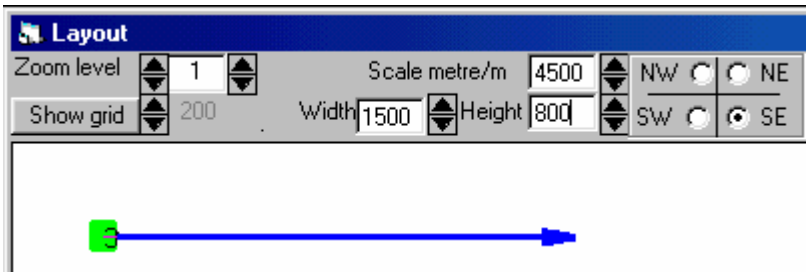
Remember:

- A hydrograph generated from a catchment is placed automatically in the Runoff bin.
- You design with this hydrograph flow only after it is placed in the Inflow bin by using **Add Runoff**.
- You can prepare to link this flow to a junction or another design element only after you have **Routed** the flow.

The layout is updated to scale the channel to approximate the 300m length you just designed.



This uses up a lot of the layout real estate so it is time to adjust the layout scaling. Use the following diagram to adjust the layout scaling.



- Change the scale to 4500.
- Change the width to 1500 and height to 800

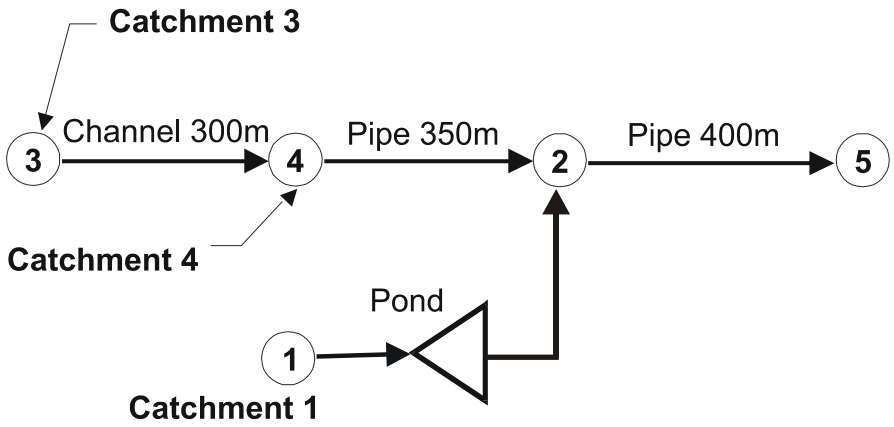
Moving Downstream

When an outflow hydrograph is computed you can do one of two things:

(1) If this is the last link on a tributary you should use the **Hydrograph/Combine** command to store the outflow at a junction node.

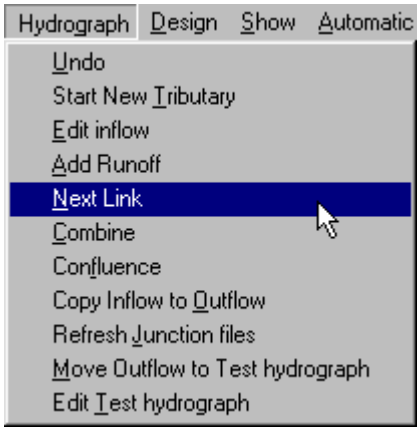
(2) If this is not the last link in the tributary, you should use the **Hydrograph/Next Link** command to convert the computed outflow from the present link into the inflow to the next node and link downstream.

Alternatively, you may want to change your mind by using the **Hydrograph / Undo** command and design a pipe or pond instead of a channel.

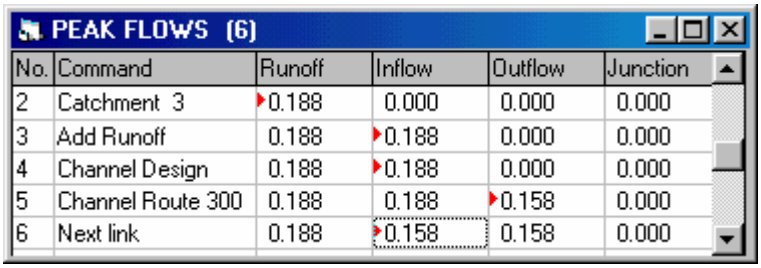


In this tutorial we will use the **Next Link** option because we want to add the runoff from area 4 and design a 350m pipe to carry the total flow to the junction at node 2.

- Navigate to the **Hydrograph/Next Link** menu item and select it.



Note the change in the peak flow summary table



PEAK FLOWS (6)

No.	Command	Runoff	Inflow	Outflow	Junction
2	Catchment 3	0.188	0.000	0.000	0.000
3	Add Runoff	0.188	0.188	0.000	0.000
4	Channel Design	0.188	0.188	0.000	0.000
5	Channel Route 300	0.188	0.188	0.158	0.000
6	Next link	0.188	0.158	0.158	0.000

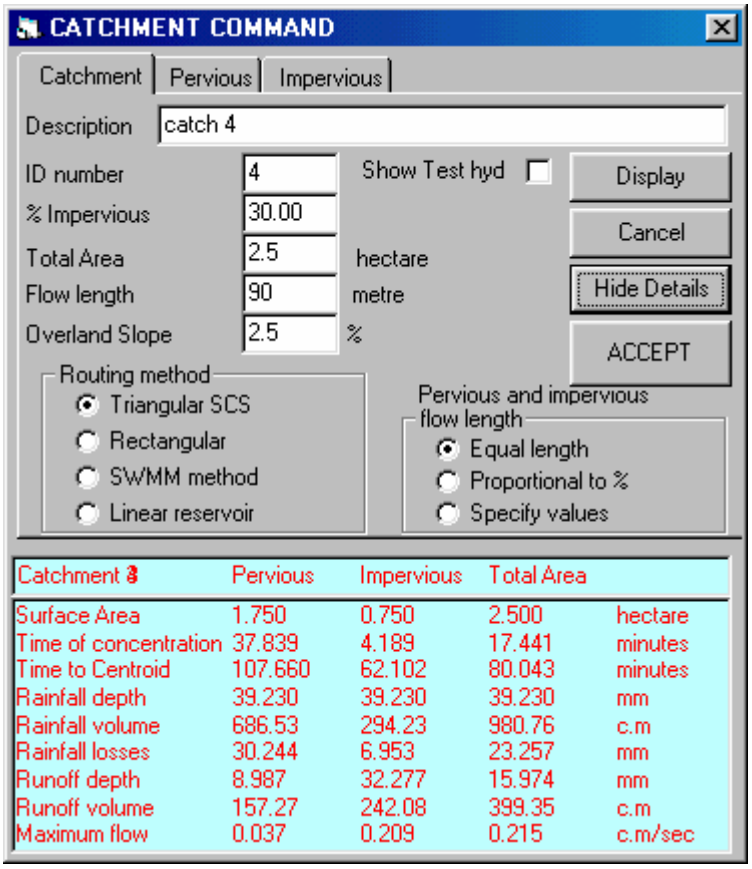
You will see that the Outflow of 0.158 has been copied to the Inflow column and is now ready to be used for the design of the next element in the drainage network. So you will see by now that you can place a hydrograph flow into the Inflow by either **Add Runoff** from a catchment, or from **Next Link** where an outflow becomes an inflow.

The 0.158 c.m/s sitting in the Inflow is actually the Outflow from the 300m channel we just finishing designing and routing. Next we are going to add more flow to this 0.158 c.m/s by adding the flow from Catchment 4.

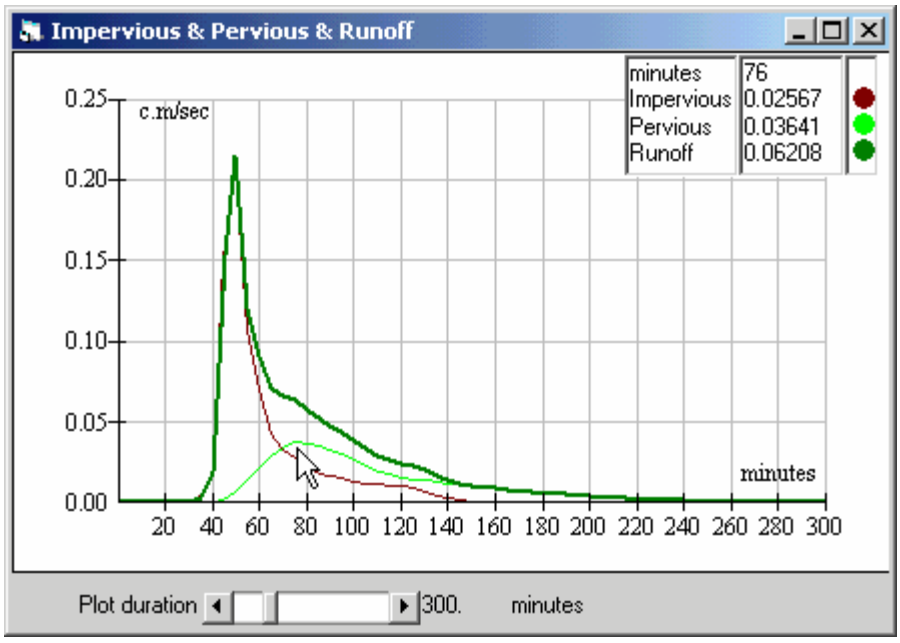
Adding the Next Catchment

We want to generate runoff from catchment 4.

- Select the **Hydrology / Catchment** command. You will see that the default values reflect the values entered for the previous catchment area.
- Add the description “catch 4” and enter the 5 parameters for this catchment as presented in the form below. The parameters for the pervious and impervious fractions are unchanged so they can remain as they are. MIDUSS always ‘remembers’ the previous data you entered in a form field.
- Press [Display].
- Press [Show Details].



From the table and plots shown we can see that the increased impervious fraction and steeper slope more than compensates for the smaller area and peak runoff is 0.215 c.m/s. The volume is 399.35 c.m and 242.08, or more than 60% of this, is generated from the impervious fraction. You should also notice from the graph and from the time of concentration shown in the details, that the time to peak is different for the pervious and impervious fractions. As a result, the total flow peak of 0.215 is significantly less than the sum of the two individual peaks (0.037 + 0.209 = 0.246). This fact is confirmed by inspection of the graph shown below.



- Press [Accept] to close the Catchment form.
- Select the **Hydrograph / Add Runoff** command to add the runoff to the current inflow.

PEAK FLOWS (8)

No.	Command	Runoff	Inflow	Outflow	Junction
1	Chicago storm	0.000	0.000	0.000	0.000
2	Catchment 3	0.188	0.000	0.000	0.000
3	Add Runoff	0.188	0.188	0.000	0.000
4	Channel Design	0.188	0.188	0.000	0.000
5	Channel Route 300	0.188	0.188	0.158	0.000
6	Next link	0.188	0.158	0.158	0.000
7	Catchment 4	0.215	0.158	0.158	0.000
8	Add Runoff	0.215	0.253	0.158	0.000

With this action the Inflow hydrograph has been created from a **Next Link** (Outflow from the 300m channel) plus **Add Runoff** (from catchment 4).

A table displaying the detail of the Inflow hydrograph (with a peak flow of 0.253 c.m/s) is also presented to you.

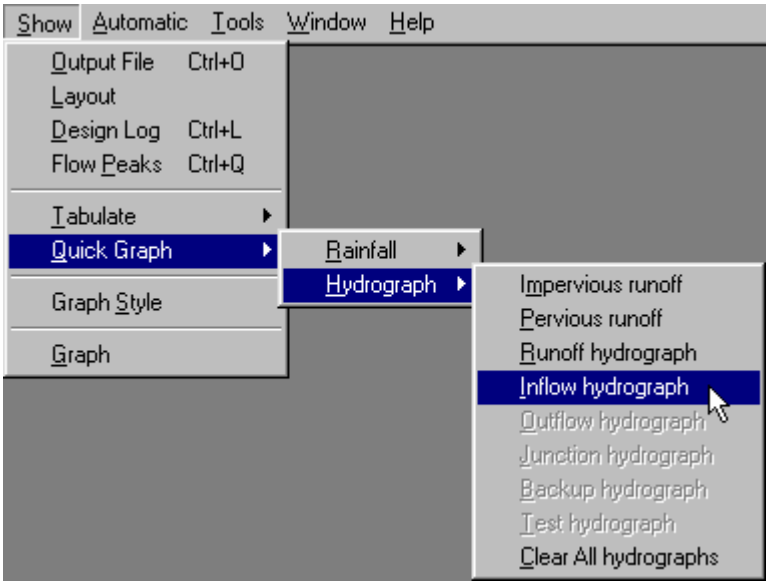
Inflow Hydrograph

Total volume 878.72 c.m Maximum flow 0.253 c.m/sec 0.0 minutes

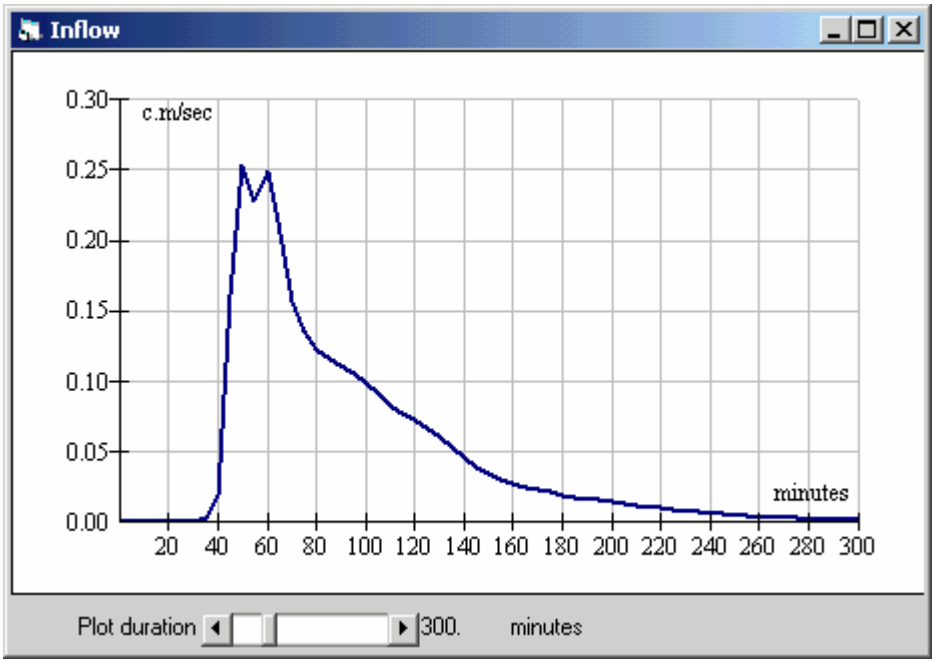
Time	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.020	0.161	0.253
55.0	0.228	0.249	0.206	0.157	0.136	0.123	0.117	0.112	0.106	0.099
105.0	0.091	0.084	0.078	0.072	0.067	0.060	0.053	0.046	0.040	0.035
155.0	0.030	0.028	0.025	0.023	0.021	0.020	0.018	0.017	0.015	0.014
205.0	0.013	0.012	0.011	0.010	0.009	0.009	0.007	0.006	0.006	0.005

Note from the table that the total volume of 878.72 c.m is equal to the sum of the runoff volumes from catchments 3 and 4. You can confirm this by using the **Show/Output File** command which lets you browse through the output file to recall the details from each of the two Catchment commands. You can also see that the time of concentration of the impervious runoffs from catchment 3 and 4 differs by about 2 minutes. Because the hydrographs are very 'peaky' this causes the total peak (0.253) to be about 35% smaller than the sum of the two constituent runoff hydrographs (0.189 + 0.216 = 0.405 c.m/s). This fact can again be confirmed graphically by using the MIDUSS Show feature.

- Click the menu item **Show / Quick Graph / Hydrograph / Inflow hydrograph**.

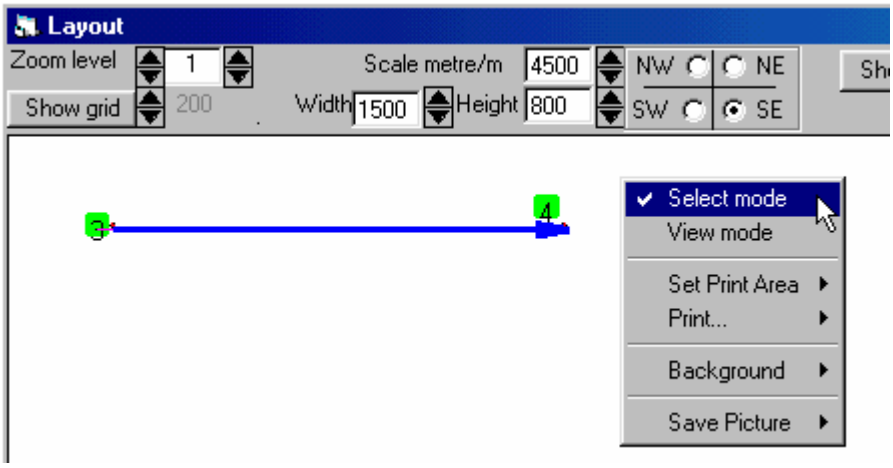


This will display the graph shown below.



- Close this window by clicking on the [X] at the top right.

Notice that the layout has been updated to reflect the new drainage elements. It should look something like the following image.

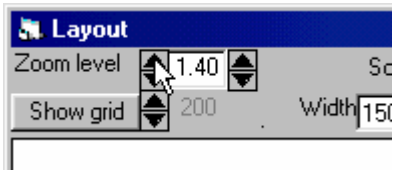


- While hovering over the layout window, right click to reveal the layout menu.

Select mode allows you to move the network elements (or groups of elements) around to make the network more visually pleasing or more representative of the real world system.

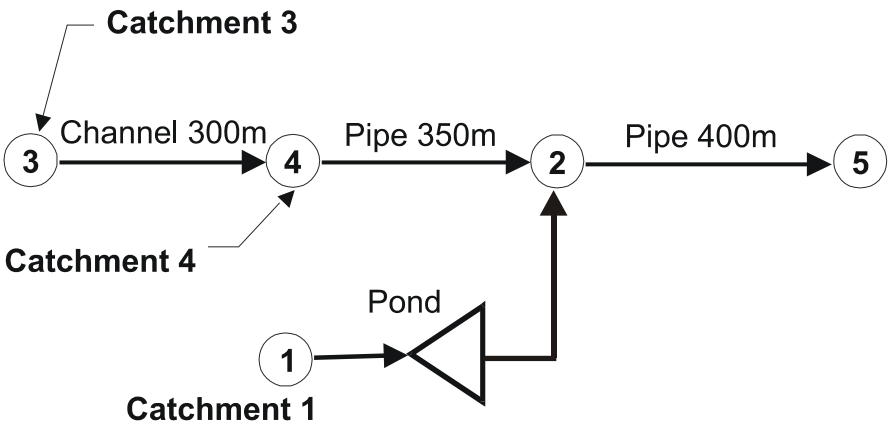
- Try moving the icons around or scaling them by dragging on the white handles.

- Try zooming the layout by clicking on the left spin buttons as shown below. Stop at 1.40.



Designing a Pipe

The Inflow hydrograph now contains the flow from catchment 3 via the channel as well as the runoff from catchment 4. The network diagram is repeated below to remind you where we are in the design.

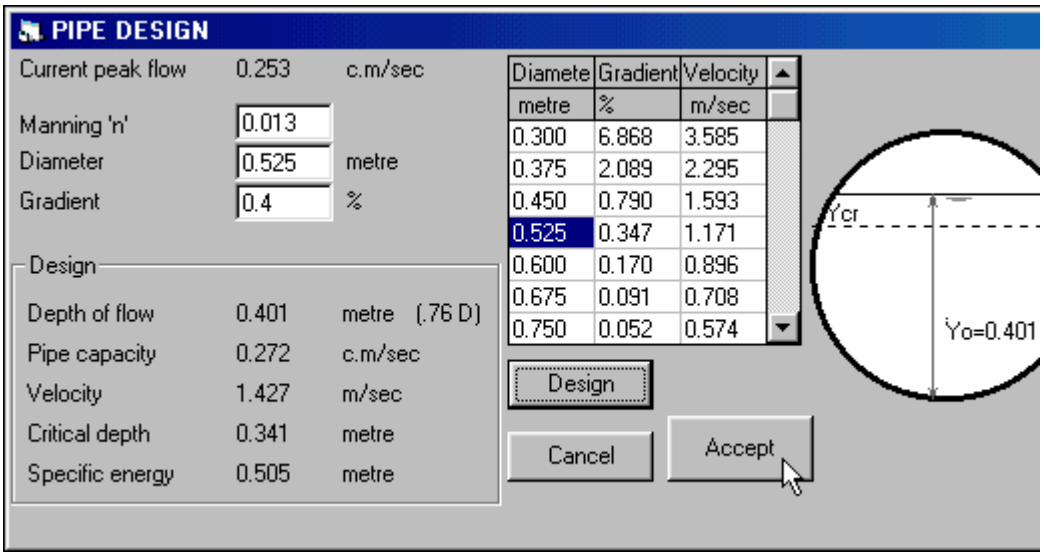


You can now design a pipe leading to junction node 2.

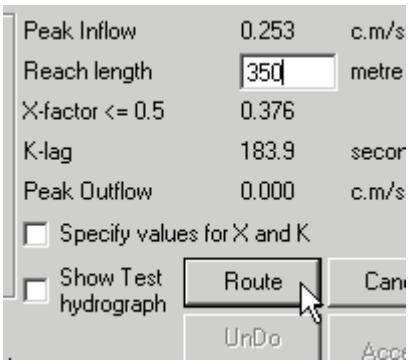
- From the menu select **Design/Pipe**.

The Pipe window opens and displays the current peak flow of 0.253 c.m/s to be used. MIDUSS calculates and displays a table of diameter-gradient pairs that would carry this flow when running full.

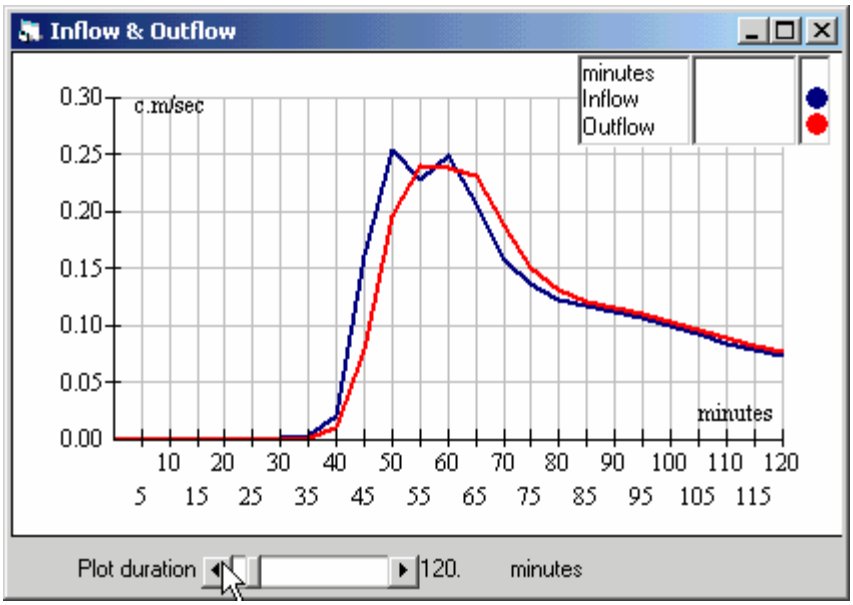
- Double click on the row containing the 525 mm diameter. The data is placed in the text box to the left and the gradient is rounded up to 0.4%.
- Press [Design]. The form tells you that this design will run just over ¾ full (i.e. .76D) and there is an average velocity of 1.427 m/s. You can experiment with different designs or different roughness values until you have an acceptable design.
- In this case we are satisfied with the design. Press [Accept] to close the window.



- Now select the **Design / Route** command. The form opens with the length of 300 m previously used for the channel.
- Change the highlighted value to 350 m and click on the [Route] button.



The outflow hydrograph table reports a peak flow of 0.240 c.m/s which represents a 5% attenuation. You will also see a plot similar the one shown below.



This is a little high for a pipe, and the reason is apparent if you look at the graph.

- Click on the horizontal scroll bar to reduce the plotted time base to about 120 minutes.

You will now see that the inflow hydrograph has a double peak – due to the difference in time to peak from catchments 3 and 4 – and the outflow hydrograph tends to average out these peaks despite the fact that the routing time step was only 2.5 minutes. However, the volume of outflow is still correct.

- Click [Accept] on the Route window to continue.

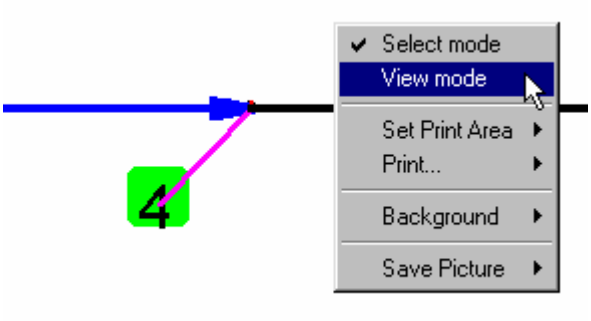
With the routing completed the Peak Flows table is updated and there should be an Outflow peak of 0.240. Your table should look similar to the one below.

PEAK FLOWS (10)

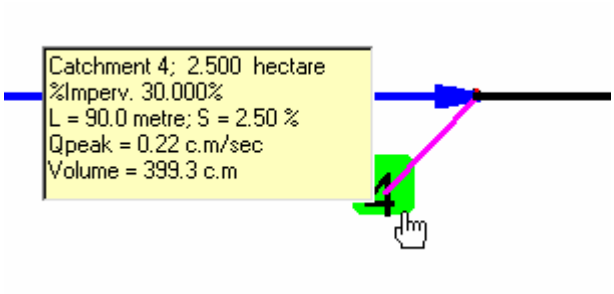
No.	Command	Runoff	Inflow	Outflow	Junction
1	Chicago storm	0.000	0.000	0.000	0.000
2	Catchment 3	0.188	0.000	0.000	0.000
3	Add Runoff	0.188	0.188	0.000	0.000
4	Channel Design	0.188	0.188	0.000	0.000
5	Channel Route 300	0.188	0.188	0.158	0.000
6	Next link	0.188	0.158	0.158	0.000
7	Catchment 4	0.215	0.158	0.158	0.000
8	Add Runoff	0.215	0.253	0.158	0.000
9	Pipe Design	0.215	0.253	0.158	0.000
10	Pipe Route 350	0.215	0.253	0.240	0.000

The layout is updated to reflect your design activities. On the layout you can see summary engineering data for each element of the layout. You do this using View mode.

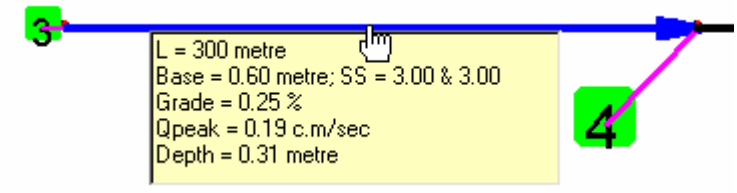
- While hovering over the layout, right click and select **View mode.**



As you hover over the various layout elements a little finger will appear and a yellow box will display information about that element. In the example below we see information about Catchment 4.



In the following example we know this is our 300m channel with a depth of 0.31m at a 0.25% grade.

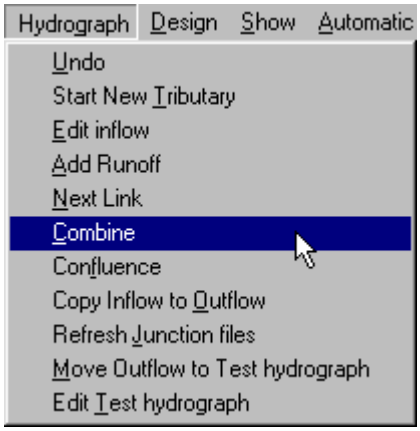


Note that MIDUSS scales the layout conduits after you have used the Route command. However, you can move the elements around and shrink them or enlarge then as you see fit. The actual design length used in the MIDUSS session is not changed – only the visual interpretation on the layout.

Defining a Junction Node

The 0.240 c.m/s outflow hydrograph needs to be stored temporarily while we work on generating flow from Catchment 1. We do this using Junction files. A Junction file will store this outflow hydrograph at junction node 2. Later on we will retrieve and use this flow.

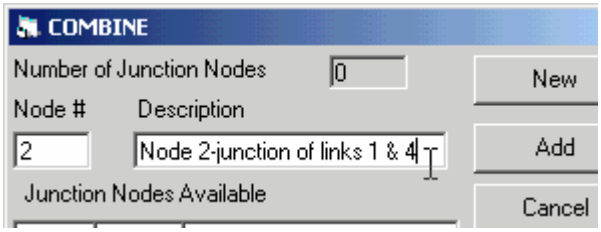
- To build a Junction file you use the **Hydrograph/Combine** command. Select this menu item now.



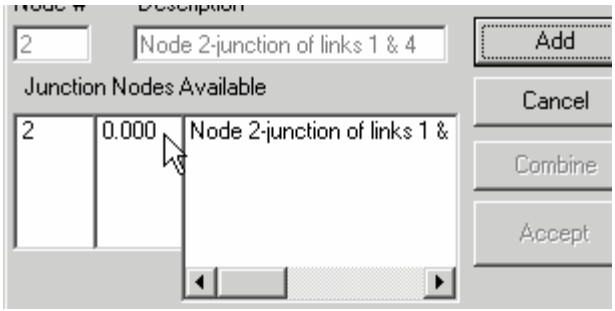
A Combine dialogue window will appear.

Since this is the first use of the Combine command the form contains no data. The procedure can be followed fairly easily by responding to the prompts in the yellow box.

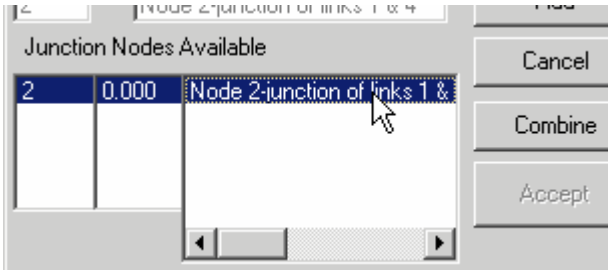
- Press [New] and enter the number and description of a new node. When you press the [New] button a text box is opened to define the Junction node number. Type '2'. As soon as a node number (or just part the number) is entered, another text box opens for a description. Type a brief description: "Node 2 – junction of links 1 & 4".



- Now press [Add] to add this to the List of Junction Nodes Available.
- This new addition causes the node number and description to appear in columns 1 and 3 of the multiple list box. The middle column shows a value of 0.000 at the moment. This value will be updated to hold the current peak value of the accumulated flows at the junction.

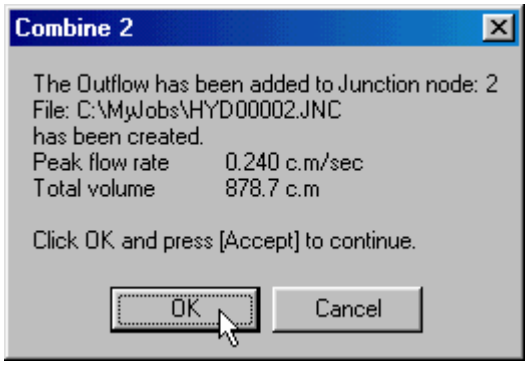


- Click anywhere on the desired junction node row, the entire row is highlighted and the [Combine] button is now enabled.

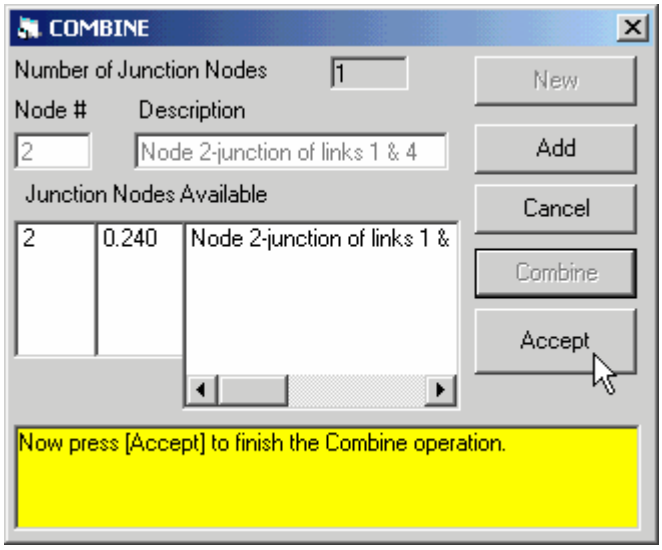


- Press the [Combine] button to add the current Outflow to the selected node. MIDUSS shows a warning message to advise you that a new file HYD00002.JNC will be created in the currently defined Job directory.
- Press the [Yes] button to confirm this. The value of 0.240 is entered in the middle column of the list box.

Another message is displayed showing the operation and the node number in the title bar, the name of the file created and the peak flow and volume of the accumulated hydrograph.



- Click on the [OK] button to continue.
- Press [Accept] on the Combine form to finish the operation.



The Combine form is closed and the Peak Flows table is updated with another record showing the Combine operation, the node number and the updated peak flow of the Junction hydrograph as shown below. Note that in the illustration below, the height of the Peak Flows table has been increased by dragging the top edge of the window upwards.

PEAK FLOWS (11)

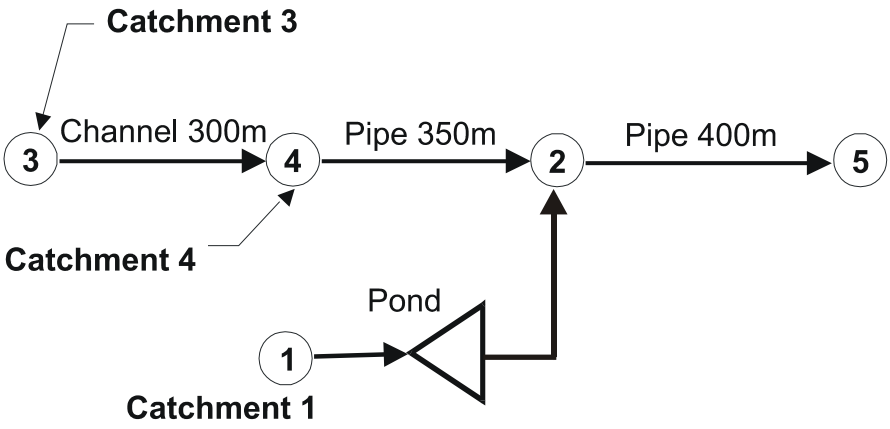
No.	Command	Runoff	Inflow	Outflow	Junction
1	Chicago storm	0.000	0.000	0.000	0.000
2	Catchment 3	0.188	0.000	0.000	0.000
3	Add Runoff	0.188	0.188	0.000	0.000
4	Channel Design	0.188	0.188	0.000	0.000
5	Channel Route 300	0.188	0.188	0.158	0.000
6	Next link	0.188	0.158	0.158	0.000
7	Catchment 4	0.215	0.158	0.158	0.000
8	Add Runoff	0.215	0.253	0.158	0.000
9	Pipe Design	0.215	0.253	0.158	0.000
10	Pipe Route 350	0.215	0.253	0.240	0.000
11	Combine 2	0.215	0.253	0.240	0.240

Notice on the table that we now have the Junction column being used to store a hydrograph flow. The flow from the 350m pipe has been stored for use later on. We will add the hydrograph from Catchment 1 to this stored hydrograph.

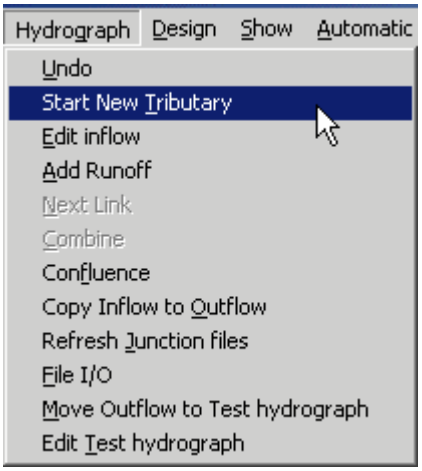
Adding Catchment Area 1

Before the new tributary branch from node 1 to junction node 2 can be designed, you must clear out the Inflow hydrograph left over from the analysis of the previous branch.

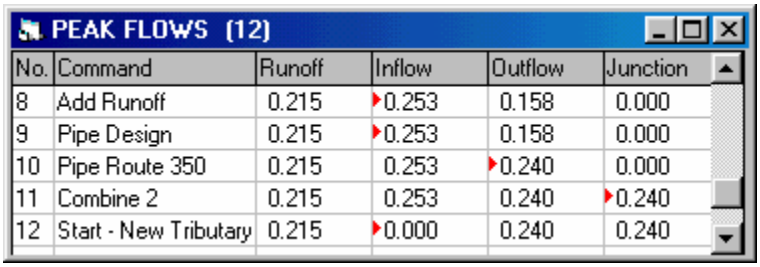
Rescue02.bin



- Click on the **Hydrograph/Start/New Tributary** menu item. You can use this command either before or after generating the runoff from catchment area 1. The Inflow value in the Peak Flows table will now show a zero value.



The Peak Flows table is updated.

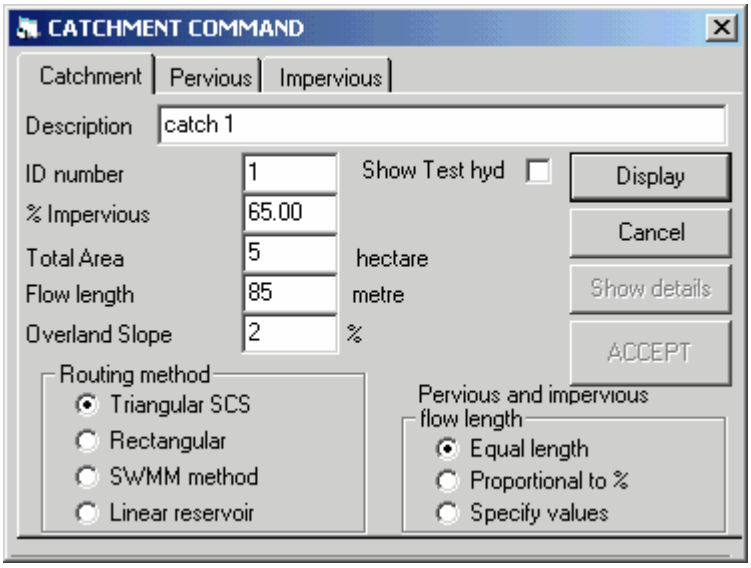


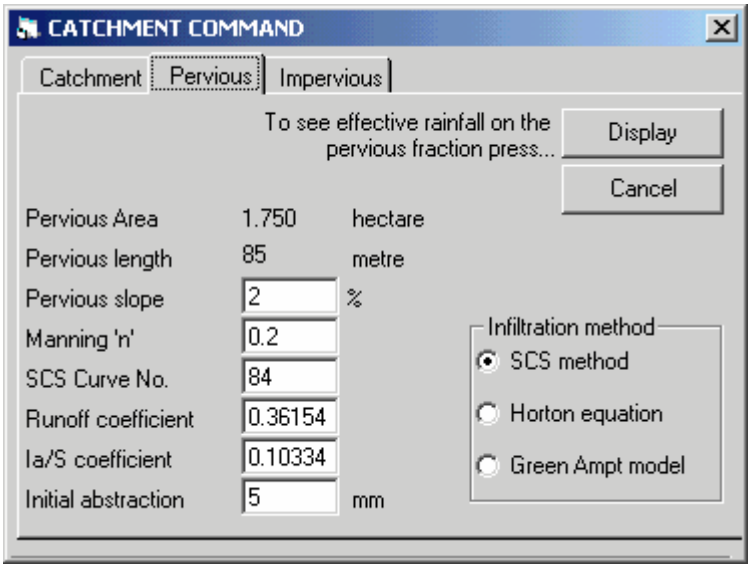
No.	Command	Runoff	Inflow	Outflow	Junction
8	Add Runoff	0.215	0.253	0.158	0.000
9	Pipe Design	0.215	0.253	0.158	0.000
10	Pipe Route 350	0.215	0.253	0.240	0.000
11	Combine 2	0.215	0.253	0.240	0.240
12	Start - New Tributary	0.215	0.000	0.240	0.240

- Select the **Hydrology/Catchment** command.

Because the parameter values are different for both the pervious and impervious fractions you will have to edit the data on all three tabs of the Catchment form.

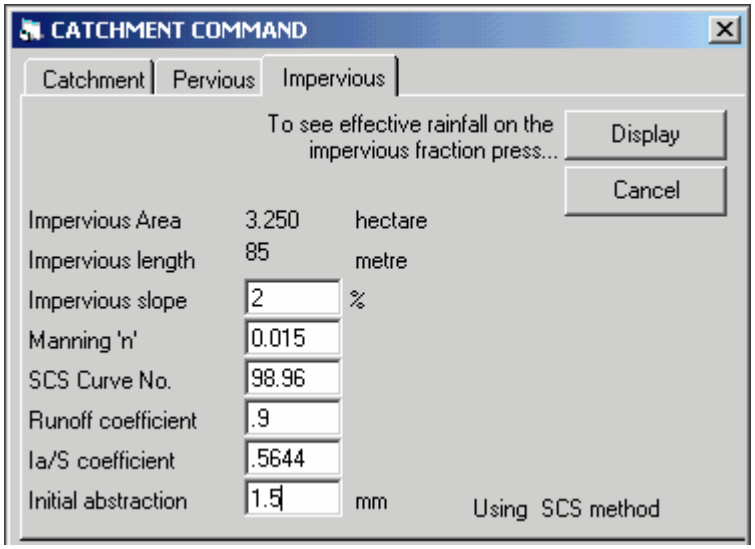
- The data for catchment 1 is displayed as shown in the forms below. Enter the data as shown.



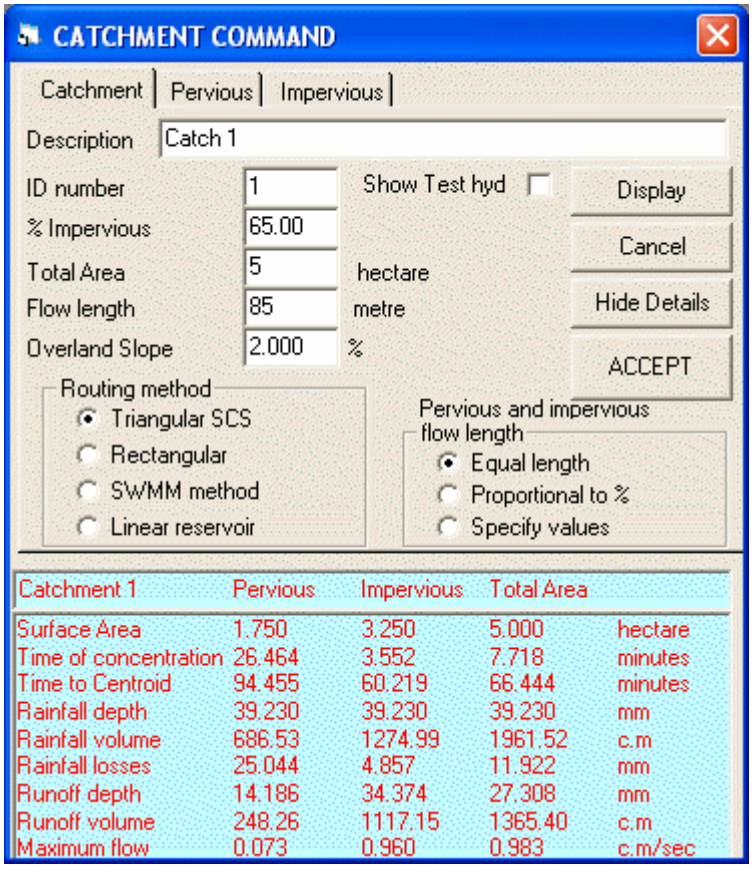


Note that the impervious fraction (coming up next) is defined in terms of a runoff coefficient of 0.9 which, for the currently defined storm and initial abstraction, is equivalent to a Curve Number of 99.96.

- On the impervious form below enter the Initial abstraction of 1.5.
- Enter the Runoff coefficient of .9. Don't enter the SCS Curve No. or the Ia/S coefficient – watch how these are calculated automatically.

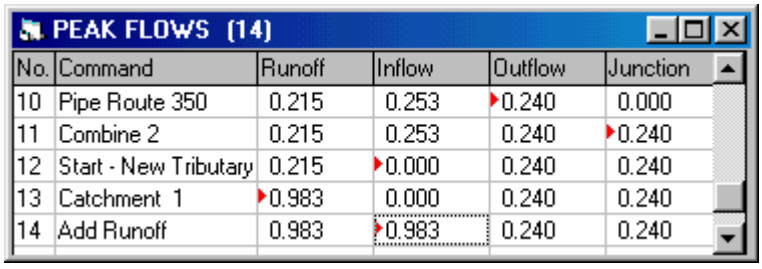


- Click on the Catchment tab.
- Press the [Display] button.
- Press the [Show Details] button.



The resulting peak runoff is 0.983 c.m/s with the hydrograph plot showing a peak occurring 50 minutes after the start of rainfall. This peak flow will be routed through a detention pond before adding the runoff to Junction node 2.

- Press the [Accept] key to close the Catchment command.
- Select the **Hydrograph / Add Runoff** command to add it to the Inflow hydrograph.



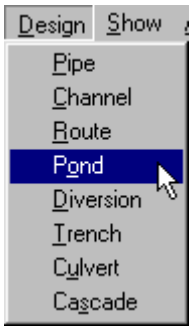
If you have forgotten to set the Inflow to zero, MIDUSS warns you that you may be double counting the inflow hydrograph from the previous branch. However, there may be situations where a new tributary runoff should be added to the previous inflow, so you must make the decision as to whether the warning is legitimate or not.

Design the Pond

For this example assume that the following criteria will guide the design of the pond.

- The pond will be a dry pond with no permanent storage.
- The outflow peak should be approximately 0.3 c.m/s for the 5-year storm.
- The maximum depth should be 2.0 m. with a top water level of 102.0 m.
- Outflow control will comprise an orifice and an overflow, broad-crested weir with a trapezoidal shape.
- The ground available is roughly rectangular in plan with an aspect ratio (i.e. length / width) of 2:1.

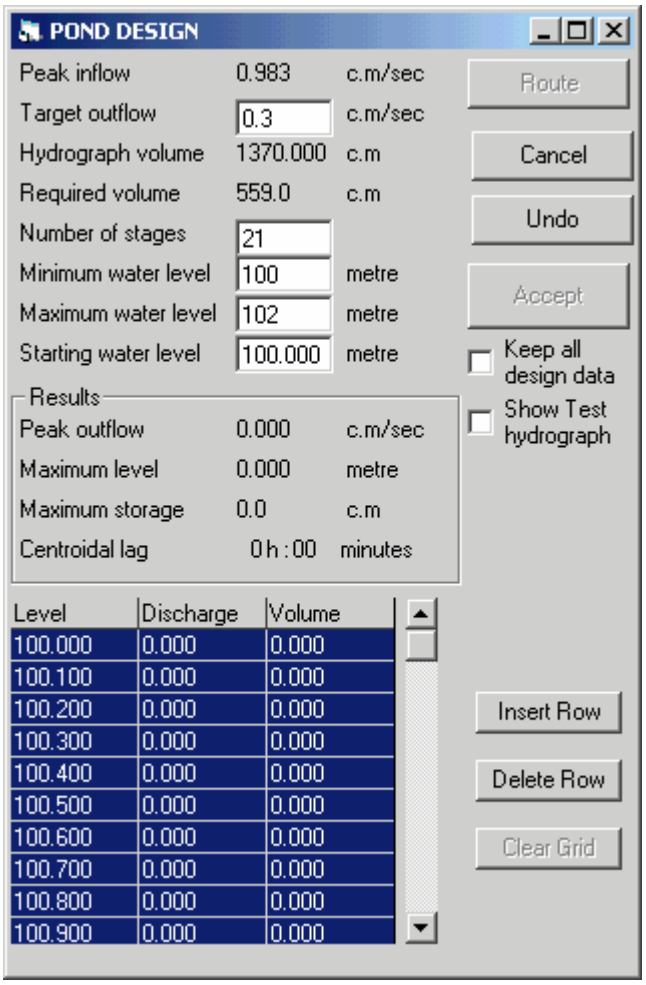
❑ Click on the **Design/Pond** command to open the Pond form.



The Pond form shows the current peak inflow of 0.983 c.m/s and the hydrograph volume of 1370 c.m.

❑ Edit the Target outflow by typing a value of 0.3 c.m/s. The required storage volume is estimated to be 559 c.m.

❑ Enter the minimum and maximum levels as 100.0 and 102.0 m. Leave the number of stages as 21 which implies 20 depth increments. This will cause the Level – Discharge – Volume table to show levels increasing by 0.1 m.



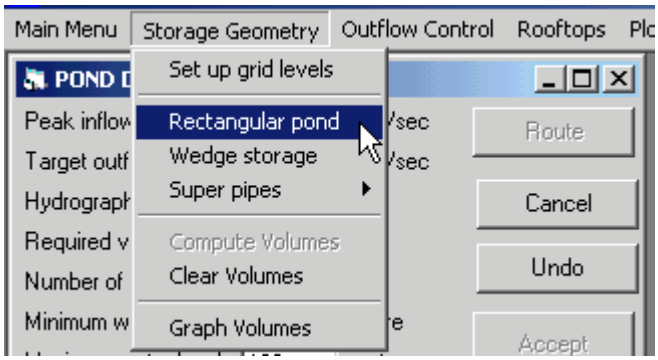
Before you can route the inflow hydrograph through the pond, you must define two characteristics of the proposed pond:

- The storage geometry, and
- The outflow control device.

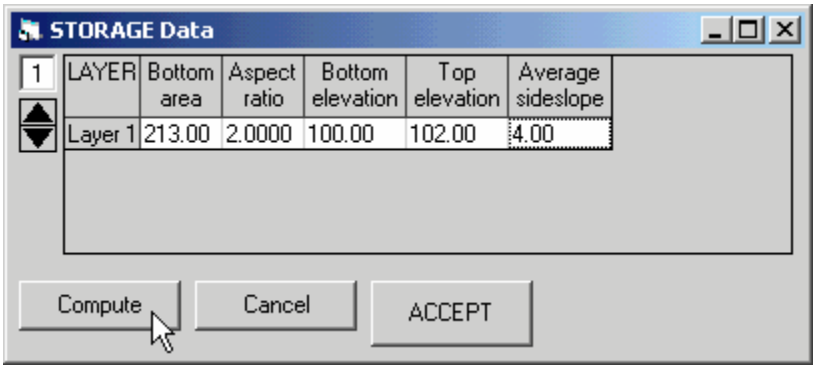
Defining the Pond Storage Geometry

Notice that the Pond command has its own menu system across the top. You can return to the Main Menu by selecting that item or by setting the focus on any other window such as the summary Peak Flows Table. For now we need to use the Storage Geometry item.

- Select the Storage Geometry/Rectangular pond menu.



This causes the Storage Geometry Data window to be opened .

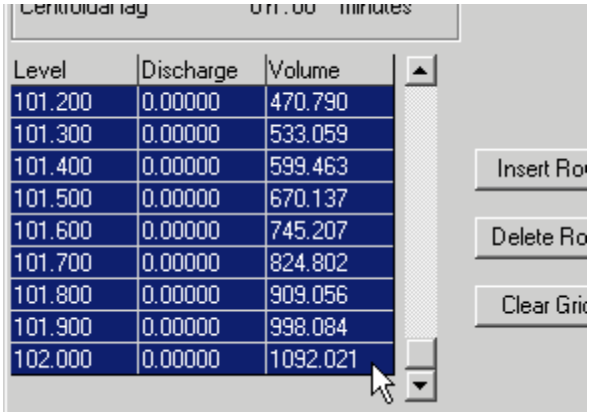


- Click once on the up-arrow of the spin button to open up a single row in the table.

MIDUSS calculates default data which will generate the required volume in a depth of roughly 2/3 of the maximum depth of 2.0 m. When you use the [Compute] button the Level – Discharge – Volume portion of the main pond window will be updated.

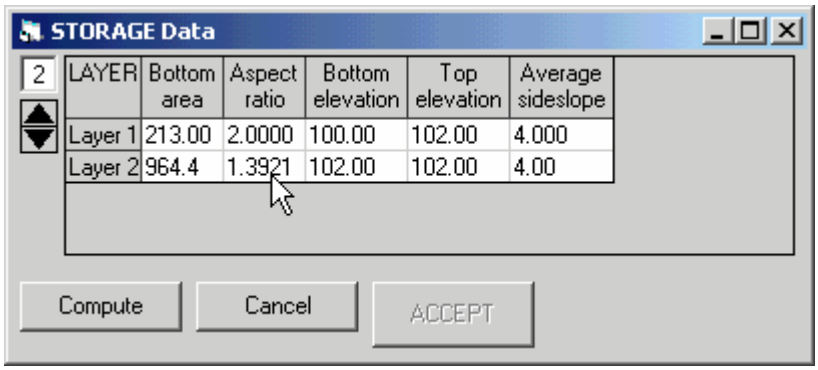
- Press the [Compute] button on the Storage Data form.

The column of volumes is computed with a maximum value of 1092.021 c.m at elevation 102.0.



To check the size and shape of the surface area at elevation 102.0 we need to open another row in the data table.

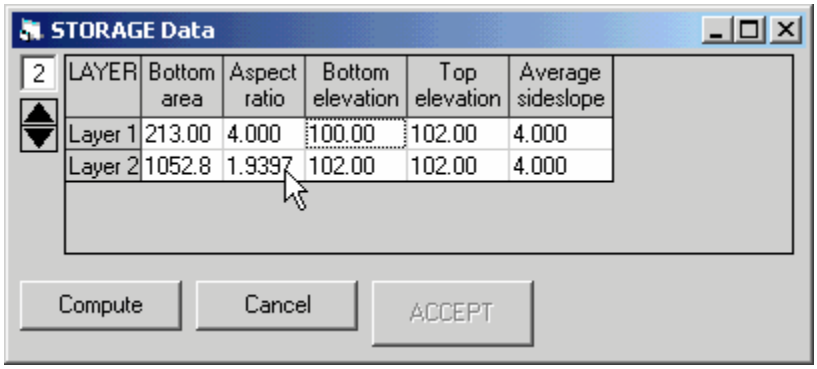
- Click again on the up-arrow of the spin-button.



The computed area is 964.4 sq.m but the aspect ratio is only 1.3921. To get the aspect ratio at elevation 102.0 to be 2:1 you must increase the aspect ratio at elevation 100.0.

- Click on the cell containing the aspect ratio of 2.0 in the first row. Type in a value of 4.0.

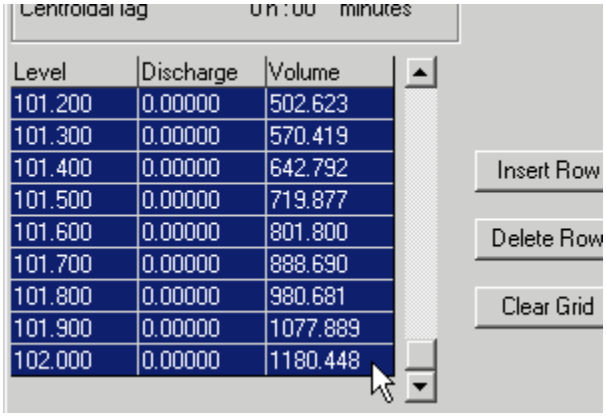
You will find that an aspect ratio of 4:1 at the pond bottom will yield a ratio of just under 2:1 (1.9397:1) at the top and the surface area at level 102.0 is 1052.8 sq.m. You should see a Storage Data form similar to the one below.



You now want to compute and transfer this updated data to our Level – Discharge – Volume grid over in the main pond window.

- Press the [Compute] button.

This refreshes the column of volumes. Doing this also enables the [Accept] button on the Pond Storage Data form. Because of your change to the aspect ratio the volume at level 102 is now increased to 1180.448 c.m.



- On the Storage Data Form, click the [Accept] button to close it.

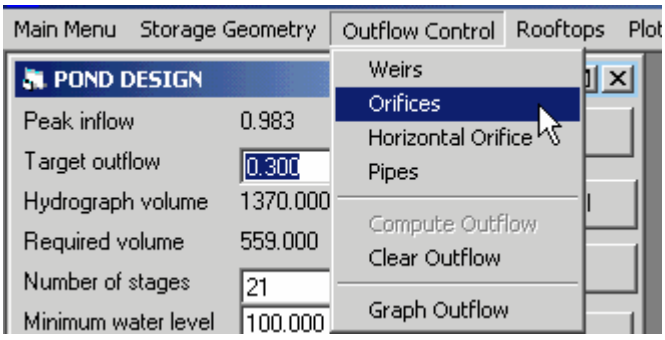
Note, the Storage Data Form can be re-opened and edited later if you wish. It is more usual to have more 'layers' with different side-slopes but for this tutorial only one layer is used for simplicity. MIDUSS lets you define up to 10 layers.

You will see on the Level – Discharge – Volume grid that we have no data in the Discharge column. We will do this next.

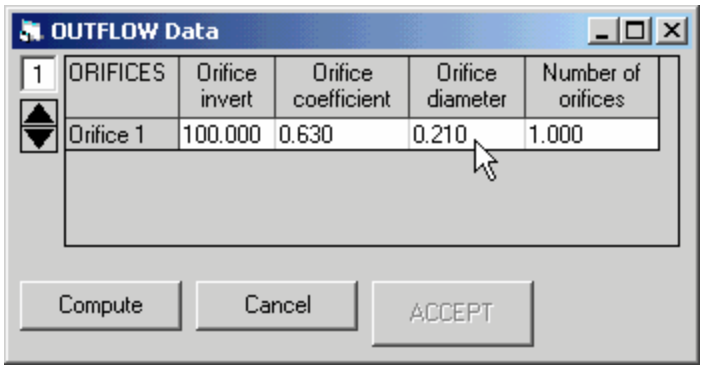
Defining the Outflow Control Device

Another item on the special Pond menu is Outflow Control. You can design orifices, weirs and pipes to control the outflow. These control are used to define the Discharge on the Level – Discharge – Volume grid We will design an orifice first.

- Select the menu item **Outflow Control / Orifices**.



A form similar to the previous storage geometry form now appears.



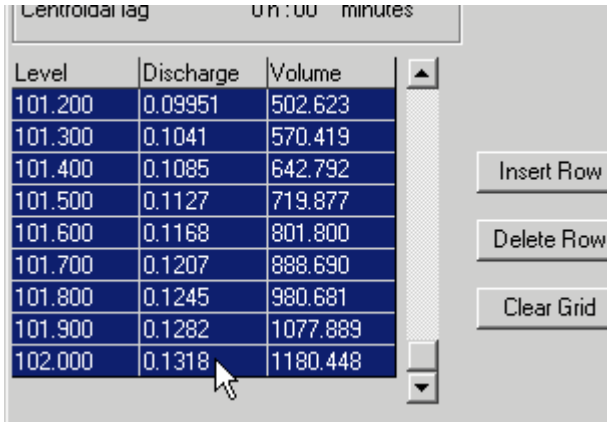
- Click on the spin-button to open a row to define an orifice.

MIDUSS will calculate default values of the orifice. The following assumptions are used:

- The invert of the orifice will be at the bottom of the pond,
- The coefficient of discharge is 0.63, and
- The suggested diameter is sized to discharge 25% of the target outflow with a head equal to 1/3 of the maximum depth.

These assumptions are merely starting points for the design. You can change them to suite your own requirements. In general, MIDUSS generates a conservative design. For this tutorial we will accept the MIDUSS assumptions. You can define up to 10 orifices.

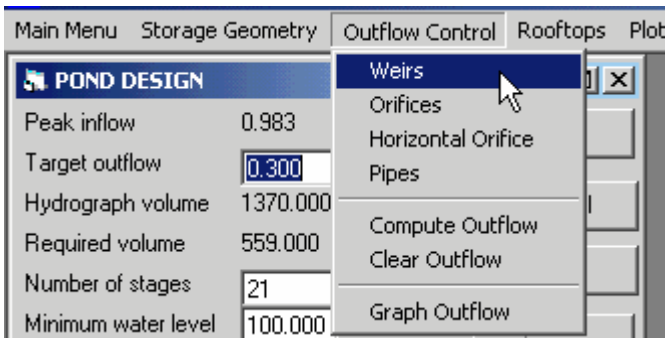
- On the Outflow Data form press the [Compute] button. Just as with the Storage Geometry form, the Discharge column is filled in to reflect your orifice design.



- To close the Outflow Data form press [Accept].

The outflow control should probably include a weir to pass the higher flows – particularly for the more severe historic storm.

- From the Pond special menu select the **Outflow Control / Weirs** menu item.



A similar form to the previous orifice design now appears.

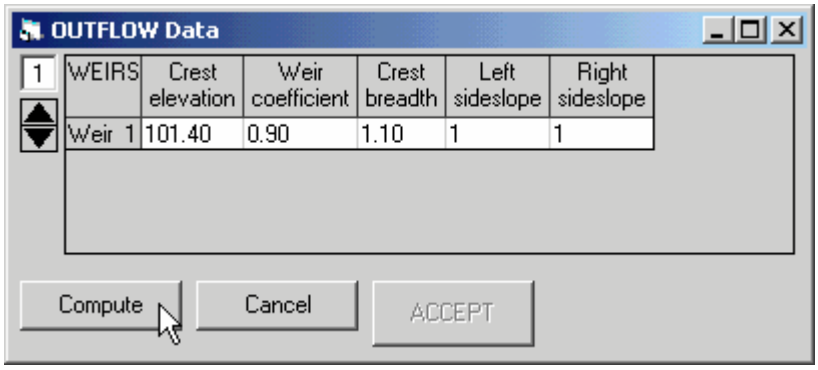
- Open a data row by clicking on the spin-button.

The default data is displayed. These data are based on certain simple assumptions:

- The crest elevation corresponds to 70% of the maximum depth.
- The coefficient of discharge is 0.9.
- The weir breadth is estimated to pass the peak inflow with a (critical depth/ breadth) ratio of 0.2.
- The side-slopes are vertical.

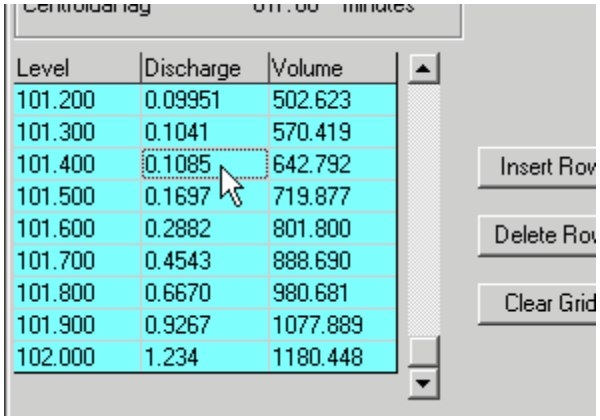
- Change the side-slopes to 1H:1V (i.e. 45°) but leave the other parameters unchanged

Your Weir form should look like the one below.



- Press the [Compute] button to update the Discharge column on the Level – Discharge – Volume grid on the main pond window.

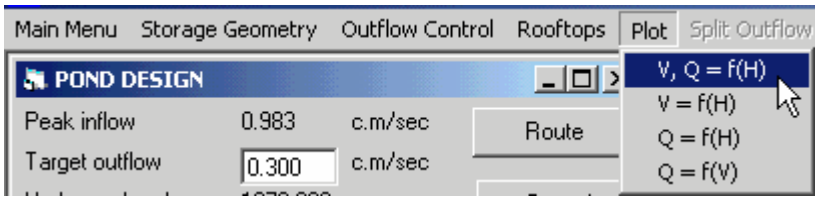
You should see that the column of discharges is updated for elevations above the weir crest elevation of 101.4.



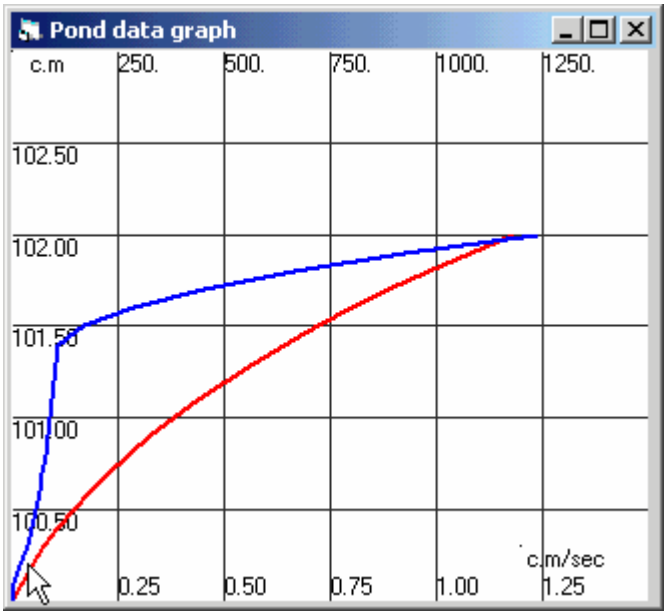
- On the Weir Outflow data form press [Accept] to close it.

The Pond special menu include a Plot item that lets you graph the storage and/or discharge characteristics.

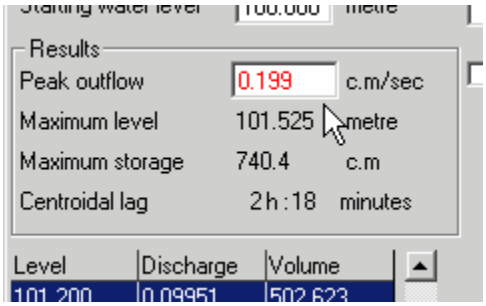
- Select the **Plot / V, Q = f(H)** menu item.



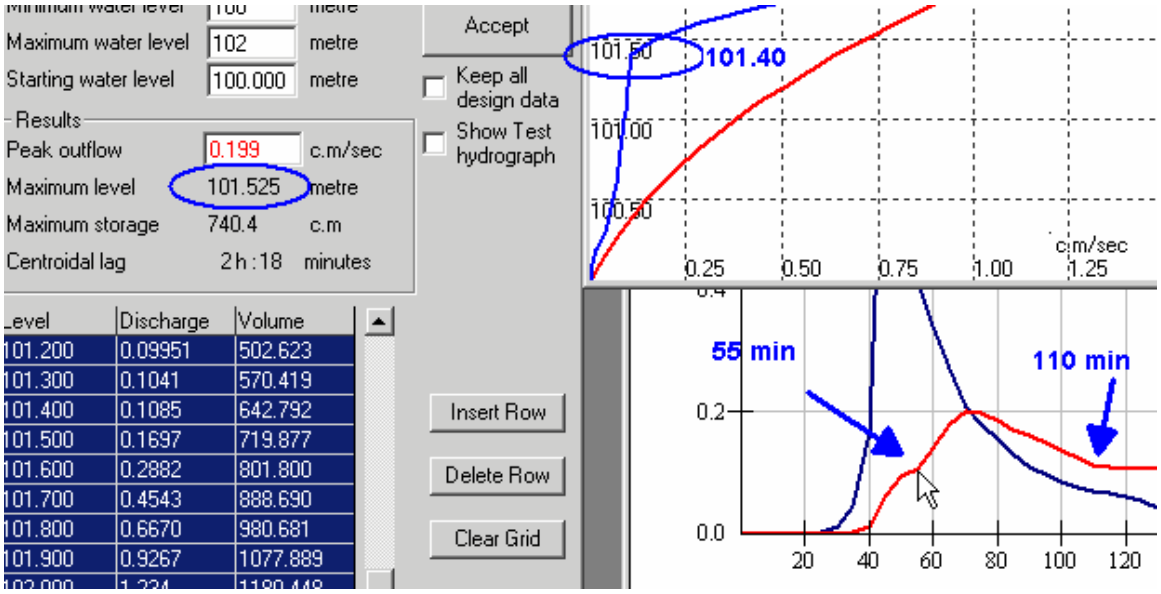
You can enlarge the plot by dragging the corners of the graph window. The highly non-linear nature of the blue, stage-discharge curve is clear. You may notice a small convex segment of the orifice discharge curve below an elevation of 100.2 which is caused by the orifice operating as a circular weir when the depth is less than the diameter.



- You can now press the [Route] button to see how the pond performs.



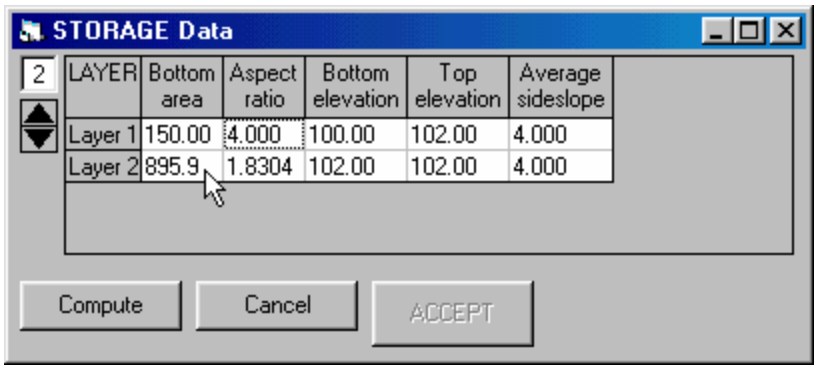
From the Pond Design form it is clear that the design is conservative. The peak outflow is only 0.199 c.m/s – well below the target outflow of 0.3 c.m/s and the storage volume is too large at 740.4 c.m. The weir is overtopped by a head of 125mm (101.525 – 101.400) for about 55 minutes.



Of the various ways in which the outflow could be increased, reducing the land area required for the pond will probably yield the greatest cost saving.

- Select the **Storage Geometry/Rectangular pond** menu item to re-open the Storage Geometry Data form again.
- Reduce the base area by entering 150 sq.m at elevation 100.0 then click on another cell to refresh the results.

The surface area is reduced to 895.9 sq.m.

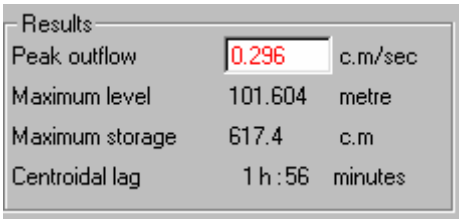


- Press [Compute] to update the 'Volumes' column. There is no need to press Accept at this point.
- Press [Route] again.

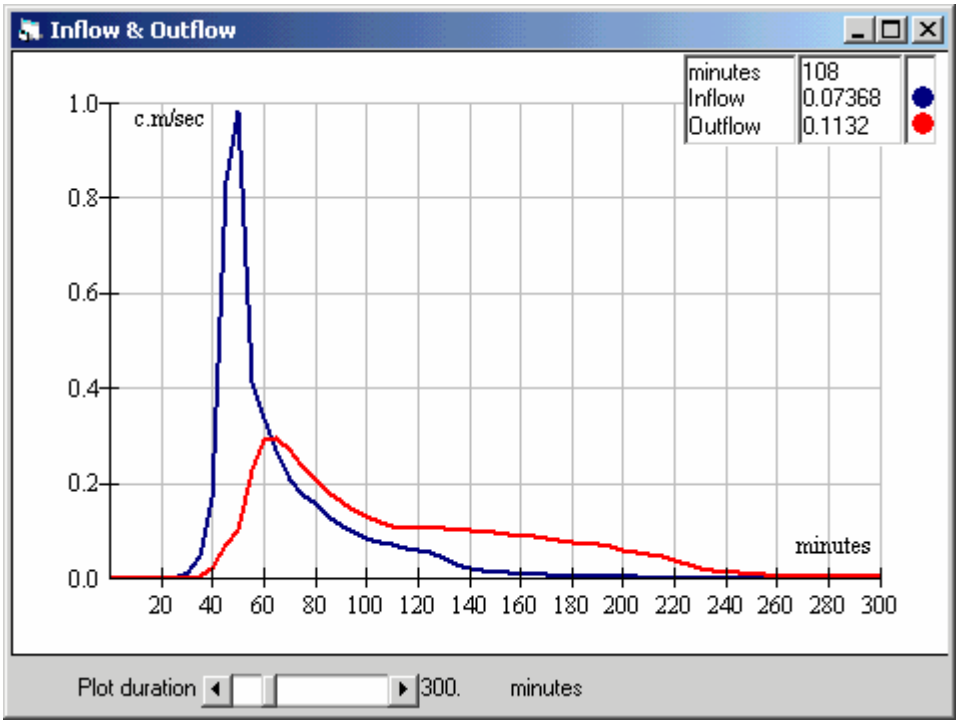
The peak outflow increases to 0.282 c.m/s, the volume is reduced to 637.6 c.m. and the head over the weir increases to 0.195 m. Try reducing the base area still further.

- On the Storage Data form once again, change the base to 140 sq.m.
- Press [Compute] and [Accept] the revised volumes.
- [Route] the flow again.

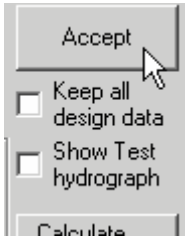
From these actions you will see that the surface area is reduced to 869.3 sq.m., the maximum storage is 617.5 c.m. and the peak outflow is 0.296 c.m/s. A fragment of the Pond Design form is shown below.



From the Outflow hydrograph Table, you may notice a small error in the volume continuity. This is caused by the pond outflow hydrograph being longer than the maximum hydrograph length so that the tail of the recession limb is truncated. MIDUSS attempts to calculate a correction in such situations but it may not always be precise. The graph of the Inflow and Outflow hydrographs is shown below.



- Press the [Accept] button to close the Pond Design forms.



At this point the Peak Flows table is updated.

PEAK FLOWS (15)

No.	Command	Runoff	Inflow	Outflow	Junction
3	Add Runoff	0.188	0.188	0.000	0.000
4	Channel Design	0.188	0.188	0.000	0.000
5	Channel Route 300	0.188	0.188	0.158	0.000
6	Next link	0.188	0.158	0.158	0.000
7	Catchment 4	0.215	0.158	0.158	0.000
8	Add Runoff	0.215	0.253	0.158	0.000
9	Pipe Design	0.215	0.253	0.158	0.000
10	Pipe Route 350	0.215	0.253	0.240	0.000
11	Combine 2	0.215	0.253	0.240	0.240
12	Start - New Tributary	0.215	0.000	0.240	0.240
13	Catchment 1	0.983	0.000	0.240	0.240
14	Add Runoff	0.983	0.983	0.240	0.240
15	Pond Route	0.983	0.983	0.296	0.240

Notice that the design of a pond places the results directly into the Outflow column. This is because you ***Routed*** the flow as an integral part of the pond design.

In conduits such as pipes and channels you need to use the Route command to place the flow in the Outflow column. In design elements such a pond, culvert, trench etc. routing is part of the design process. The following table summarizes this point.

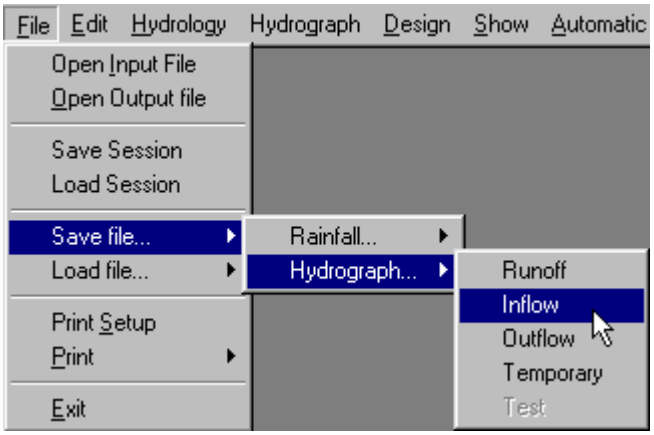
With design element…	…when the design is accepted, the active hydrograph is:
Pipe	Inflow
Channel	Inflow
Route	Outflow
Pond	Outflow
Cascade	Outflow
Trench	Outflow
Diversion	Outflow
Culvert	Outflow

Saving the Inflow Hydrograph File

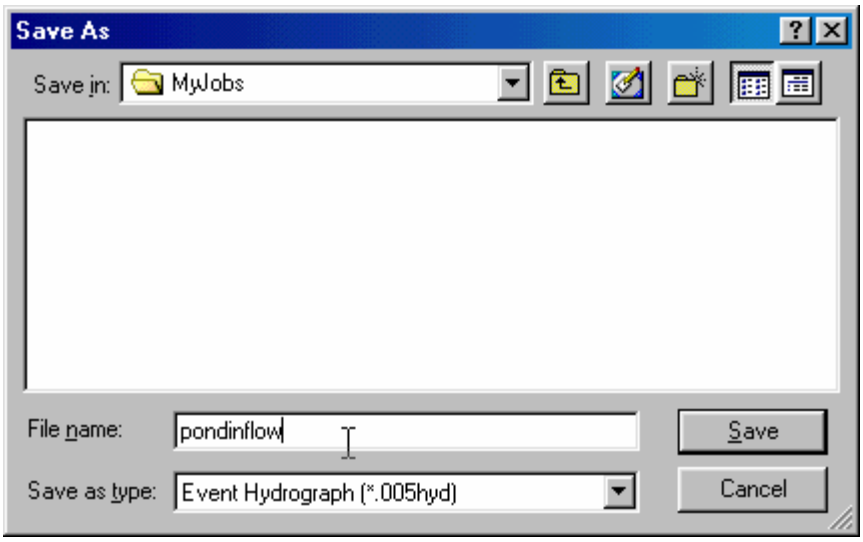
As it is possible that you may want to revise the pond design when you subject it to the historic storm, it would be useful to save the pond inflow file before continuing.

Rescue03.bin

- Select the **File / Save file / Hydrograph / Inflow** command to open the Windows file dialog.

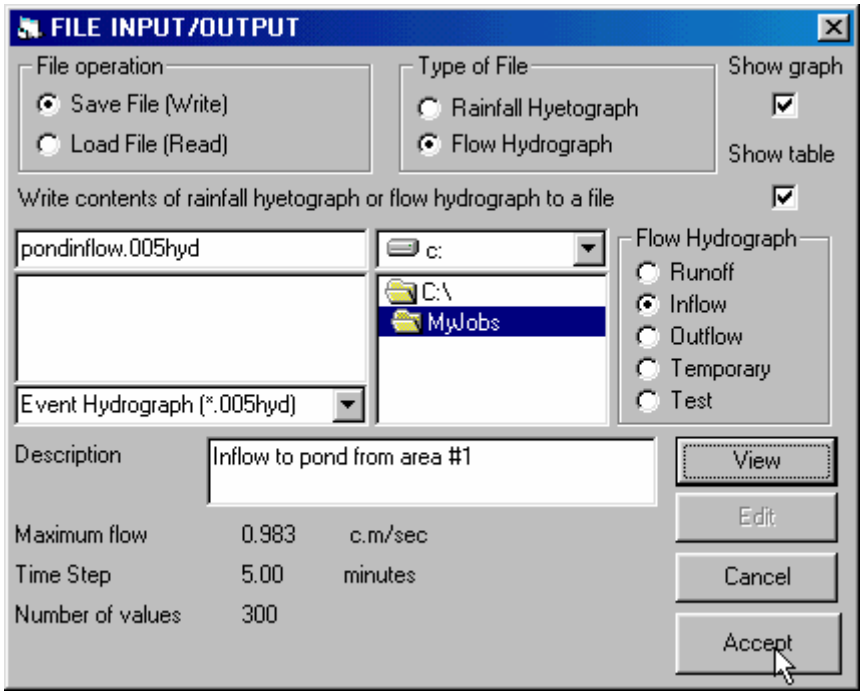


- When the File Save common dialogue box is displayed, enter the name ‘pondinflow’. There is no need for the 005hyd extension as MIDUSS will do this.

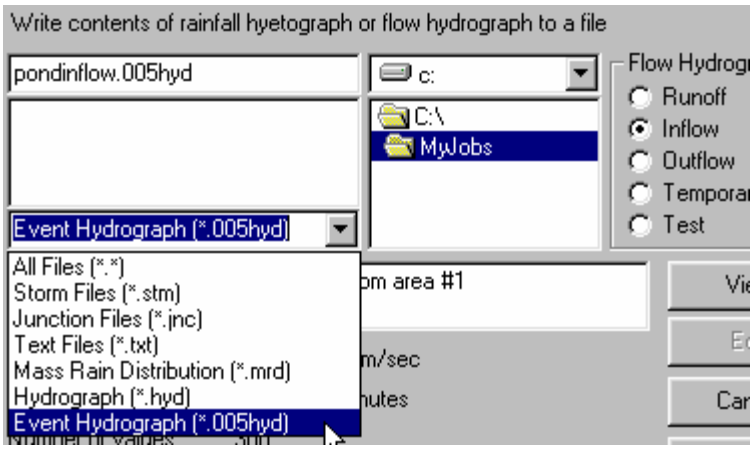


- Click [Save]

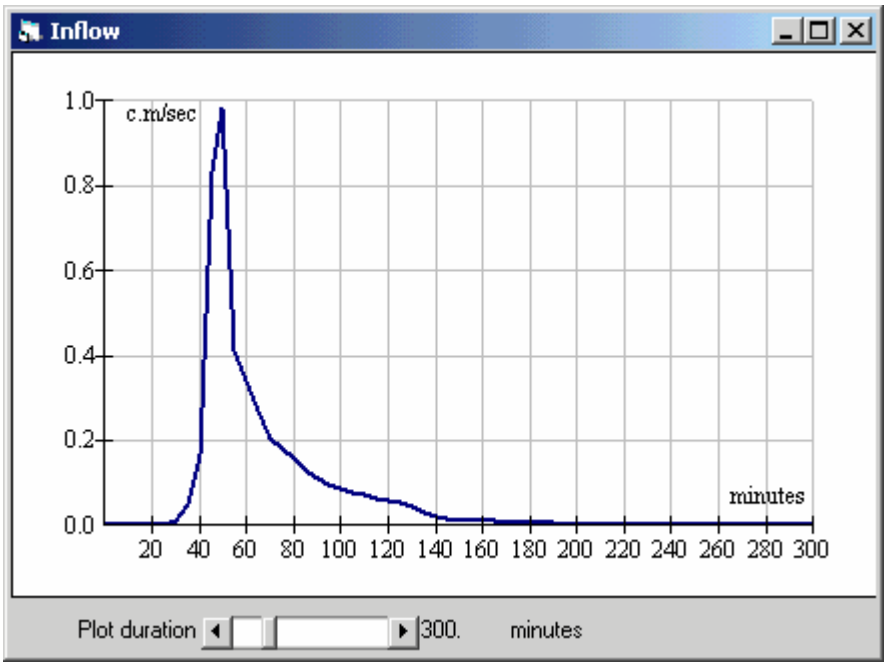
The File Input / Output form is displayed.



- Confirm the File Operation is selected to be '**Save File (Write)**'.
- Confirm the Type of File is selected to be '**Flow Hydrograph'**. This causes the Flow Hydrograph frame to be displayed.
- Confirm that the desired Flow Hydrograph is selected as the '**Inflow**'.
- Make sure the file is to be saved to your working folder. In this case to **MyJobs**.
- Confirm the Hydrograph type drop-down list box; make sure the **'Event Hydrograph (*.005hyd)**' is selected.



- Press the [View] command button to display the Graph and/or the table. This is necessary to enable the [Accept] button.

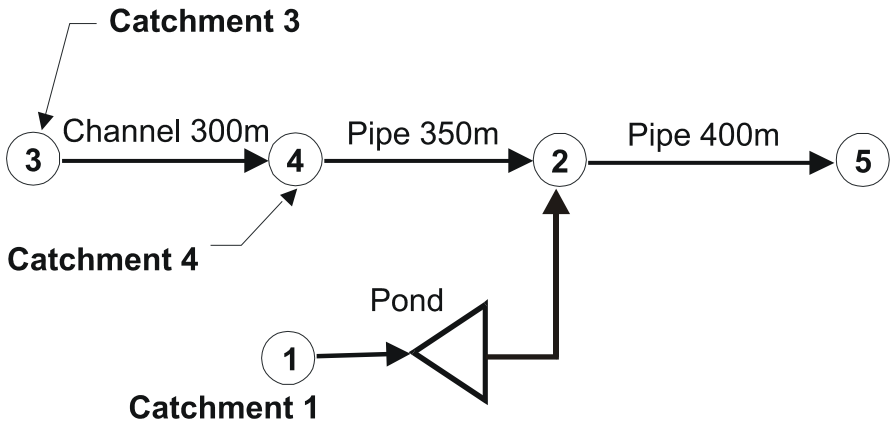


- Press [Accept].
- Type in a description of at about 20 characters as: "**Inflow to pond from area #1**".
- Press [Accept] again to close the form.

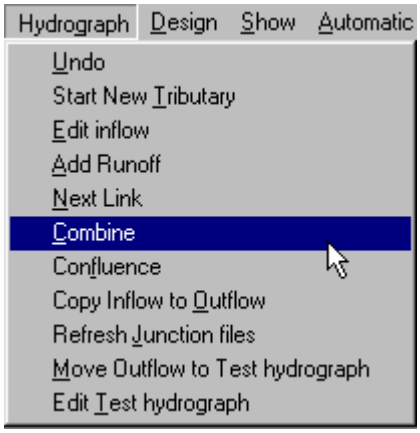
The **File Input / Output** command allows you to read or write any hydrograph or hyetograph you are in the process of using at the time. You can generate hydrographs in other software packages and then import them to MIDUSS using this feature.

Adding Flow from the Two Branches

When the Pond Design form was closed, the Peak Flows table was updated with a new record showing the value of 0.296 in the Outflow column. If you assume that the outflow from the pond is close to the junction node 2, you can add the pond outflow to the junction at node 2 without the need to define a connecting pipe or channel.

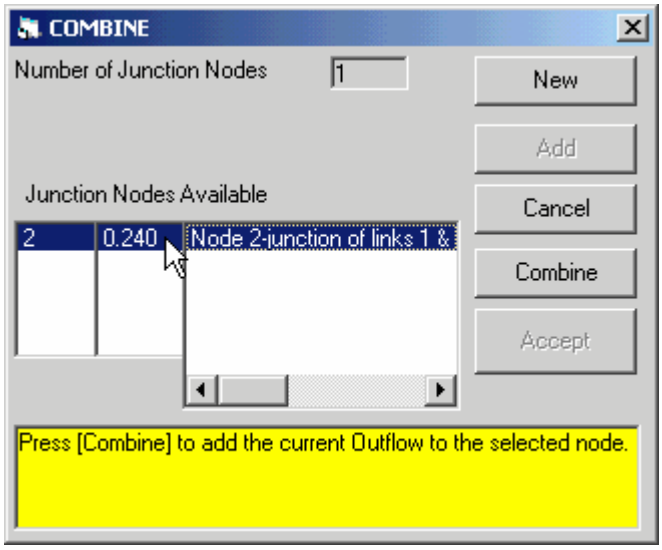


- From the menu select the **Hydrograph/Combine** command.

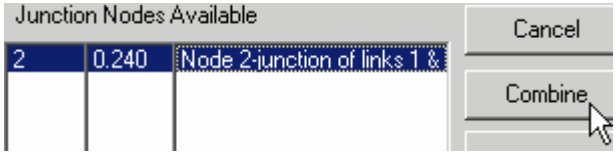


The process is simpler this time because you have already created the junction node. Follow the directions in the yellow box as before.

- Click on the row describing Node 2 to highlight it, This enables the [Combine] button.

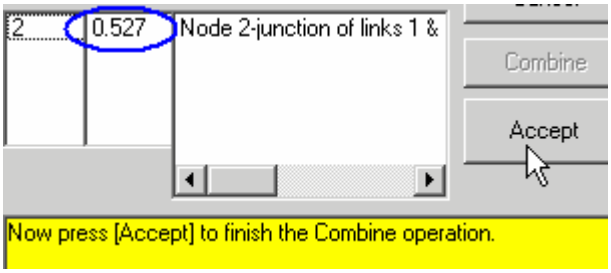


- Click the [Combine] button to update the peak of the total junction hydrograph to 0.527 c.m/s.



MIDUSS displays a message to confirm the junction file name, the peak flow and the total volume.

- Click [OK] and then [Accept] to close the form.



You have now combined all the flows from all catchments 1, 3 and 4 at Junction node 2.

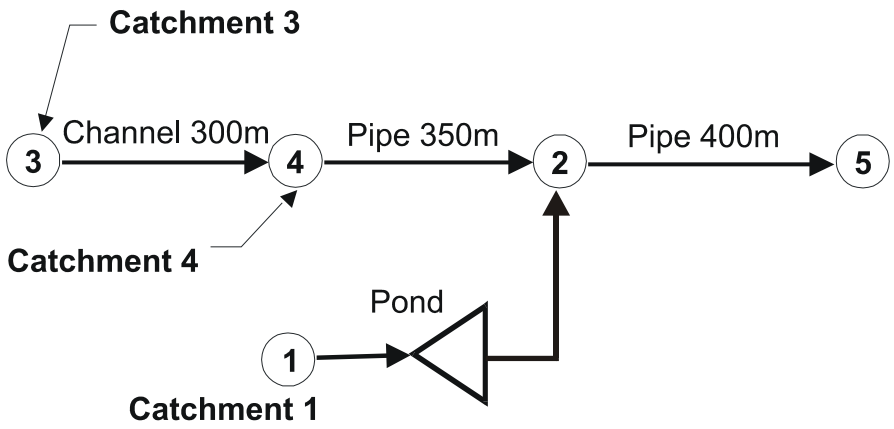
The Peak Flows table is updated and should look like the one below.

PEAK FLOWS (16)

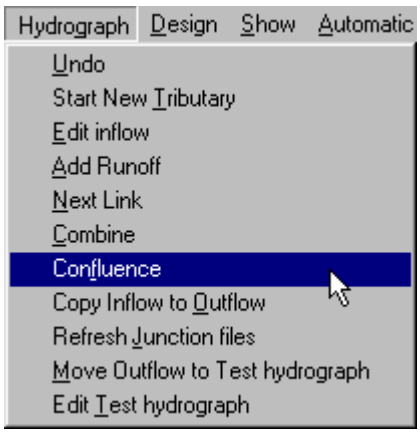
No.	Command	Runoff	Inflow	Outflow	Junction
12	Start - New Tributary	0.215	0.000	0.240	0.240
13	Catchment 1	0.983	0.000	0.240	0.240
14	Add Runoff	0.983	0.983	0.240	0.240
15	Pond Route	0.983	0.983	0.296	0.240
16	Combine 2	0.983	0.983	0.296	0.527

Designing the Last Pipe

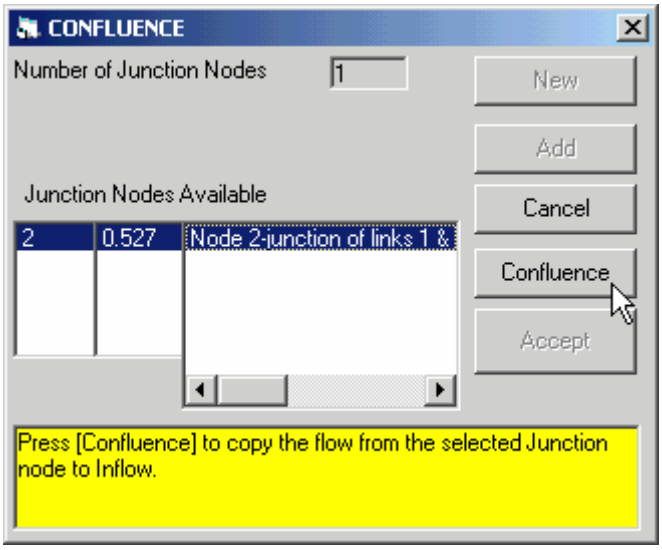
The final step in the design is to recover the accumulated flow from the Junction node 2 and design a pipe to carry this flow over the last 400 m reach.



- To recover the hydrograph at Junction node 2 select the **Hydrograph/Confluence** command.



The Confluence dialogue form below is similar in appearance to the Combine form. The [New] and [Add] buttons are disabled as they have no relevance for the Confluence operation. The 3-column list box shows the currently active junction nodes.



- Click on the row describing Node 2 to highlight it. This enables the [Confluence] button.
- Press the [Confluence] button.

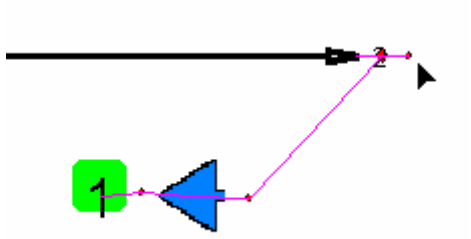
You will see a message box that reports the junction file has been deleted. In fact, the file is not really deleted but is renamed with the extension *.JNK. You may therefore recover the file by renaming it prior to the end of the session at which point it will be erased.

Your Peak Flows table should look similar to the one below. Notice that the Confluence flow of 0.527 c.m/s you just processed is now sitting in the Inflow column ready to be used to design a network element.

PEAK FLOWS (17)

No.	Command	Runoff	Inflow	Outflow	Junction
13	Catchment 1	0.983	0.000	0.240	0.240
14	Add Runoff	0.983	0.983	0.240	0.240
15	Pond Route	0.983	0.983	0.296	0.240
16	Combine 2	0.983	0.983	0.296	0.527
17	Confluence 2	0.983	0.527	0.296	0.000

Also, on your layout you will now see a small connector circle added to node 2. This indicates that there is an Inflow ready to be used for design. Next, you will design a pipe to link to this node.



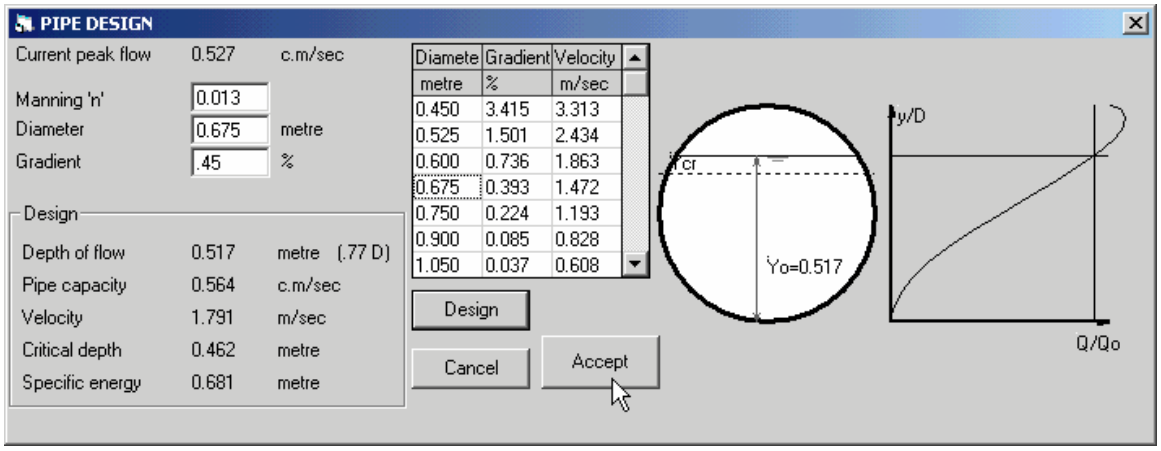
The Final Pipe Design

The Inflow hydrograph is 0.527 c.m/s and we need to design a 400m pipe.

- Select the **Design / Pipe** command.
- Assume the default value of n = 0.013
- Use a 675 mm diameter pipe and use a 0.5% gradient.
- Press [Design].

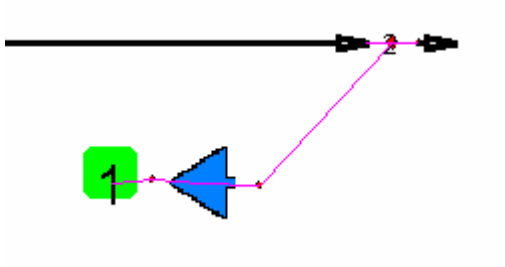
This design will carry the peak flow with a depth of 0.5 m. Note, however, that the critical depth is only slightly less than the uniform flow depth. This implies a Froude number close to 1.0 which is close to the condition of easy wave formation.

- Flatten the slope slightly to 0.45%.
- Press [Design]. This produces a flow depth of 0.517 m. Your Pipe Design windows should look like the one below.



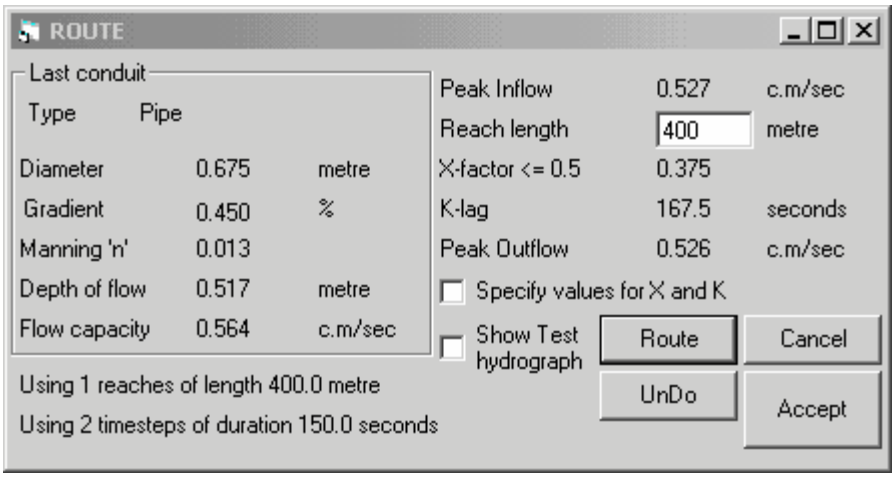
- Press [Accept] to close the Pipe window.

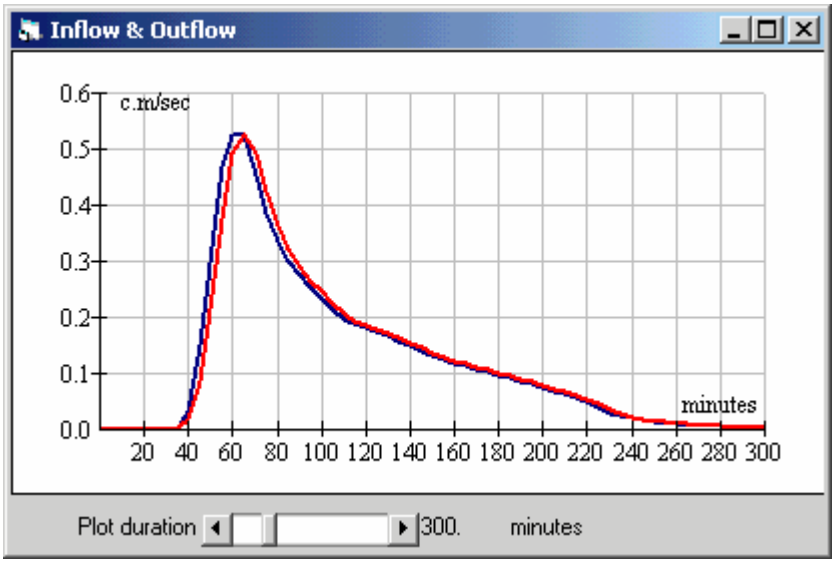
On your layout a small pipe is added to node 2. It will be lengthened with the Route command.



Next, you need to route the flow.

- Select the **Design / Route** command
- Enter 400 m for the Reach length.
- Press [Route]





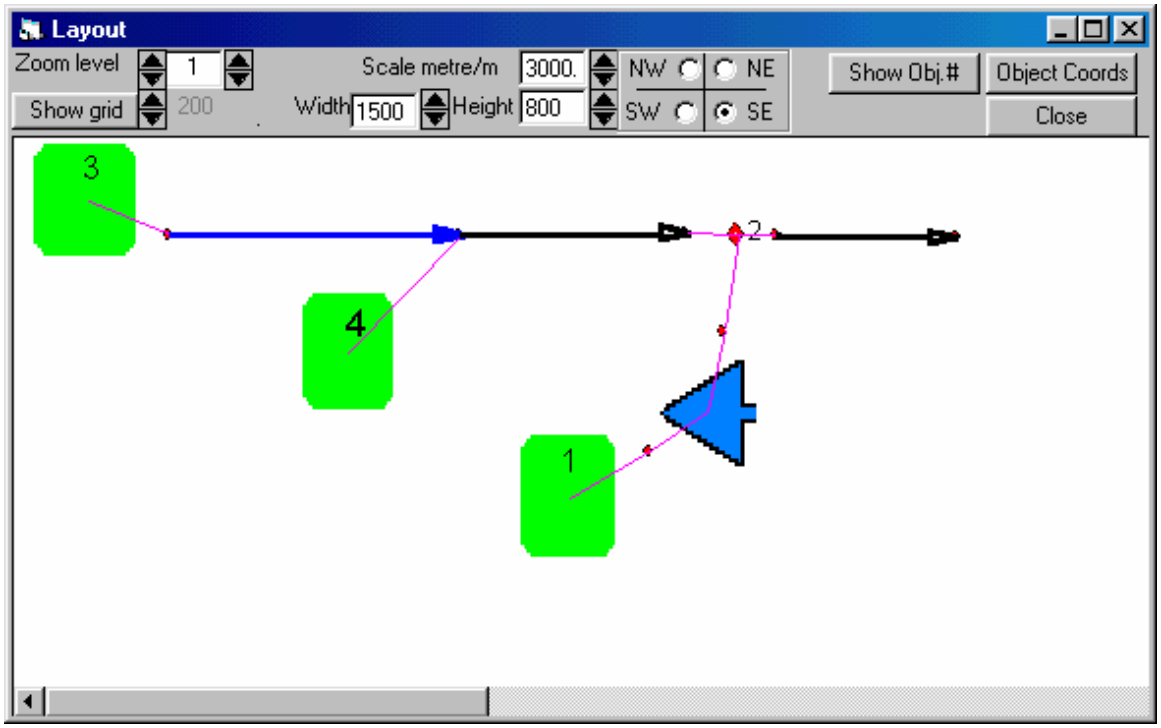
This yields an Outflow peak flow of 0.526 c.m/s with negligible attenuation and lag. The Peak Flows table is updated with another line item.

PEAK FLOWS (19)

No.	Command	Runoff	Inflow	Outflow	Junction
15	Pond Route	0.983	0.983	0.296	0.240
16	Combine 2	0.983	0.983	0.296	0.527
17	Confluence 2	0.983	0.527	0.296	0.000
18	Pipe Design	0.983	0.527	0.296	0.000
19	Pipe Route 400	0.983	0.527	0.526	0.000

This finishes the design for the 5-year storm.

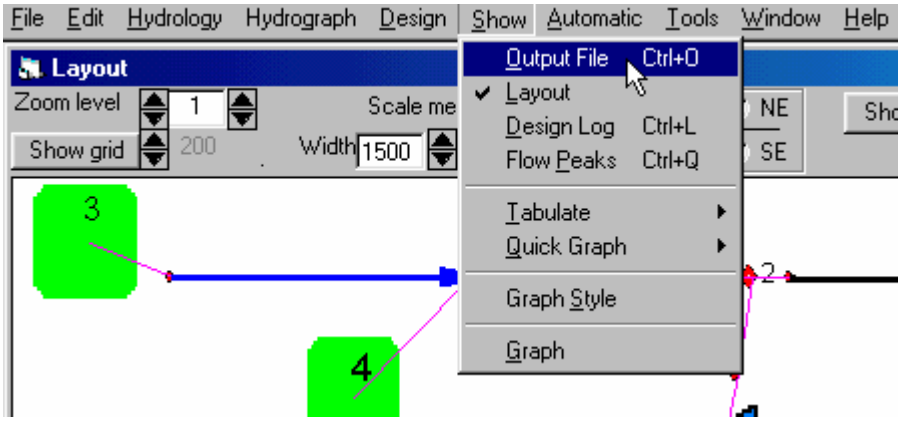
Your layout should look similar to the one below.



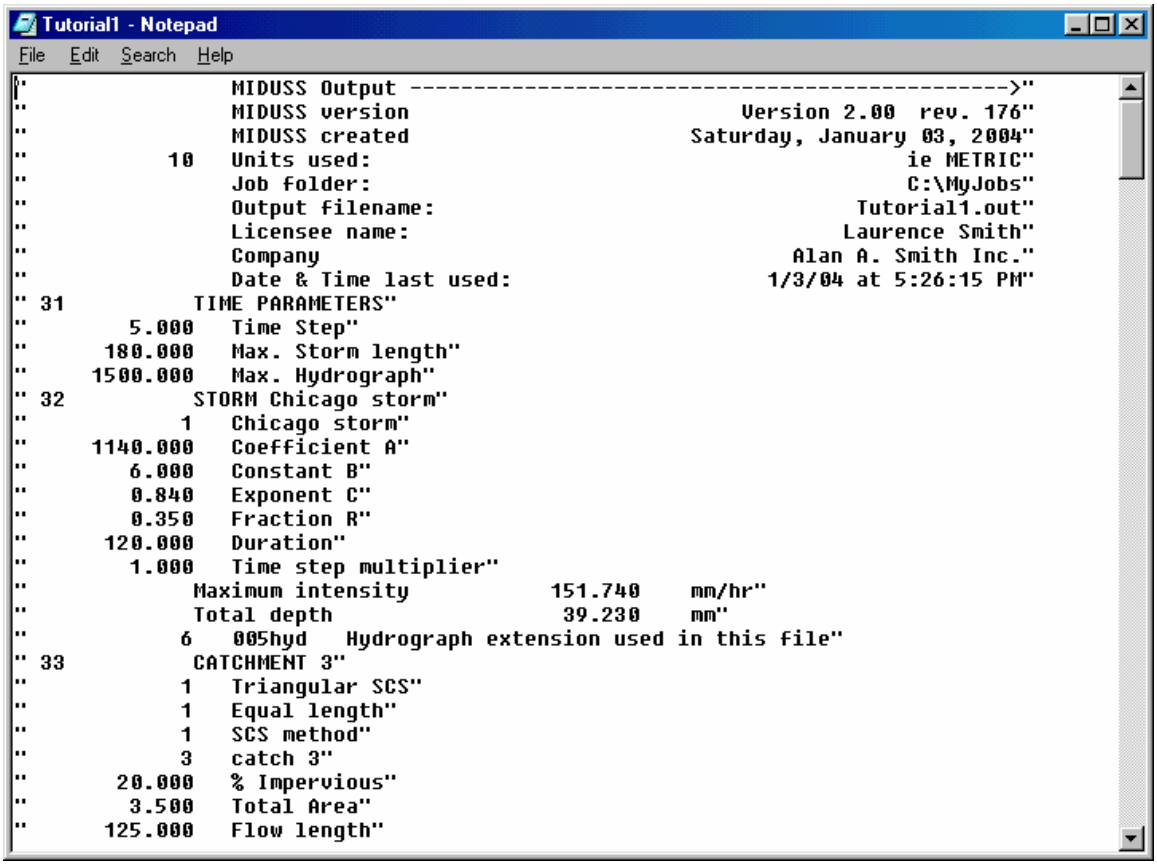
You will recall that we specified an output file at the beginning of this session. As you were designing this drainage network, MIDUSS was storing all your design decisions in this output file. The output file is used for reporting purposes and will also be used as an input for MIDUSS in Automatic mode.

You can view the output file at any time.

- Click the menu item **Show / Output File**.

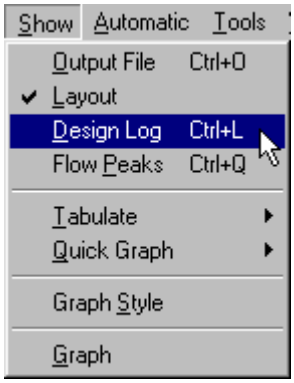


Notepad will open and contain the data for our output file Tutorial1.out.

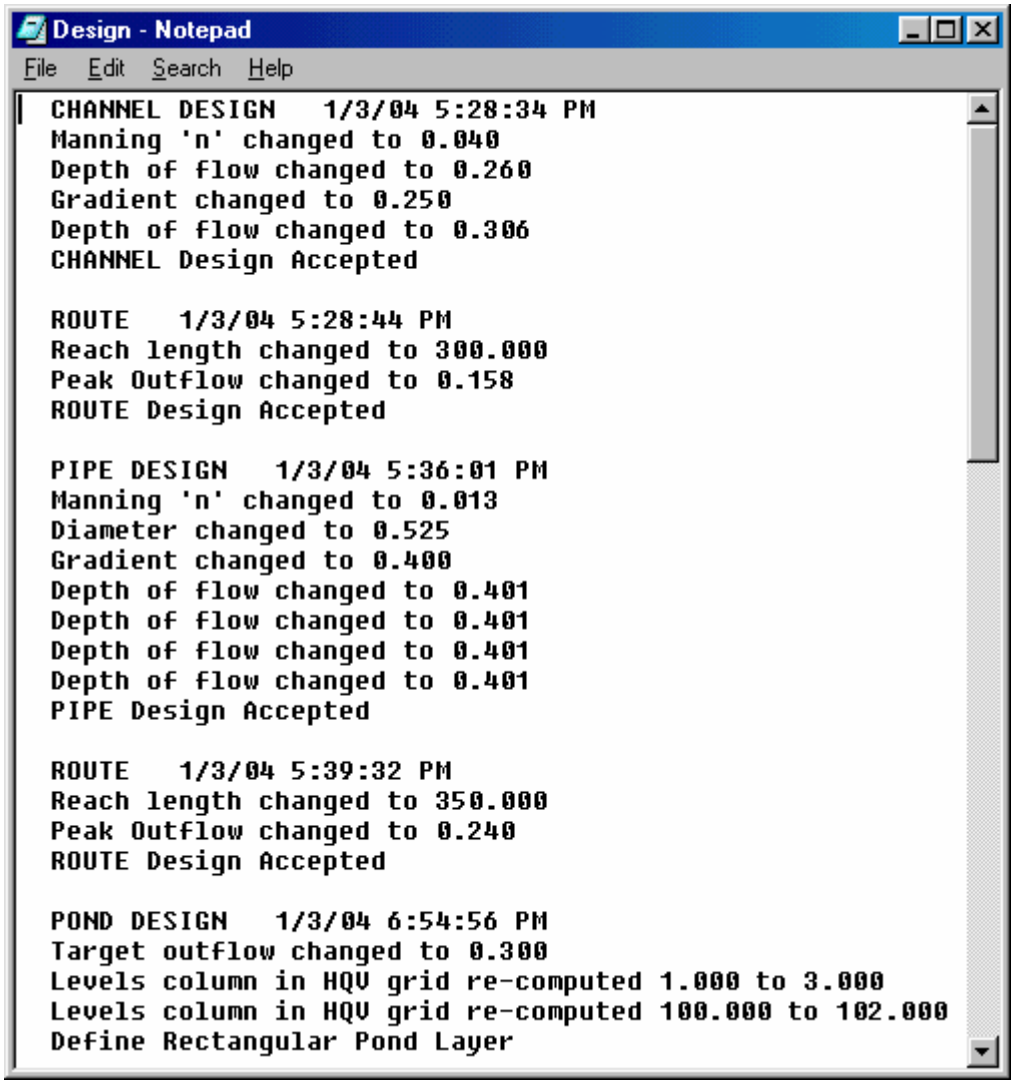


You can also view all your design iterations for all the drainage elements in the network.

- Select **Show / Design Log** from the main menu.



Notepad will open and contain the contents of the Design.log file that MIDUSS is constantly updating in the background.

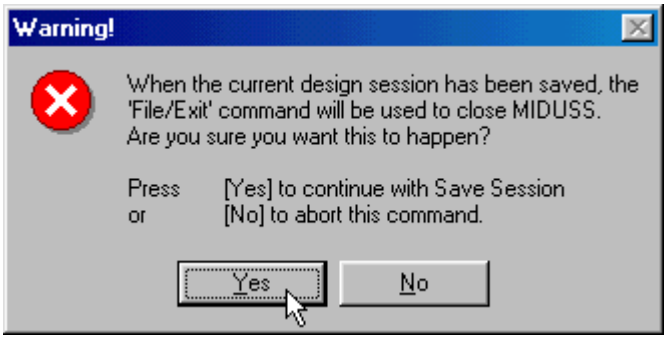


MIDUSS includes a feature called Save Session which is like saving a snapshot of exactly where you are in a session. This let's you continue where you left off in a previous design session. You can do the same by running the output file in Automatic mode but Save Session is quicker and easier to use.

We will not be using the corresponding **File / Load Session** command to continue this manual design but the **Save Session** command is included here to illustrate the procedure.

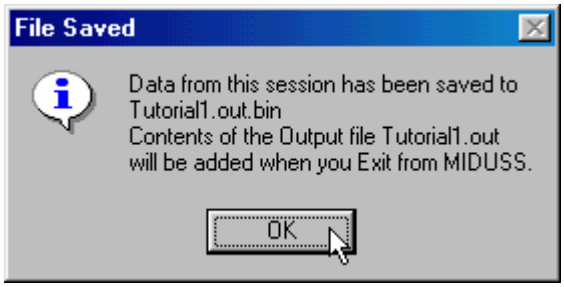
- From the main menu select **File / Save Session**.

A warning message will appear telling you that MIDUSS will now close down.



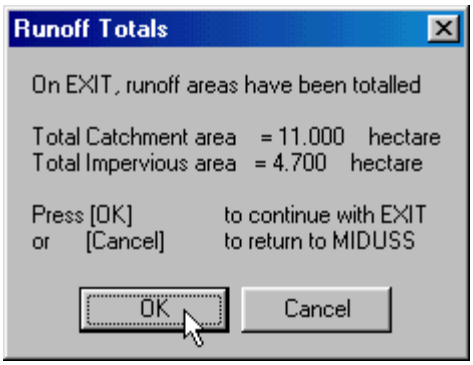
- Click [Yes]

Another message appears telling you the name of the Session filename. This is always the name of your current output file with '.bin' added. In this example the session filename is **Tutorial1.out.bin**.



The Session file will be stored in your working folder. In this tutorial we have been using MyJobs as the working folder. You should be aware that any previous session files in the working folder with the same name will be overwritten. Hence, if you want to save several MIDUSS sessions you will need to navigate to the working folder and change the name of the previously created .bin files.

As MIDUSS exits you will see a message providing you with a quick summary of the runoff areas for all the catchments used in the session. This data can help you feel more comfortable that no catchments were missed in the design session. This data is also provided at the very bottom of the output file.



- Click [Ok]

Finally, before closing down MIDUSS reminds you of the name of the output file. This file will be used in Automatic mode to test and adjust your drainage network under a more severe storm.

Notes:

An Automatic Design for a Historic Storm

When the design for the 5-year storm has been completed, you can check how this drainage system will respond to the more extreme event described by the 3 hour historic storm defined at the beginning of this tutorial.

Rescue04.bin

You can use the Automatic mode to do this without having to re-enter all of the commands and data from the keyboard.

The procedure is described in the topics that follow in the remainder of this tutorial and can be summarized as follows.

- Run MIDUSS and define a new output file.
- Use the previous output file to create an Input Database called Miduss.Mdb that resides in your local \My Jobs\ folder.
- Run MIDUSS in Automatic mode using the database as input.
- Step through the database in EDIT mode to allow you to modify the design parameters as desired.
- When the previous Chicago hyetograph is displayed, reject this and replace it with a historic storm.
- Continue with the design, making any adjustments that you may feel are appropriate. These will include some refinement of the Pond design and separation of major and minor flow components if a pipe is surcharged under the more severe storm.
- Complete the run and compare peak outflows for the two events.

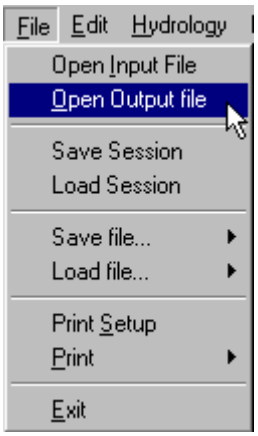
First Steps

- ❑ Start MIDUSS and acknowledge the various messages.

When you reach the message asking if you wish to use the previous output file again. Reject this.

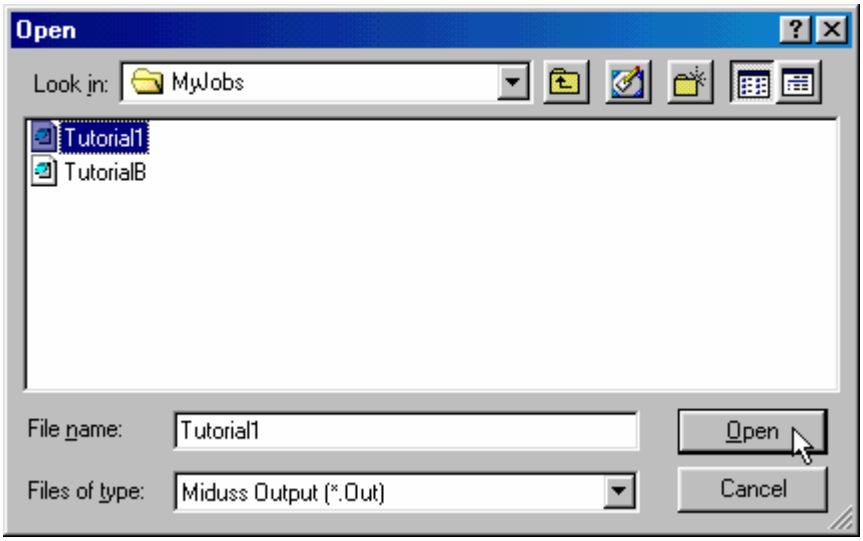
The mouse will be positioned over the **File / Open Output file** command to specify a new filename. You must use a different filename to avoid overwriting the output file created in the previous session.

- ❑ Click **File / Open Output file** menu item.



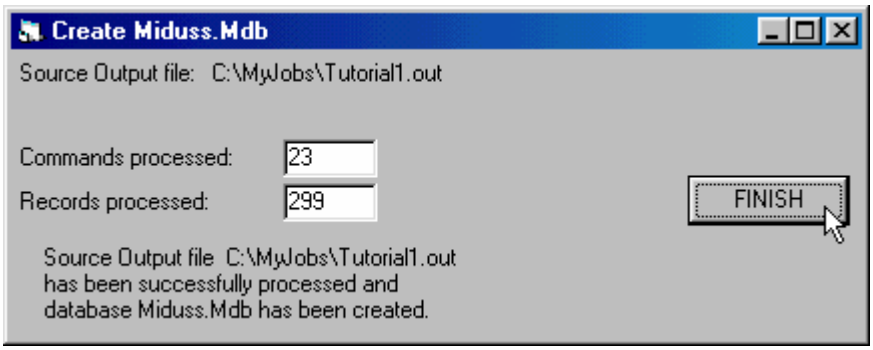
- For this example, use a different output filename such as '**C:\MyJobs\TutorialB.out**'.
- Select **File / Open Input File** command. We want to use the output file from the previous session an input resource for this session. This is where we declare the name of the file to be used.

- A File Open dialog box is displayed. Select the file used in the last session - it was **Tutorial1.out**.



- Click [Open].

A window titled ‘Create Miduss.Mdb’ is opened similar to the one below.



This is where the input file is processed into a file named MIDUSS.Mdb. This is a quasi-database file that MIDUSS uses to process all the commands and data in an organized manner.

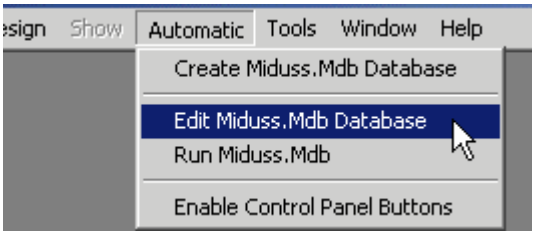
The names of your input files will change from project to project and from session to session, but there is only one MIDUSS.Mdb file created and used by MIDUSS for Automatic processing. However, the MIDUSS.Mdb file is stored in the folder where the input file originated so it is normal to have one MIDUSS.Mdb file in each of your working folders.

- Click the [Finish] button.

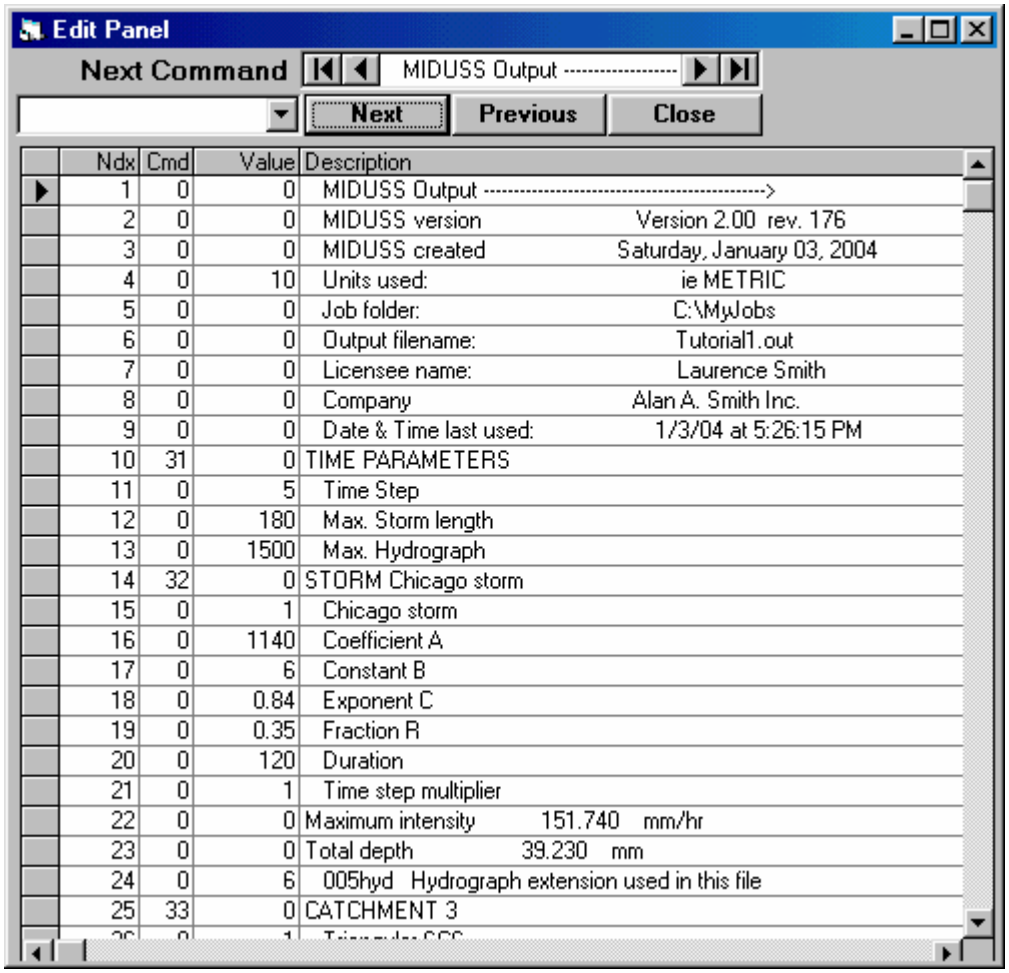
Reviewing the Input Database

Before running the Input Database, it is worth taking a moment to review the file Miduss.Mdb.

- Select **Automatic / Edit Miduss.Mdb Database**.



The window shown below is displayed. The Edit Panel lets you navigate through the file to verify or change data. If you want to edit any of the command parameters it is possible to make simple changes in this window. However, this can result in processing errors if you are not careful and editing at this level should be left until you are experienced with MIDUSS. In the remainder of the automatic session, you will be processing and adjusting the design but will do so interactively and not by editing this MIDUSS.Mdb file.

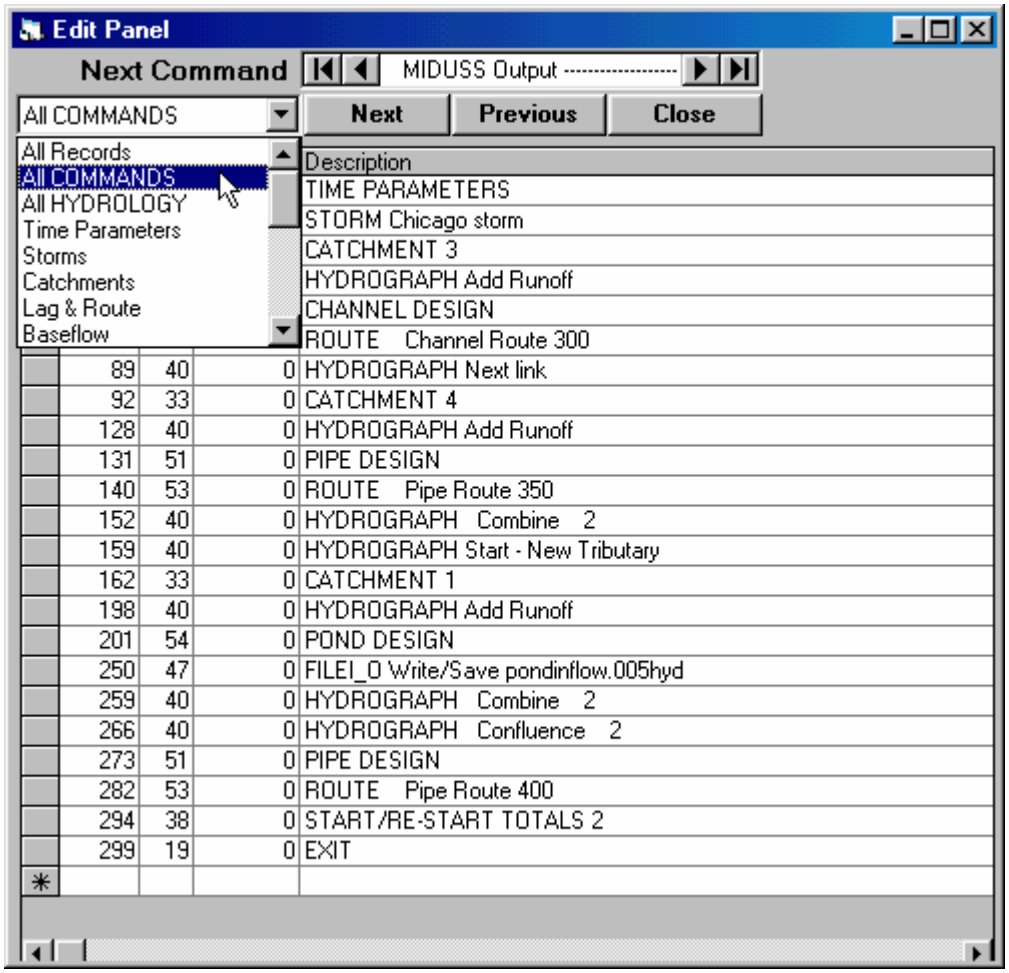


Ndx	Cmd	Value	Description	
1	0	0	MIDUSS Output ---------->	
2	0	0	MIDUSS version	Version 2.00 rev. 176
3	0	0	MIDUSS created	Saturday, January 03, 2004
4	0	10	Units used:	ie METRIC
5	0	0	Job folder:	C:\MyJobs
6	0	0	Output filename:	Tutorial1.out
7	0	0	Licensee name:	Laurence Smith
8	0	0	Company	Alan A. Smith Inc.
9	0	0	Date & Time last used:	1/3/04 at 5:26:15 PM
10	31	0	TIME PARAMETERS	
11	0	5	Time Step	
12	0	180	Max. Storm length	
13	0	1500	Max. Hydrograph	
14	32	0	STORM Chicago storm	
15	0	1	Chicago storm	
16	0	1140	Coefficient A	
17	0	6	Constant B	
18	0	0.84	Exponent C	
19	0	0.35	Fraction R	
20	0	120	Duration	
21	0	1	Time step multiplier	
22	0	0	Maximum intensity	151.740 mm/hr
23	0	0	Total depth	39.230 mm
24	0	6	005hyd Hydrograph extension used in this file	
25	33	0	CATCHMENT 3	

To provide an overview of the session, you can also review a subset of the records.

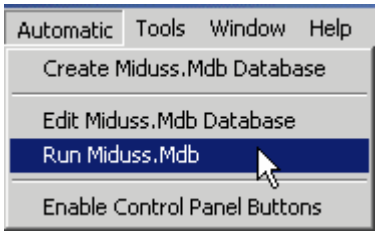
- Click on the down arrow and select **All Commands.**

You will see a summary of all the menu commands that are used in the database file.

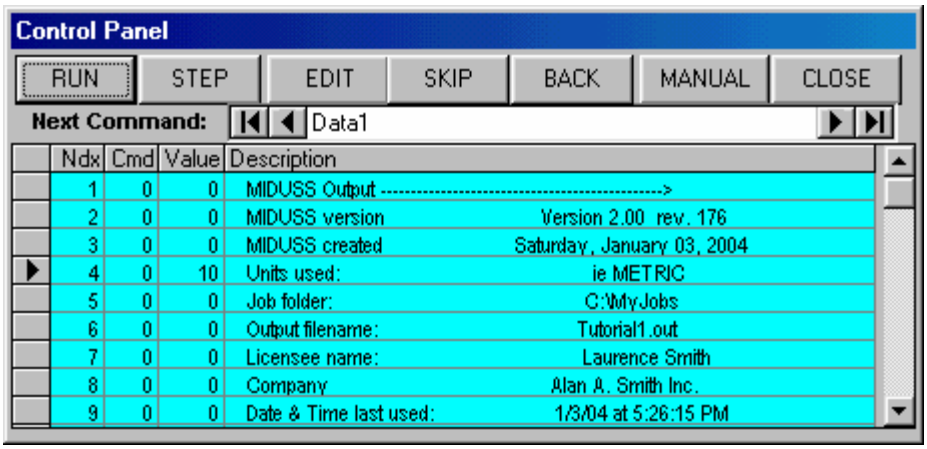


Starting the Automatic Run

- Select the **Automatic / Run Miduss.Mdb** menu item to start the run.



The Control Panel shown below is displayed in the lower right of the screen. In its default size it displays only 9 records at a time but you can increase the height of the window by dragging on the top or bottom edge of the form.



When initially displayed, only the first 3 records have been read and the current record – indicated by the right arrow in the left margin of the grid – is about to read the units used. Note that if you have specified the wrong type of units for this input file, MIDUSS will change the units for this design session to match these used when the previous run was made.

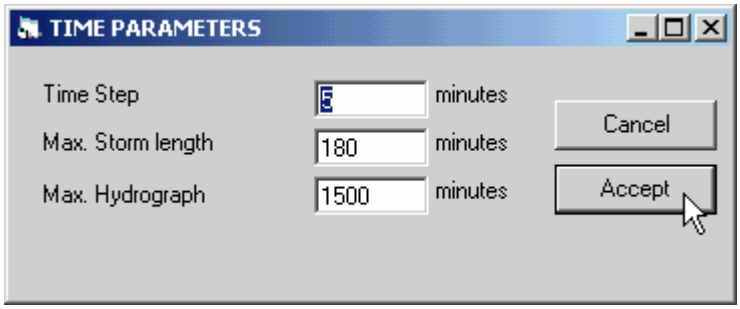
The default command button is [RUN] which processes the commands sequentially and continuously without giving you a chance to change or even monitor the results.

In this automatic run you will use the [EDIT] button to pause after each command to display the result and give you a chance to modify the parameters.

- Click on [EDIT].

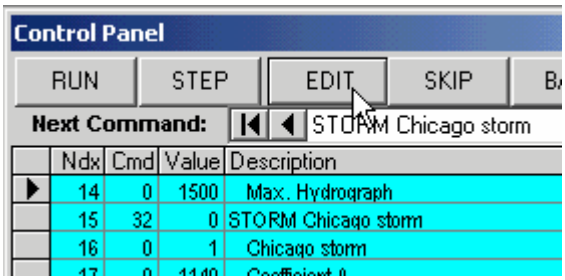
MIDUSS displays the Time Parameters and the mouse pointer is automatically positioned on the [Accept] button of the form. The maximum storm duration is 180 minutes, which is enough for the historic storm.

- Click [Accept] to close the form.

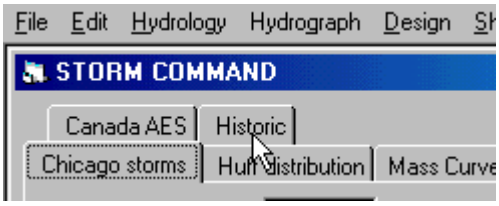


Change the Storm Event

After you have accepted the time parameters, the mouse pointer is positioned over the [EDIT] button again. The next record is seen to be the Storm command.

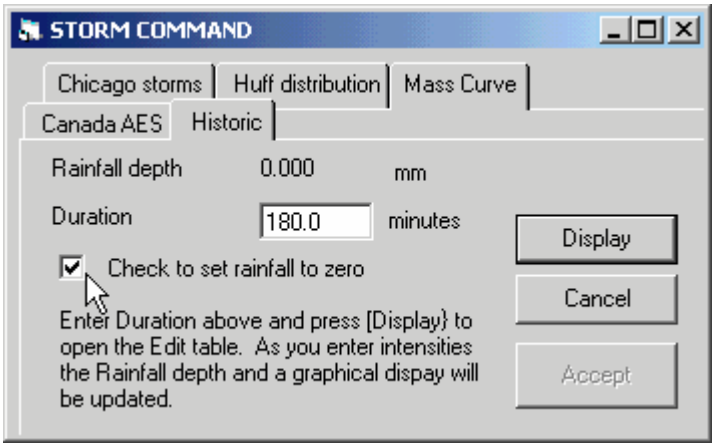


- Click on [EDIT] to show the Storm window with the 2-hour Chicago hyetograph. You need to specify the Historic storm instead.
- Click on the Historic tab on the Storms form.



- Check the box labeled 'Check to set rainfall to zero', and
- Increase the duration from 120 to 180 minutes
- Click on the [Display] command button.

The Historic tab should now be similar to the figure below. The Graph window will be empty and the tabular form will have an extra row added with all the 36 cells having a value of '0.00'.



Defining the Historic Storm.

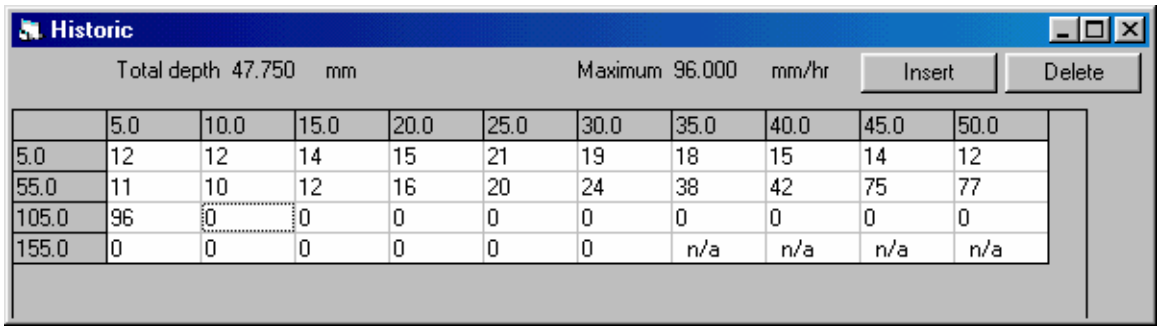
The Historic table is initially blank. You can now start typing in the intensities shown in the table at the beginning of this tutorial. The correct date is shown in the graphic displays below.

- Enter the data for the historic storm using the data in the tables below.

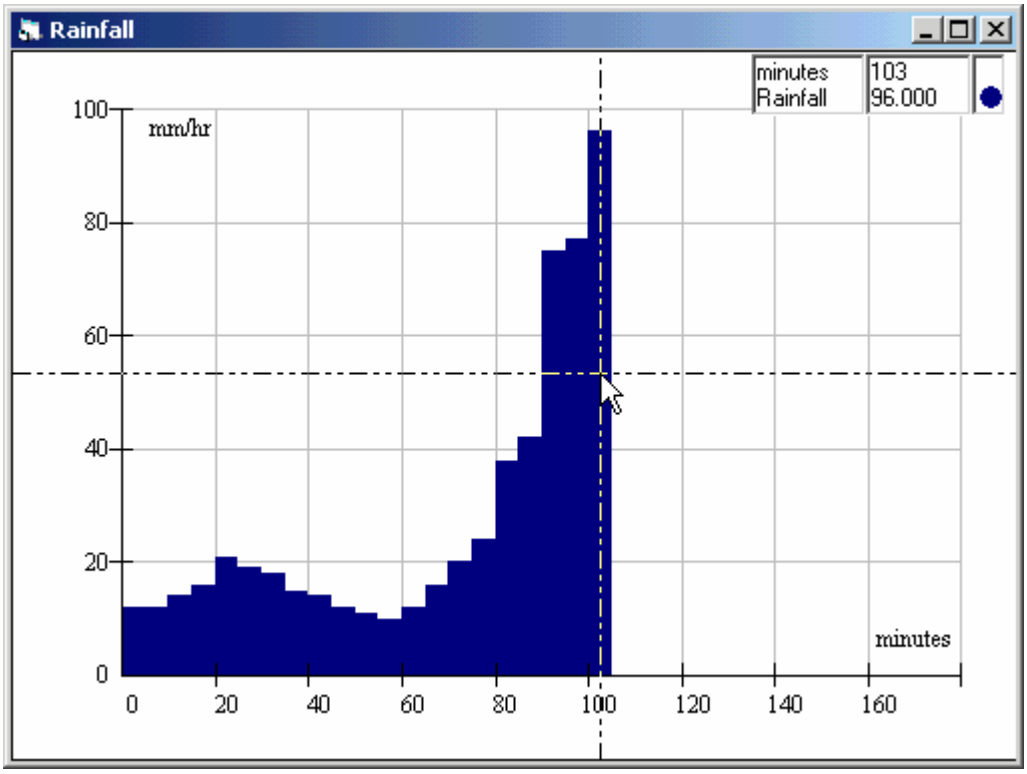
Click on the first cell to select it for data entry. As soon as you type a numbers you will notice that the first bar of the storm hyetograph is plotted and the Rainfall depth in the Storm window is updated. As each cell value is entered, use the Right-arrow key on the keyboard to advance the active cell. When you are at the right end of a row, pressing the Right-arrow will 'wrap' around to the first cell of the next row.

Note: On most Windows-type computers you need to use the number keys on the main keyboard and NOT the left hand number keypad.
You can copy and paste date from a spreadsheet such as Excel. In transferring data to and from the Clipboard it is recommended that the number of columns is the same in both source and target grids.

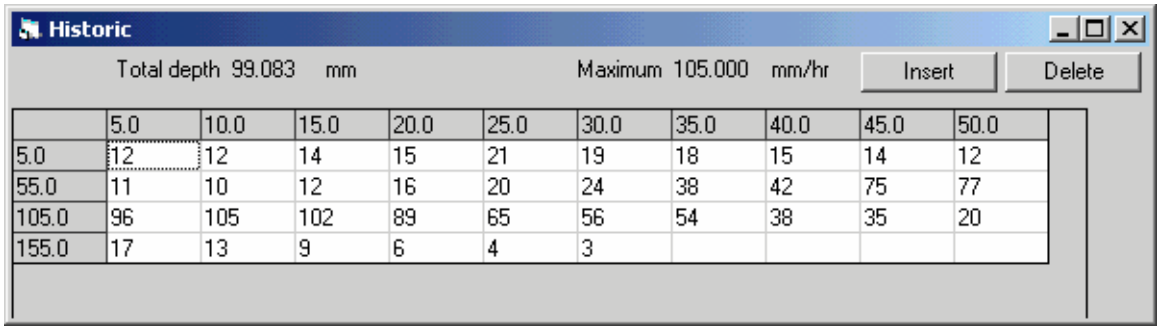
The tables and plot below show the status when 21 values have been entered. At this point the total rainfall depth is 47.750 mm.



	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
5.0	12	12	14	15	21	19	18	15	14	12
55.0	11	10	12	16	20	24	38	42	75	77
105.0	96	0	0	0	0	0	0	0	0	0
155.0	0	0	0	0	0	0	n/a	n/a	n/a	n/a



After entry of the Historic storm is complete, the total rainfall depth should be 99.083 mm.



	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
5.0	12	12	14	15	21	19	18	15	14	12
55.0	11	10	12	16	20	24	38	42	75	77
105.0	96	105	102	89	65	56	54	38	35	20
155.0	17	13	9	6	4	3				

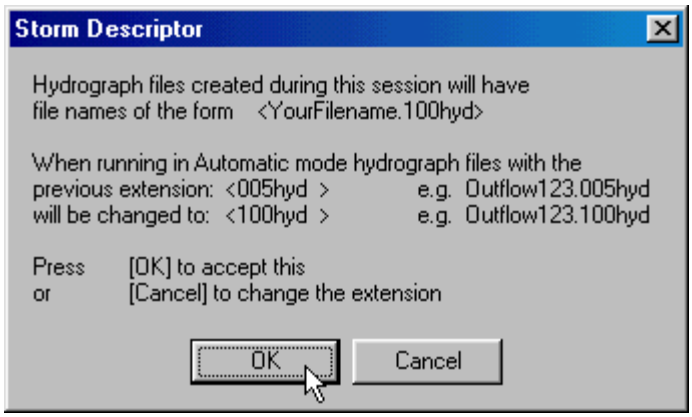
- Press [Accept] on the Historic storm tab to close all three forms.

The Storm Descriptor window is opened and contains the value of '005' that you used for the minor storm. MIDUSS remembers all previous data that has been entered into forms.

- If not already highlighted, click on this text box to highlight the value and replace it with '100'.

- Press the [Accept] key.

MIDUSS displays the message shown below.



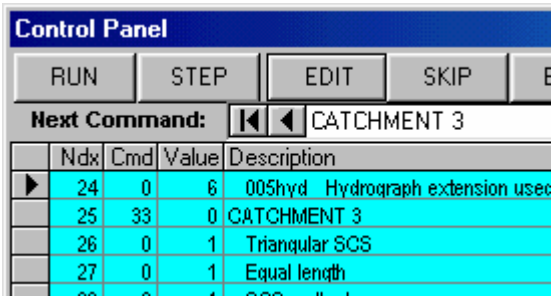
The change in file extension means that if any hydrograph files are created they may have the same name and share the same directory as previous hydrograph files but are distinguished by a unique file extension.

- Click on the [OK] button. This accepts the action of replacing the previous extension '.005hyd' with the new file extension '.100hyd'.

Continuing with the New Storm

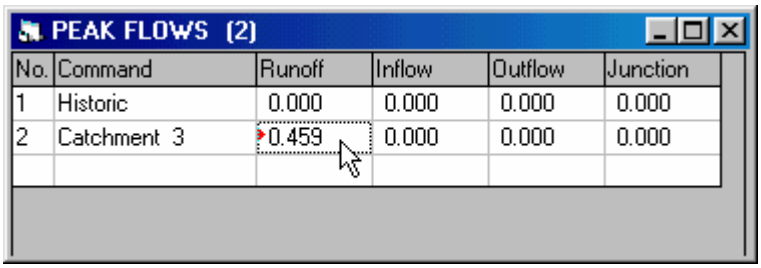
While you were changing the storm, MIDUSS has been waiting patiently in Automatic mode for you to finish. Now that you have replaced the Chicago storm with the Historic storm you are returned back to the Automatic Control Panel where you will continue the run.

The Control Panel should now show the next record (#25) as the start of the Catchment command for area 3.



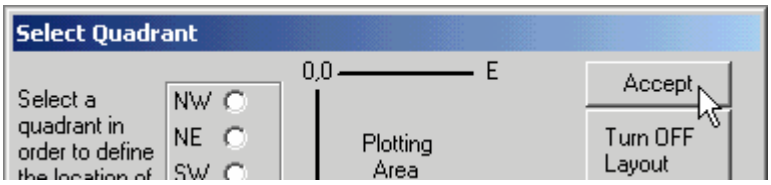
- Click on the [EDIT] button to cause the results of this command to be displayed.
- Click on [Accept] on the Catchment form.

The peak flow is now 0.459 c.m/s. The Peak Flows table is updated.



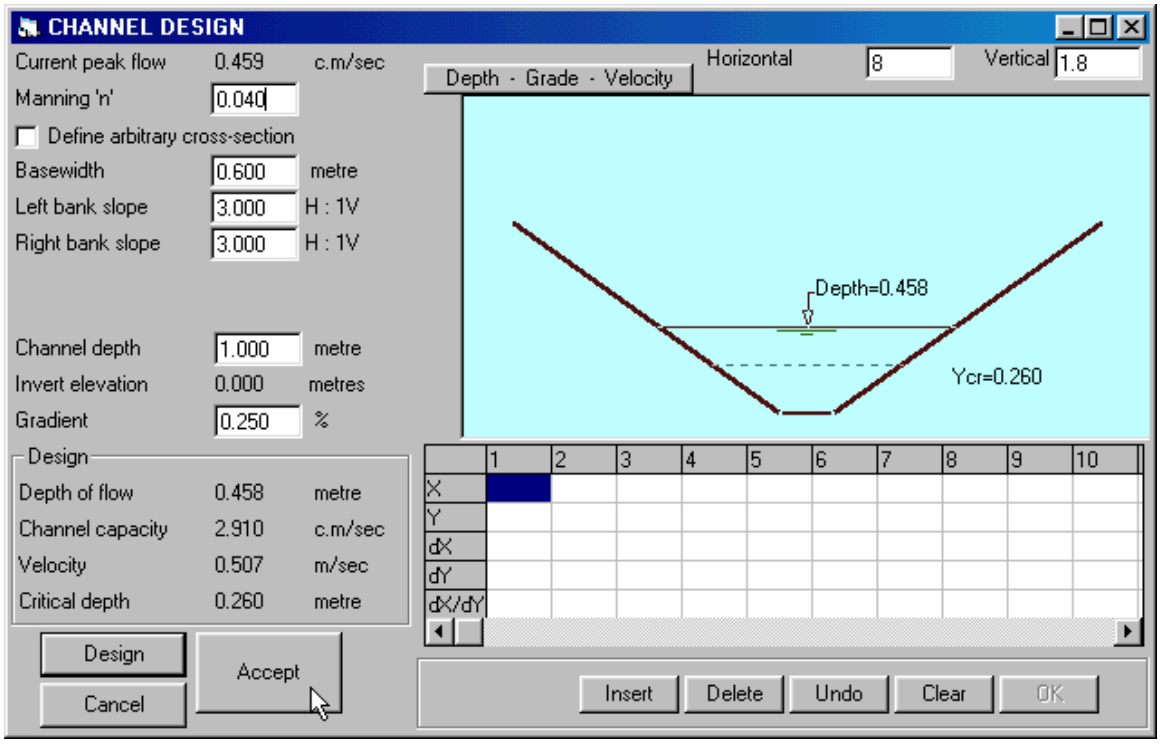
No.	Command	Runoff	Inflow	Outflow	Junction
1	Historic	0.000	0.000	0.000	0.000
2	Catchment 3	0.459	0.000	0.000	0.000

- Verify the layout plotting direction by pressing [Accept].



- Back at the Control Panel, click on [EDIT] to execute the Add Runoff command.
- The Inflow hydrograph is displayed in a table along with a message confirming the action. Click [OK] on the message to close both windows.
- Back at the Control Panel, click on [EDIT] to run the Channel Design command.

The depth in the channel has increased from 0.306 m with the previous 5 year storm to 0.458 m with this storm. MIDUSS performs these design calculations automatically. You do not need to press the [Design] button. Of course, you can override the MIDUSS designs and adjust any part of the channel design. For this tutorial we will accept this channel design.



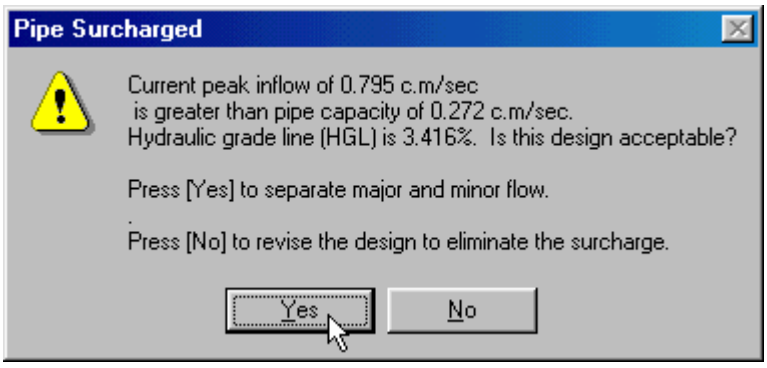
- Press [Accept] on the Channel window.

At this point you should now feel comfortable with the way MIDUSS operates the Automatic run, the use of the Edit button on the Control Panel and how you can edit and / or accept the various stages of the design.

You are on your own for a few steps. Continue with the Automatic run to:

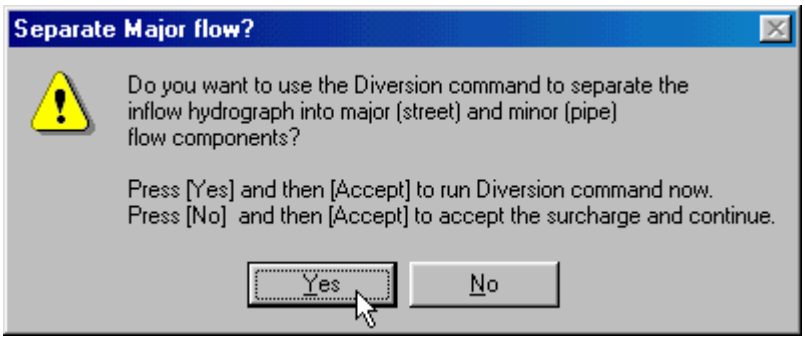
- Route the flow through the channel
- Add the runoff from area 4
- Design the pipe from node 4 to Junction node 2

When the Pipe Design form is displayed a message is also shown warning you that the pipe is surcharged



- Click on the [Yes] button to separate the major and minor flows and return to the Pipe Design window.

A confirmation message will appear similar to the form below.



- Click [Yes] again on the 'Separate Major Flow?' message box.
- Then use the [Accept] command button to close the Pipe form. We will return to the Pipe design in a moment. For now we need to design the Diversion.

The Diversion window should automatically open.

Separating the Major System Flow

At this point you must split the Inflow hydrograph into two components:

- A minor system fraction which does not exceed the capture capacity of the pipe, and
- A major system fraction that is rejected by the minor system and which will flow on the surface – typically on the street.

You can do this by introducing a diversion device that simulates one or more catch basins at the upstream end of the pipe. The following steps summarize the process.

(1) Revert into Manual mode for steps (2) and (3) noted below. You may find this is not always necessary but it is included here for completeness.
Note that using the [Manual] Control Panel button causes a 'page marker' to be inserted in the database so that you can resume automatic processing where you left off. The [Close] button does not allow you this flexibility.

(2) Design a diversion structure that will split the inflow hydrograph into two components. The outflow should have a peak equal to, or slightly less than the capacity of the pipe and the remainder will flow on the major system – typically the street.

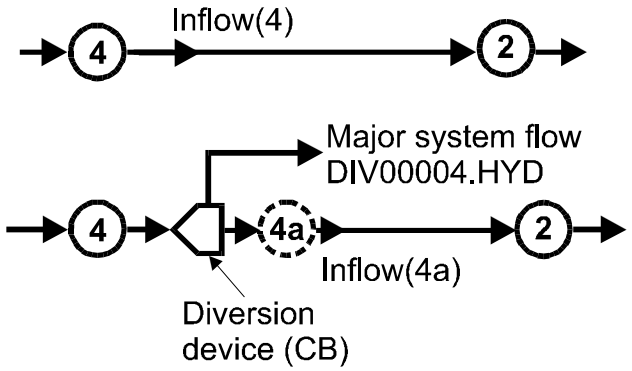
(3) Make the Outflow from the diversion the Inflow to the pipe by using the **Next Link** command.

(4) Accept (or adjust) the pipe design for this reduced flow.

(5) Return to Automatic mode by clicking on the '**Automatic / Resume MIDUSS.Mdb**' menu item and then execute the next command that will Route the captured flow through the pipe to node 2.

(6) Continue in Automatic mode.

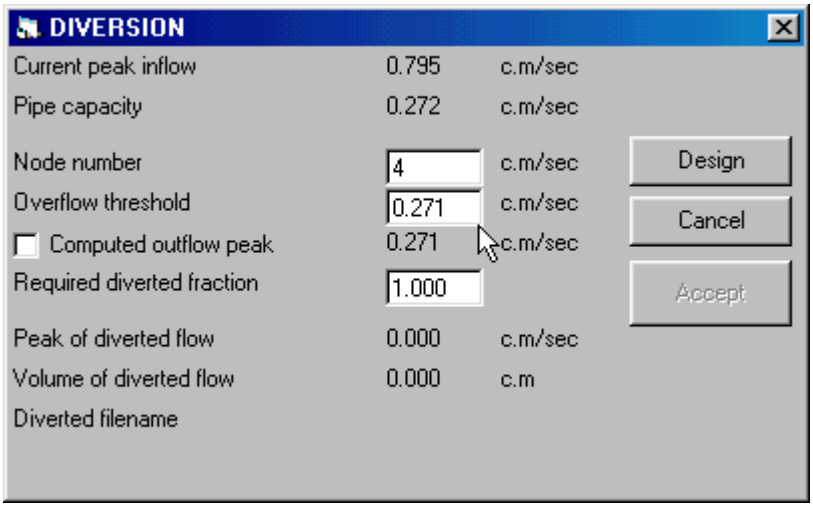
The diagram below illustrates the technique of substituting a diversion structure plus a pipe when the pipe is surcharged. At a later stage you can recover the diverted hydrograph and check the capacity of the road system to convey this flow. The procedure is described in more detail in the topics which follow.



Design of a Diversion Device

In most cases, if you have responded to a warning message, MIDUSS will open the Diversion window automatically. If not, use the **Design / Diversion** menu to open it up.

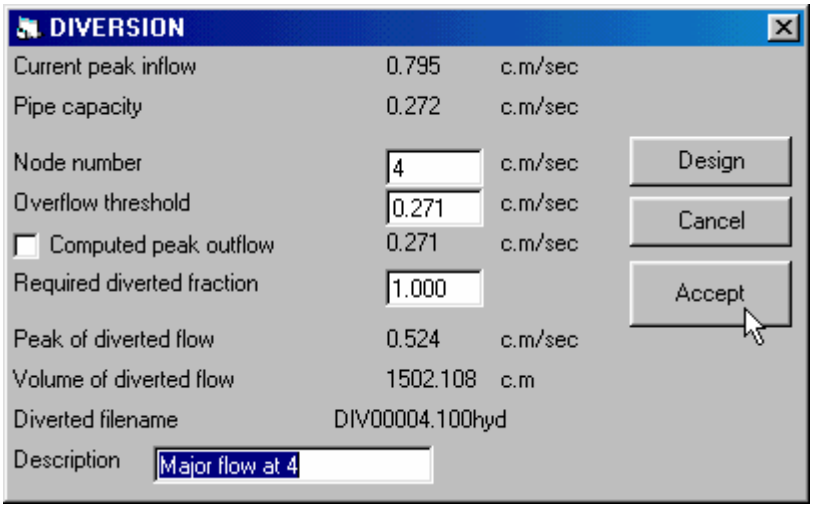
In the top two rows, the form displays the peak flow of the current Inflow hydrograph and the type and capacity of the last conduit. The node number is copied from the last Catchment area. This may not always be appropriate and you may want to edit this. In this example it is correct because the runoff from area 4 enters at node 4.



Before doing the diversion design we should change to Manual mode on the Control Panel. This leaves a bookmark in the database and we can resume running from that bookmark once our diversion completed and pipe re-designed.

- Press the [Manual] button on the Control Panel.
- Acknowledge the message about book marking this spot. Press [OK].
- With the Diversion window now open, edit the Overflow Threshold to 0.271. This small reduction will make sure that MIDUSS does not interpret the pipe as surcharged again.
- Click [Design].

The lower portion of the Diversion form now includes the volume of diverted flow, the peak flow, the name of the diverted file and an opportunity to enter a short description of the diverted flow.



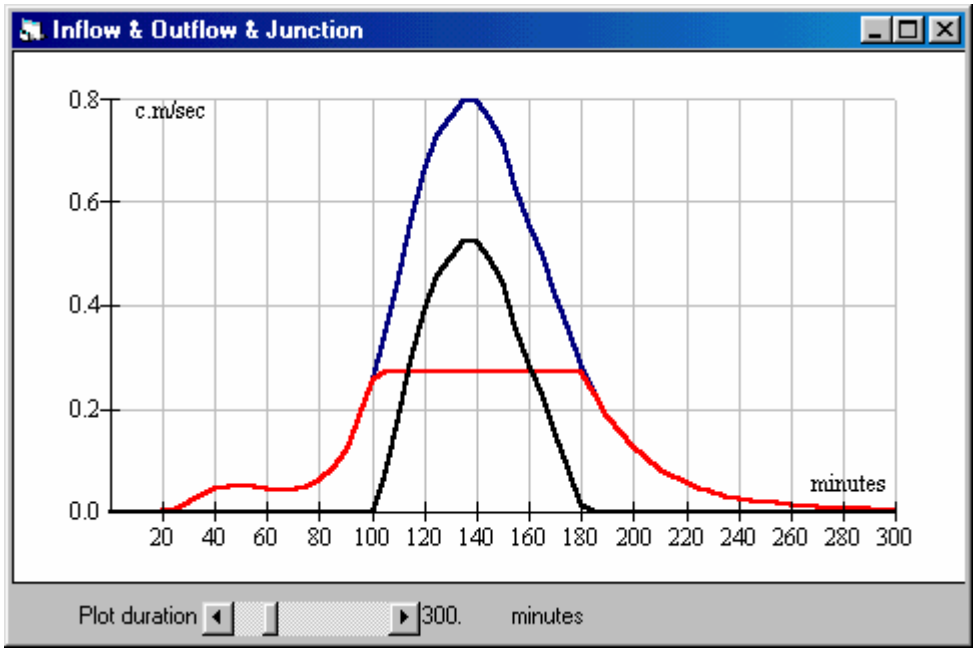
- Enter a description such as “Major flow at 4”

When used following the design of a surcharged pipe, the Diversion sets the threshold flow equal to the pipe capacity and assumes that the diverted fraction is 1.0 – i.e. 100% of the excess flow is diverted to the hydrograph file DIV00004.HYD. You may prefer to set the diverted fraction to a value slightly greater than 1.0 to allow for the increased carrying capacity of the pipe under surcharged conditions, i.e. when the hydraulic grade line is steeper than the pipe gradient. Also, if the catch basins are fitted with inflow control devices (ICDs) you may set the threshold to a value less than the pipe capacity.

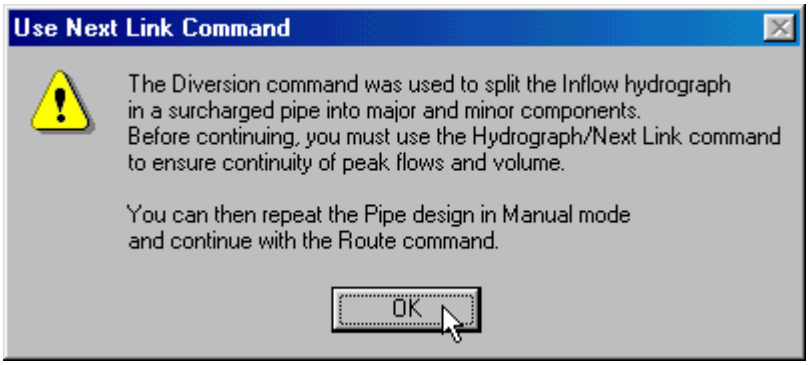
If you think that surcharged conditions may cause the maximum outflow to be greater than the overflow threshold, you can check the box labeled ‘Compute peak outflow’ to change to ‘Required peak outflow’. You can then specify the peak outflow and the corresponding diverted fraction will be computed and displayed.

- Click the [Accept] button.

The Outflow hydrograph exhibits a plateau or constant value because almost 100% of the excess inflow is diverted. If the diverted fraction is less than 1.0 the ‘plateau’ will show some increase above the threshold flow rate.



The outflow from the diversion can now be converted to the inflow to the pipe by using the Hydrograph / Next Link command. If the Diversion command was invoked by a surcharged pipe, MIDUSS will do this automatically so all you need to do is acknowledge this action.



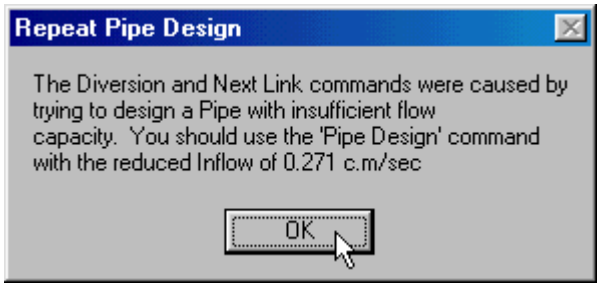
- Click [Ok} to acknowledge the message.

The result is seen in the Peak flow summary table displayed below.

PEAK FLOWS (10)

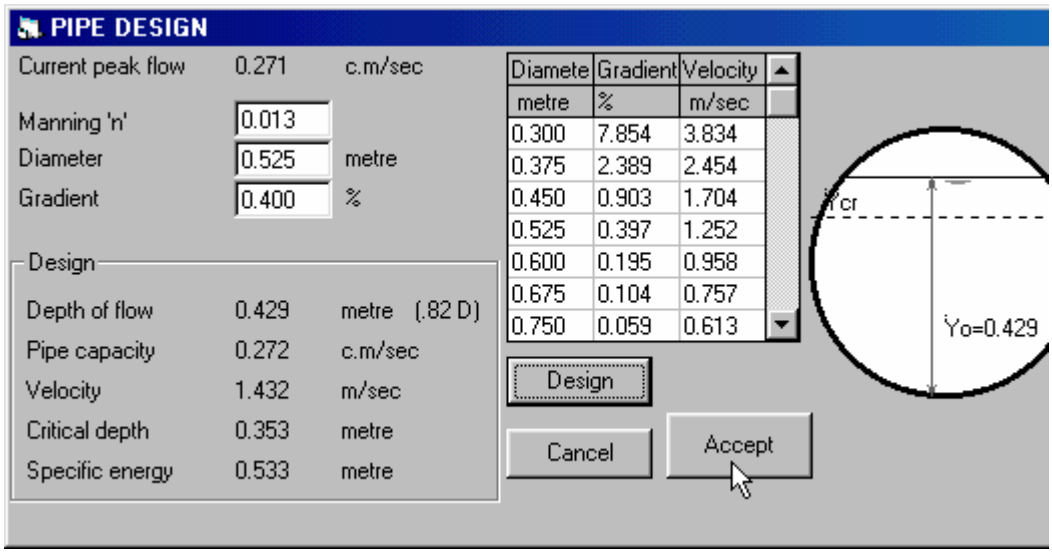
No.	Command	Runoff	Inflow	Outflow	Junction
2	Catchment 3	0.459	0.000	0.000	0.000
3	Add Runoff	0.459	0.459	0.000	0.000
4	Channel Design	0.459	0.459	0.000	0.000
5	Channel Route 300	0.459	0.459	0.451	0.000
6	Next link	0.459	0.451	0.451	0.000
7	Catchment 4	0.398	0.451	0.451	0.000
8	Add Runoff	0.398	0.795	0.451	0.000
9	Diversion 4	0.398	0.795	0.271	0.000
10	Next link	0.398	0.271	0.271	0.000

MIDUSS has detected that a surcharged pipe has resulted in the design of a Diversion. The program will then inform you through a message that the next step is to repeat the Pipe design using the flow that has **not** been diverted. In this case the flow of 0.271 c.m/sec. You should see the following message.



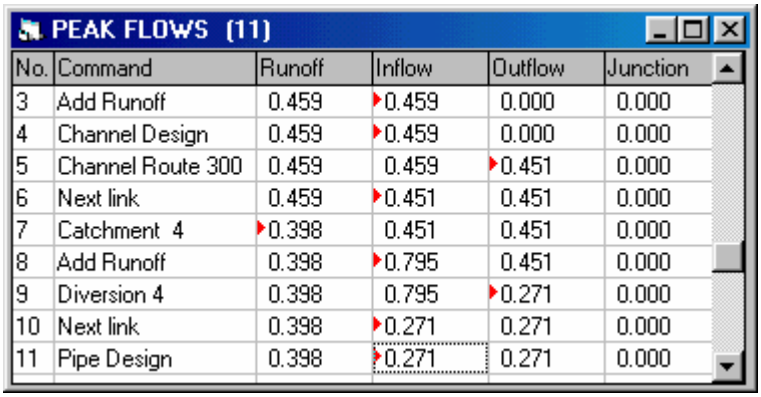
- Click [OK].

The **Design/Pipe** window will open and a pipe design that will accommodate the 0.271 flow will be presented to you for acceptance.



- Click [Accept].

The Peak Flows table is updated with the new pipe design.

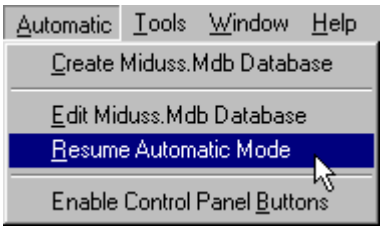


No.	Command	Runoff	Inflow	Outflow	Junction
3	Add Runoff	0.459	0.459	0.000	0.000
4	Channel Design	0.459	0.459	0.000	0.000
5	Channel Route 300	0.459	0.459	0.451	0.000
6	Next link	0.459	0.451	0.451	0.000
7	Catchment 4	0.398	0.451	0.451	0.000
8	Add Runoff	0.398	0.795	0.451	0.000
9	Diversion 4	0.398	0.795	0.271	0.000
10	Next link	0.398	0.271	0.271	0.000
11	Pipe Design	0.398	0.271	0.271	0.000

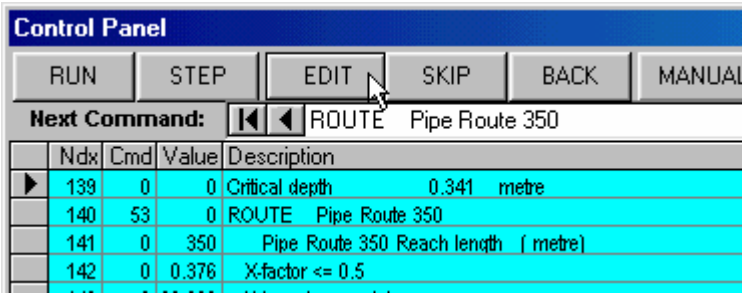
Continuing in Automatic Mode

You can now resume the automatic processing of the Control Panel commands. However, since we are running in Manual mode (with the database bookmarked) we need to tell MIDUSS to resume automatic processing.

- From the main menu select the **Automatic / Resume Automatic Mode** command.



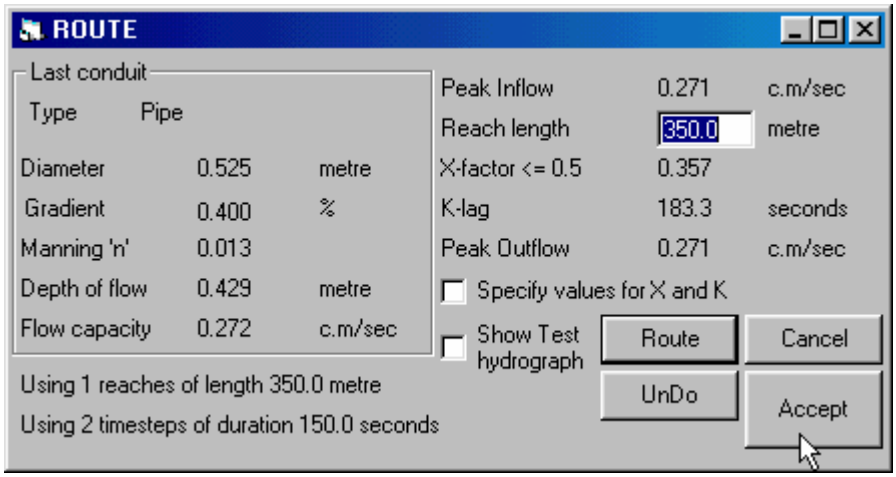
The Control Panel will be opened and paused at the point where you paused automatic mode with the Manual button.



From the Next Command displayed in the Control Panel you will see that the command to be processed is the Routing of the 350 m pipe.

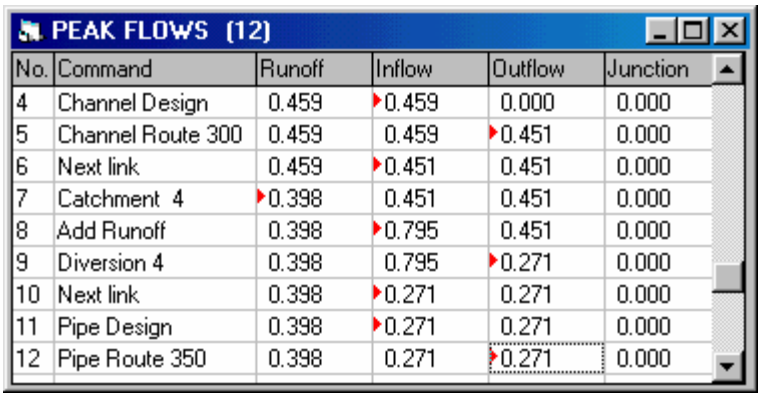
- Click the [Edit] button.

The Route window opens.



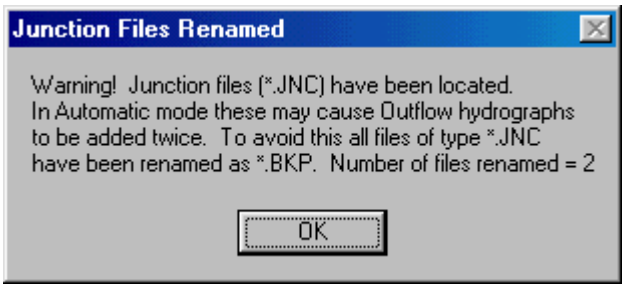
- Click [Accept].

The Peak Flows table is updated and should look similar to the one below.



No.	Command	Runoff	Inflow	Outflow	Junction
4	Channel Design	0.459	0.459	0.000	0.000
5	Channel Route 300	0.459	0.459	0.451	0.000
6	Next link	0.459	0.451	0.451	0.000
7	Catchment 4	0.398	0.451	0.451	0.000
8	Add Runoff	0.398	0.795	0.451	0.000
9	Diversion 4	0.398	0.795	0.271	0.000
10	Next link	0.398	0.271	0.271	0.000
11	Pipe Design	0.398	0.271	0.271	0.000
12	Pipe Route 350	0.398	0.271	0.271	0.000

You can continue with the automatic processing (using the [EDIT] command to store the outflow from the pipe at junction node 2. Because the Automatic run is re-creating junction files in the same working directory MIDUSS renames any older junction files and provides you with a message telling you this is to be performed.



In practice, most design sessions should include a Confluence command for each junction node created, so residual *.JNC files should not be found.

- ❑ Click [Ok] to acknowledge this message.

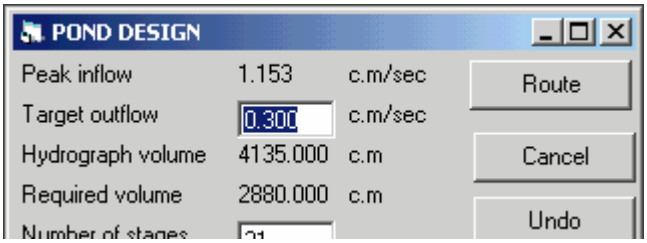
Continue with the Automatic processing to:

- Accept the new junction files
- Start the new tributary at node 1
- Compute the runoff from node 1

When you get to the Pond design you will be modifying the design to accommodate the higher flow.

Refining the Pond Design

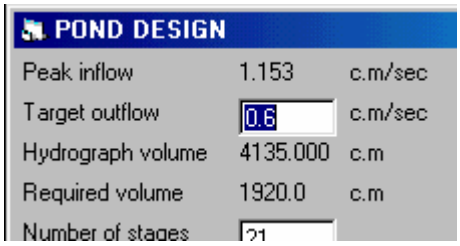
The flow entering the pond now has a peak of 1.153 c.m/sec. The peak flow is 16% greater than previously but, at 4135 c.m the volume is almost three times larger. It is likely, therefore, that the outflow control can be left unchanged but the storage will have to be increased by using more area.



When the Pond design is executed in Automatic mode the concern expressed in the previous paragraph may be confirmed by MIDUSS with a warning message in the Pond window to the effect that the upper limit of either the discharge or storage is too small to route the increased hydrograph. The storage routing function $(Q + 2S/\Delta t)$ involves both discharge and storage volume and the design could be adjusted by increasing either one or the other or both.

- Change the Target Outflow to 0.6 c.m/sec a value that makes more sense for this extreme event.

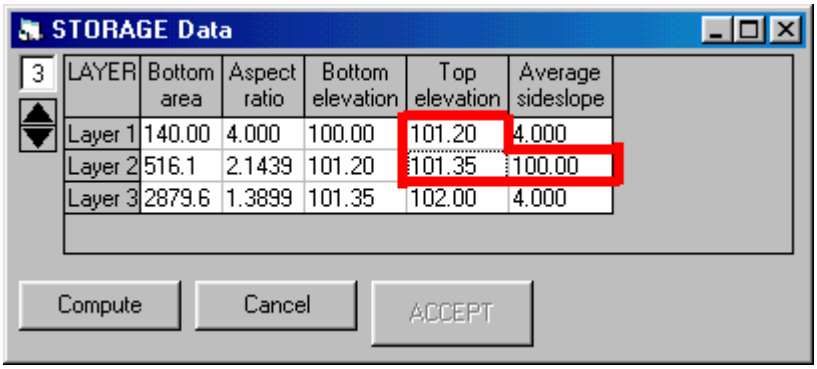
The Pond Design form shows that a required volume of 1920 c.m. is necessary to reduce the outflow to 0.6 c.m/sec.



- Click on the **Storage Geometry/Rectangular pond** menu item to re-open the data table.

Previously, only one layer was used covering the total depth of 2.0.

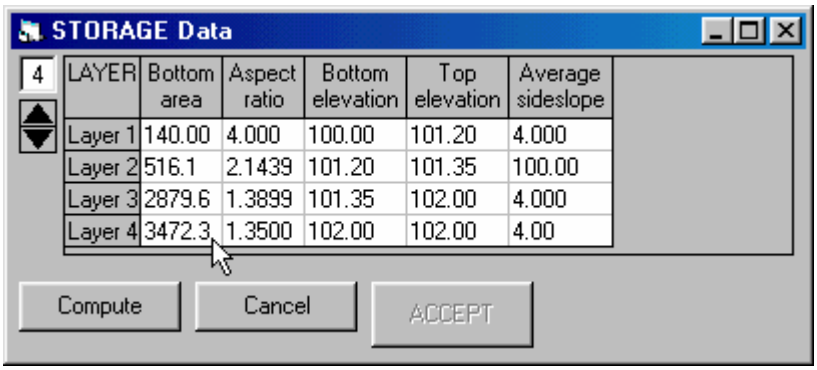
- Make the changes shown below to add another layer. You only need to edit the top elevations of Layer 1 and 2 and the Layer 2 side slope. The bottom area column will be recalculated automatically based on your entries. The entries you need to do are outlined in the graphic below.



Layer 2 introduces a step in the side-slope at a level of 101.2 with a width of 15 m which is given by the depth of 0.15m (or 6") for Layer 2 multiplied by the side slope of 100H:1V.

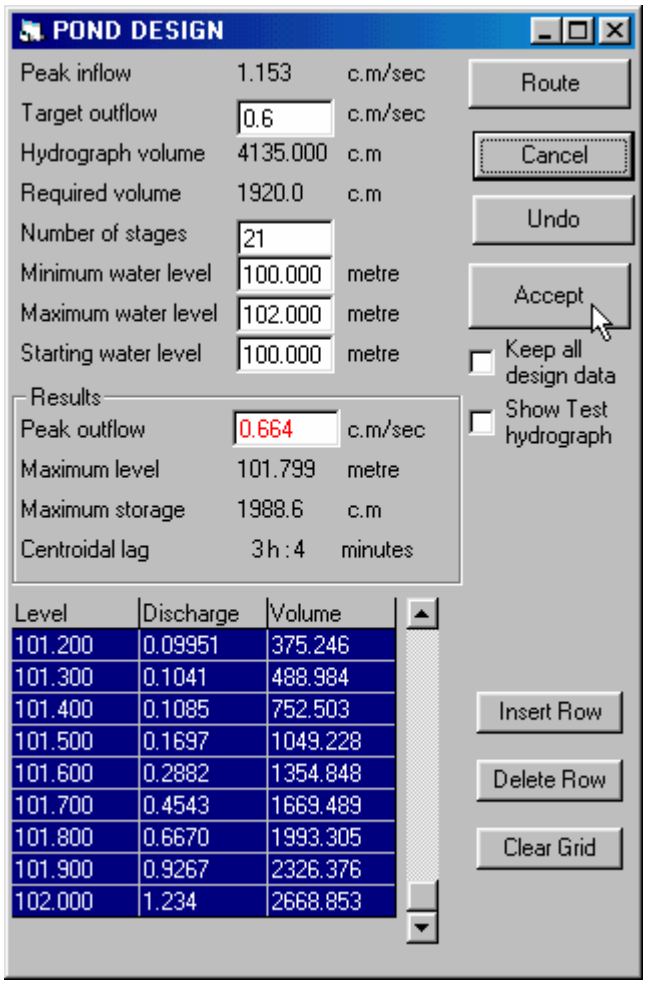
The bottom area of the top Layer 3 is 2879.6 sq.m but we need to learn the land area at elevation 102.0. To do this, simply add another layer (for a total of 4 layer rows).

- Click on the spin button to add a layer.



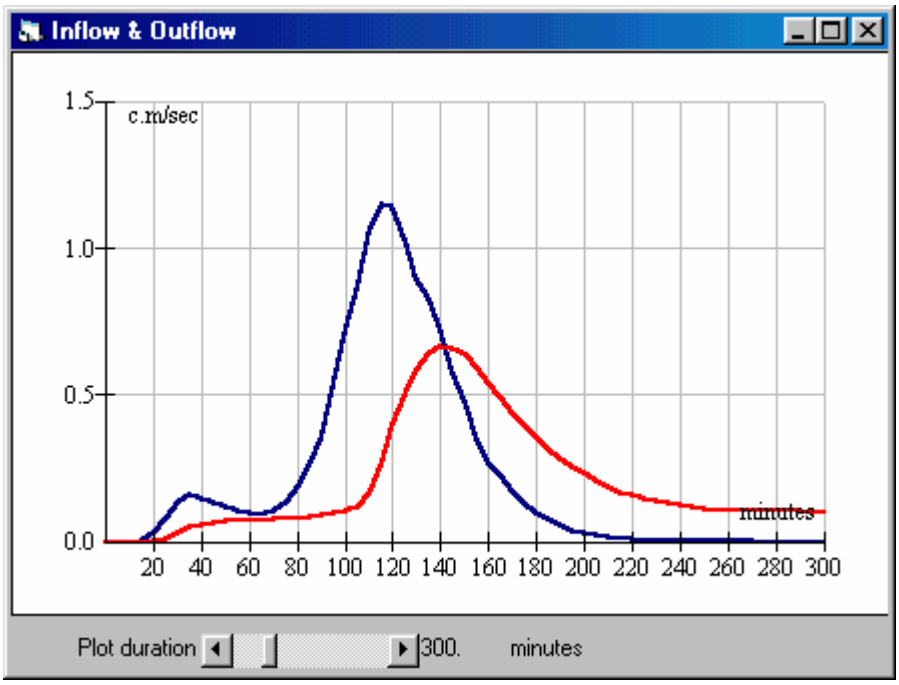
The depth of Layer 4 depth is zero (nil) because the bottom and top elevations are the same. From this you will learn that the surface area of the pond is 3472.3 sq.m.

- Click [Compute] to process the storage geometry and update the Pond window.
- Press [Accept] on the Storage Data form to close it.
- On the Pond window click [Route] to route the flow.



From this exercise you have redesigned the pond to accommodate the larger flow. The land area required has increased from 1094 sq.m (using the 5 year storm design) to 3472 sq.m for this more severe storm. The maximum storage in the pond has increased from 1238 c.m. to 1988.6 c.m.

The attenuation provided by this redesigned pond is shown on the hydrograph plots.



The stage-discharge curve remains unchanged but the increase in storage is sufficient to enable routing to be completed with a peak outflow of 0.664 c.m/sec and maximum storage of 1988 c.m. You will notice that the maximum water level of 101.799 provides a freeboard of only 0.2 m and you may wish to either lower the top water level or increase the top-of-bank by 0.1 m. You could experiment further with changes to both geometry and discharge control, but for this example you should accept this design and continue with the automatic design session.

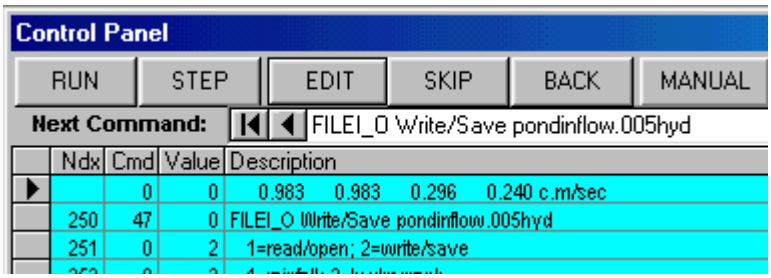
- Click [Accept] on the Pond window.

The Peak Flows table will be updated and the pond outflow placed in the Outflow column.

PEAK FLOWS (17)

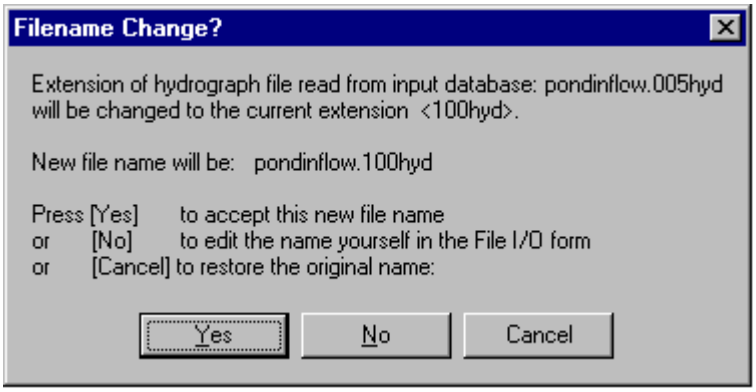
No.	Command	Runoff	Inflow	Outflow	Junction
9	Diversion 4	0.398	0.795	0.271	0.000
10	Next link	0.398	0.271	0.271	0.000
11	Pipe Design	0.398	0.271	0.271	0.000
12	Pipe Route 350	0.398	0.271	0.271	0.000
13	Combine 2	0.398	0.271	0.271	0.271
14	Start - New Tributary	0.398	0.000	0.271	0.271
15	Catchment 1	1.153	0.000	0.271	0.271
16	Add Runoff	1.153	1.153	0.271	0.271
17	Pond Route	1.153	1.153	0.664	0.271

If you check the next record in the Control Panel you will see that this was the point at which the 5-year Inflow to the pond was saved as a file. You may wish to refine the design of the pond still further in a separate design session, so it would be useful to save the Inflow for the historic storm as well. Should this not be required you could easily avoid processing this command by pressing the [SKIP] button. However, assume that this is not the case.



- Click [Edit] on the Control Panel.

When the Hydrograph/FileI/O command is executed from the Input database, a message is displayed as shown below.

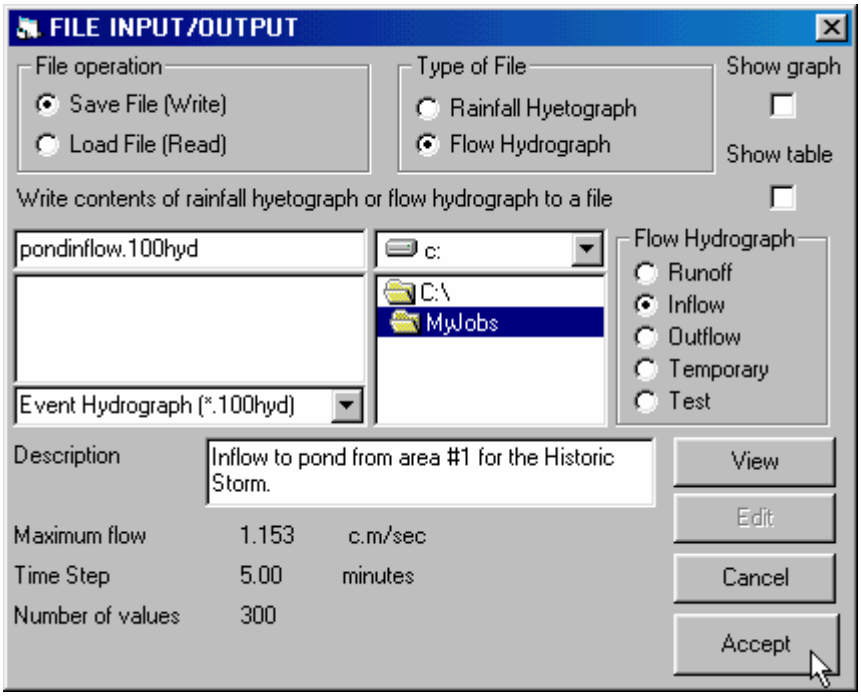


MIDUSS recognizes that the hydrograph file extension has been changed for the historic storm and gives you the choice to accept the modified filename, keep the original name (most unlikely!) or enter a special filename.

- Click on the [Yes] button to accept the change in the file extension.

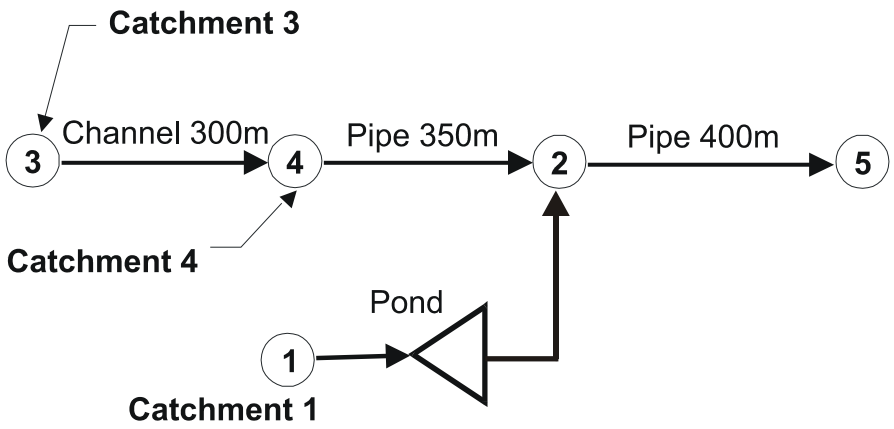
The **File Input/Output** window remains open to allow you to edit the description should you wish to do so.

- Add to the previous description so that it now reads **"Inflow to Pond from area #1 *for the Historic storm*".**

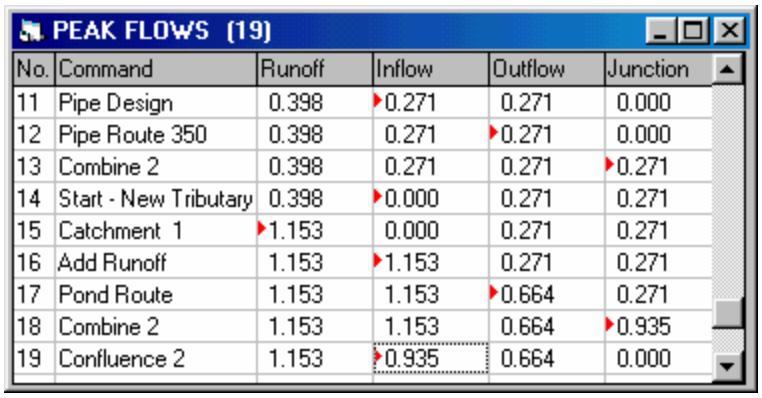


- Press the [Accept] button to close the form.

Designing the Final Pipe



- Continue with the automatic processing by pressing the [Edit} button on the Control panel to use the **Combine** and **Confluence** commands.

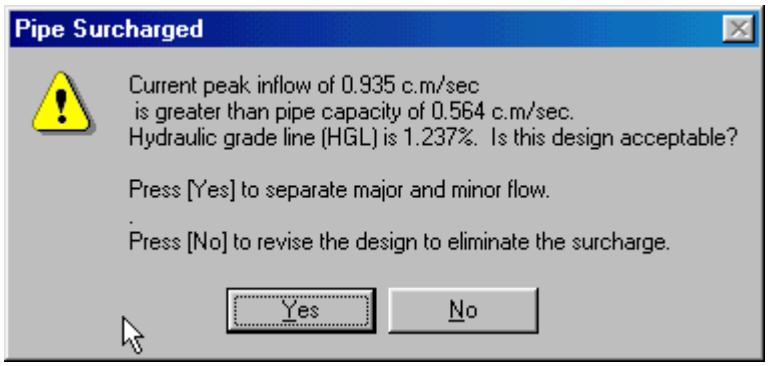


No.	Command	Runoff	Inflow	Outflow	Junction
11	Pipe Design	0.398	0.271	0.271	0.000
12	Pipe Route 350	0.398	0.271	0.271	0.000
13	Combine 2	0.398	0.271	0.271	0.271
14	Start - New Tributary	0.398	0.000	0.271	0.271
15	Catchment 1	1.153	0.000	0.271	0.271
16	Add Runoff	1.153	1.153	0.271	0.271
17	Pond Route	1.153	1.153	0.664	0.271
18	Combine 2	1.153	1.153	0.664	0.935
19	Confluence 2	1.153	0.935	0.664	0.000

Notice that the Inflow column has been populated with the 0.935 flow that was stored at junction 2.

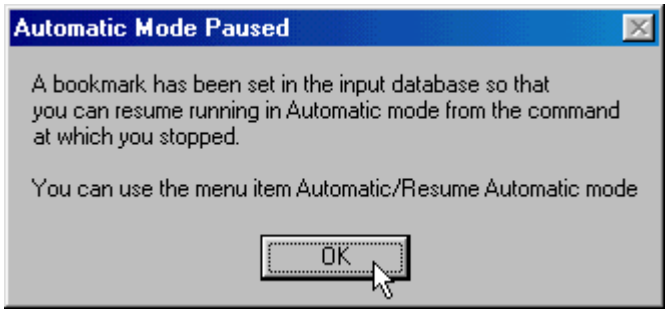
This now yields an inflow to Pipe (2) - (5) with a peak of 0.935 c.m/sec. You can see from the record in the Control Panel that the pipe capacity is 0.564 c.m/sec, so this pipe will be surcharged as well. If the capacity had been greater than the inflow from Junction node 2 you would have had to check if any fraction of the major system flow from reach (4)-(2) could have been captured by the minor system at this point.

The process of separating the major and minor flow hydrographs is repeated here. You should do the following.



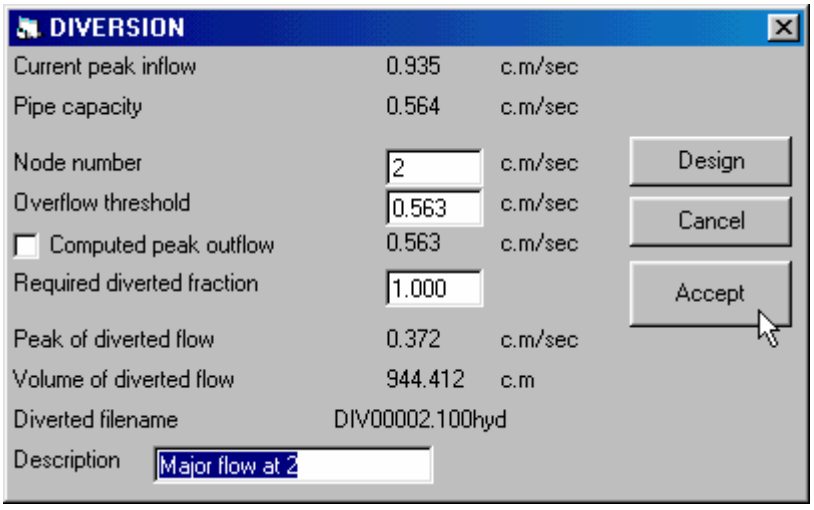
- Click [Yes] to separate the major and minor flows.
- Revert to Manual mode by pressing the [MANUAL] command button in the Control Panel.

MIDUSS will inform you that a input database we are processing has a bookmark placed in it to allow resumption after some additional design tasks have been completed.



- Click [Ok] on the message
- On the Pipe window that appears, click [Accept] to accept this condition. You will return to the pipe design after the Diversion is designed.

- On the Diversion window that appears, edit the Overflow Threshold to 0.563 c.m/sec.
- Click [Design]

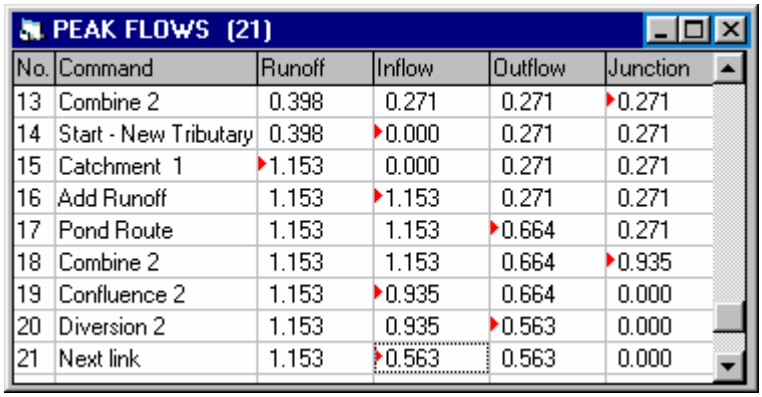


The Diversion design generates the hydrograph file DIV00002.HYD with a peak of 0.372 c.m/sec.

- Edit the Description to read "**Major flow at 2.**"
- Click [Accept]

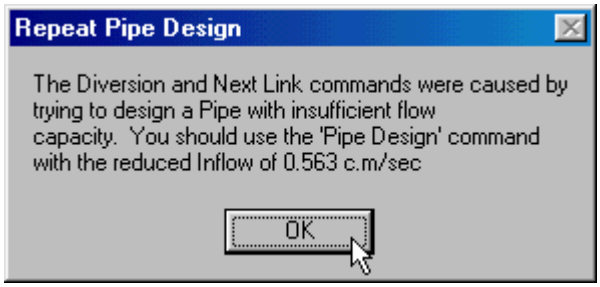
The plot shows you the diverted hydrographs.

- Select the **Hydrograph / Next Link** command to make the inflow to the pipe equal to the pipe capacity of 0.563 c.m/sec.



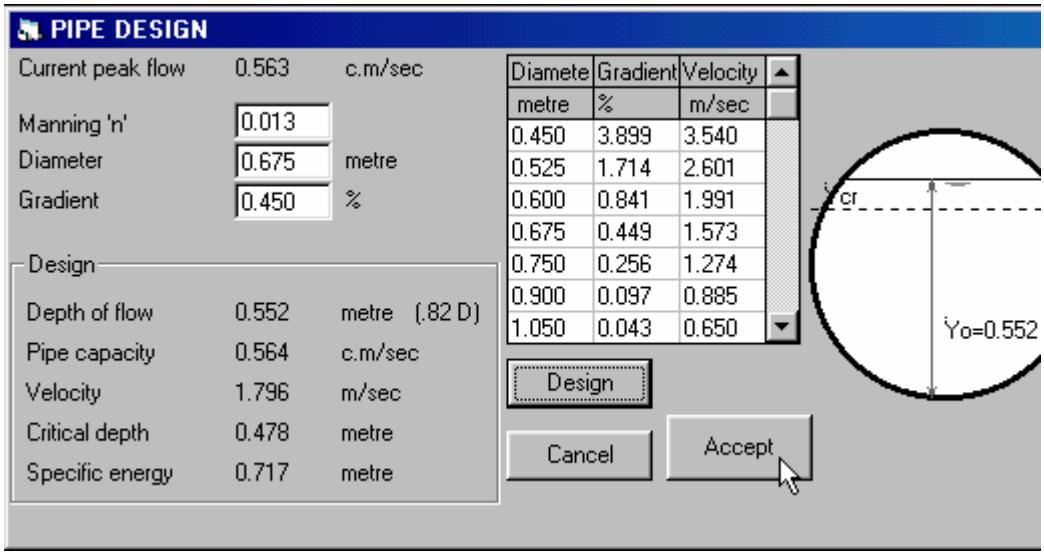
No.	Command	Runoff	Inflow	Outflow	Junction
13	Combine 2	0.398	0.271	0.271	0.271
14	Start - New Tributary	0.398	0.000	0.271	0.271
15	Catchment 1	1.153	0.000	0.271	0.271
16	Add Runoff	1.153	1.153	0.271	0.271
17	Pond Route	1.153	1.153	0.664	0.271
18	Combine 2	1.153	1.153	0.664	0.935
19	Confluence 2	1.153	0.935	0.664	0.000
20	Diversion 2	1.153	0.935	0.563	0.000
21	Next link	1.153	0.563	0.563	0.000

In the diversion design you told MIDUSS you wanted a threshold of 0.563 c.m/s. This flow is placed in the Outflow column. Now we need to design the original pipe that was surcharged. MIDUSS knows this and comes back with a message like the one below.



- Click [OK] to acknowledge the message.

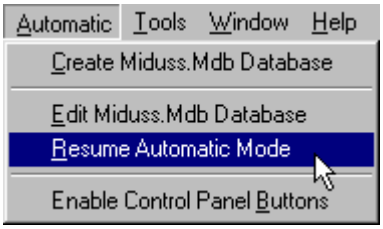
The Pipe design window opens now with a peak flow of 0.563 c.m/s as its inflow.



- The design is automatic. Simply press [Accept] on the Pipe Design window.

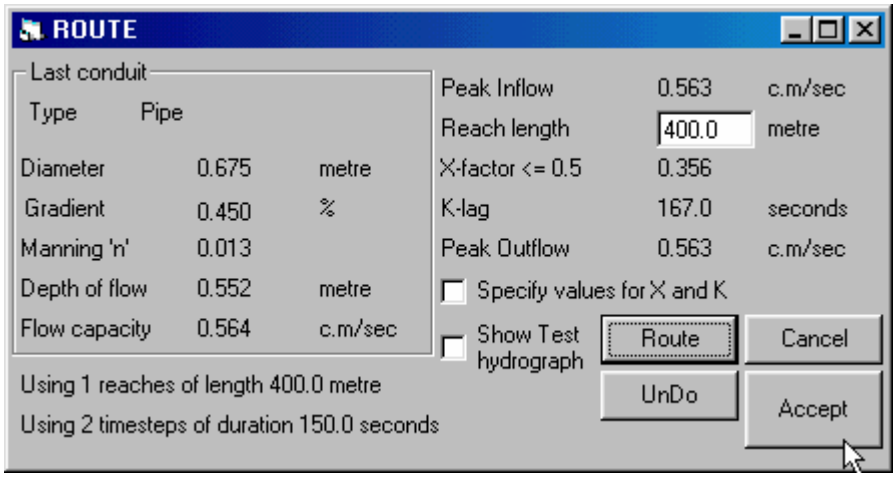
Now we want to return to the automatic processing of the data. MIDUSS has been waiting for you to return and the Automatic menu item now reads **resume** rather than run.

- From the main menu select the **Automatic / Resume Automatic Mode** command.



The Control Panel appears.

- Click [Edit] on the Control Panel.
- Run the Route command and when prompted to do so, press the [Yes] button to copy the Inflow to the Outflow at node 5. The peak outflow is equal to the pipe capacity of 0.563 c.m/sec.



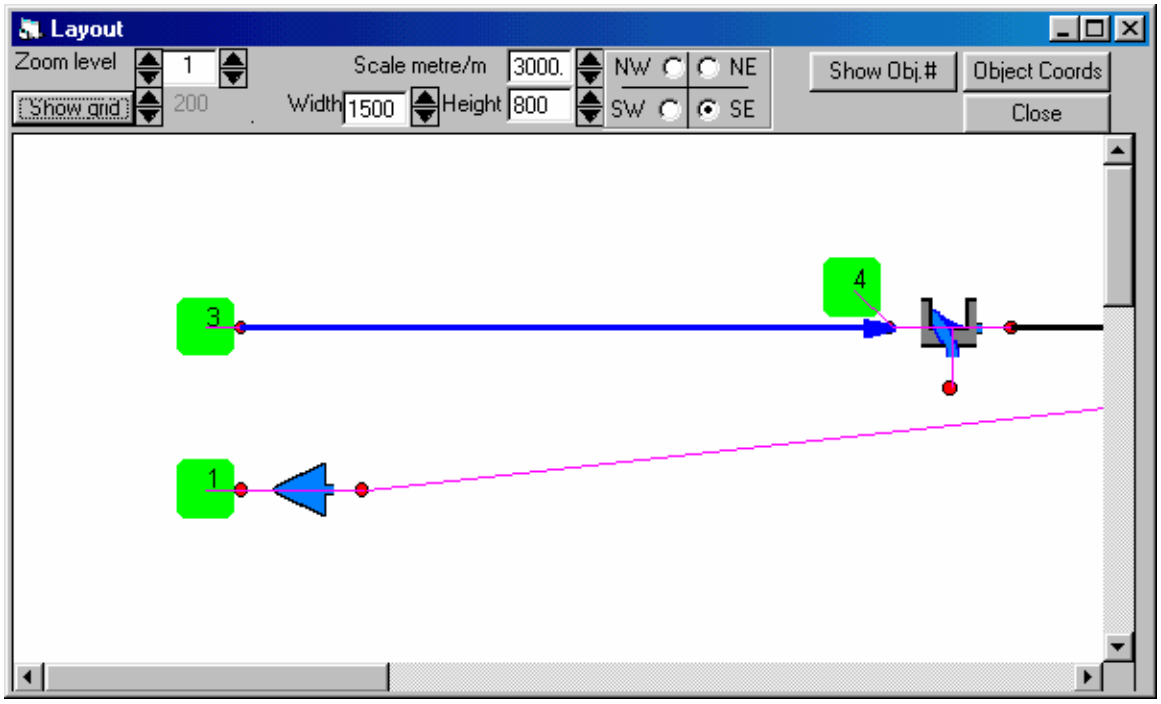
- Complete the automatic processing by pressing the [EDIT] button to execute the 'EXIT' command This closes the Input database.
- Click on the [CLOSE] button to close the Control Panel.

The final Peak Flows table should look like the following.

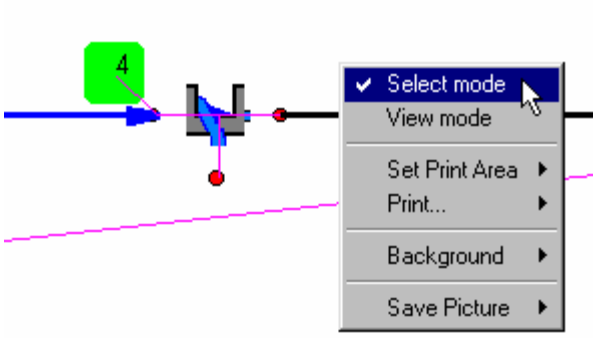
PEAK FLOWS (23)

No.	Command	Runoff	Inflow	Outflow	Junction
10	Next link	0.398	0.271	0.271	0.000
11	Pipe Design	0.398	0.271	0.271	0.000
12	Pipe Route 350	0.398	0.271	0.271	0.000
13	Combine 2	0.398	0.271	0.271	0.271
14	Start - New Tributary	0.398	0.000	0.271	0.271
15	Catchment 1	1.153	0.000	0.271	0.271
16	Add Runoff	1.153	1.153	0.271	0.271
17	Pond Route	1.153	1.153	0.664	0.271
18	Combine 2	1.153	1.153	0.664	0.935
19	Confluence 2	1.153	0.935	0.664	0.000
20	Diversion 2	1.153	0.935	0.563	0.000
21	Next link	1.153	0.563	0.563	0.000
22	Pipe Design	1.153	0.563	0.563	0.000
23	Pipe Route 400	1.153	0.563	0.563	0.000

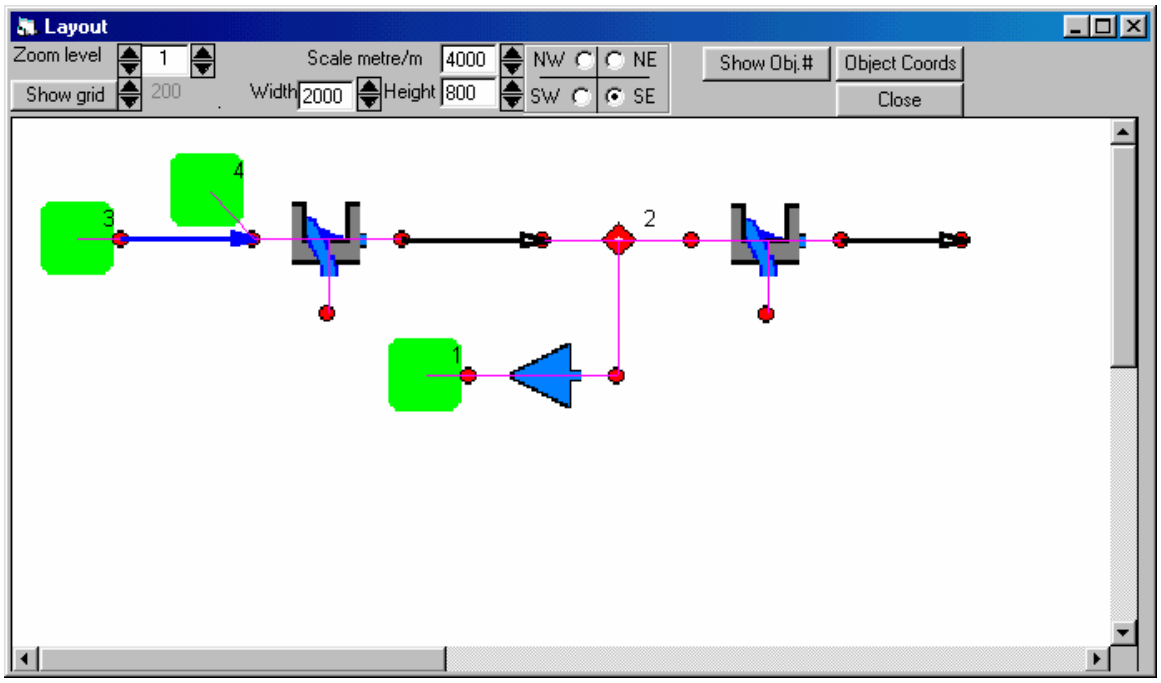
You will see from the layout that the icons and conduits are stretched due to the scaling imposed by the Route command. Your layout likely looks like the following.



- Let's fix this up. On the layout window, right click to reveal the layout menu and make sure Select mode is checked.



- Move the icons around on the layout to consolidate the overall image. Try adjusting the scale, width and height to approximate the image you see below.



The act of shrinking or expanding conduits on the layout does not change the actual underlying design dimensions. The lengths of the pipes and channels in your design will remain as you specified in the use of the Route command. The layout image is a conceptual representation of the drainage network.

Checking the Major System Flow

The Diversions you designed in the drainage network involved writing the diverted flow to hydrograph files. These files represent flows to the major system, typically the road surface.

Rescue05.bin

In this section you will use these flows to design conduits to carry the flow to a junction. At this junction the major and minor system flows will come together.

This section is quite advanced in nature and once completed you should have a good grasp of how MIDUSS is used at the advanced level.

The remainder of the design involves the following steps.

(1) Save the pipe outflow at a junction node (5) with the Combine command.

(2) Recover the major system flow in the surface link from node (4) to (2).

(3) Check the capacity of a typical road profile assuming a road grade of 0.5%.

(4) Route this over some fraction of the reach length – say half of the length of 350 m.

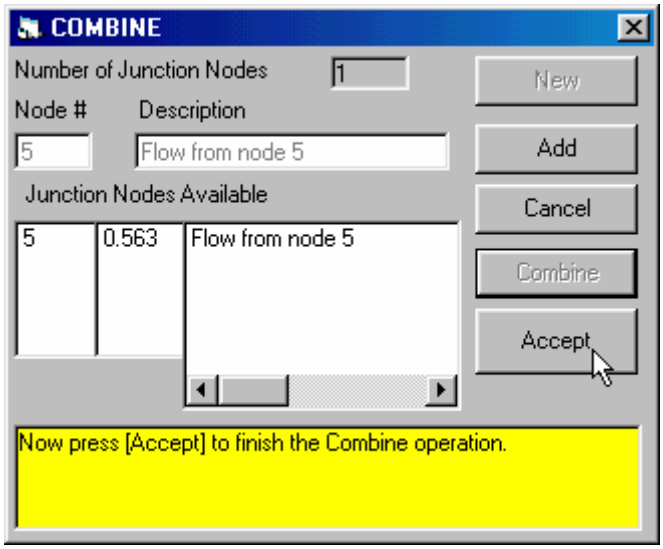
(5) Add the routed flow to the surface flow from file DIV00002.HYD.

(6) Check the total major system flow on the road cross-section from the junction node (2) to the Outlet node (5).

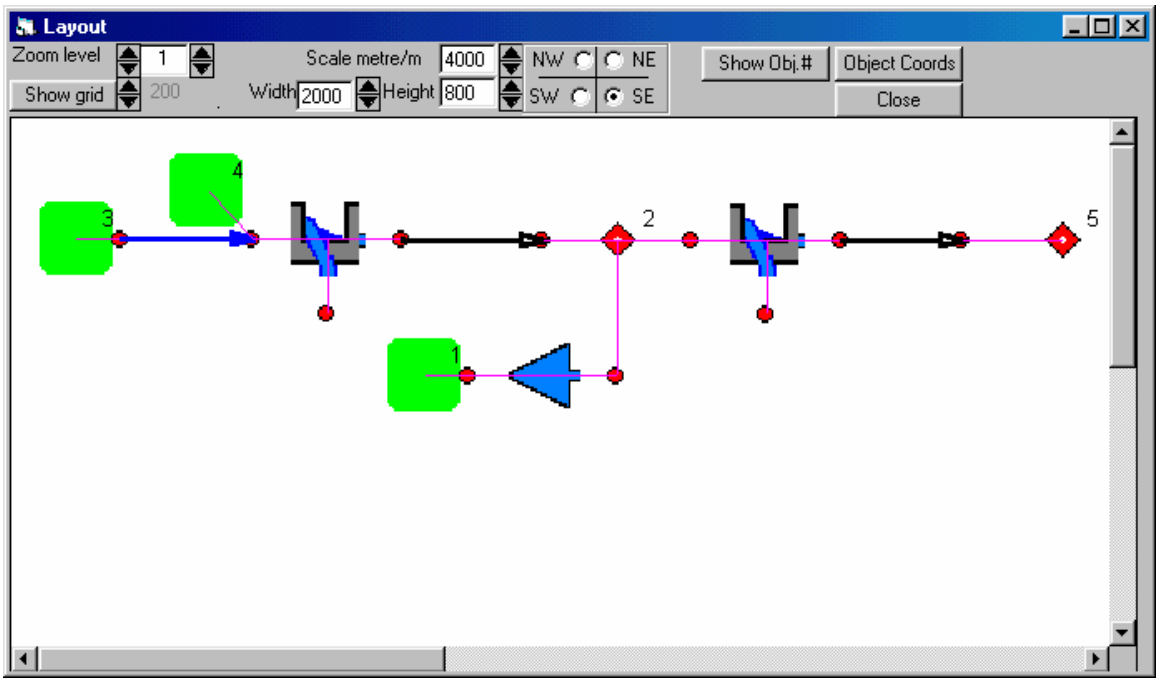
(7) Add the minor and major flows at junction node (5).

Before starting on the major system analysis you need to store the minor system flow at a junction.

- Select the **Hydrograph / Combine** command and accumulate the outflow from the pipe at node (5). The peak flow stored here is 0.563 c.m/sec.



The layout will add a junction icon.



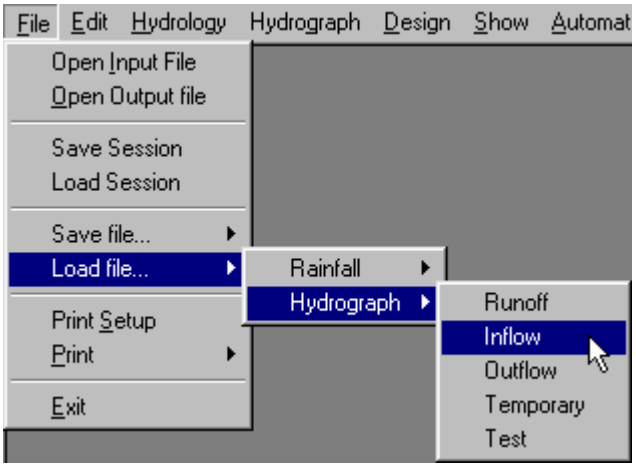
Your Peak Flows table should look like the one below.

PEAK FLOWS (24)

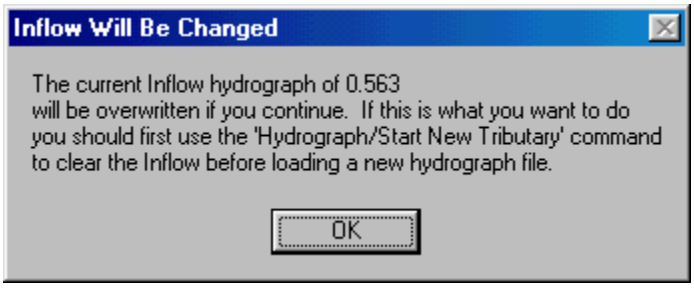
No.	Command	Runoff	Inflow	Outflow	Junction
20	Diversion 2	1.153	0.935	0.563	0.000
21	Next link	1.153	0.563	0.563	0.000
22	Pipe Design	1.153	0.563	0.563	0.000
23	Pipe Route 400	1.153	0.563	0.563	0.000
24	Combine 5	1.153	0.563	0.563	0.563

Recovering the Major System Flow

- Select **File / Load File / Hydrograph / Inflow** command.

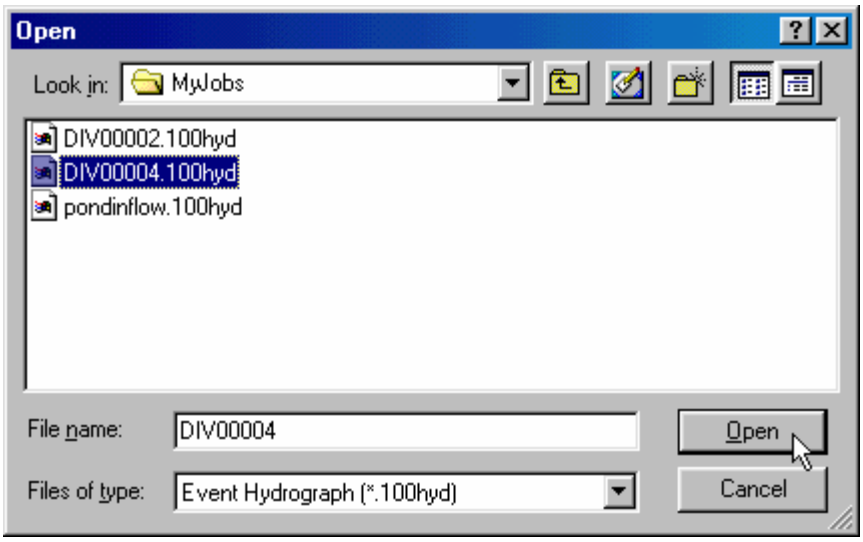


MIDUSS will return with a warning that the data contained in the Inflow will be overwritten. This is okay to do.



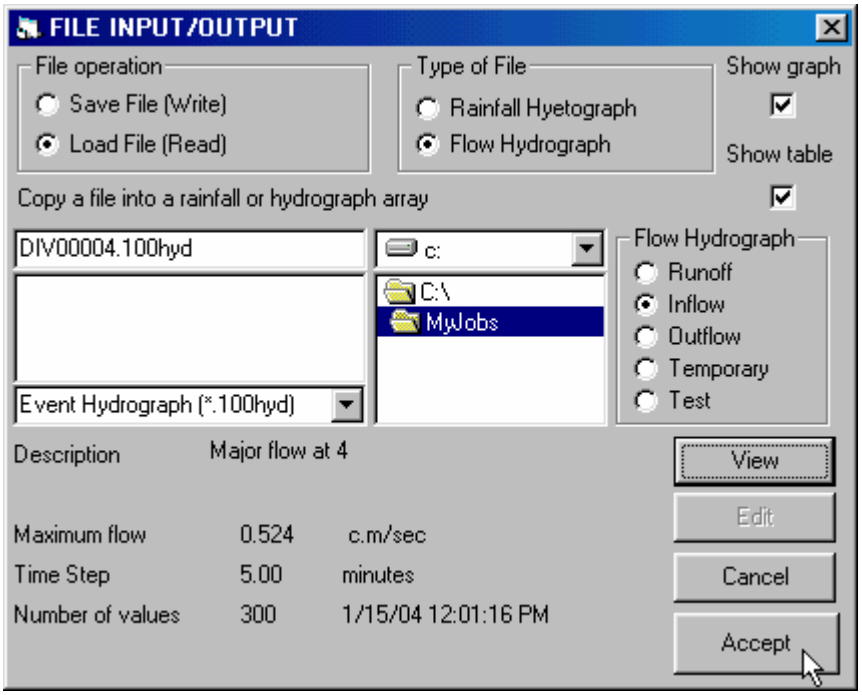
- Click [OK] to acknowledge the message.

Next, the file Windows dialog box appears and displays only the *.100hyd files stored in your working folder.



- Select the DIV00004.100hyd file and click the [Open] button. It is the diverted flow from node 4 that we will use first.

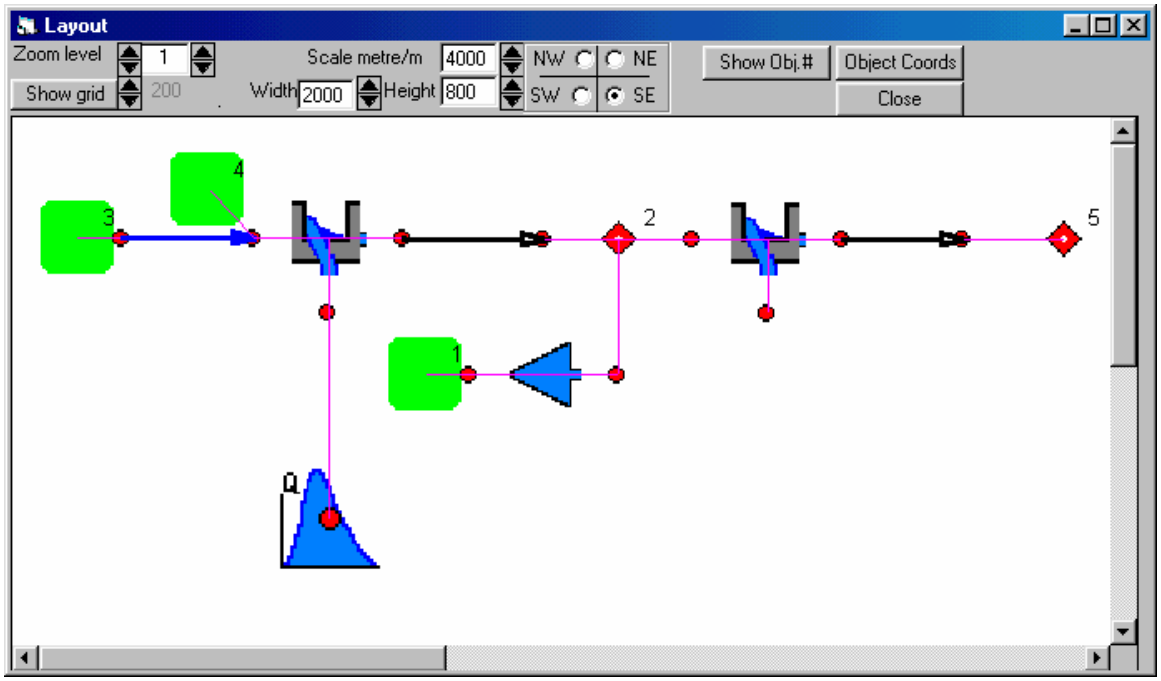
The File Input / Output form opens.



Confirm that the operations indicated by the radio buttons and the file name are correct. Note that you want to import this hydrograph to the **Inflow** hydrograph.

- Click the [View] button.
- Click the [Accept] button.

The imported hydrograph is displayed on the layout. It is automatically linked to the originating Diversion structure that created the diversion hydrograph in the first place.

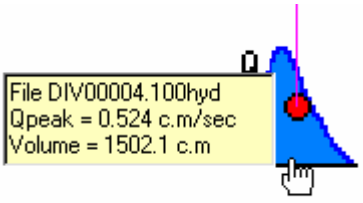


Your Peak Flows table should look like the one below. You see a peak of 0.524 in the Inflow.

PEAK FLOWS (25)

No.	Command	Runoff	Inflow	Outflow	Junction
21	Next link	1.153	0.563	0.563	0.000
22	Pipe Design	1.153	0.563	0.563	0.000
23	Pipe Route 400	1.153	0.563	0.563	0.000
24	Combine 5	1.153	0.563	0.563	0.563
25	DIV00004.100hyd	1.153	0.524	0.563	0.563

You can further reassure yourself that the imported hydrograph is correct by hovering over the hydrograph icon on the layout while in View mode.



Defining a Road Cross-section as a Channel

You can check the capacity of the major system by defining a channel cross-section which approximates a typical urban road cross-section.

- Select the **Design / Channel** command to open the Channel Design window.
- Before sketching the cross-section, set the horizontal and vertical scales (in the top right corner of the form) to contain a width of 16 m and a depth of 1.2 m.

You can sketch the shape approximately by watching the coordinates of the mouse pointer.

- Use 7 or 8 points to define boulevard slopes of around 2.5%, curb heights of 0.15 m and a road cross fall of 2% over a road-width of 10 m between curbs. Remember to use the secondary mouse button to define the last point. Your first attempt will look quite chaotic at first. Just make it a rough approximation and then edit the X and Y coordinates to the values displayed below to create the cross section displayed.

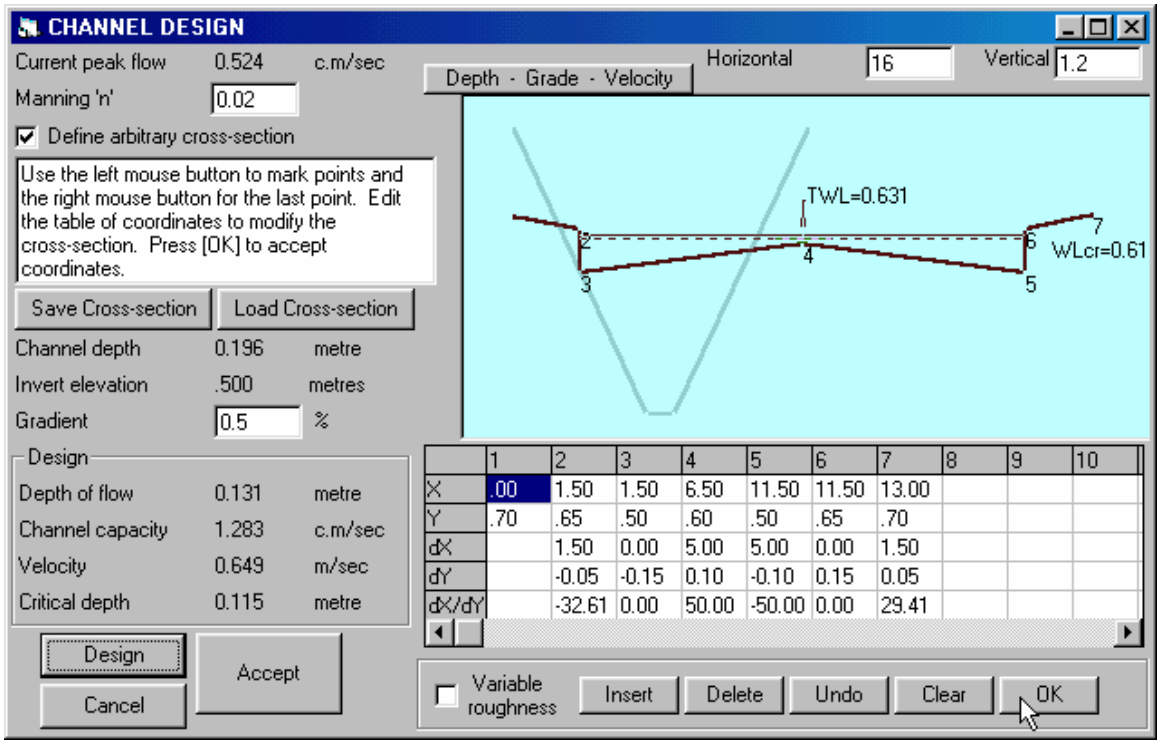
You can move the active cell by means of the left and right arrow keys. Note that the [Design] command is not enabled until you press the [OK] button to indicate that editing of the cross-section coordinates has been completed.

If you are finding it difficult to produce the same cross section as below you can retrieve the necessary data from a .XSEC file stored in the MIDUSS Tutorials folder. Press the **[Load Cross-section]** button on the Channel window and load file '**road01.xsec**'. This will produce the exact cross section as displayed below.
Note: the shaded 'V' seen on the plotting area is a 'ghost' of the previous use of the channel command. These 'ghosts' can be used as a reference to assist you with a cross section design further downstream. In the channel we are designing at the moment the ghost image looks quite out-of-place.

To complete the design you must specify a value for Manning's 'n' and a longitudinal road gradient.

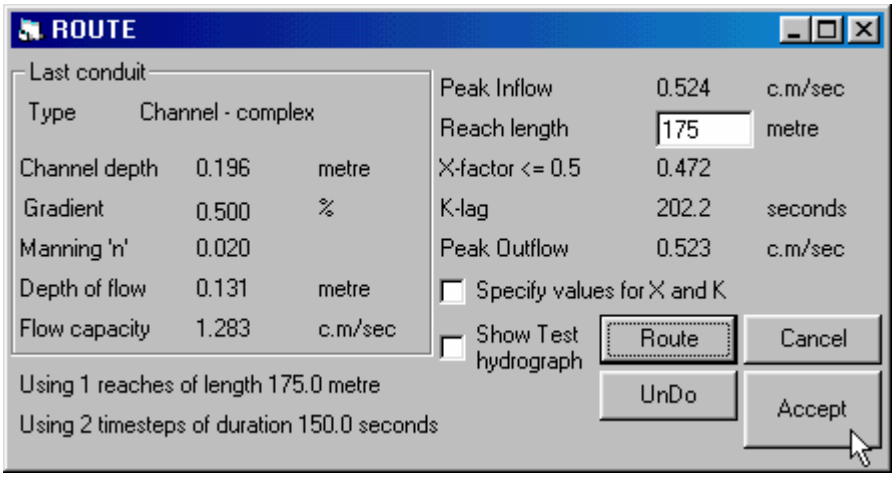
- Enter n = 0.02.
- Enter a Gradient of 0.5%.

The final design is shown in the figure below.



You have the option at this point of saving the cross section to a file which can be reused in future design sessions. In this instance we do not need to do this because MIDUSS remembers this particular cross section from this point forward in the design session.

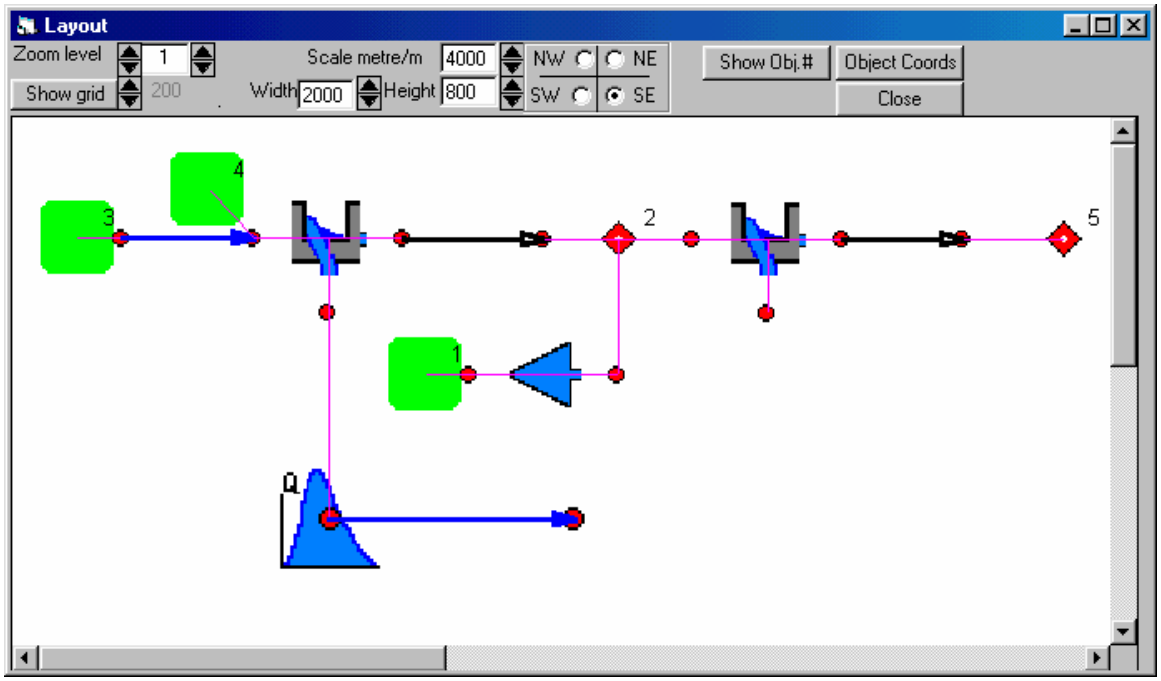
- From the main menu click the **Design / Route** command.



This will get the Outflow from the major system at node (2).

- Use a reach length of 175 m. This would be reasonable but in practice, the attenuation is negligible.

Your layout should now look similar to the one below.



At this point the operations get a little tricky so pay close attention to the sequence of steps.

The Peak Flows table should look like the one below.

PEAK FLOWS (27)

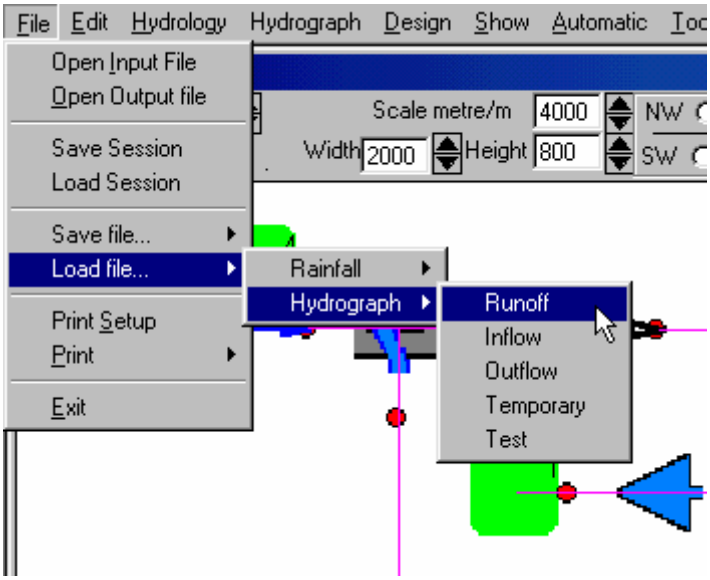
No.	Command	Runoff	Inflow	Outflow	Junction
23	Pipe Route 400	1.153	0.563	0.563	0.000
24	Combine 5	1.153	0.563	0.563	0.563
25	DIV00004.100hyd	1.153	0.524	0.563	0.563
26	Channel Design	1.153	0.524	0.563	0.563
27	Channel Route 175	1.153	0.524	0.523	0.563

We want to add to this major flow to the diversion hydrograph from node 2. In preparation for this we need to move the major flow into the Inflow using the Next Link command.

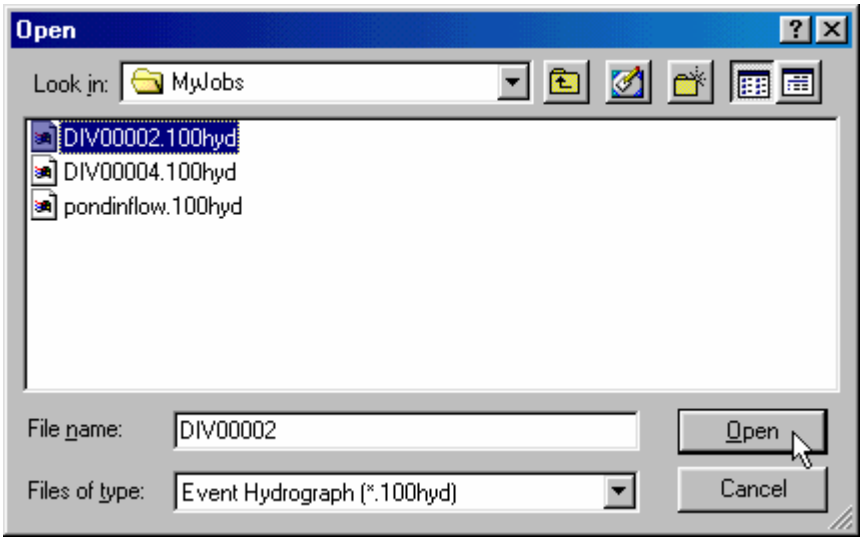
- Select the **Hydrograph / Next Link** command.

Now we need to import the diversion hydrograph that came from node 2.

- Select the **File / Load file / Hydrograph / Runoff** from the main menu. Note we are loading the file to the Runoff hydrograph this time and not to the Inflow (as we did with the previous diversion file).



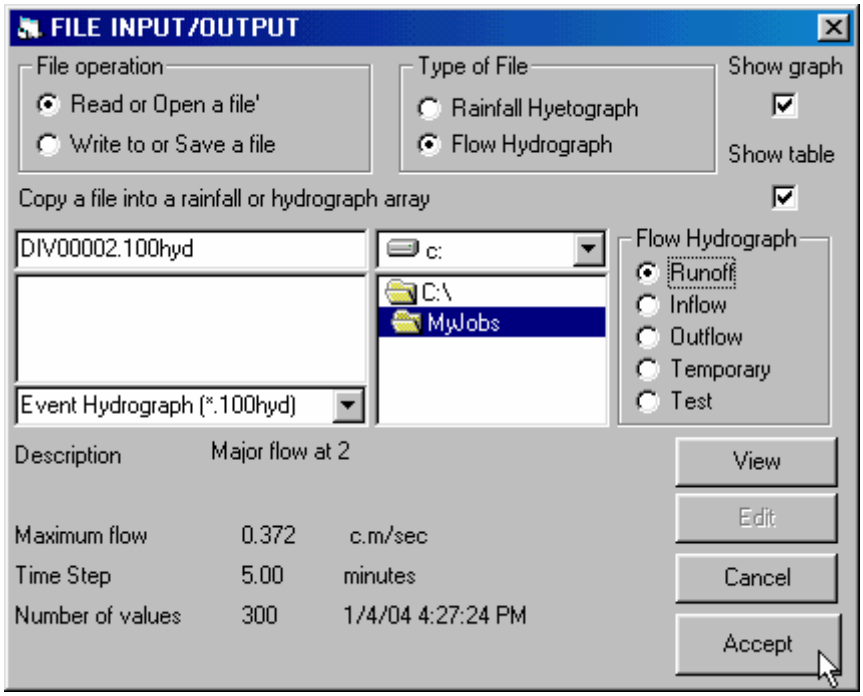
You are going to import the hydrograph to the Runoff and then add it to the Inflow just created above.



- Select the **DIV00002.100hyd** file and click [Open].

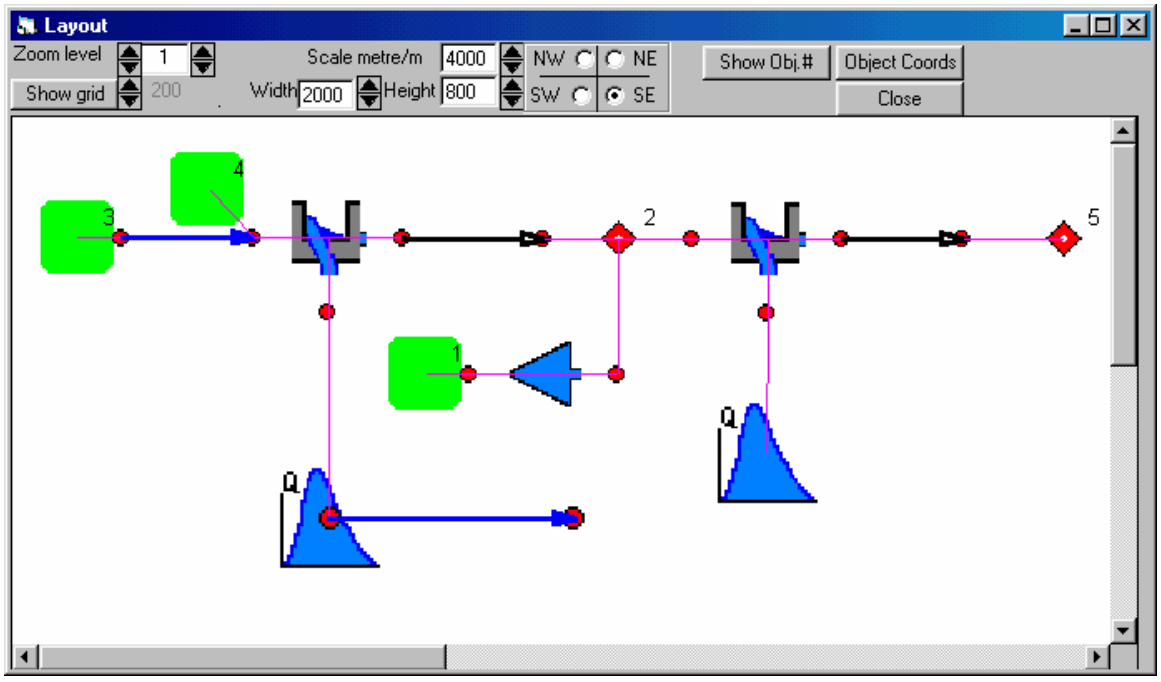
The File Input / Output window appears.

- Confirm that the import operations are correct.



- Click [Accept].

The layout should now have the diversion hydrograph on the layout and linked to the diversion it originally came from.



Your Peak Flow table should look like the following screen.

PEAK FLOWS (29)

No.	Command	Runoff	Inflow	Outflow	Junction
25	DIV00004.100hyd	1.153	0.524	0.563	0.563
26	Channel Design	1.153	0.524	0.563	0.563
27	Channel Route 175	1.153	0.524	0.523	0.563
28	Next link	1.153	0.523	0.523	0.563
29	DIV00002.100hyd	0.372	0.523	0.523	0.563

You can see the diversion 2 hydrograph as 0.372 in the Runoff position and the diversion 4 hydrograph as 0.523 in the Inflow position. You can now add these together.

- Select the **Hydrograph / Add Runoff** command from the main menu. This is one of the situations in which MIDUSS may issue a warning that you should have used the **Hydrograph / Start New Tributary** command. Press [Yes] to force the addition if you see the message.

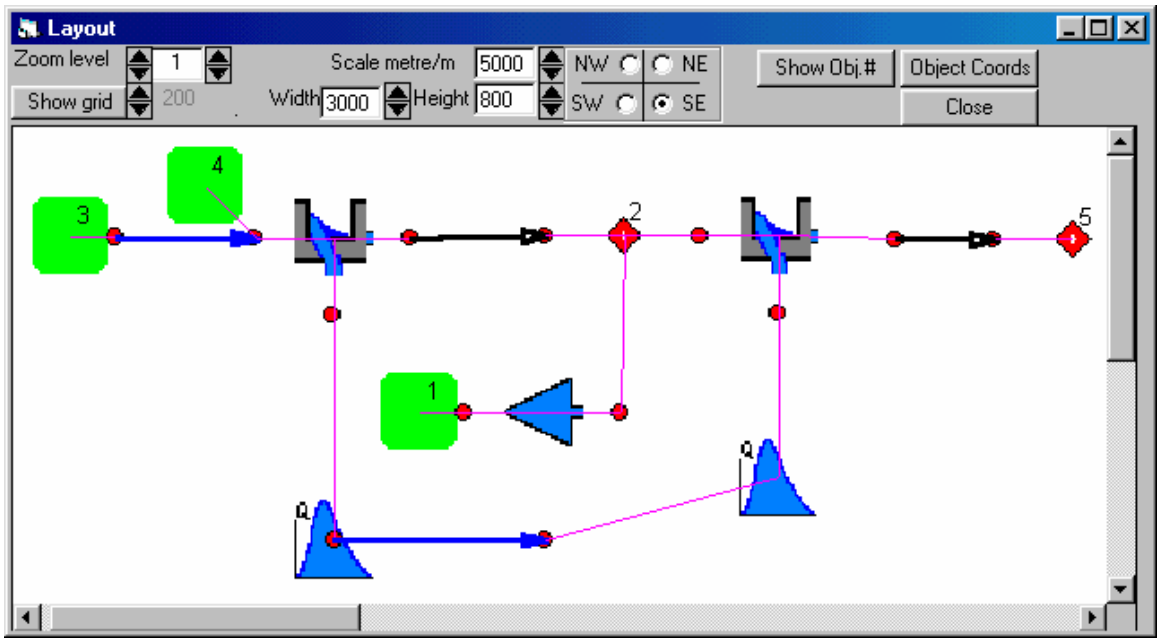
The Peak Flows table is updated.

PEAK FLOWS (30)

No.	Command	Runoff	Inflow	Outflow	Junction
26	Channel Design	1.153	0.524	0.563	0.563
27	Channel Route 175	1.153	0.524	0.523	0.563
28	Next link	1.153	0.523	0.523	0.563
29	DIV00002.100hyd	0.372	0.523	0.523	0.563
30	Add Runoff	0.372	0.895	0.523	0.563

The Inflow now shows 0.895 c.m/s and with this we can check the conveyance of the road surface (channel).

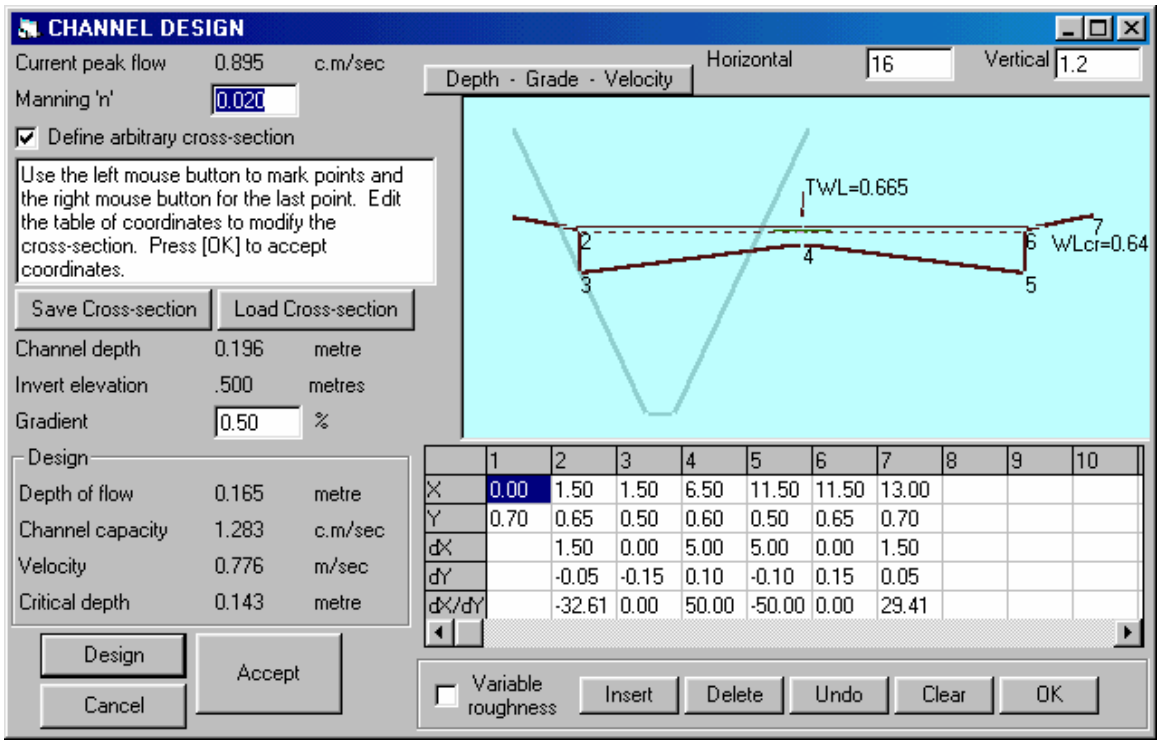
Your layout should look similar to the one below.



A Second Channel Command

- From the main menu select **Design / Channel**.

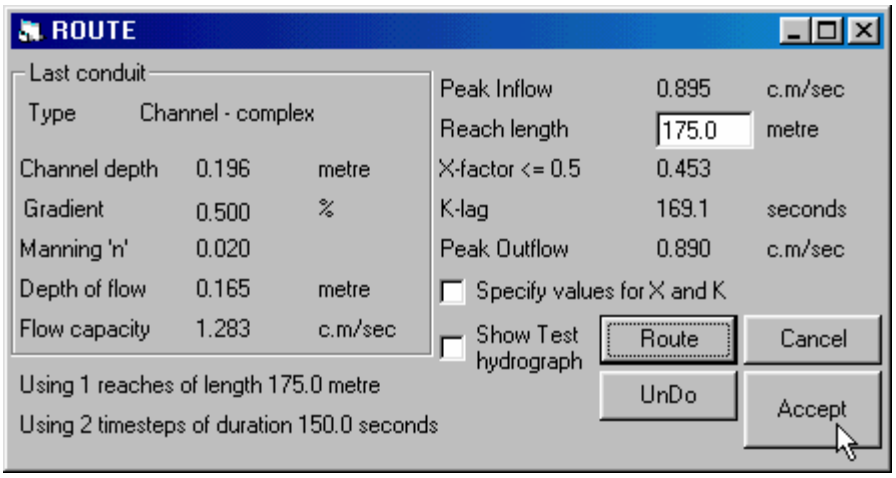
The Channel window opens and it is populated with the same cross section used previously. The design is automatically performed. Notice in the window (top left) the Current peak flow of 0.895 c.m/sec is used - as we would expect.



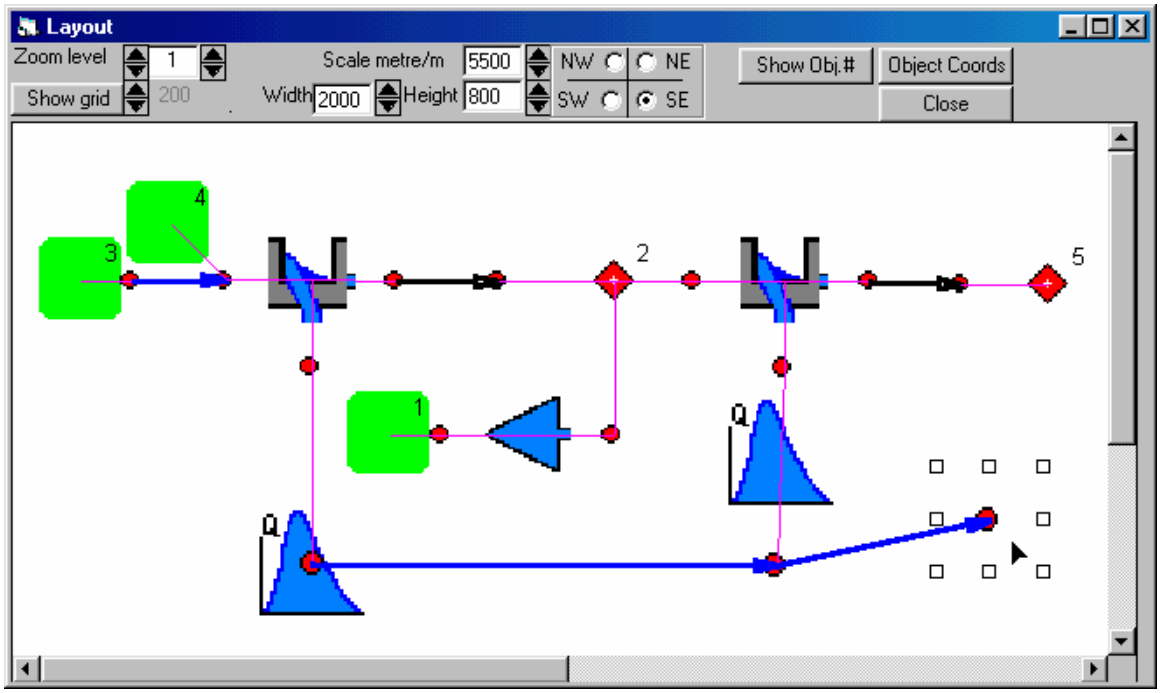
- Click [Accept] to use this design.

Now you need to Route this flow.

- Select **Design / Route** from the main menu.



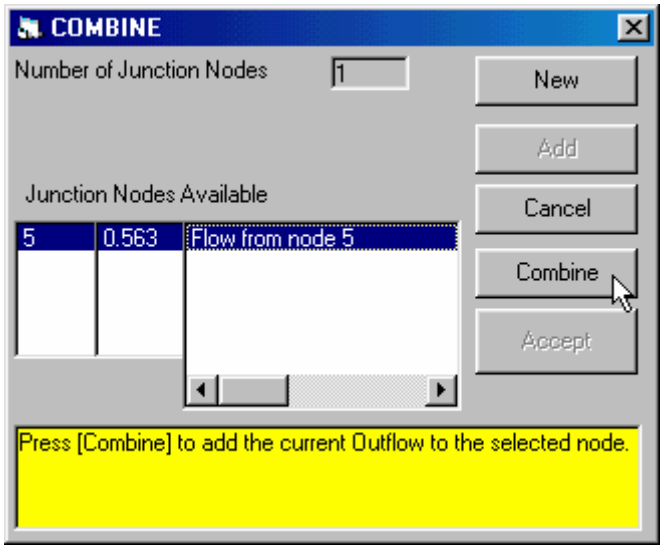
- Use 175 m once again as the reach length.
- Click [Accept].
- Move your layout icons around so that your layout looks like the one below.



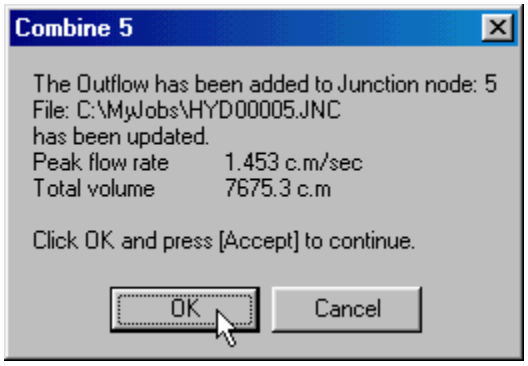
At this point the Peak Flows table should have an Outflow of 0.890.

We will now Combine this flow with the minor system storage waiting at node 5.

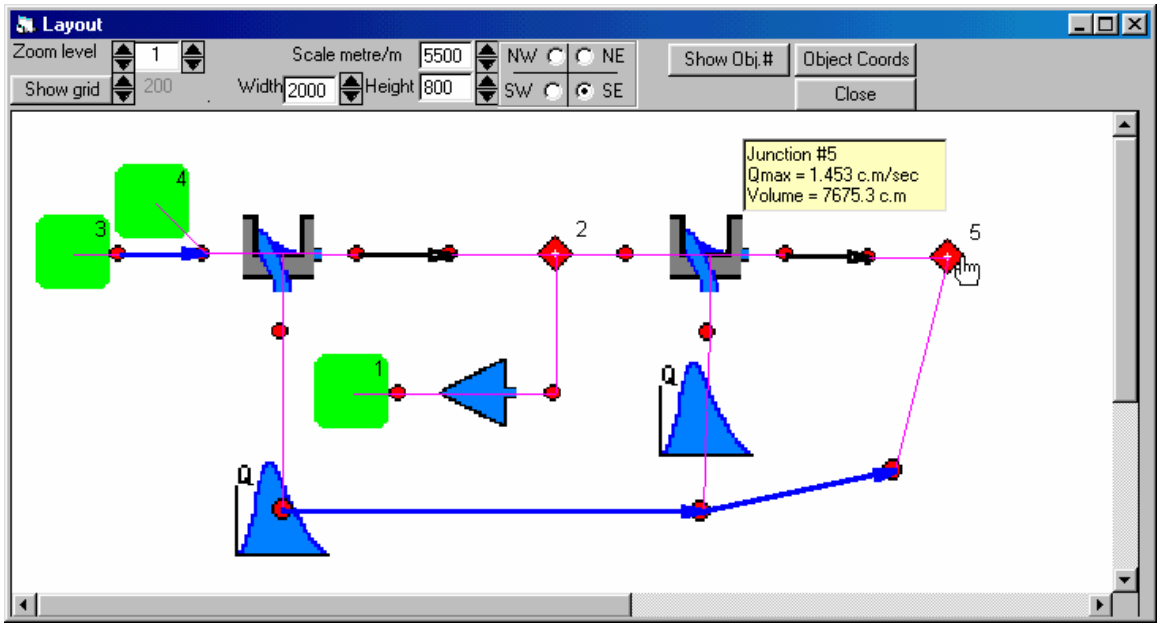
- From the main menu select **Hydrograph / Combine**.
- By now you should be quite experienced with the Combine command. Your Combine window should look like the one below just before you click the [Combine] button.



A message appears telling you that the combined flow at node 5 will have a peak flow of 1.453 c.m/sec and a total volume of 7675.3 c.m. This is the accumulation of flows from the minor and major systems.



On the layout this final use of Combine adds a connecting link to node 5. You can hover over the node and observe a pop-up data box with the essential information.



Your final Peak Flows table will look like the one below.

PEAK FLOWS (33)

No.	Command	Runoff	Inflow	Outflow	Junction
29	DIV00002.100hyd	0.372	0.523	0.523	0.563
30	Add Runoff	0.372	0.895	0.523	0.563
31	Channel Design	0.372	0.895	0.523	0.563
32	Channel Route 175	0.372	0.895	0.890	0.563
33	Combine 5	0.372	0.895	0.890	1.453

You will see the peak of 1.453 c.m/sec stored in the Junction location.

You may wish to use a final **Hydrograph / Confluence** command at this point to remove the last junction file. If not, we are finished.

- Exit from MIDUSS as normal. The output file **TutorialB.out** is stored in your working folder and can be re-used in later sessions or for reporting purposes.

MIDUSS has considerable flexibility and power to let you design much more complex drainage networks. If you have followed the tutorial so far and ended up with the same data then you should have a good grasp on the procedures MIDUSS uses.

This concludes the design portion of this MIDUSS tutorial. Next, you will generate a custom plot of some of the hydrographs and hyetographs used in this design.

Notes:

Generating a Custom Plot

Once the design has been completed you may want to generate one or more figures for inclusion in a report.

Rescue06.bin

During both the manual and automatic design sessions you have the opportunity to use the **File / Print / MIDUSS Window** menu command to make a hard copy of any of the screens.

However, you will quite likely require a customized plot of one or more hydrographs, together with a storm hyetograph.

In addition, you may need to compare data from different design sessions – such as pre- and post-development hydrographs – or add information to illustrate a point. This section will illustrate how you can do this for the design which you have just completed using the **Show / Graph** menu command.

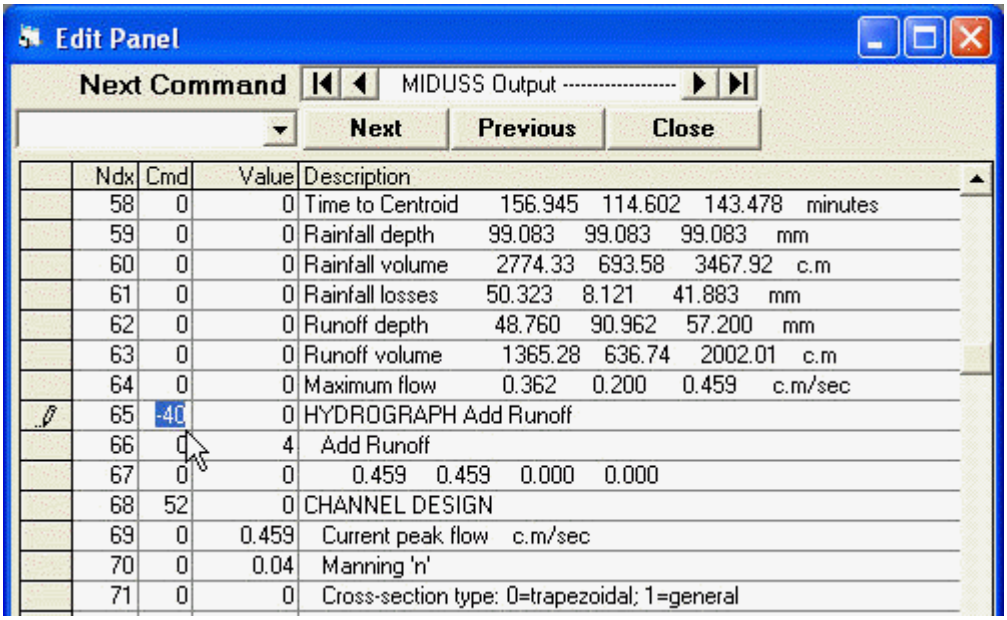
To do this you will run MIDUSS a third time using the second output file in automatic mode. The object is to produce a diagram to show the three runoff hydrographs from areas 1, 3 and 4 together with hyetographs of storm rainfall and effective rainfall on the impervious and pervious fractions respectively..

This design session will use the previous output file to generate an input database and write the results to a temporary file in the same Job directory. The procedure is described in the topics that follow. These can be summarized as follows.

- Run MIDUSS and define a new output file. Use the previous output file to create an Input Database called Miduss.Mdb that resides your working folder.
- Run MIDUSS in Automatic mode using the database as input.
- Set one or more points in the input database where you want to carry out some manual operations by adding a negative sign to the command numbers at which you want Automatic processing to stop.
- Run MIDUSS in automatic mode using the [RUN] command button in the Control Panel,
- Use the **Show / Graph** command to create one or more graphs to print out.

- Start MIDUSS.
- Define a new output file called '**Temp.out**'.
- Use the **File / Open Input File** command and select the previous output file '**C:\MyJobs\TutorialB.out**'.
- Use the **Automatic/Edit Miduss.Mdb Database** to review the commands.

A form titled Edit Panel is opened to display a 4-column list of the database as shown below.



Ndx	Cmd	Value	Description
58	0	0	Time to Centroid 156.945 114.602 143.478 minutes
59	0	0	Rainfall depth 99.083 99.083 99.083 mm
60	0	0	Rainfall volume 2774.33 693.58 3467.92 c.m
61	0	0	Rainfall losses 50.323 8.121 41.883 mm
62	0	0	Runoff depth 48.760 90.962 57.200 mm
63	0	0	Runoff volume 1365.28 636.74 2002.01 c.m
64	0	0	Maximum flow 0.362 0.200 0.459 c.m/sec
65	-40	0	HYDROGRAPH Add Runoff
66	0	4	Add Runoff
67	0	0	0.459 0.459 0.000 0.000
68	52	0	CHANNEL DESIGN
69	0	0.459	Current peak flow c.m/sec
70	0	0.04	Manning 'n'
71	0	0	Cross-section type: 0=trapezoidal; 1=general

Assume that you want to display a figure showing all three runoff hydrographs from areas 1, 3 and 4 together with a plot of the historic storm hyetograph.

- Using the [Next] command button on the Edit Panel or using the mouse pointer, move the arrow indicating the active record to the record immediately after the Catchment 3 command.
- Using the mouse pointer, click with the primary mouse button on or in front of the Command 40 in column 2. If the '40' is highlighted, type in '-40' in column 2 of the 'HYDROGRAPH Add Runoff' command. If the value is not highlighted simply type '-' (negative) in front of the '40'. (See the figure above.)
- Repeat the process at the record immediately after the 'Catchment 4' command.
- Repeat the process again after the 'Catchment 1' command. Note that this is the largest of the three runoff peaks with a value of 1.153 c.m/sec.
- Close the Edit Panel by clicking the [Close] command button. You are now ready to start the second run in automatic mode.

A Second Automatic Run

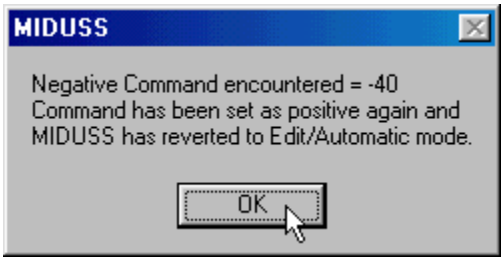
- Select the **Automatic/Run Miduss.Mdb** menu command to open the Control Panel.
- This time, instead of using the [EDIT] button, click on the [RUN] command button.

Depending on the speed of the computer, you may see some of the detail as the commands are processed in sequence. When MIDUSS encounters the negative command number it does three things:

(1) The negative command number is restored to the original positive value.

(2) The automatic mode reverts to the [EDIT] mode instead of the continuous [RUN] mode.

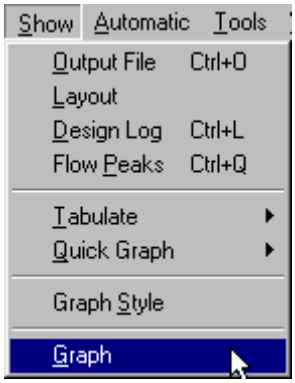
(3) MIDUSS displays a message advising you what has been done as shown below.



Plotting a Hyetograph and Hydrograph

You may prefer to revert to Manual mode by clicking on the [MANUAL] button on the Control Panel but this is not necessary.

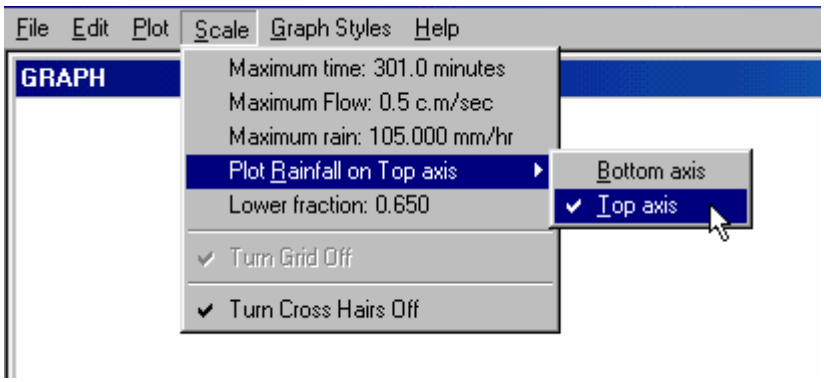
- Select the **Show / Graph** menu command.



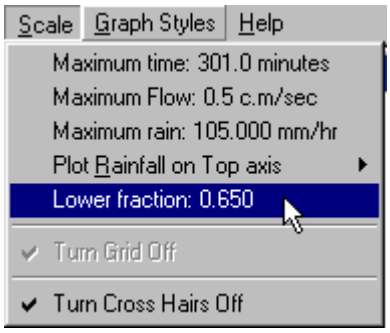
A blank plotting form is displayed together with a special menu.

Assume that you want to plot the hydrograph on the bottom edge and the inverted storm hyetograph on the top edge of the form. Remember that you will want to plot two other hydrographs on this diagram so the vertical scaling should be adjusted to suit the maximum flow rate which was 1.154 c.m/sec for catchment #1.

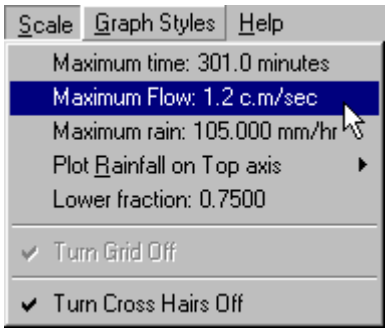
- Select the menu item **Scale/Plot Rainfall on…** and click on **Top Axis** if this is not already the default.



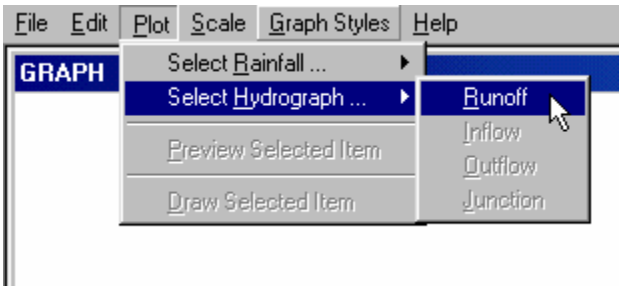
- Select **Scale/Lower fraction 0.650** . A small window opens prompting you to enter the desired lower fraction of the plotting area on which the hydrographs will be plotted. Change the default of 0.65 by typing in 0.75.



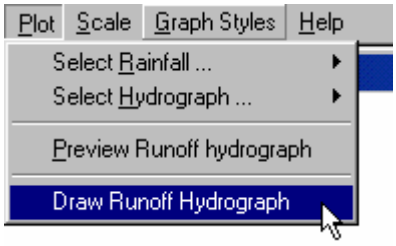
- Select **Scale/Maximum flow 0.500 c.m/sec** and type in a peak flow rate of 1.2 in the text box.



- Select and click on the menu command **Plot/Select Hydrograph…/Runoff**.



The menu items **Plot/View Selected Item** and **Plot/Draw Selected Item** are enabled and modified to read **Plot/View Runoff hydrograph** and **Plot/Display Runoff Hydrograph** respectively.

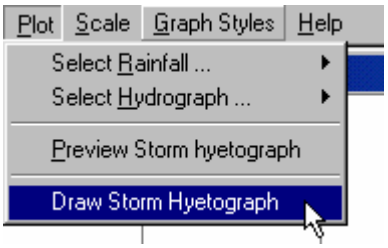


- Click on **Draw Runoff Hydrograph** to draw the first hydrograph with a small text legend to show the peak value of 0.459.

Adding the Rainfall Hyetographs

- To add the storm hyetograph, select the menu command **Plot/Select Rainfall…/Storm** and click on it.
- Setup the Preview and Draw menu items in a similar fashion to the technique you used for the hydrographs above.

Your menu should look like then one below.



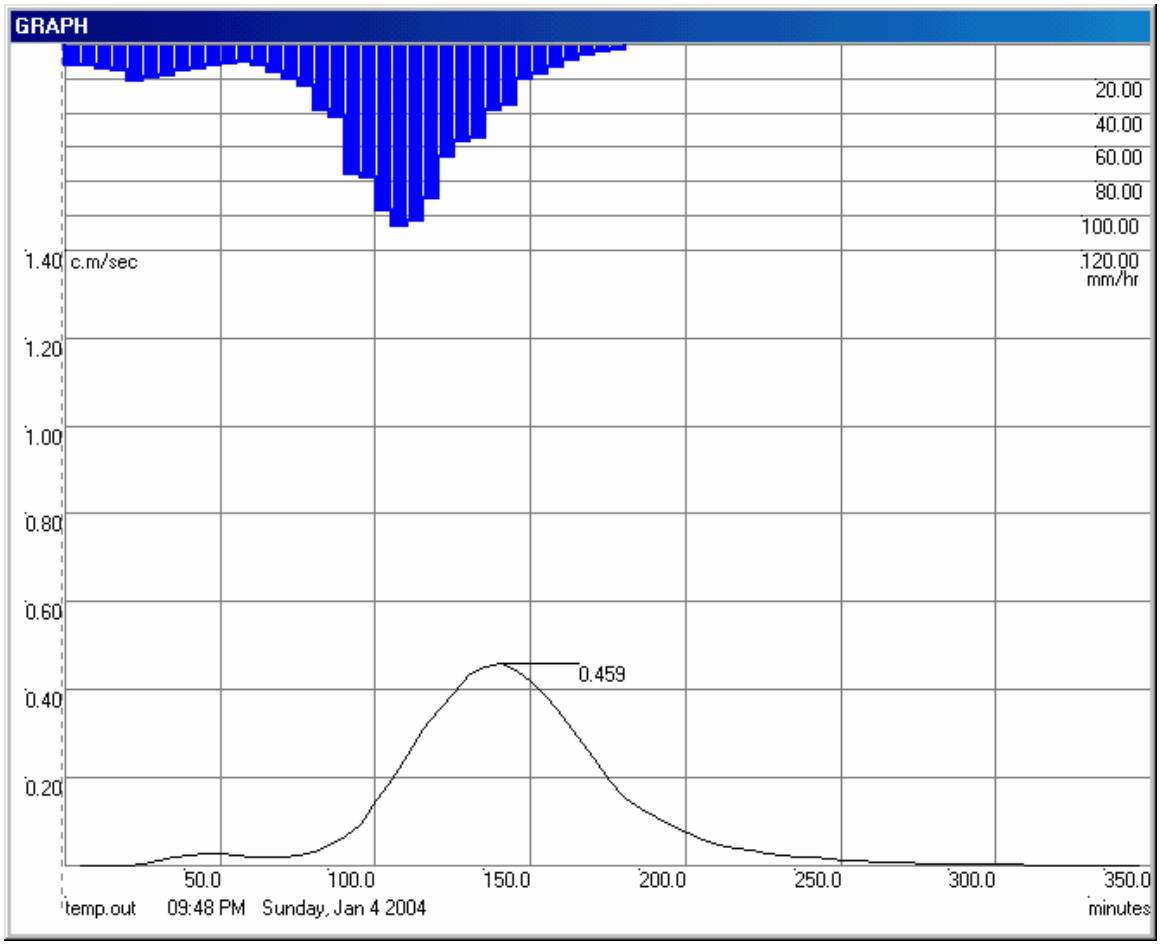
- Click the Draw Storm Hyetograph

This will draw the storm rainfall inverted on the top edge of the window, with values of intensity shown on the right-hand vertical axis. If you want to estimate the value of intensity at any point with greater accuracy, you can move the mouse pointer with the primary button held down to display the cross-hairs. In this mode the title bar of the GRAPH window displays the coordinates of the mouse pointer expressed in the units of the most recently plotted object.

- Add the effective rainfall hyetographs for the impervious and pervious fractions by repeating the process for these items.

Note that since each plotted item overlays the previous one(s) you must draw the filled bar graphs in this order in order to see all of them.

So far you should have one hydrograph and three hyetographs (over-layed on each other) on the plot.



Now you need to return to the Automatic processing so that the run will stop at the next –40 signal.

- You need to use the **File / Minimize Form** command to reduce the window to an icon. Later, you can use the **Show/Graph** menu command to restore it without loss of data.

Note that you cannot return to the main menu (with the **File/Main Menu** command) without losing all of the data that has been plotted so far. Should you try to do this – either intentionally or in error – a warning message is displayed.

Adding the Other Hydrographs to the Plot

- Once the Graph window has been iconized you can press [RUN] on the Control Panel once again.

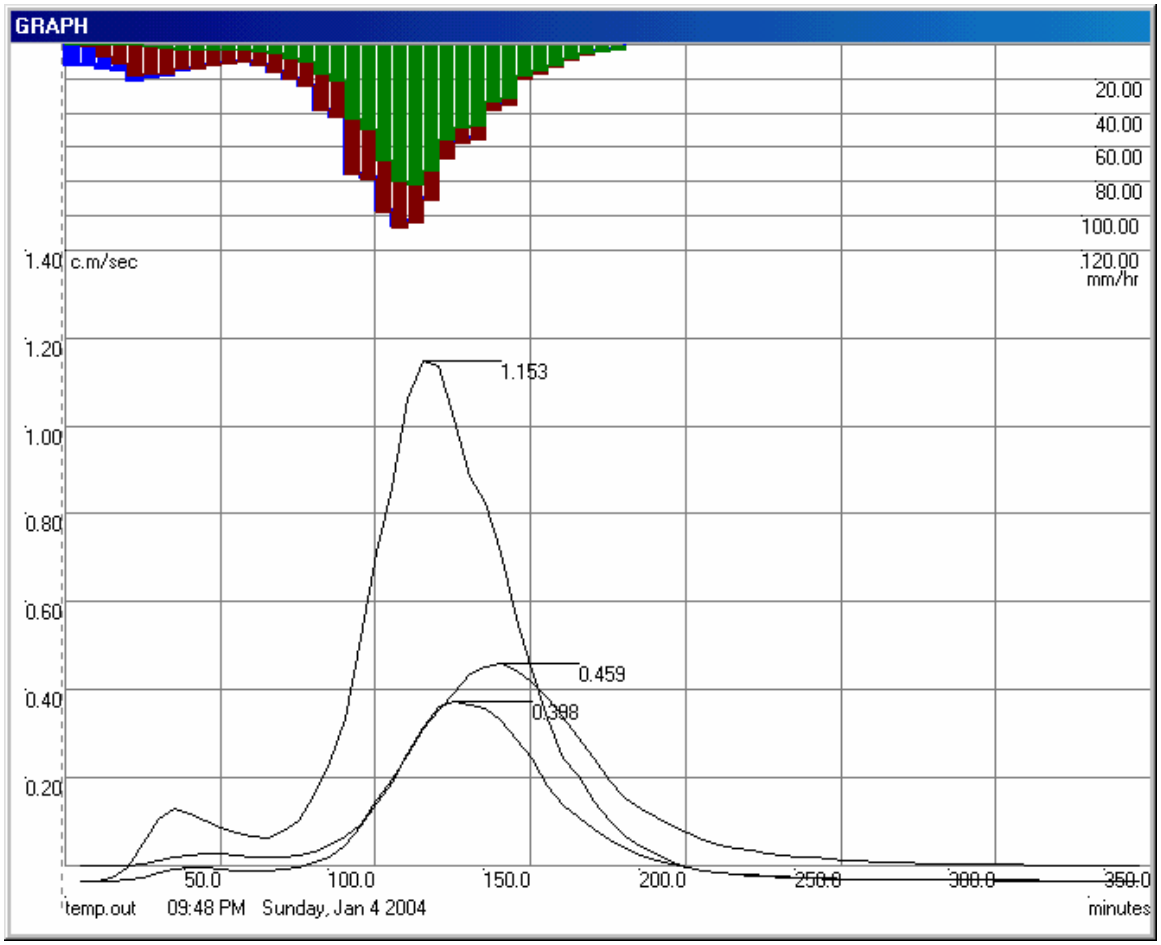
Processing is automatic until the runoff from area #4 has been calculated.

- Use **the Show / Graph** command to re-open the Graph window.
- From the graph menu select the **Plot / Select Hydrograph/Runoff** command and add it to the plot with the **Plot/Draw Runoff Hydrograph** command.

You can repeat the process to:

- Iconize the Graph window
- Run the input database to compute the runoff from area #1
- Re-open the Graph window
- Select the third runoff hydrograph, and
- Add it to the plot.

You should now have a plot showing three hydrographs and three hyetographs similar to the one below.


GRAPH
20.00
40.00
60.00
80.00
100.00
120.00
mm/hr
1.40
c.m/sec
1.20
1.00
0.80
0.60
0.40
0.20
1.153
0.459
0.388
50.0
100.0
150.0
200.0
250.0
300.0
350.0
minutes
temp.out
09:48 PM
Sunday, Jan 4 2004

Adding Explanatory Text

Before printing it you should add some text to identify the area from which each hydrograph is generated. The following steps describe the process.

(1) Use the **Edit / Erase a rectangle** command to draw a space (i.e. erasing a portion of a grid line) to the right of (say) the value of 1.153 on the hydrograph from area #1. You may clear similar rectangles to the right of the other two values.

(2) Select the **Edit / Enter Text Mode** command. The mouse pointer changes to a 'writing hand' as a reminder. Click the primary mouse button at a location where you want to enter text. The mouse pointer changes to a cross and any character you enter from the keyboard will be in the lower right quadrant of this cross. You can position the cross and click again to adjust the location.

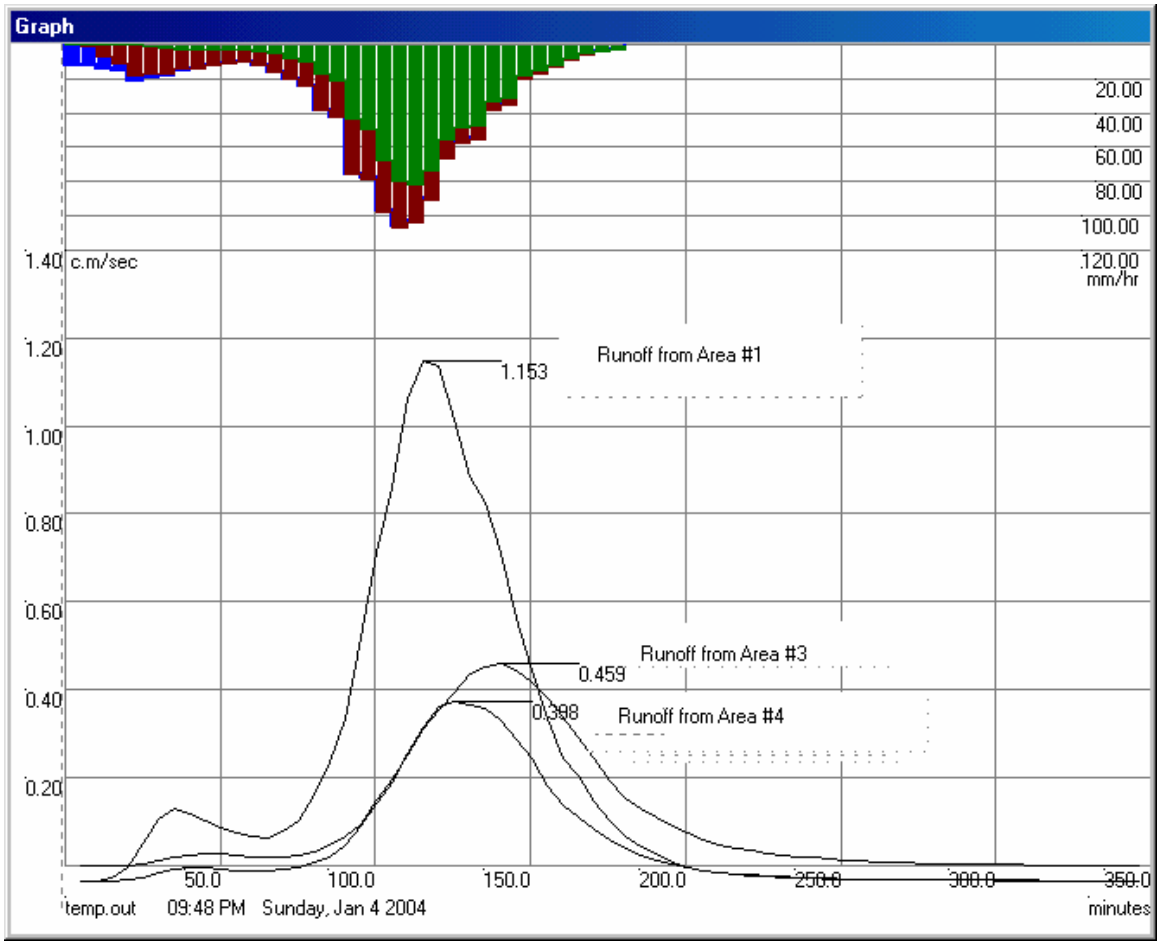
(3) Type '**Runoff from Area #1**'. Be careful because errors can be corrected only by using the **Erase a rectangle** tool.

(4) You may relocate the cross pointer and enter other items of text.

(5) Press either the Escape or End key to restore the 'writing hand' mouse pointer. At this stage, only the **Enter Text Mode** and the **Font items** are enabled in the **Edit** menu. This allows you to alter the style and colour of text.

(6) To finish entering text, click on the checked menu item **Enter Text Mode** to return to the normal mouse icon and re-enable the menu items.

Your plot should look similar the one below.

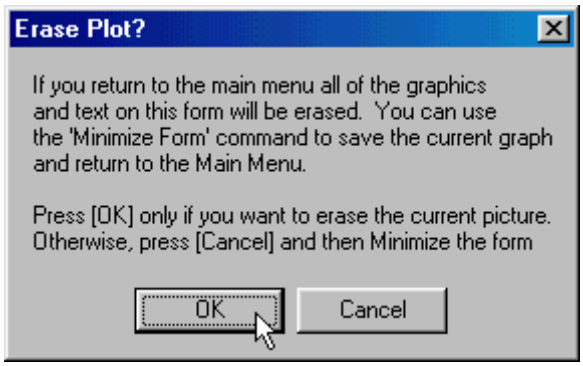

Graph
20.00
40.00
60.00
80.00
100.00
120.00
mm/hr
1.40 c.m/sec
1.20
1.00
0.80
0.60
0.40
0.20
Runoff from Area #1
1.153
Runoff from Area #3
0.459
0.398
Runoff from Area #4
50.0
100.0
150.0
200.0
250.0
300.0
350.0
minutes
temp.out 09:48 PM Sunday, Jan 4 2004

Saving the Plot File

If you want to save only the main features of the plot and add the text notes at a later time, you can use the **File / Save Graph As** command to save a bitmap file of the Graph window at any time. With this command you are prompted to provide a directory and a filename of your choice. With the **File / Save Graph** command, the file is saved with the default name 'GraphDefaultFile.bmp' and is stored in your working files folder – 'MyJobs' in this tutorial.

Subsequently you can recover the file with the **File / Load Graph** command. The file is restored but any Scale parameters which you set will be lost and you will have to re-define these.

When you leave the Graph command and return to the main menu a warning message appears telling you that all data on the plot will be erased.



- Click [Ok} to return to the main MIDUSS screen.

You can now exit MIDUSS in the normal way.

Notes:

MIDUSS® Version 2

Steps:

1. Photocopy this form.
2. Enter details.
3. Fax to our offices.

Error Report

Printed Manuals or Help Files	Installation and Setup	Running MIDUSS
[ ] Reference Manual [ ] Tutorial Manual [ ] Reference Help [ ] Tutorial Help [ ] Audio / Visual Tutorials [ ] Other (e.g. comment or suggestion)	[ ] CD media files missing, not working [ ] Setup program errors [ ] License number problems [ ] Network use or permissions [ ] Other (e.g. comment or suggestion)	[ ] Critical error - Urgent, program crashes. [ ] Serious – Error, but program needs attention. [ ] Cosmetic – Visual error. [ ] Other (e.g. comment or suggestion)
Name of Topic:	Your version of MIDUSS (e.g. 2.00Rev200):	Version of MIDUSS (e.g. 2.00Rev200):
Page number or file date:		
Description of error or problem:		
Would you like to be contacted about this report? [ ] No [ ] Yes……by [ ] E-mail [ ] Phone		
Name:	Organization:	
E-mail address:	Phone number:	

Thank you for completing this report.

Please fax to: **Alan A. Smith Inc. +1 (905) 628-1364**