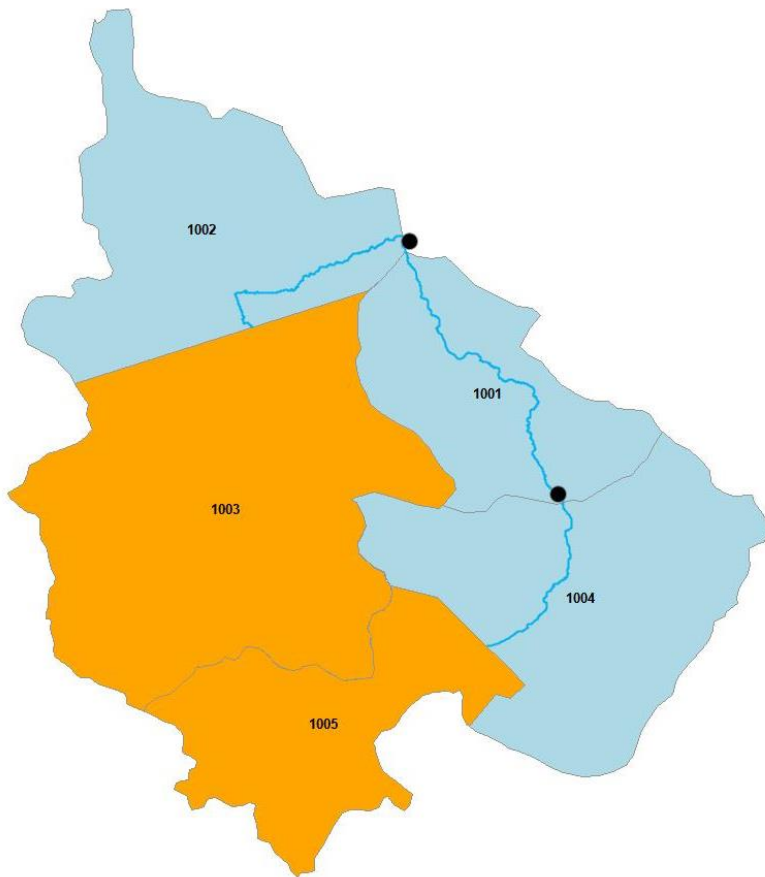


# Exercise #1 - Creating a VO model in Schematic View

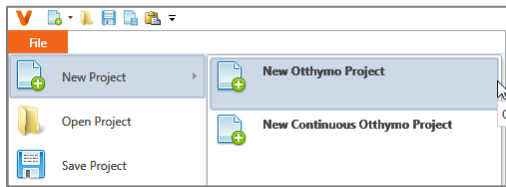
In this exercise, we will create a VO model for the watershed shown below. It has two urban sub-catchment (1003 and 1005) and three rural sub-catchments (1001, 1002 and 1004).

This exercise will mainly focus on the basic operation of VO. Default parameters and storms will be used. You should become familiar with VO concepts and workflow after completing this exercise.



## Exercise #1 - Creating a VO model in Schematic View

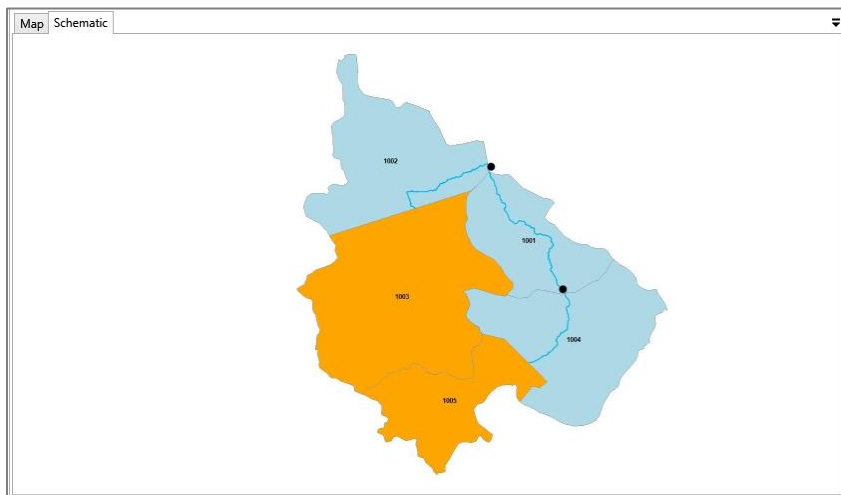
### 1. Open VO and create a new Otthymo project



### 2. Add a Background

It's good to have a watershed layout reference when creating the model schematic. VO has the ability to add a picture as the background in the Canvas. A picture is provided for this exercise in the training package located at /exercise #1/data with name VO\_Training\_Exercise\_#1\_Background.JPG. We will use it as the background in this exercise.

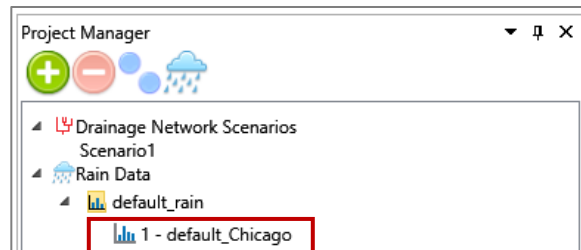
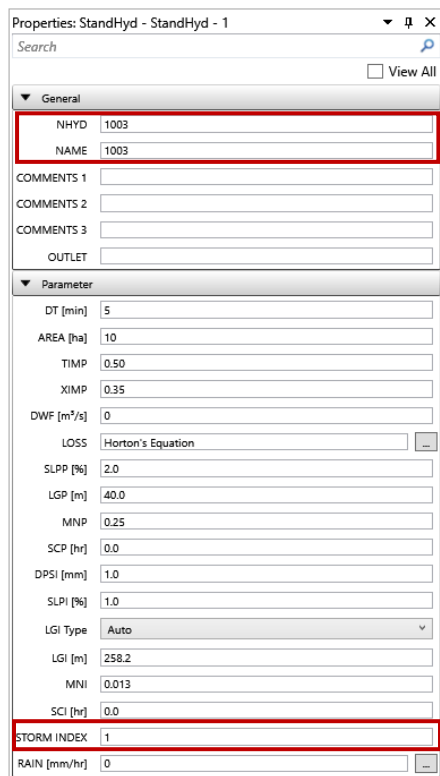
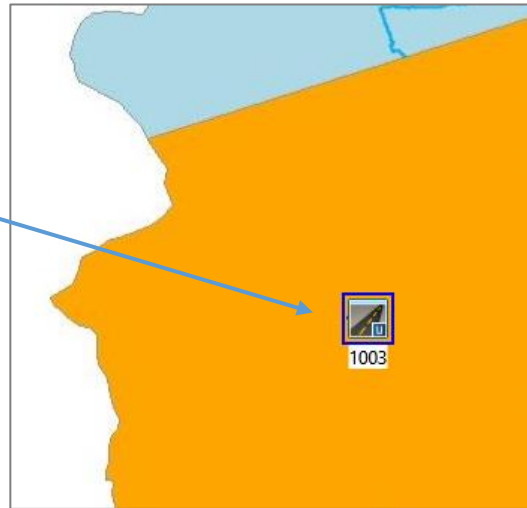
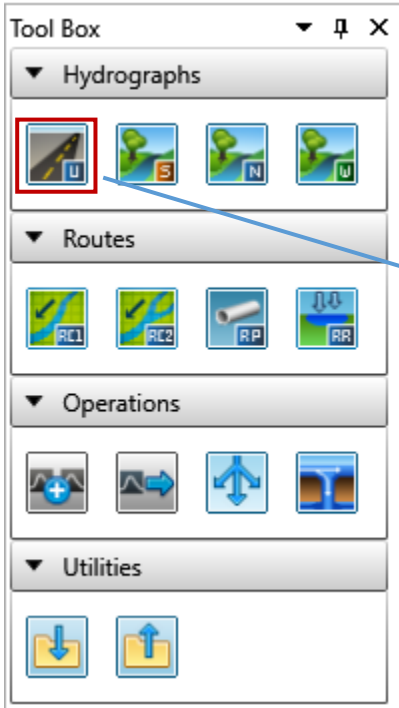
To set the background, right-click on canvas and choose **Background -> Change Background...** to select the picture. Move the picture around to put it in the center. Practice using the mouse to move the background around and zoom in/out (with the wheel).



### 3. Create a StandHyd for two urban sub-catchments (1003 and 1005)

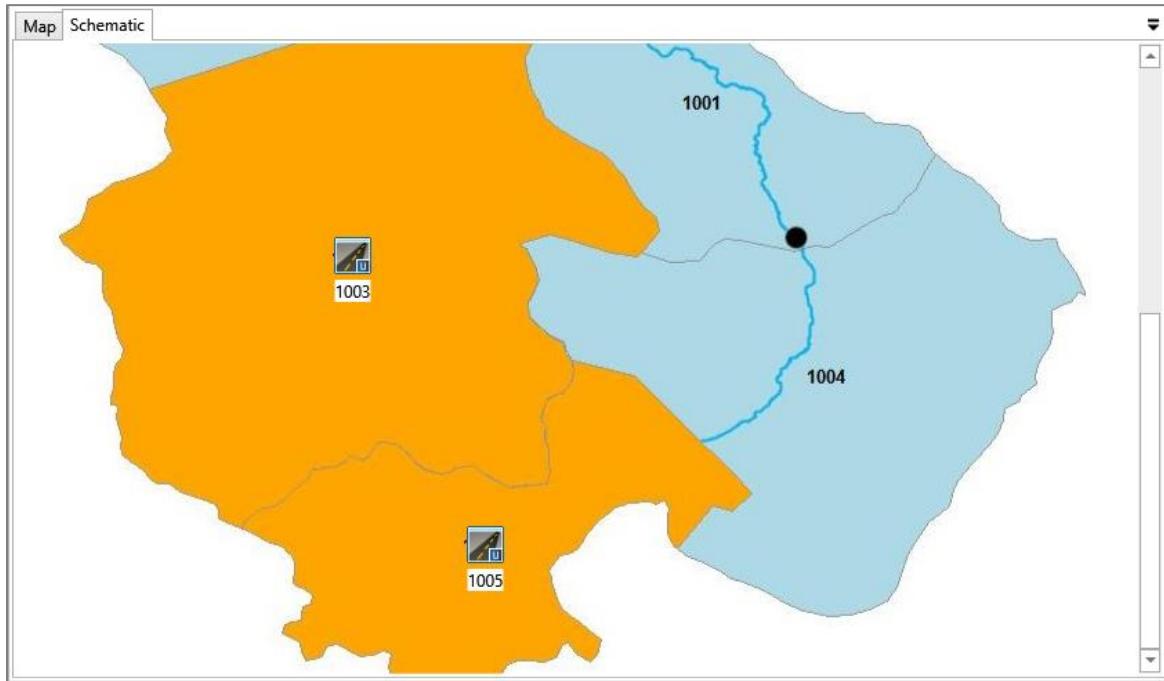
Select **StandHyd** in the **Tool Box**, drag it to the desired location (somewhere in sub-catchment 1003 in this case) on the canvas and release it. A new StandHyd will be created in the given location with all default parameters. Change the Name (and NHYD) to 1003 in the property grid. Spend some time to see what parameters are available and what are the default values. Notice that a default hyetograph has been created and assigned to the new StandHyd.

# Exercise #1 - Creating a VO model in Schematic View



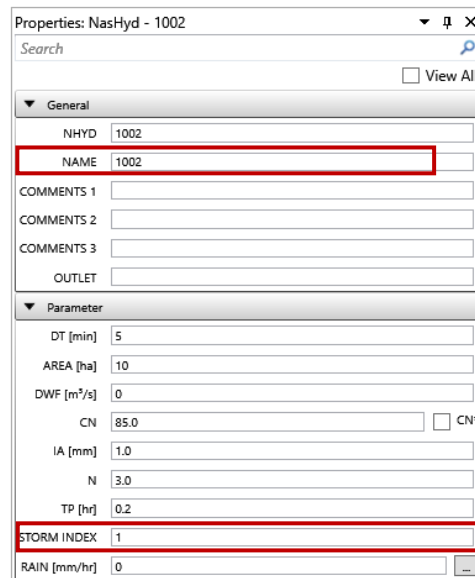
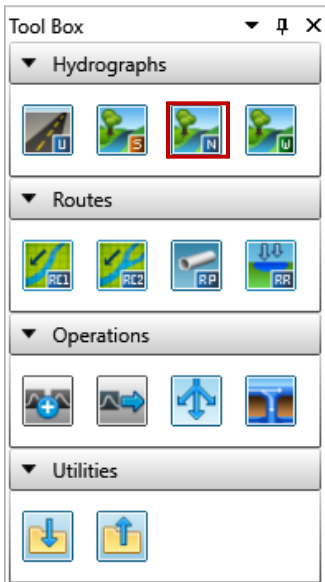
## Exercise #1 - Creating a VO model in Schematic View

Continue to add another StandHyd for sub-catchment 1005 and rename it as 1005. At this stage, the canvas will be like the one shown below.



### 4. Create a NasHyd for three rural sub-catchments (1001, 1002, 1004)

Use the same method to create the three NasHyds. Select the NasHyd in the tool box as shown below. Rename them as 1001, 1002 and 1004. Spend time to explore the parameters of NasHyd and see what are the differences as compared to StandHyd.



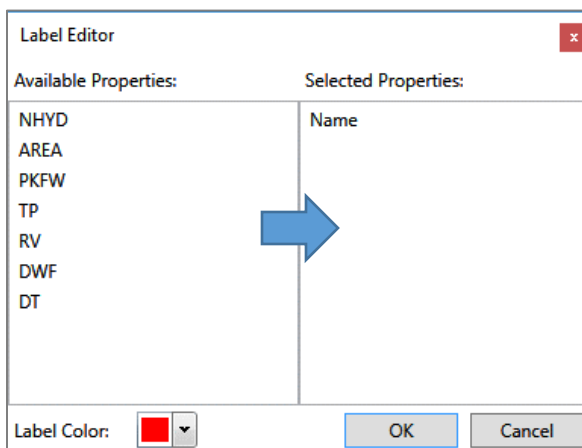
## Exercise #1 - Creating a VO model in Schematic View

After this step, the canvas will appear similar to the one shown below.



### 5. Label Hydrologic Objects

Choose the five hydrologic objects by drawing a rectangle on the Canvas. Right click and select **Set labels...** to open the **Label Editor** window as shown below.



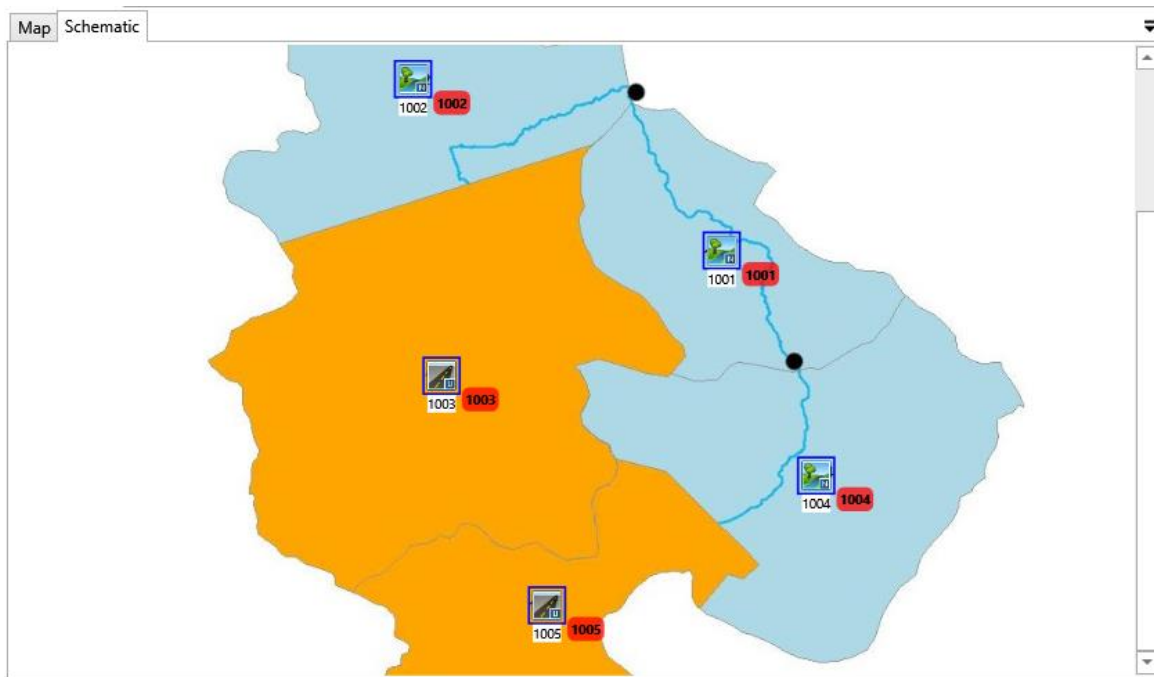
The window lists all available properties that could be added as a label. Notice that some of them are hydrograph summaries which will only have a value after the simulation, e.g. PKFW and TP. As no results are available at this stage, only add **Name** as the label property. To do this, you need to select **Name** and drag it to the right panel.

Also choose a background colour for the label at the bottom of the window. At this stage, the Label window will be similar to the one shown below. Click **OK** to apply the settings.

## Exercise #1 - Creating a VO model in Schematic View

The label doesn't show up on the Canvas after the setup because labels are not visible by default. To show the labels, keep the hydrologic objects selected and right-click on the Canvas again and choose **Show Labels**. The labels will be shown on the Canvas as the one shown below.

Note that the settings only apply for selected hydrologic objects. If one hydrologic object is not selected, the label will not be added.

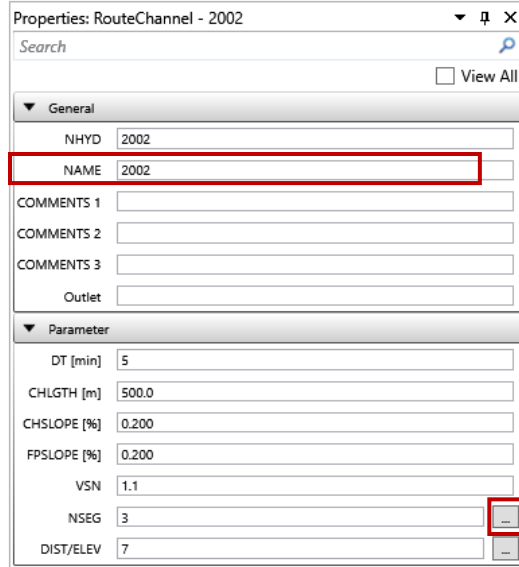
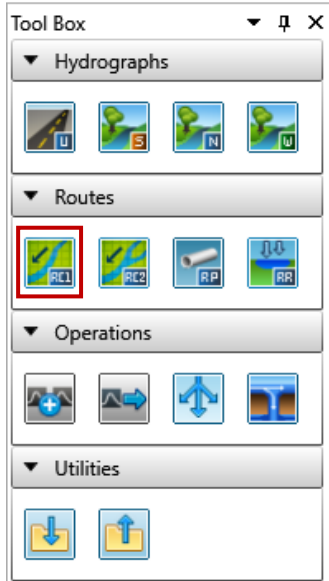


### 6. Create three RouteChannels for channels located in sub-catchment 1001, 1002 and 1003

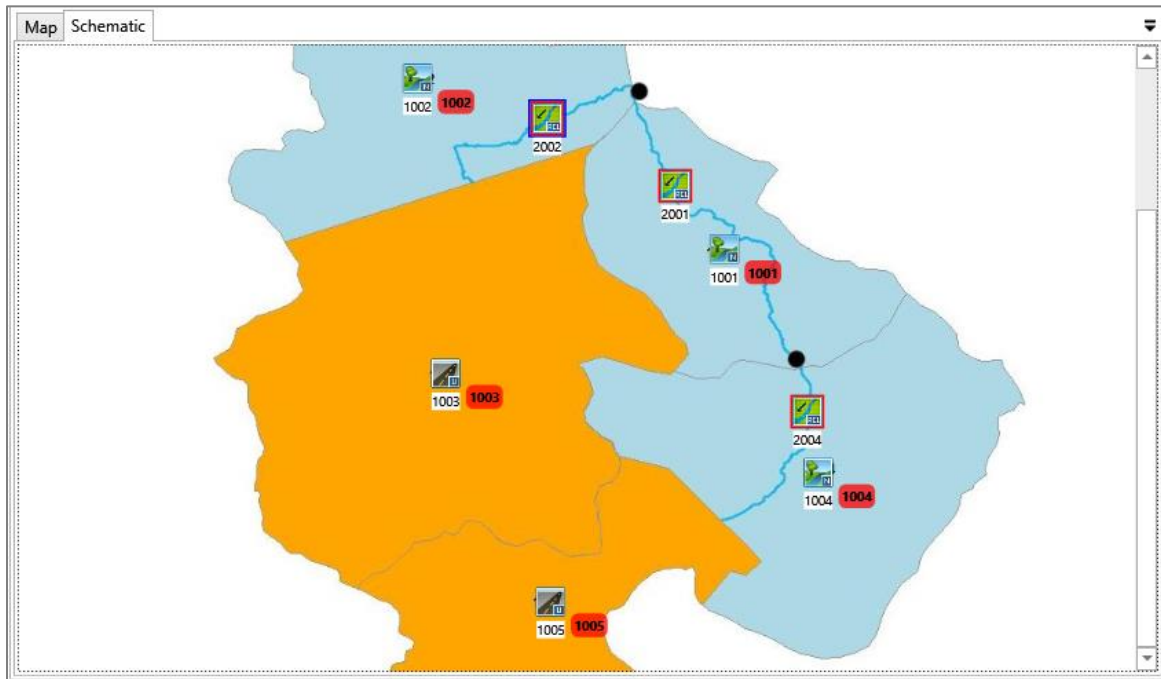
StandHyd and NasHyd generate hydrographs. These hydrographs are then passed through channels by RouteChannel to the downstream.

To create a RouteChannel, select RouteChannel in the tool box and drag it to the Canvas. Put it on the channels it will simulate. Move other hydrologic objects if necessary to allow a clear distribution. Name them as 2001, 2002, and 2004 respectively. Spend time to explore all the parameters. Click the buttons to see further information if necessary.

## Exercise #1 - Creating a VO model in Schematic View



At this stage, the Canvas will be similar to the one shown below. Note that the symbol for the three routechannels are red-outlined, which means there are errors associated with them. Error details can be found in the Error List window usually located at bottom. It says "A source link is required", which reminds the user that the routechannel must have an input. This error will be fixed in the next step.



## Exercise #1 - Creating a VO model in Schematic View

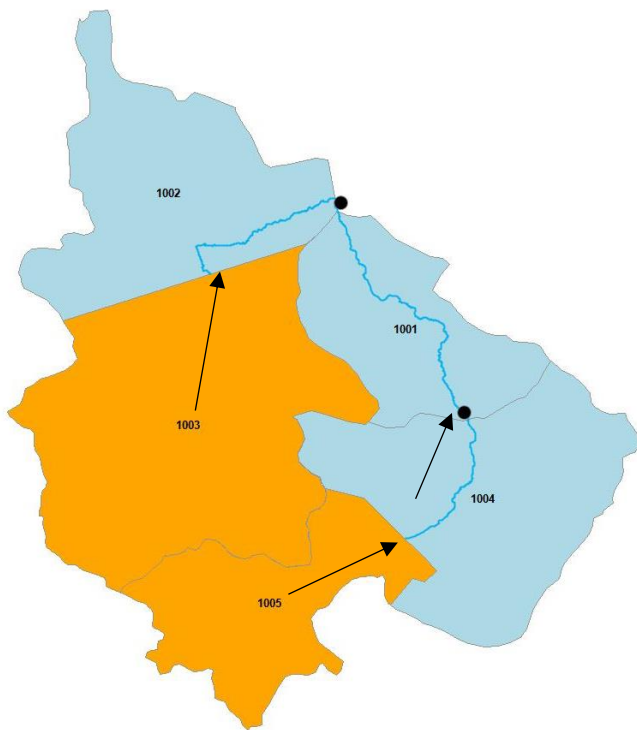
Error List

✖ 0 Scenario Errors | ✖ 3 Glyph Errors | ⚠ 8 Glyph Warnings

	NHYD	Name	Type	Message
✖	2002	2002	RouteChannel	A source link is required.
✖	2001	2001	RouteChannel	A source link is required.
✖	2004	2004	RouteChannel	A source link is required.

### 7. Connect StandHyd and NasHyd to downstream RouteChannels

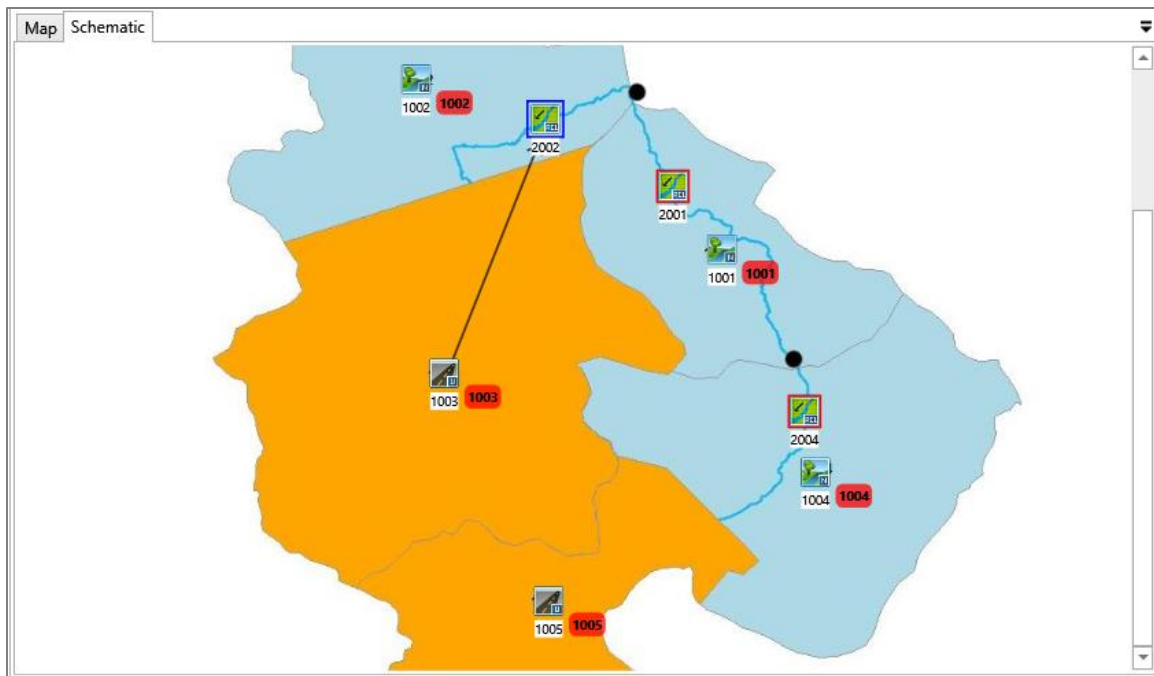
The hydrograph generated at StandHyd and NasHyd will go to downstream channels as shown below. If there is no channel available downstream, it will go out of the system, which could be represented by an AddHyd.



The connection is represented by a connector between StandHyd/NasHyd and RouteChannel/AddHyd. To add a connection, move the cursor on top of the StandHyd/NasHyd. Notice that the curve changes to a cross. Then press the left mouse button and move to the hydrologic object it will be connected to. An arrowed line will be created and it will point from the source to the destination as shown below.



## Exercise #1 - Creating a VO model in Schematic View



Notice that outlet of the StandHyd is set to the ID of the connected RouteChannel automatically.

Properties: StandHyd - 1003

Search

View All

General

NHYD	1003
NAME	1003
COMMENTS 1	
COMMENTS 2	
COMMENTS 3	
OUTLET	2002

The connector could also be created by changing the outlet property directly. To do this, choose StandHyd 1005 on the Canvas and change the outlet to 2004 in the property grid. Notice that a connector is added automatically on the Canvas pointing from StandHyd 1005 to RouteChannel 2004.

## Exercise #1 - Creating a VO model in Schematic View

Properties: StandHyd - 1005

Search

View All

▼ General

NHYD

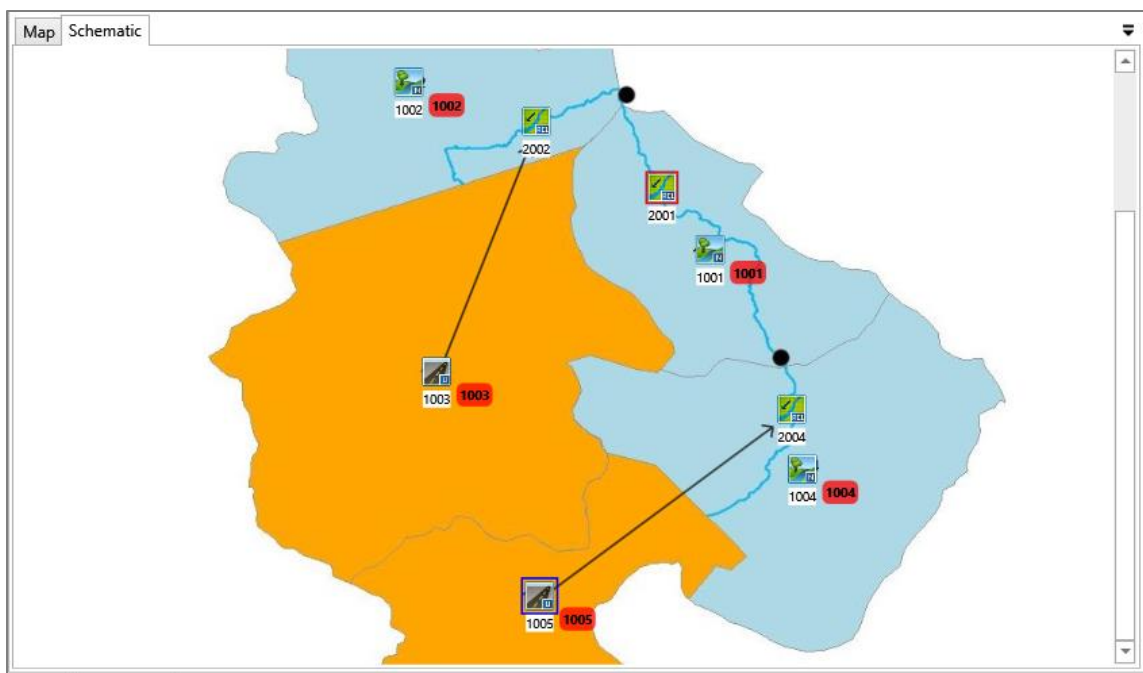
NAME

COMMENTS 1

COMMENTS 2

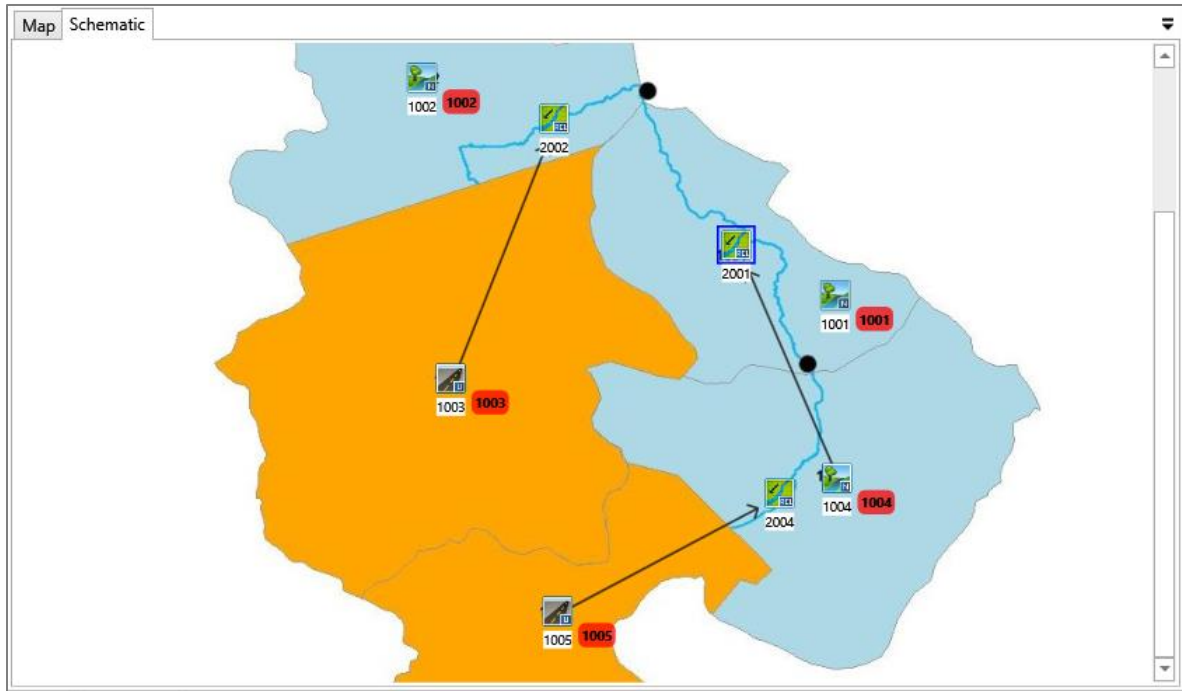
COMMENTS 3

**OUTLET**



Continue to connect NasHyd 1004 to RouteChannel 2001 either by drawing on the Canvas or by editing the outlet property. Move the hydrologic objects around to avoid the connector crossing any other hydrologic objects. The Canvas will be similar to the one shown below.

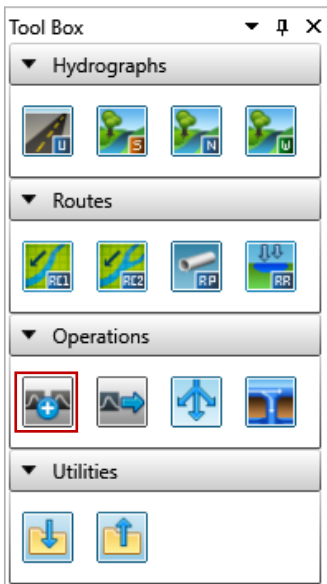
## Exercise #1 - Creating a VO model in Schematic View



### 8. Create AddHyds and connect all hydrologic objects together

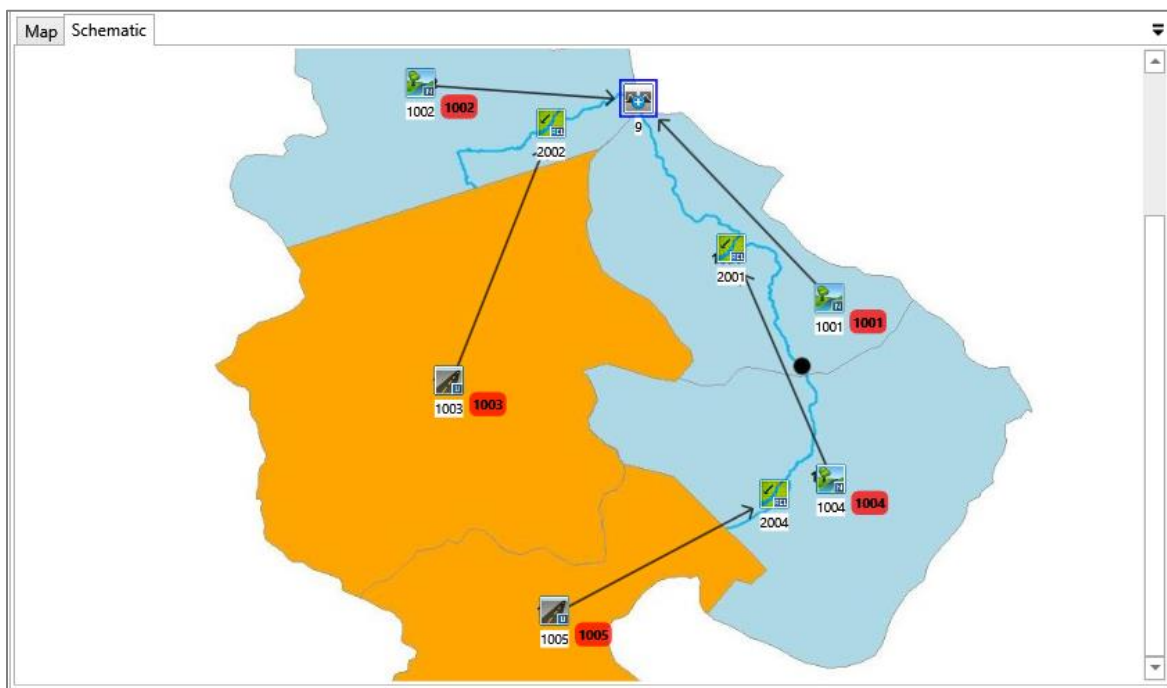
Now, two StandHyds and one NashHyd have been connected to the RouteChannel. The other two NashHyds don't have a downstream channel. Instead, all the hydrographs will be added together at the watershed outlet. To represent this, add an AddHyd to add hydrographs from these two NashHyds.

To create an AddHyd, choose AddHyd in the tool box and drag to the desired location on the Canvas. In this case, put the AddHyd at the watershed outlet. Then, add a connector from the two left NashHyds (1002, 1001) to this AddHyd.

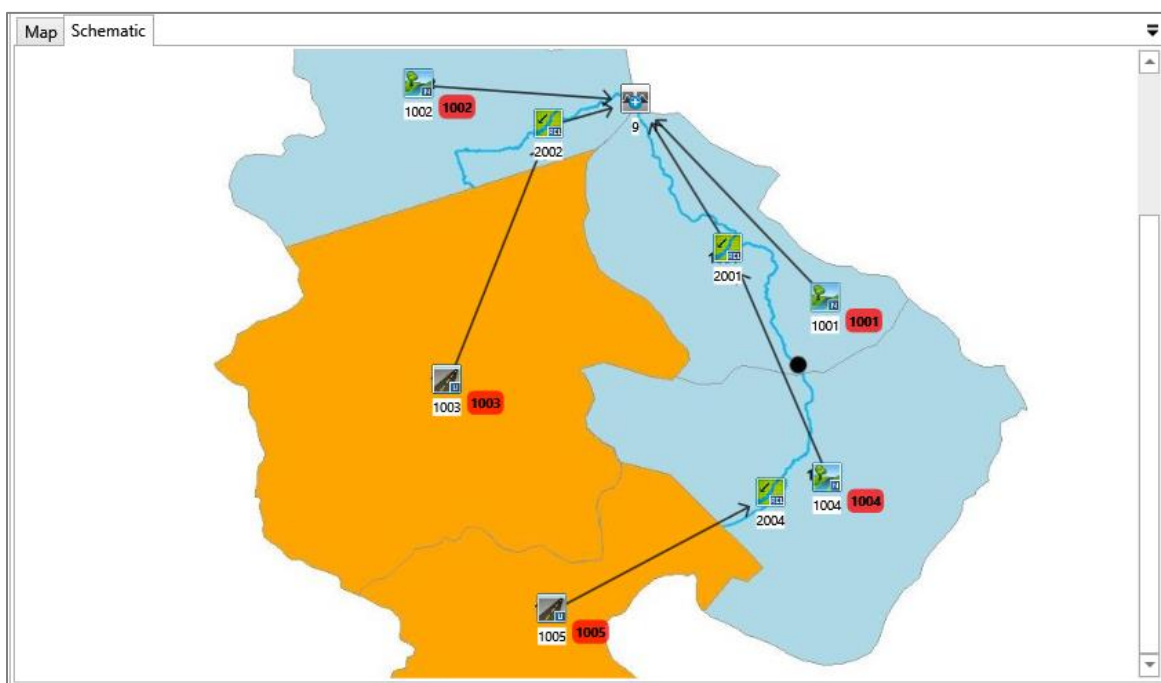


## Exercise #1 - Creating a VO model in Schematic View

The Canvas will be similar to the one shown below.



The two channels (2002 and 2001) also flow to the outlet. To represent this, connect the two channels to the newly-created AddHyd as shown below.



Now, most of the hydrologic objects are connected together except Channel 2004. This channel is located upstream of Channel 2001. To represent this, a connector can be added to connect them together. As a RouteChannel can only have one input link and Channel 2001

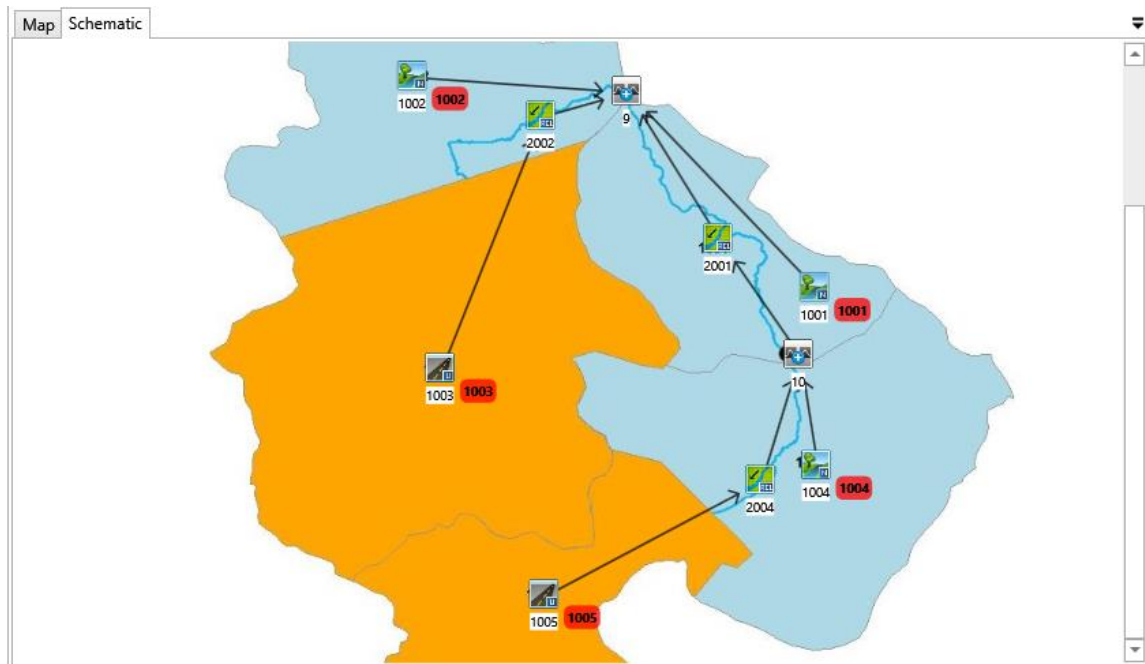
## Exercise #1 - Creating a VO model in Schematic View

already has an input link from NasHyd 1004, an AddHyd can be added to join Channel 2004 and NasHyd 1004 together and then output to Channel 2001.

To do this, follow the steps below.

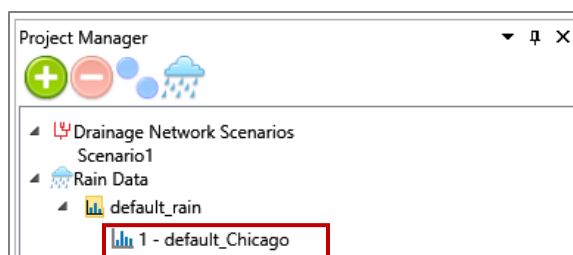
- 1) Add another AddHyd at the end of channel 2004 and add a connector from RouteChannel 2004 to this AddHyd.
- 2) Delete the connector between NasHyd 1004 and RouteChannel 2001 and add a new connector from NasHyd 1004 to the new AddHyd.
- 3) Connect the new AddHyd to Channel 2001.

Now, the Canvas will be similar to the one shown below. All hydrologic objects are created and connected together. We are ready to set up the hyetograph and run the simulation.

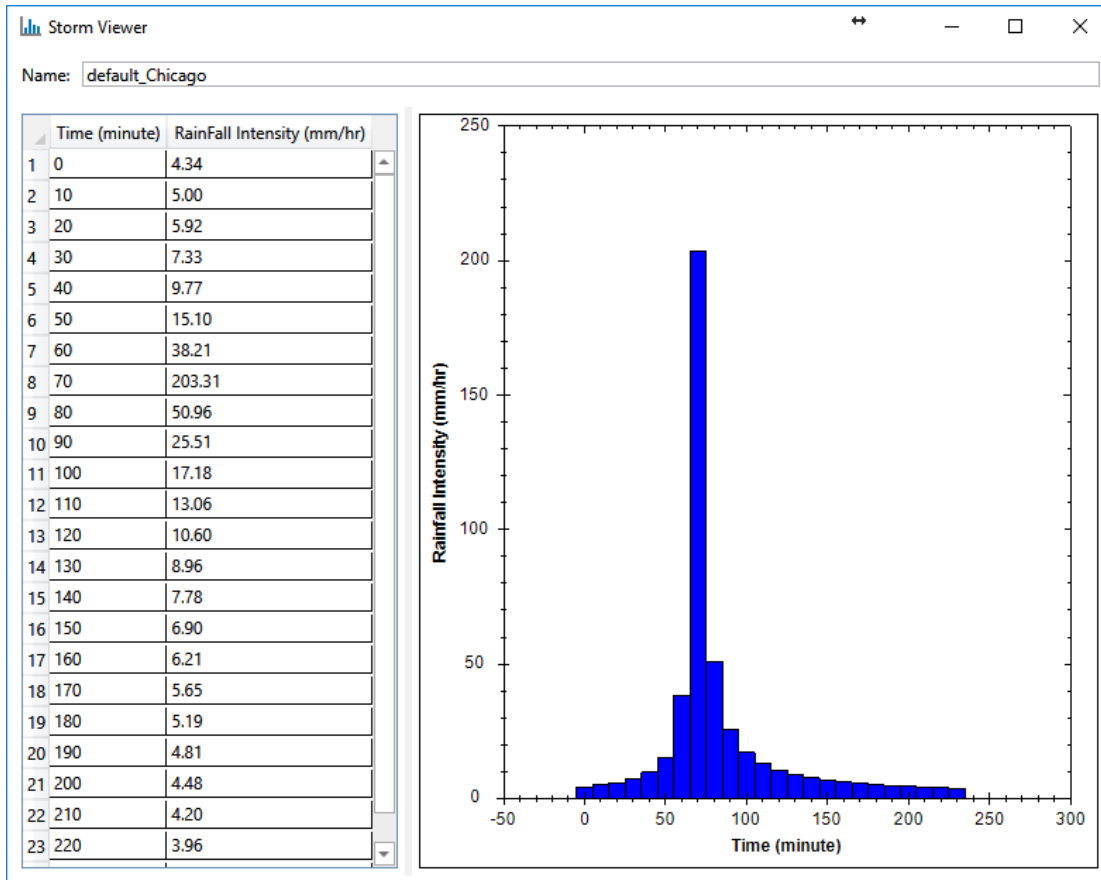


### 9. Check the Default Hyetograph


A default hyetograph has been created in the model. It's a Chicago design storm lasting for four hours and with total rainfall volume of 78mm. Double-click the "1-default\_Chicago" in **Project Manager** to open the **Storm Viewer** window to see the details. It will be the hyetograph for the simulation.

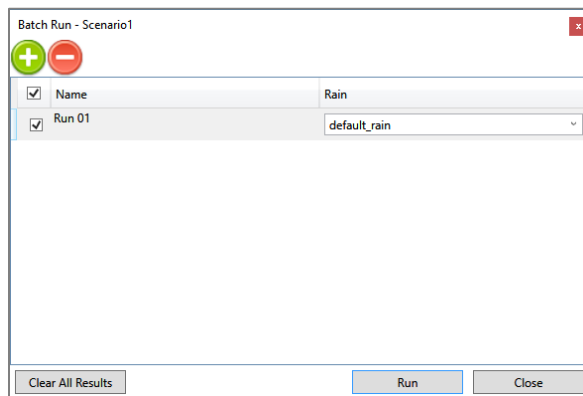


## Exercise #1 - Creating a VO model in Schematic View



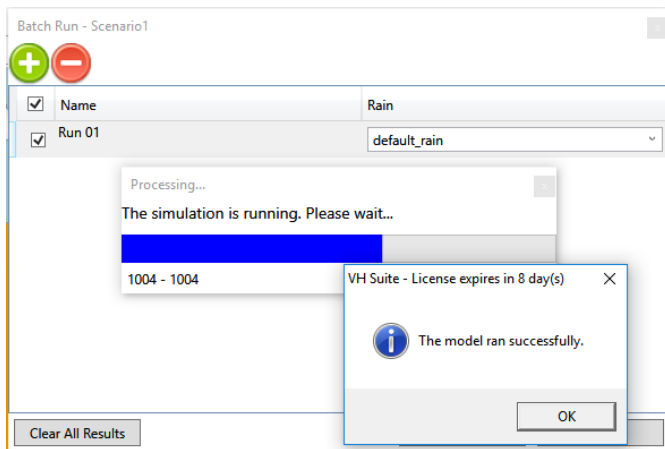
### 10. Run the Simulation

Click the **Run** button  located at the **Simulation** ribbon to open the **Batch Run** window. Simulation runs can be created for different storms. A default simulation has been created to run the model with the default rain. We will use this default simulation to run the model.



Click the **Run** button to run the model. Notice that a progress bar is given to show the progress and a message window is given upon the successful completion of the run.

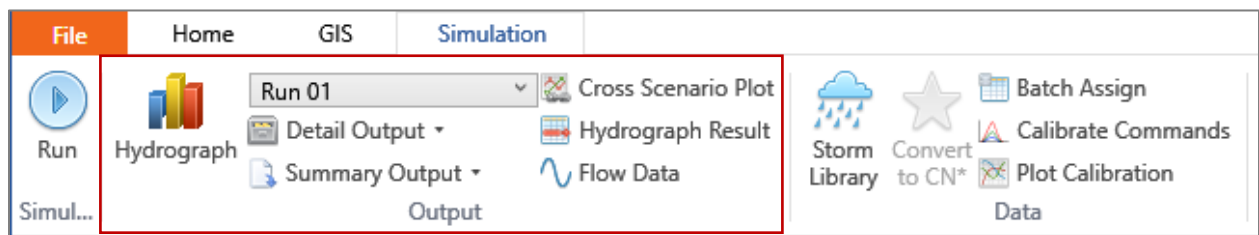
## Exercise #1 - Creating a VO model in Schematic View




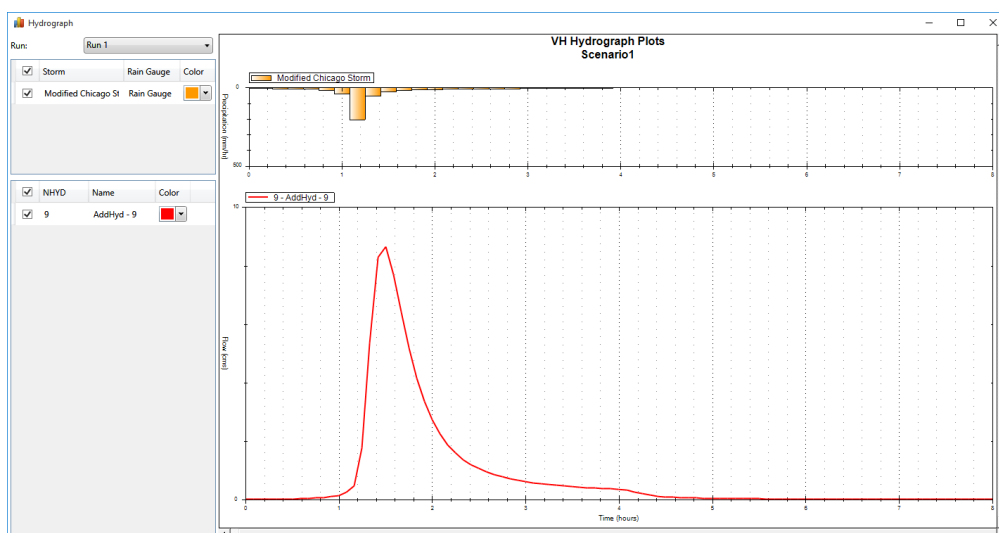
### 11. View Outputs

A hydrograph is the main output in VO. It can be viewed by graph, table, summary text and label.

Select the AddHyd located at the outlet on the Canvas. Notice that the buttons located at the **Output** section in the **Simulation** ribbon are enabled. All these buttons are used to view results in a different format.

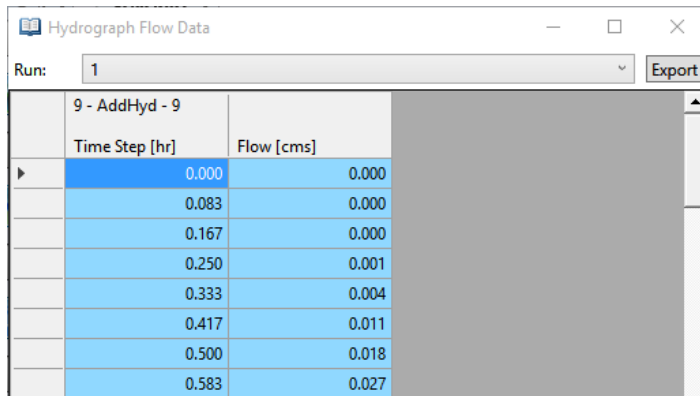


1) The **Hydrograph** button  gives the hydrograph graph. The hydrograph is shown on the top. Multi-graph can be shown here for comparison.




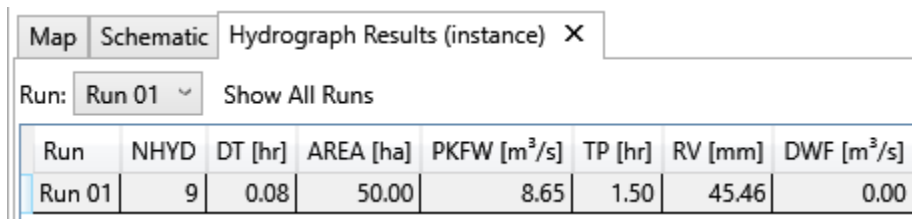
Exercise #1 - Creating a VO model in Schematic View

2) The **Flow Data** button  gives the hydrograph table.



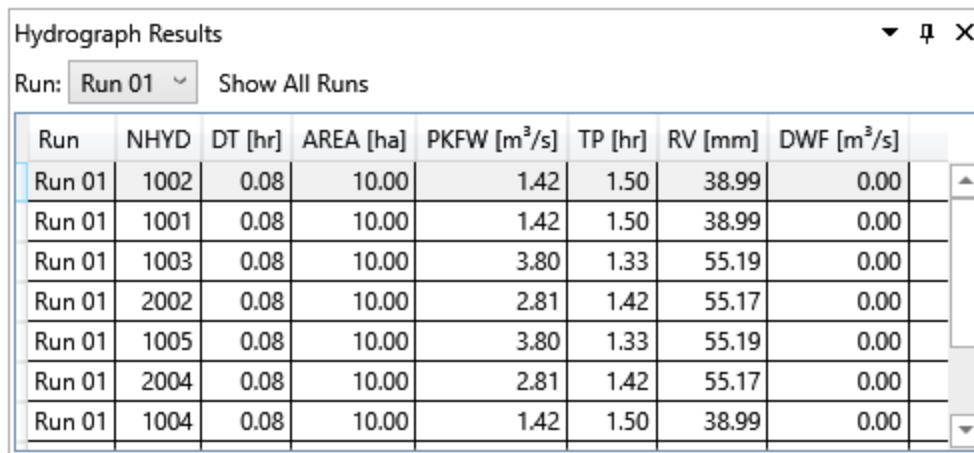
Time Step [hr]	Flow [cms]
0.000	0.000
0.083	0.000
0.167	0.000
0.250	0.001
0.333	0.004
0.417	0.011
0.500	0.018
0.583	0.027

3) The **Hydrograph Result** button  gives a summary of the hydrograph in table format.



Run	NHYD	DT [hr]	AREA [ha]	PKFW [m³/s]	TP [hr]	RV [mm]	DWF [m³/s]
Run 01	9	0.08	50.00	8.65	1.50	45.46	0.00

The same information is also shown in the **Hydrograph Results** window at the bottom of the application window.



Run	NHYD	DT [hr]	AREA [ha]	PKFW [m³/s]	TP [hr]	RV [mm]	DWF [m³/s]
Run 01	1002	0.08	10.00	1.42	1.50	38.99	0.00
Run 01	1001	0.08	10.00	1.42	1.50	38.99	0.00
Run 01	1003	0.08	10.00	3.80	1.33	55.19	0.00
Run 01	2002	0.08	10.00	2.81	1.42	55.17	0.00
Run 01	1005	0.08	10.00	3.80	1.33	55.19	0.00
Run 01	2004	0.08	10.00	2.81	1.42	55.17	0.00
Run 01	1004	0.08	10.00	1.42	1.50	38.99	0.00



Exercise #1 - Creating a VO model in Schematic View

- 4) The **Detail Output** button  gives the detailed text output.

Detail - All Runs X Map Schematic Hydrograph Results (instance)

```

*****
** SIMULATION:Run 01 **
*****

-----
| ADD HYD ( 0009) |
| 1 + 2 = 3 |
-----
ID1= 1 ( 1001):   AREA      QPEAK      TPEAK      R. V.
+ ID2= 2 ( 1002):  (ha)      (cms)      (hrs)      (mm)
                  10.00    1.416     1.50     38.99
-----
ID = 3 ( 0009):   20.00    2.833     1.50     38.99
-----

NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-----

```

Note that information shown is dependent on the selected hydrologic objects. The detail information for NasHyd 1002 is shown below.

Detail - All Runs X Map Schematic Hydrograph Results (instance)

```

*****
** SIMULATION:Run 01 **
*****

-----
| CHICAGO STORM |
| Ptotal= 78.03 mm |
-----

IDF curve parameters: A=1770.000
                      B= 4.000
                      C= 0.820
used in:  INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step   = 10.00 min
Time to peak ratio = 0.33

      TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
      hrs     mm/hr |    hrs     mm/hr |    hrs     mm/hr |    hrs     mm/hr
0.17   4.34 | 1.17   38.21 | 2.17   10.60 | 3.17   5.19
0.33   5.00 | 1.33  203.31 | 2.33   8.96 | 3.33   4.81
0.50   5.92 | 1.50   50.96 | 2.50   7.78 | 3.50   4.48
0.67   7.33 | 1.67   25.51 | 2.67   6.90 | 3.67   4.20
0.83   9.77 | 1.83   17.18 | 2.83   6.21 | 3.83   3.96
1.00  15.10 | 2.00   13.06 | 3.00   5.65 | 4.00   3.74
-----

```

- 5) The **summary output** button gives a summary text output.

Map Schematic Hydrograph Results (instance) Summary - All Runs X

```

*****
** SIMULATION:Run 01 **
*****
*   ADD [ 1001+ 1002] 0009 3 5.0    20.00  2.83  1.50  38.99  n/a  0.000
*
*   ADD [ 0009+ 2001] 0009 1 5.0    40.00  6.27  1.50  43.03  n/a  0.000
*
*   ADD [ 0009+ 2002] 0009 3 5.0    50.00  8.65  1.50  45.46  n/a  0.000
*

```

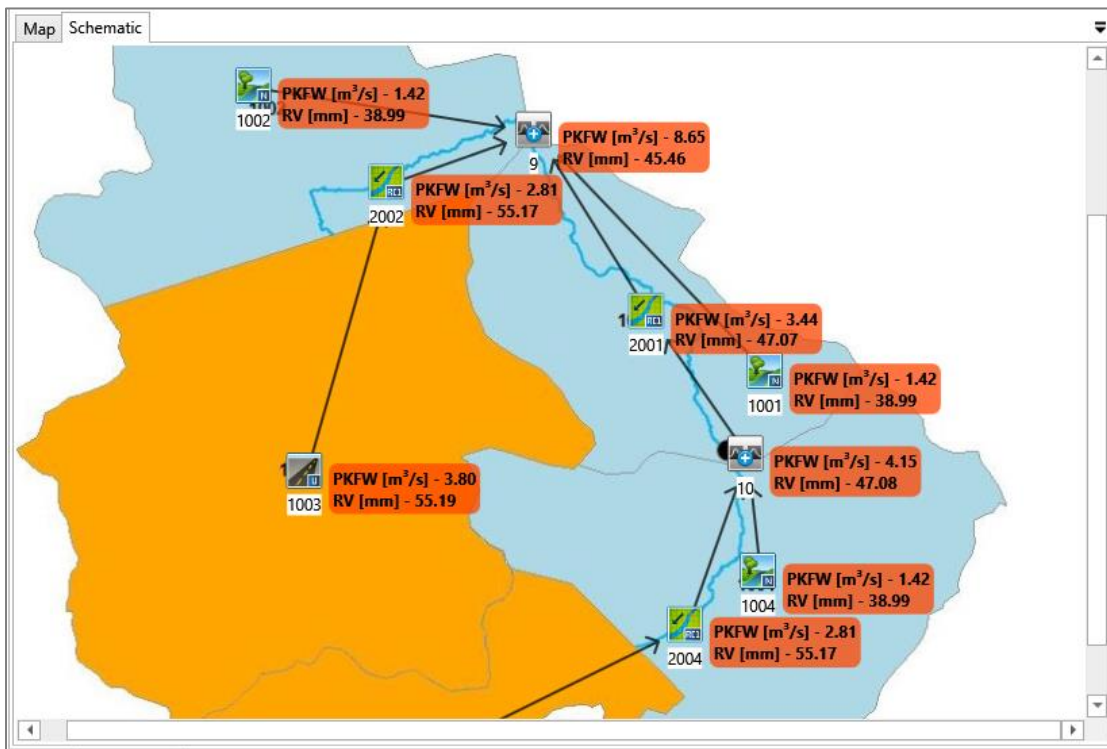
## Exercise #1 - Creating a VO model in Schematic View

The output is dependent on the type of hydrologic object. For NasHyd 1002, the output is similar the one show below.


Map	Schematic	Hydrograph Results (instance)	Summary - All Runs	X
*****				
** SIMULATION:Run 01 **				
*****				
CHIC STORM 10.0				
[ Ptot= 78.03 mm ]				
*				
** CALIB NASHYD 1002 1 5.0 10.00 1.42 1.50 38.99 0.50 0.000				
[ CN=80.0 ]				
[ N = 3.0:Tp 0.20 ]				
*				

Notice that the numbers shown here are the same as the ones in the Hydrograph Result.

6) The summaries can also be labeled on the Canvas by using the **Label Editor**.



## 12. Save and Close the Project

Since all the work is done, we want to save all of our work. Click the **Save Project** button  to save all information (including all hydrologic objects and storms) to a project file. Now, it's safe to close the application.