Works 2013

Design sewer collector

WHITEPAPER

TECHNO logismiki
Advanced Technical Software

5 Imitou str, 15561, Cholargos, Athens, Greece
tel: ++30 210 65 64 147 - fax: ++30 210 65 48 461
www.technologismiki.com - info@technologismiki.com

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1 About the whitepaper

1.1 Purpose

Note that the procedures presented herein are not necessarily optimum. The purpose of this whitepaper is to demonstrate the main features and capabilities of the program through a small example.

Also note that the metric unit system and Greek regulations are used with this example. This is not restrictive, as different unit systems and regulations can be used.

The purpose of this whitepaper is the design of a sewer collector that will be built for the needs of a village. The area of the village is 50 hectares (ha). The collector has a length of 1000m. The population of the village was 498 persons in 1991 and 544 persons in 2001. The design of the collector should follow the Greek regulations.

The known ground elevations are as follows:

Stations	Ground Elevations (m)
0+000	150
0+140	147
0+160	147.5
0+260	145.4
0+400	145
0+420	144.8
0+600	142.3
0+620	142.7
0+640	142.3
0+800	141.2
0+960	140.5
1+000	140.2

Nevertheless, the distances between the check points should be taken equal to 20m. The collector handles sewage from domestic use only. The Manning friction formula will be used.

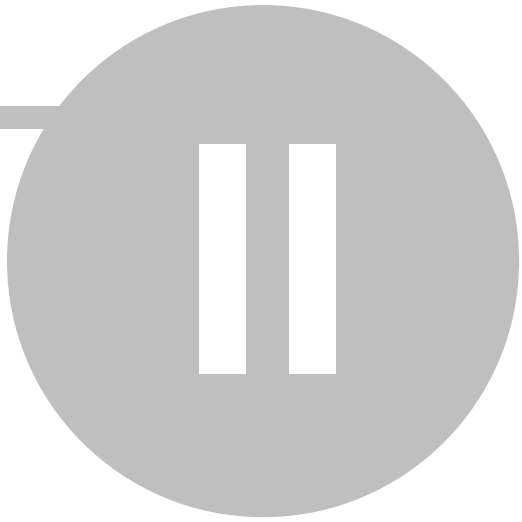
1.2 Software

In order to complete the example successfully, the following software is required:

- Sewer Networks v11.0.

Later versions of the aforementioned software may be incompatible with the structure of the example as it is presented herein.

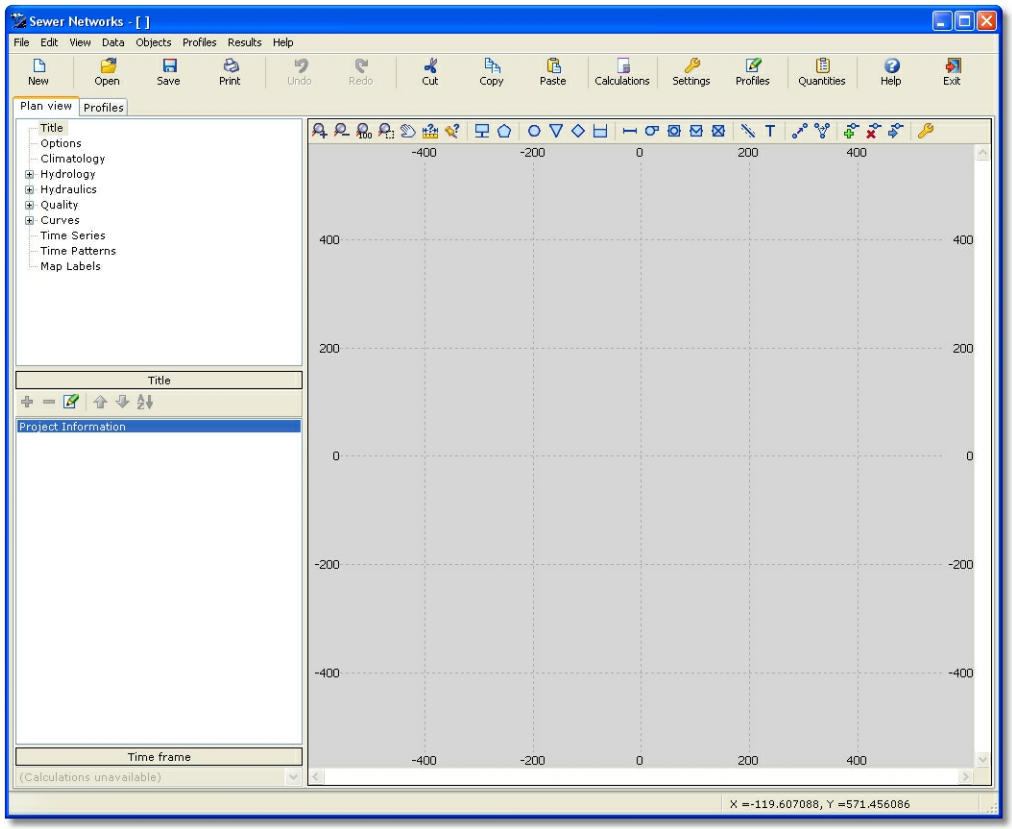
Chapter



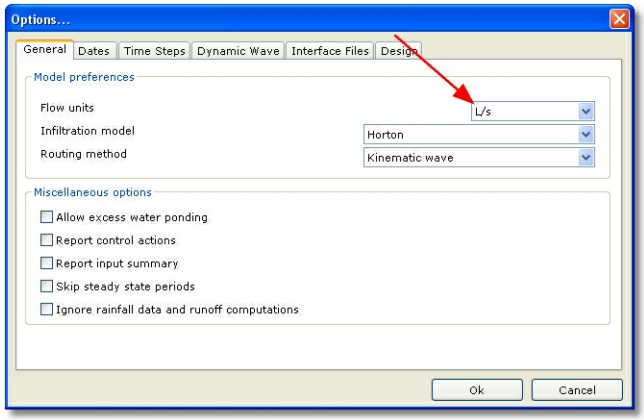
2 Steps

2.1 Step 01: New Project

Select **New Project** from the **File** menu. The program will remove any data from memory and prepare to start a new project:



In case of sewer networks, the flows are in general small. It is convenient to use L/s instead of m^3/s. From the menu, select **Data > General Data > General** and select **L/s** as flow units**:**



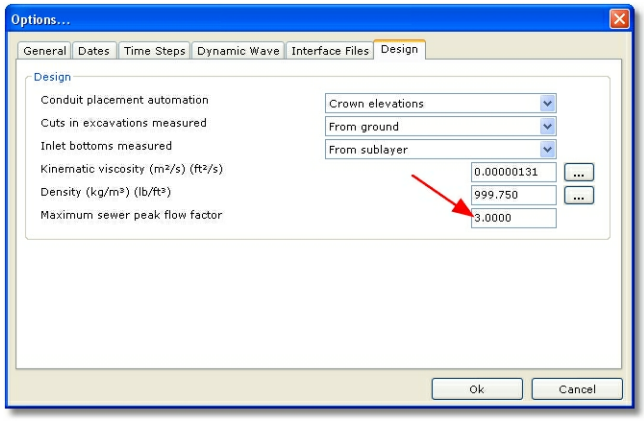
Press **Ok.**

2.2 Step 02: Regulations and Runoff Areas

First we will select the regulations. From the menu, select **Data > Options > Algorithm:**

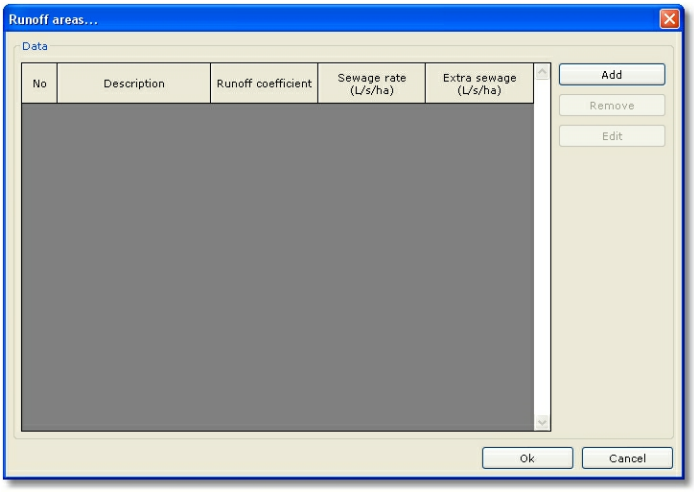
Select the **peak coefficient** to be evaluated according to **Greek Regulations 696/64** and the **extra flow rate** to be taken from **user values.** Press **Ok** to close the form.

From the menu, select **Data > General Data > Design.** Type **3.0** as the **maximum sewer peak flow factor:**

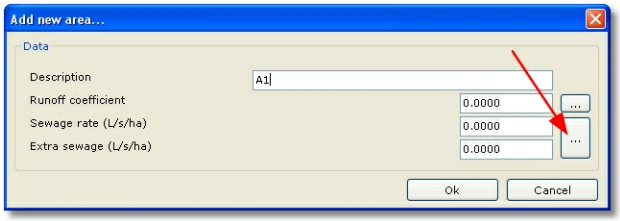


According to Greek Regulations, the maximum sewer peak flow factor cannot exceed 3.0.

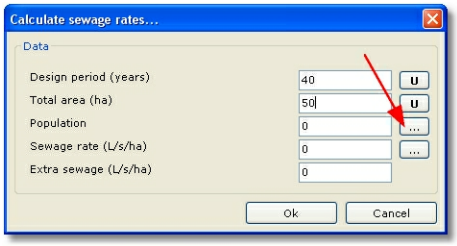
Next, we will define the characteristics of the runoff areas. Select **Data > Runoff areas:**



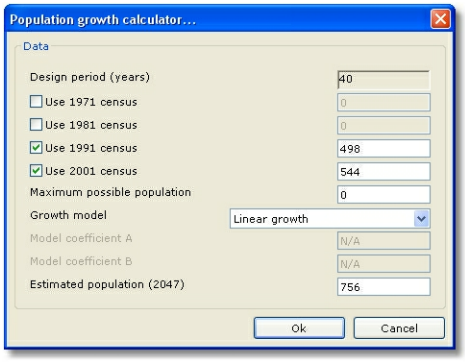
Press **Add** to add a new area:



Type **A1** as the description of the new area. The runoff coefficient is irrelevant in this case. To evaluate the **sewage rate**, click the button with the ellipses ("...") in the previous picture. The following form appears:



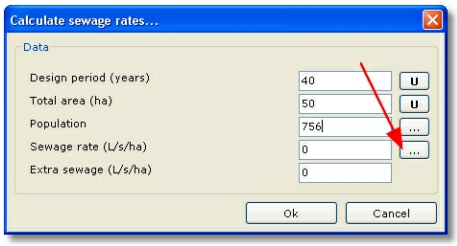
Set the **design period** equal to 40 years and the **total area** equal to 50 ha. The **population** is unknown and must be estimated. Click the button with the ellipses ("...") in the previous picture. The following form appears:



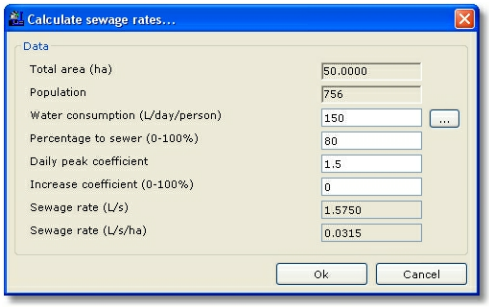
Fill the data for the 1991 and 2001 census and deselect the use of 1971 and 1981 census. The maximum possible population is an upper limit to the population and depends on the characteristics of the village. Depending on the amount of entries, various growth models may be employed. In this case, only the linear and exponential growth are available.

Assuming that we choose the linear growth model, the estimated population is 756 persons. Press **Ok.**

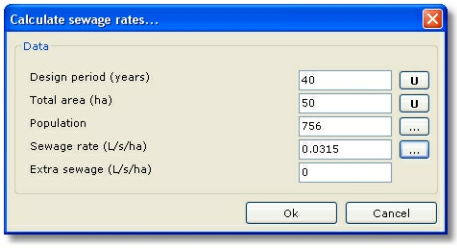
To estimate the sewage rate, click the button with the ellipses ("...") in the following picture:



The following form appears:

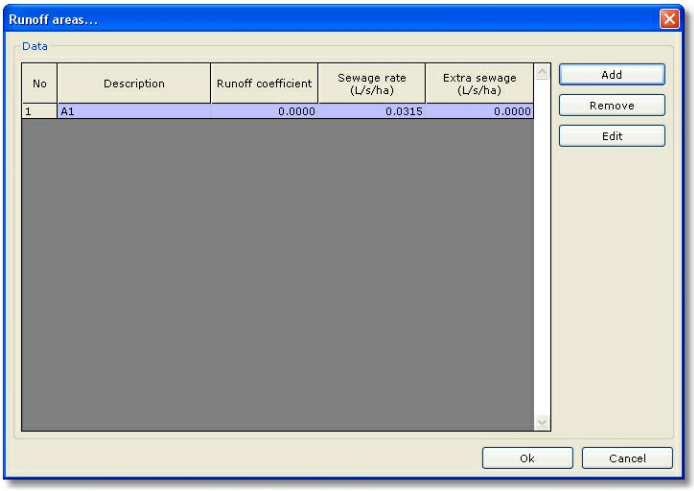


Typical values include **water consumption** equal to 150 L /day /person, **80%** of the water consumption ends up in the sewer and the **daily peak coefficient** is set equal to **1.5.** Press **Ok** to accept the calculated values of **sewage rate** and return to the previous form:



Assuming that the **extra sewage** is equal to 10% of the sewage rate, enter **0.0031 L /s /ha** in the corresponding field. Press **Ok.**

Press **Ok** again to add the area to the list:

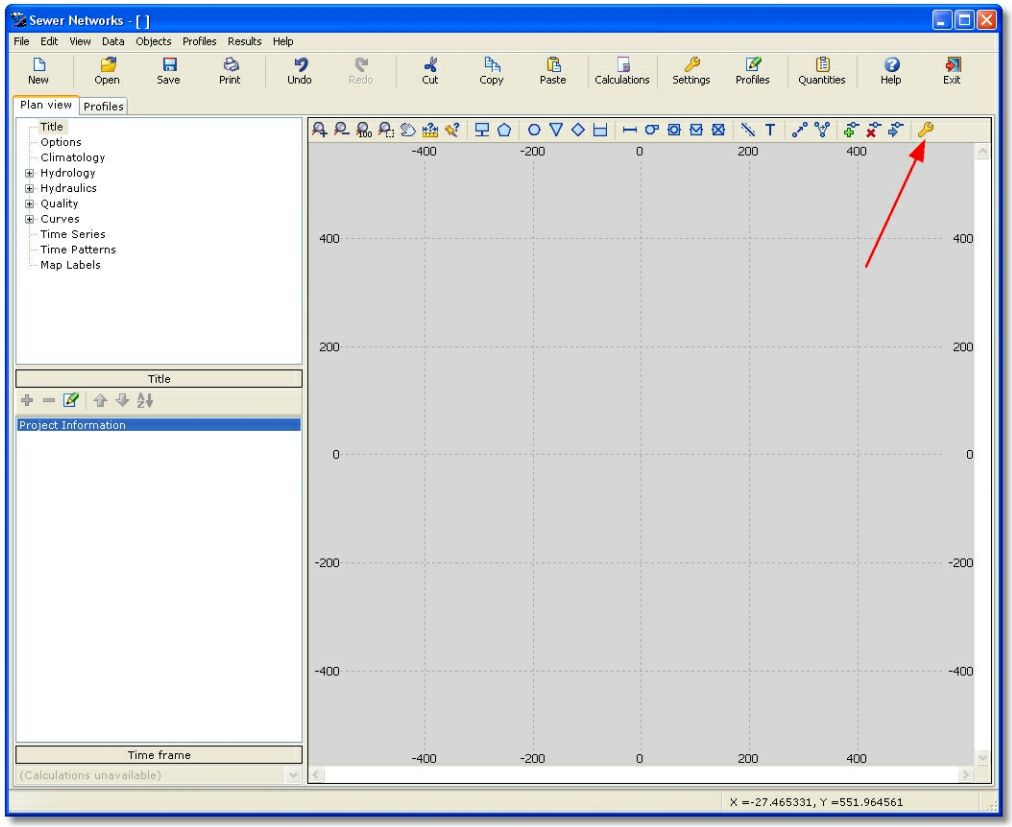


Press **Ok** to close the form.

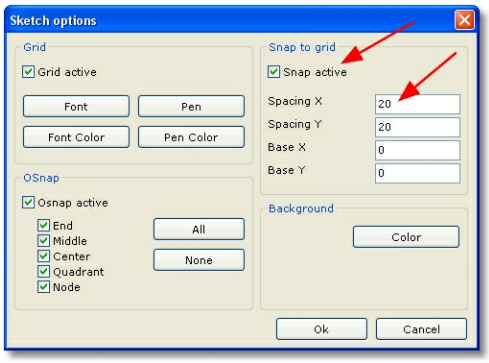
2.3 Step 03: Network

In this step, you will define the network and its connectivity.

Since there is no plan view, the distances between check points will be input explicitly. Alternatively, you can activate the snap to a 20 * 20m grid. Click the **options** button in the plan view:

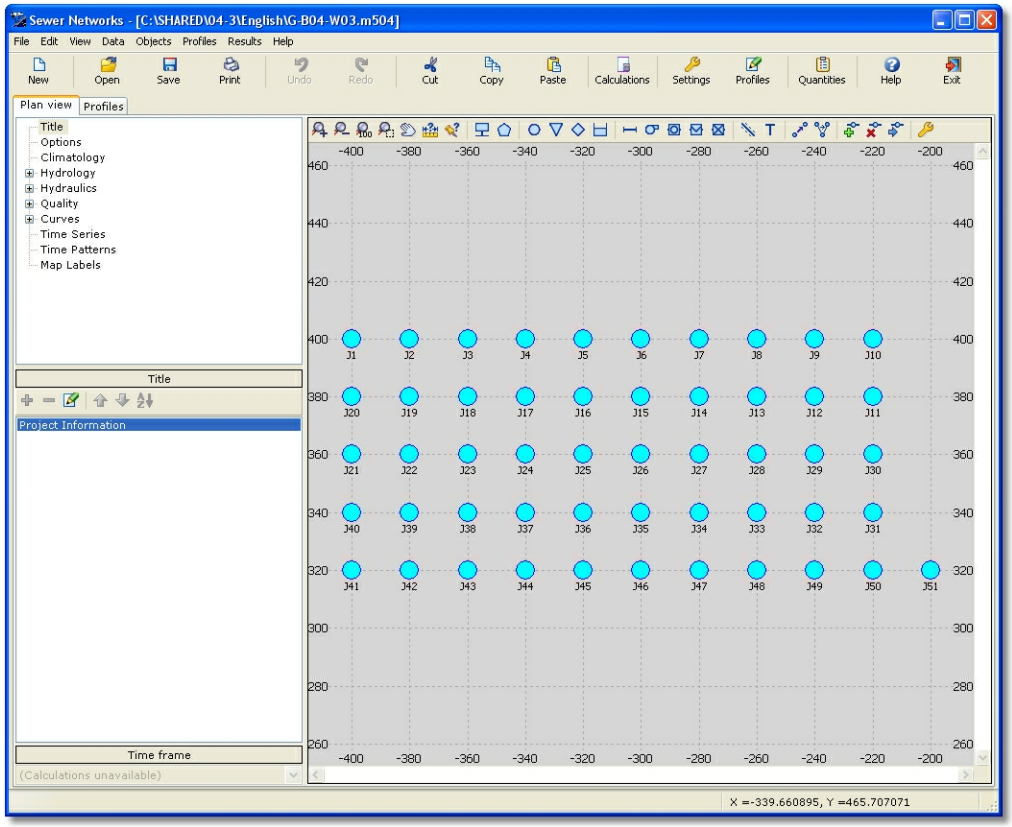


The following form will appear:

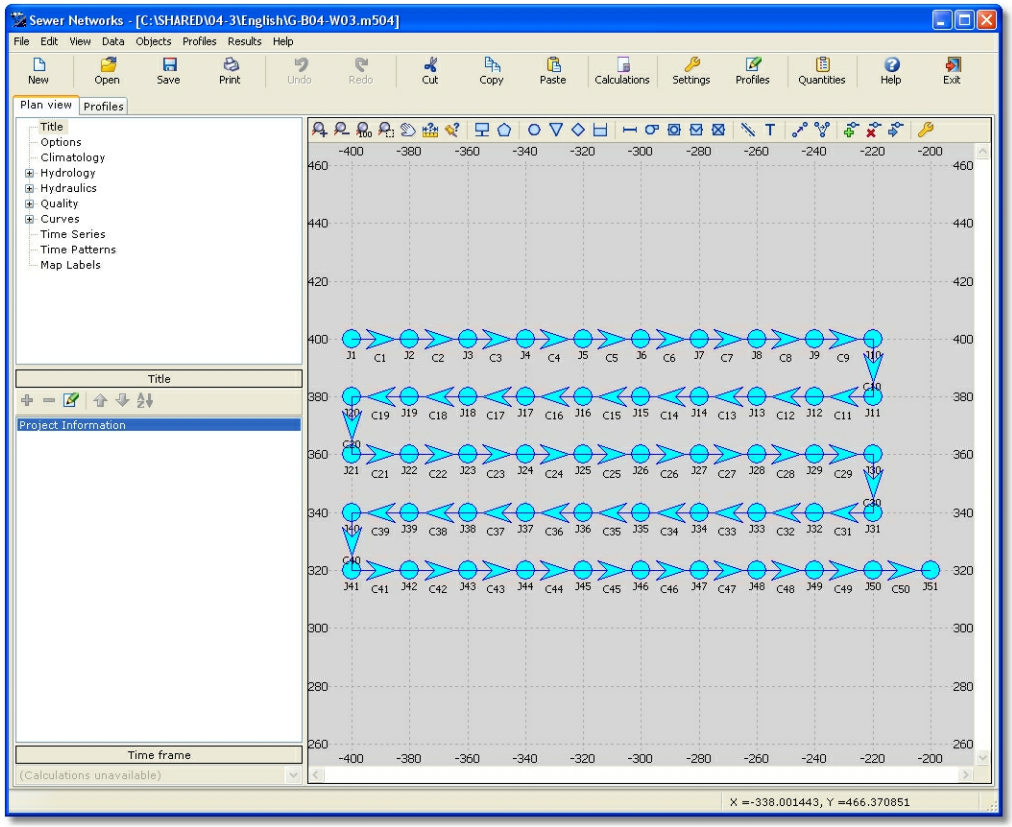


Check **Snap active** and set the **spacing X** and **spacing Y** equal to 20. Press **Ok.**

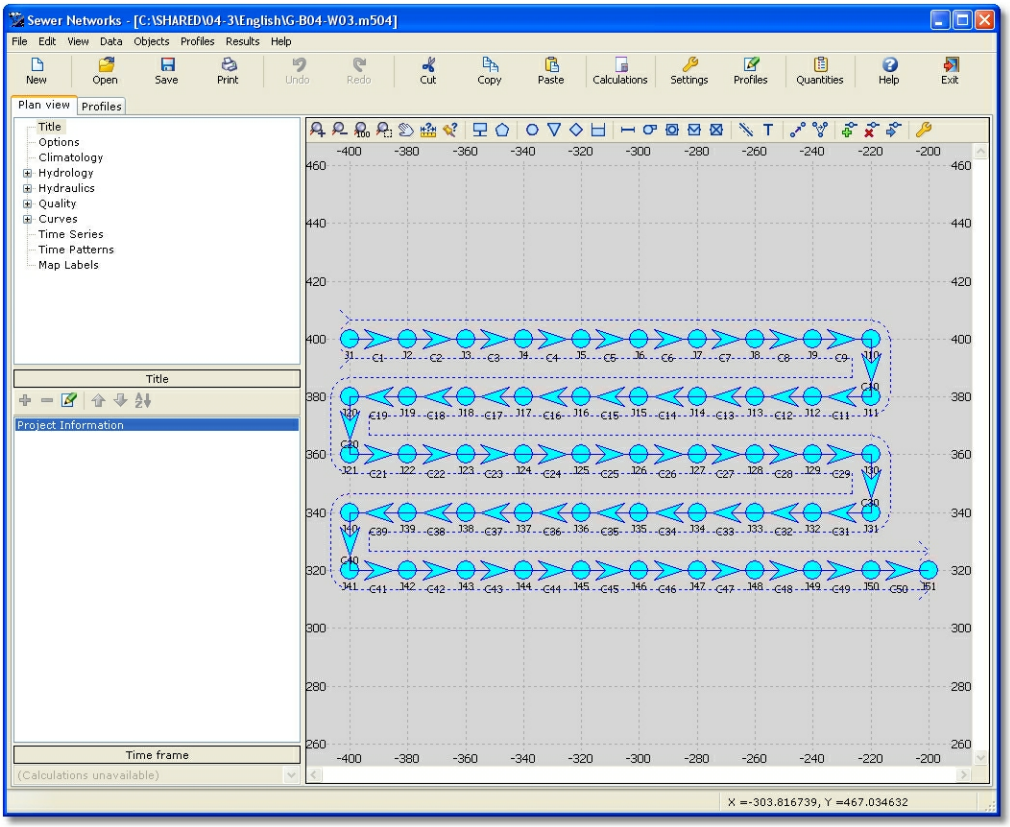
Using the zoom tools of the plan view (or using the roller of the mouse), zoom in the drawing to show the correct grid graphically. from the menu, select **Objects > Add > Junction.** Holding down the **CTRL** key, click successively on the plan view to define 51 junctions boustrophedon:



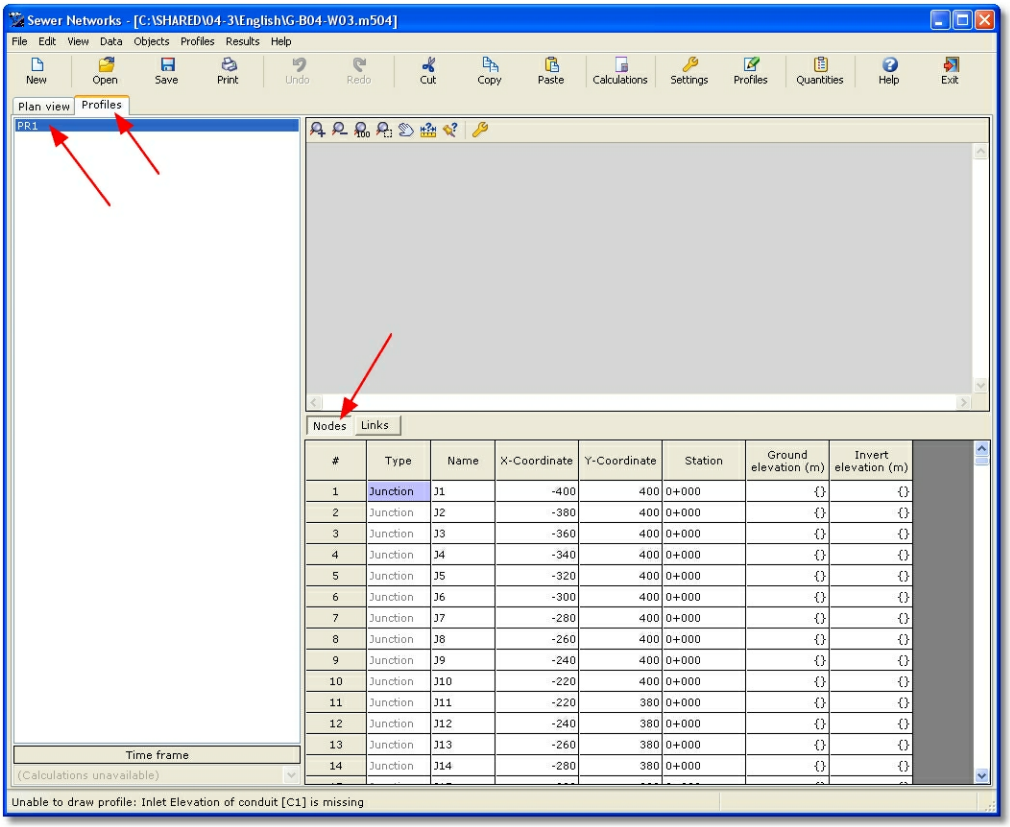
From the menu, select **Objects > Add > Conduit.** Holding down the **CTRL** key, click successively from junction to junction to create conduits according to the flow direction:



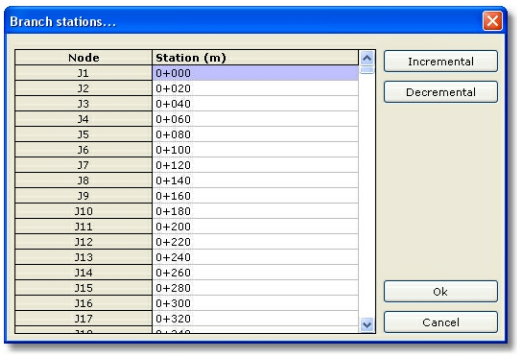
The data input becomes significantly easier if we create the profile. From the menu, select **Objects > Add > Profile.** Click junction J1 first and then click junction J51. The program seeks the shortest route connecting these two nodes. Press **ENTER** to define the profile. The network looks like this:



Select the **Profiles** tab below the main toolbar and click on the profile (automatically named as **PR1**) from the list on the left. Click on the **Nodes** tab above the spreadsheet:



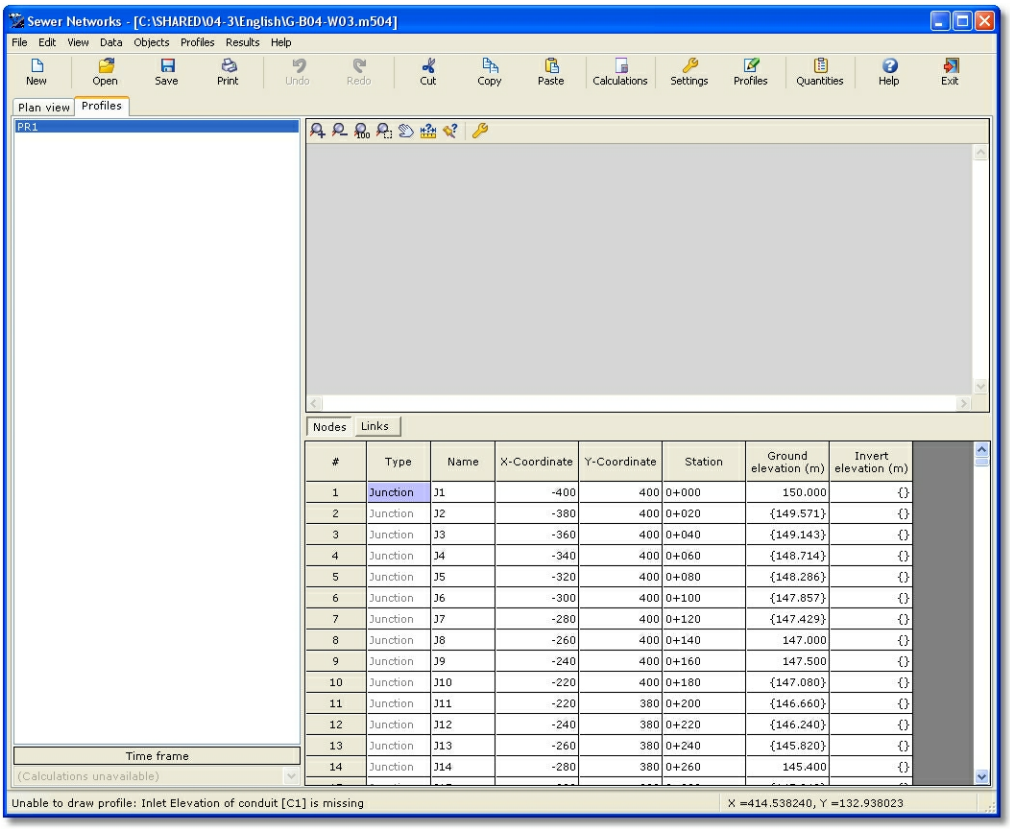
As displayed in the status bar, drawing the profile is impossible as critical information is missing. Click on the **Links** tab. To facilitate data input, from the menu select **Profiles > Stations:**



Press **Incremental.** The program assign the correct stations to junctions according to the distances in plan view. Press **Ok.**

Back in the main form, enter the ground elevation data in the **Nodes** tab. The fields in the **Ground Elevation** are displayed within curly braces "**{}**". In general, the curly braces mean that the specific field is **auto-filled** based on logical rules. In this case, the logical rule is the linear interpolation between upstream and downstream known values. For the **Invert Elevation** column, the logical rule is the lowest of the elevations of all conduits connected to the specific junction.

After the data input, the program looks like this:

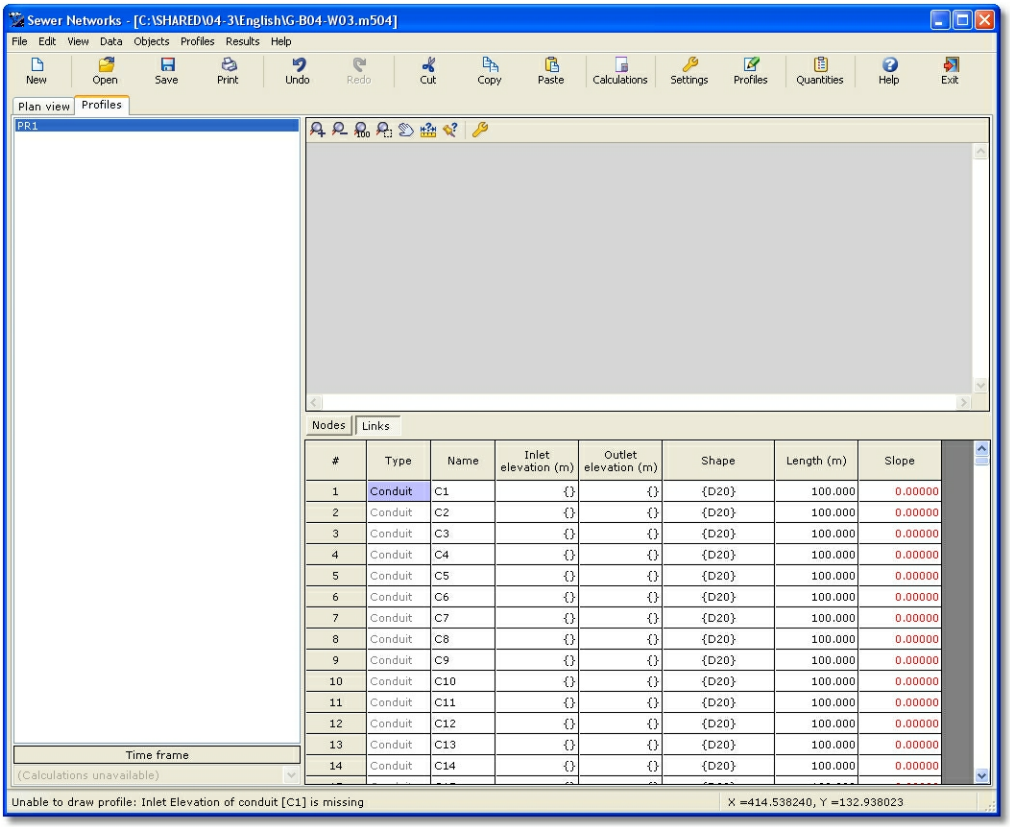


#	Type	Name	X-Coordinate	Y-Coordinate	Station	Ground elevation (m)	Invert elevation (m)
1	Junction	J1	-400	400	0+000	150.000	{}
2	Junction	J2	-380	400	0+020	{149.571}	{}
3	Junction	J3	-360	400	0+040	{149.143}	{}
4	Junction	J4	-340	400	0+060	{148.714}	{}
5	Junction	J5	-320	400	0+080	{148.286}	{}
6	Junction	J6	-300	400	0+100	{147.857}	{}
7	Junction	J7	-280	400	0+120	{147.429}	{}
8	Junction	J8	-260	400	0+140	147.000	{}
9	Junction	J9	-240	400	0+160	147.500	{}
10	Junction	J10	-220	400	0+180	{147.080}	{}
11	Junction	J11	-220	380	0+200	{146.660}	{}
12	Junction	J12	-240	380	0+220	{146.240}	{}
13	Junction	J13	-260	380	0+240	{145.820}	{}
14	Junction	J14	-280	380	0+260	145.400	{}

Note that the cells in which you typed a known ground elevation do not have curly braces. On the other hand, the unknown ground elevations are auto-filled based on upstream and downstream known values and, thus, they are displayed within curly braces.

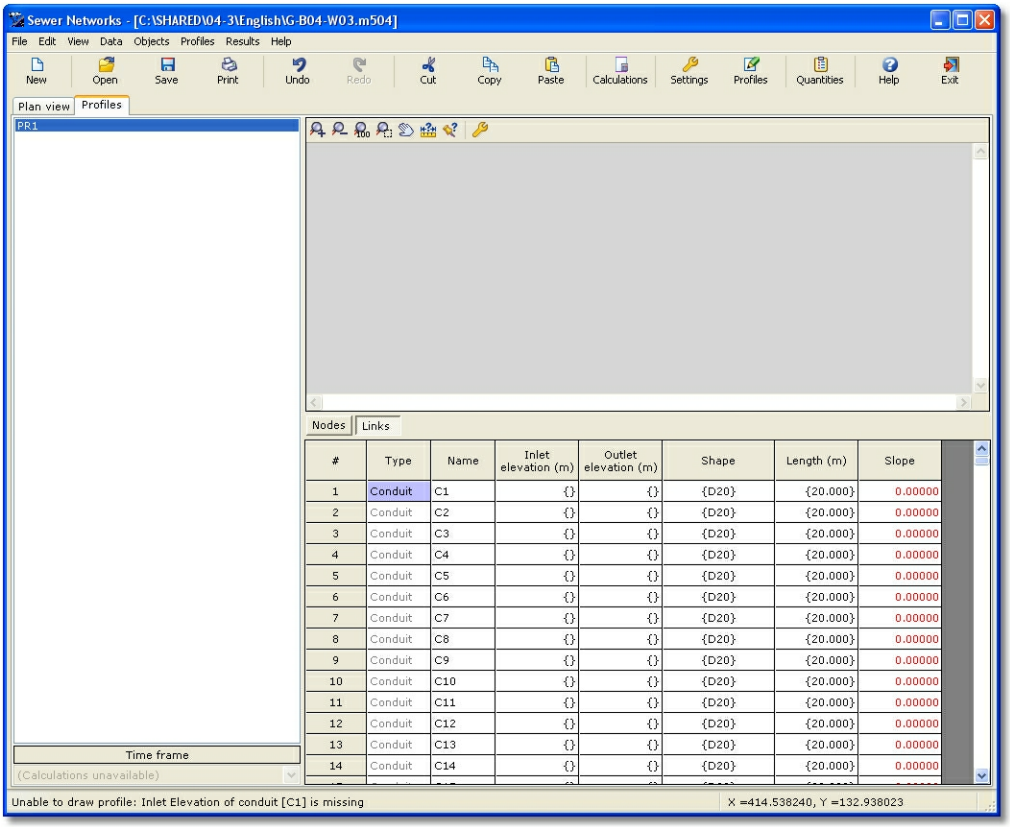
In general, to define a known value just type it explicitly. To return the field in auto-fill mode, select it and press **DEL** or enter a zero-length string **""**.

Click the **Links** tab, above the spreadsheet. The spreadsheet is loaded with link data:



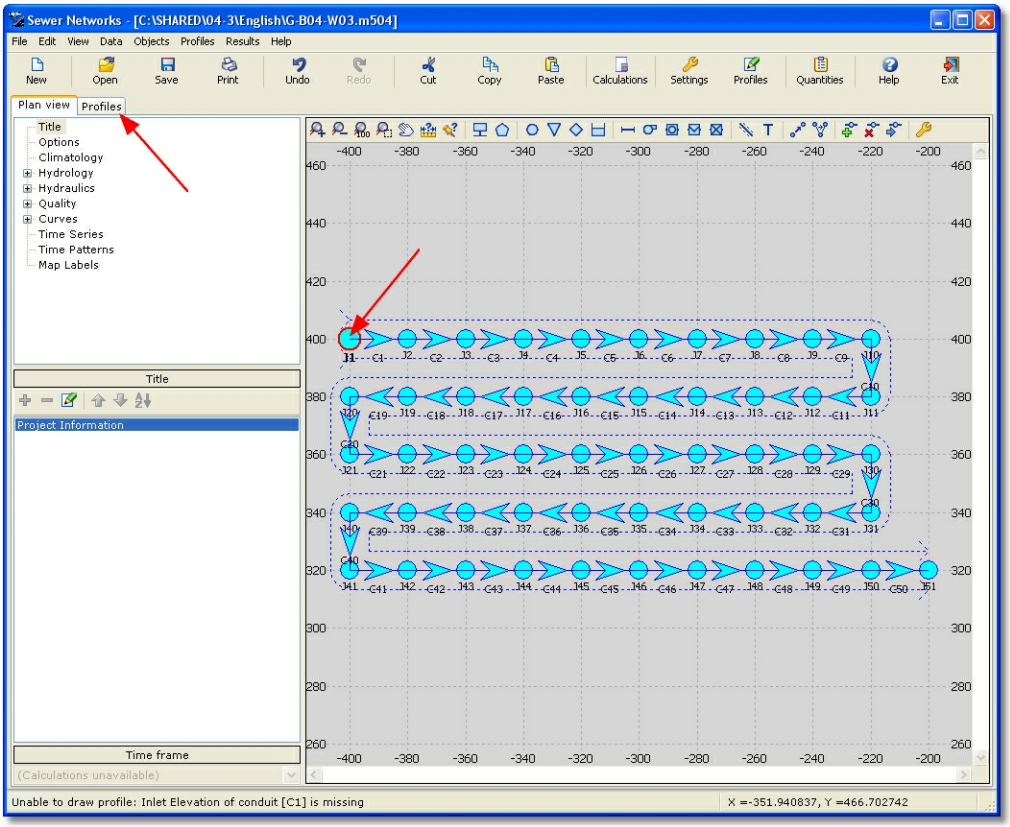
Note that although the distances are equal to 20m (based on the plan view) the program can use a different value. This facilitates data input when there is no plan view. Also, it allows for backwards compatibility with respect to earlier versions of the software. The default value of length for a new link is 100m. This can be modified by selecting **Data > Options > Default Values** from the menu. In this way, the length of the conduits would be 20m (i.e. we wouldn't need to activate the snap to grid).

You can modify the length of all conduits by typing 20 in all cells. An easier way is to select all the cells in this column and press **DEL**. Auto-fill will be activated for all cells. The logical rule is to assign the lengths measured from the plan view (which, due to the grid, are all equal to 20m):

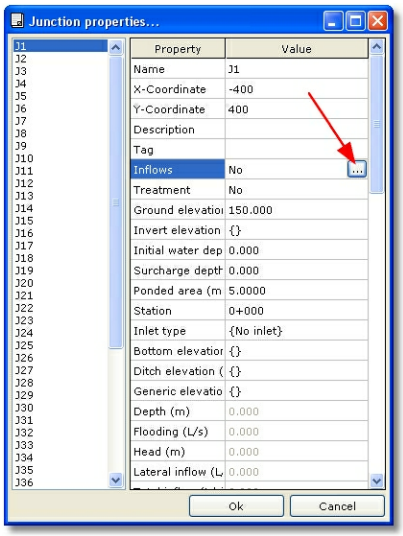


2.4 Step 04: Runoff

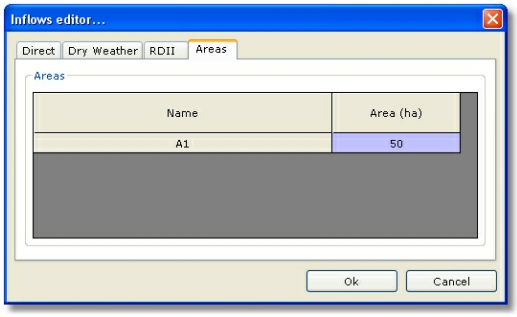
In this step, you will provide data regarding runoff. Click the **Plan view** tab below the main toolbar:



We will make the safest assumption that all the runoff area ends up in the first junction. Double-click on junction **J1** in the plan view to display its properties:



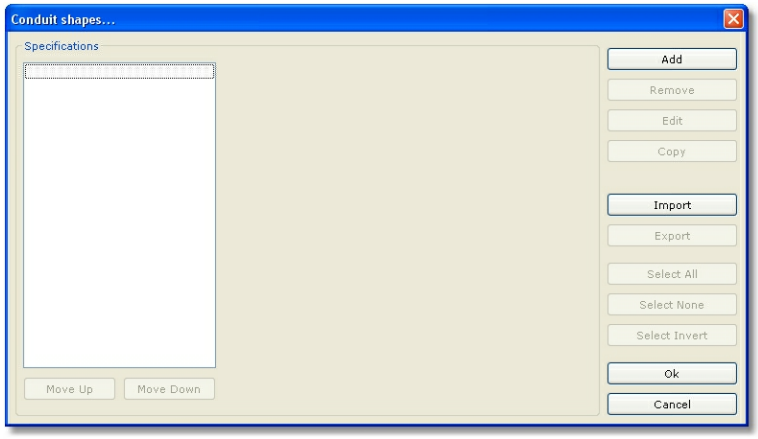
Double-click on **Inflows** and then click the button with the ellipses "...". The inflows form will be displayed. In the **Area** tab, enter the full area of 50ha:



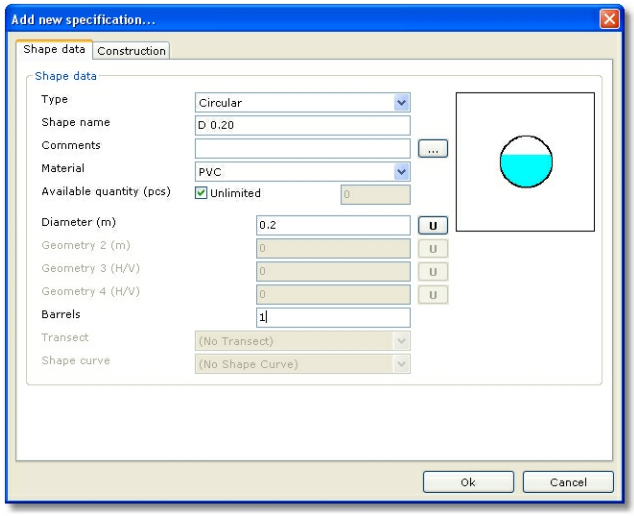
Press **Ok** to close the form.

2.5 Step 05: Design

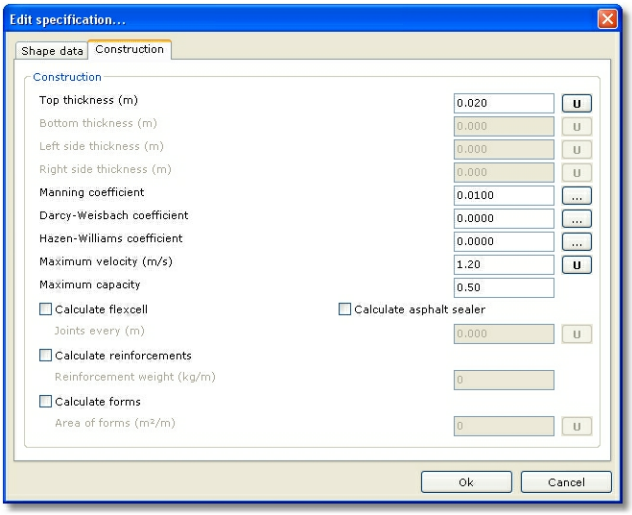
In this step, you will proceed with the design of the network. From the menu, select **Data > Conduit Shapes**:



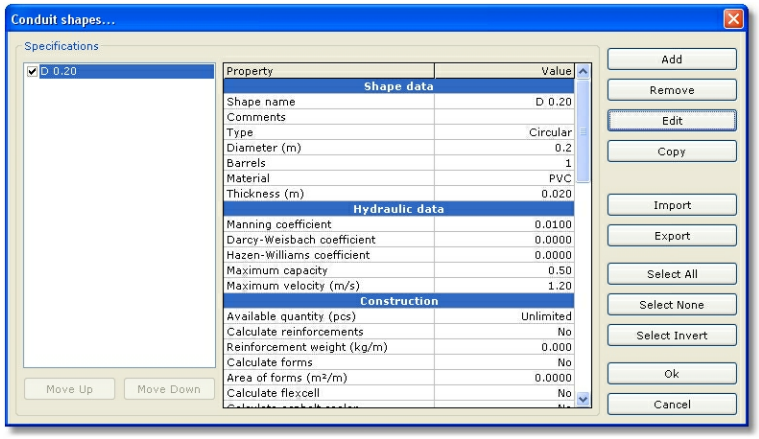
Press **Add**. In the **Shape data** tab, input the data of a circular shape made of PVC with internal diameter of 0.2m:



Click the **Construction** tab and enter additional data:



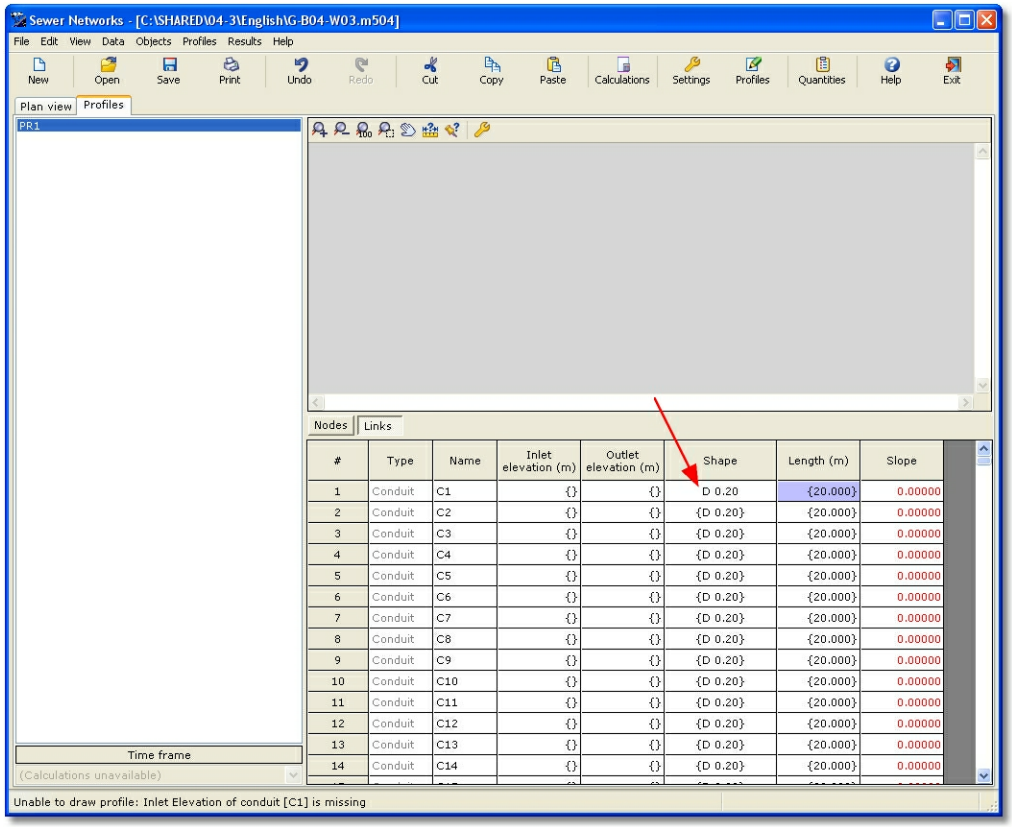
Press **Ok** to store the conduit shape:



In similar manner, you can input additional conduit shapes.

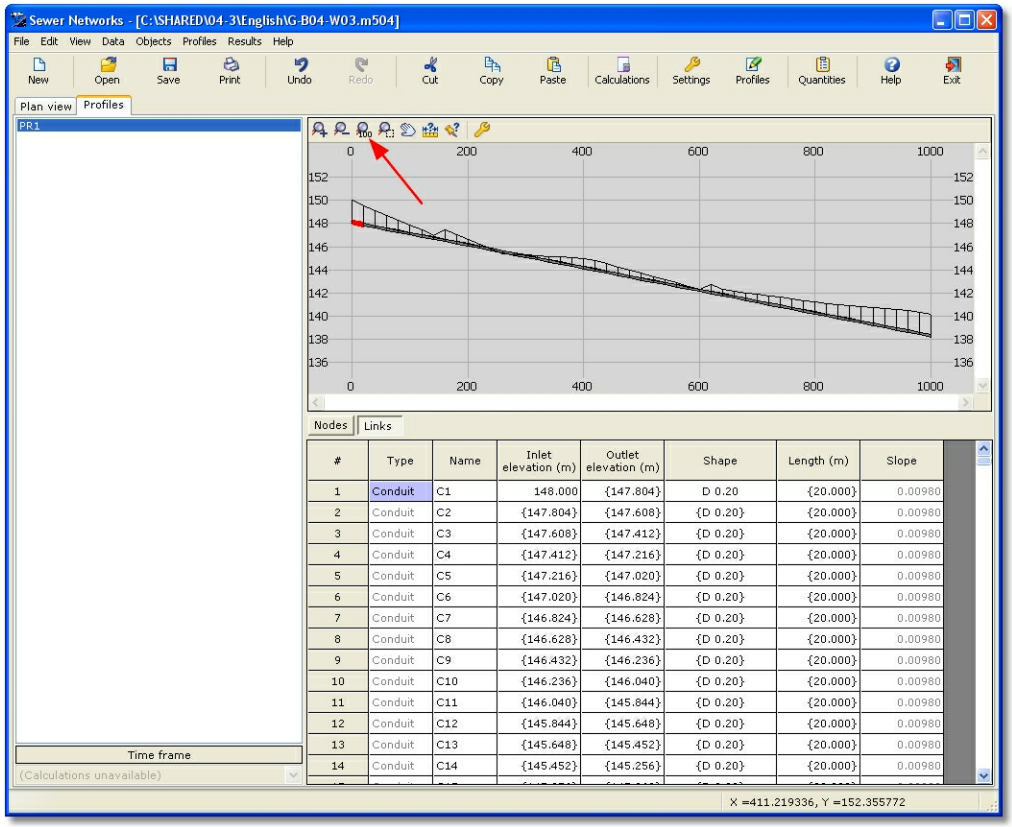
Note that this procedure needs not be repeated for each project. After you have defined a full set of conduit shapes, with various sizes and made of various materials, select **Export** to export the data to an external file. This file may be imported by pressing the **Import** button in other projects.

We will set the newly defined shape to all the conduits of the collector. Select the **Profiles** tab, click on the **PR1** profile and then click on the **Links** tab. Select the "D 0.20" from the drop-down list as the **Shape** of the first conduit:

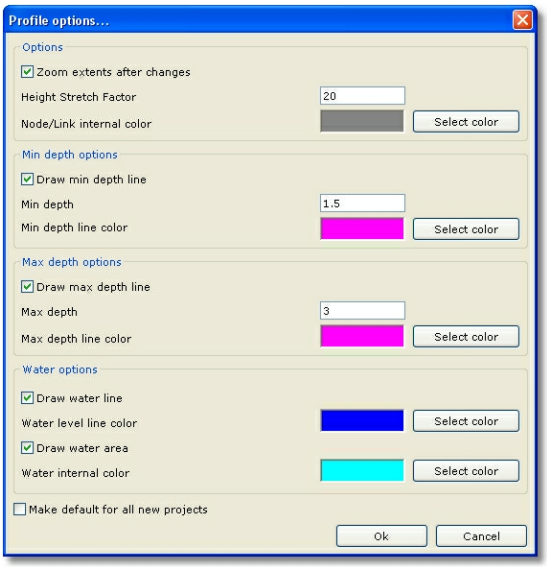


Based on auto-fill, the rest of the conduits are assigned the same shape. In their case, the name of the shape appears within curly braces.

The drawing of the profile is not possible because we need to define the elevation of the conduits. As a first attempt, we will set the depth of the conduit equal to 2m in the first and last junction. Type 150-2=**148** in the **inlet elevation** of the first conduit (C1) and 140.2-2=**138.2** in the **outlet elevation** of the last conduit **(C50).** The intermediate elevations are calculated automatically and drawing of the profile is now possible. If the drawing is invisible, press the **Zoom extents** button in the toolbar:



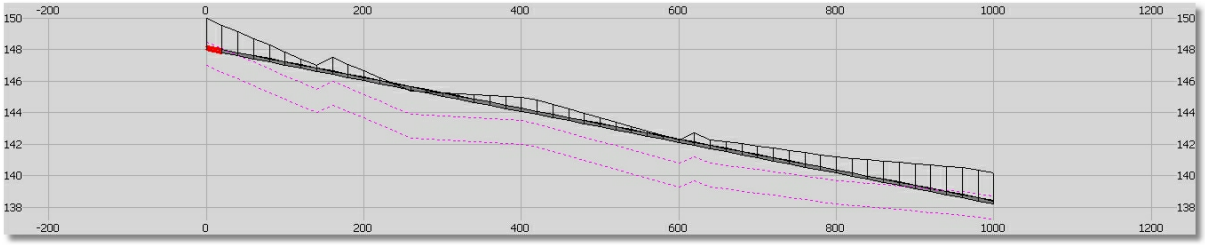
The profile sketch is a very useful design tool. Assuming that the minimum acceptable backfill depth is 1.5m and the maximum acceptable excavation depth is 3m. Right-click on the profile sketch. From the menu, select **options**. The following form appears:



Select **Zoom extents after changes** and set the **Stretch height factor** equal to 20. In this way, the profile sketch zooms to drawing extents every time a change is made,

while the ratio of distances in the vertical to horizontal axis is equal to 10. Select **draw min depth line** with a minimum depth equal to **1.5m** and **draw max depth line** with a maximum depth of 3m. Press **Ok.**

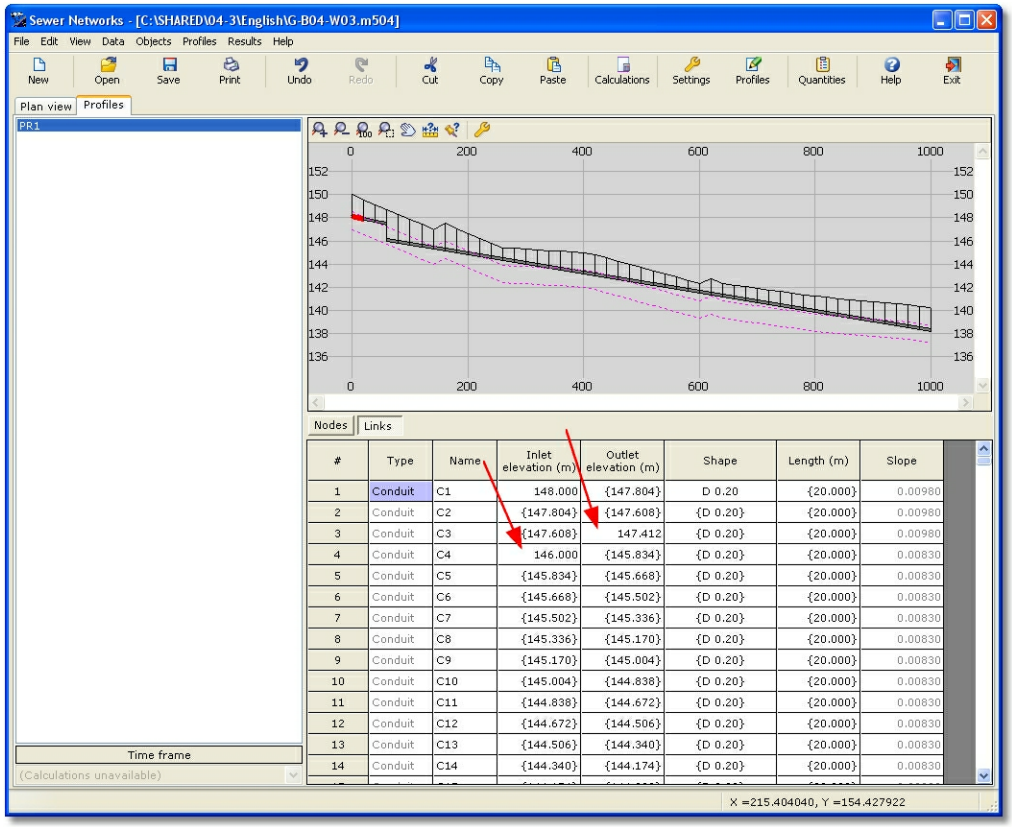
The profile is redrawn, and two dotted lines mark the zone in which the conduit should be placed (not obligatory):



It is evident that we need to lower the conduit. We will use a drop inlet between the third and fourth conduit. Double-click on the third conduit **in the profile sketch.** The corresponding line will be highlighted in the spreadsheet.

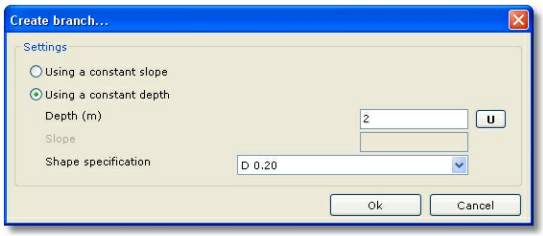
Select the **outlet elevation** cell of conduit C3, which is auto-filled to the value of {147.412}. Double-click or press **F2** to edit the field. Press **ENTER**. The field is now fixed to the value of 147.412 (i.e. auto-fill is disabled).

Select the **inlet elevation** cell of conduit C4, which is auto-filled to the value of {147.412}. Type 146 as the new value and press **ENTER**. In this way you create a drop inlet. The profile is as follows:

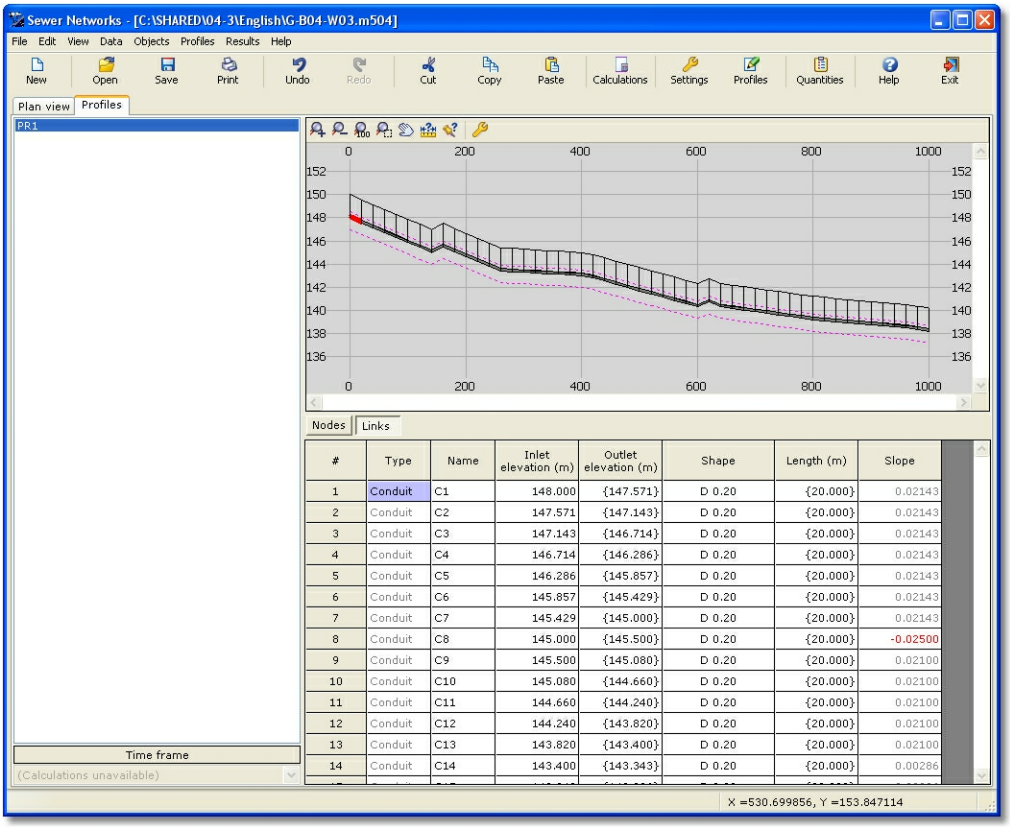


#	Type	Name	Inlet elevation (m)	Outlet elevation (m)	Shape	Length (m)	Slope
1	Conduit	C1	148.000	{147.804}	D 0.20	{20.000}	0.00980
2	Conduit	C2	{147.804}	{147.608}	{D 0.20}	{20.000}	0.00980
3	Conduit	C3	{147.608}	147.412	{D 0.20}	{20.000}	0.00980
4	Conduit	C4	146.000	{145.834}	{D 0.20}	{20.000}	0.00830
5	Conduit	C5	{145.834}	{145.668}	{D 0.20}	{20.000}	0.00830
6	Conduit	C6	{145.668}	{145.502}	{D 0.20}	{20.000}	0.00830
7	Conduit	C7	{145.502}	{145.336}	{D 0.20}	{20.000}	0.00830
8	Conduit	C8	{145.336}	{145.170}	{D 0.20}	{20.000}	0.00830
9	Conduit	C9	{145.170}	{145.004}	{D 0.20}	{20.000}	0.00830
10	Conduit	C10	{145.004}	{144.838}	{D 0.20}	{20.000}	0.00830
11	Conduit	C11	{144.838}	{144.672}	{D 0.20}	{20.000}	0.00830
12	Conduit	C12	{144.672}	{144.506}	{D 0.20}	{20.000}	0.00830
13	Conduit	C13	{144.506}	{144.340}	{D 0.20}	{20.000}	0.00830
14	Conduit	C14	{144.340}	{144.174}	{D 0.20}	{20.000}	0.00830

Alternatively, the program can put the conduit automatically to a specified depth. Select **Profiles > Automated branch design** from the main menu**:**



Select **Using a constant depth** and set the **Depth** equal to 2m. Also, select **D 0.20** as the conduit specification. Press **Ok** to apply these changes:

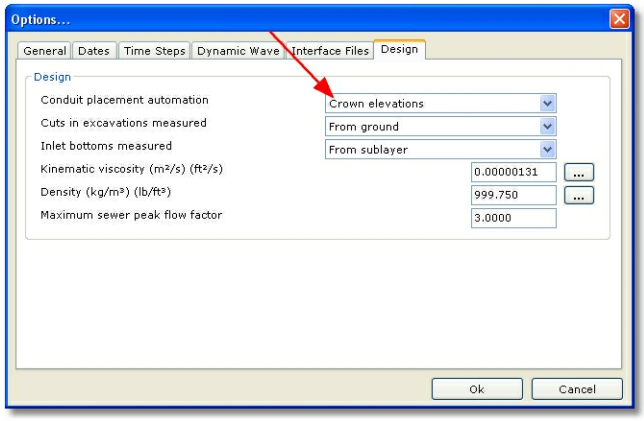


#	Type	Name	Inlet elevation (m)	Outlet elevation (m)	Shape	Length (m)	Slope
1	Conduit	C1	148.000	{147.571}	D 0.20	{20.000}	0.02143
2	Conduit	C2	147.571	{147.143}	D 0.20	{20.000}	0.02143
3	Conduit	C3	147.143	{146.714}	D 0.20	{20.000}	0.02143
4	Conduit	C4	146.714	{146.286}	D 0.20	{20.000}	0.02143
5	Conduit	C5	146.286	{145.857}	D 0.20	{20.000}	0.02143
6	Conduit	C6	145.857	{145.429}	D 0.20	{20.000}	0.02143
7	Conduit	C7	145.429	{145.000}	D 0.20	{20.000}	0.02143
8	Conduit	C8	145.000	{145.500}	D 0.20	{20.000}	-0.02500
9	Conduit	C9	145.500	{145.080}	D 0.20	{20.000}	0.02100
10	Conduit	C10	145.080	{144.660}	D 0.20	{20.000}	0.02100
11	Conduit	C11	144.660	{144.240}	D 0.20	{20.000}	0.02100
12	Conduit	C12	144.240	{143.820}	D 0.20	{20.000}	0.02100
13	Conduit	C13	143.820	{143.400}	D 0.20	{20.000}	0.02100
14	Conduit	C14	143.400	{143.343}	D 0.20	{20.000}	0.00286

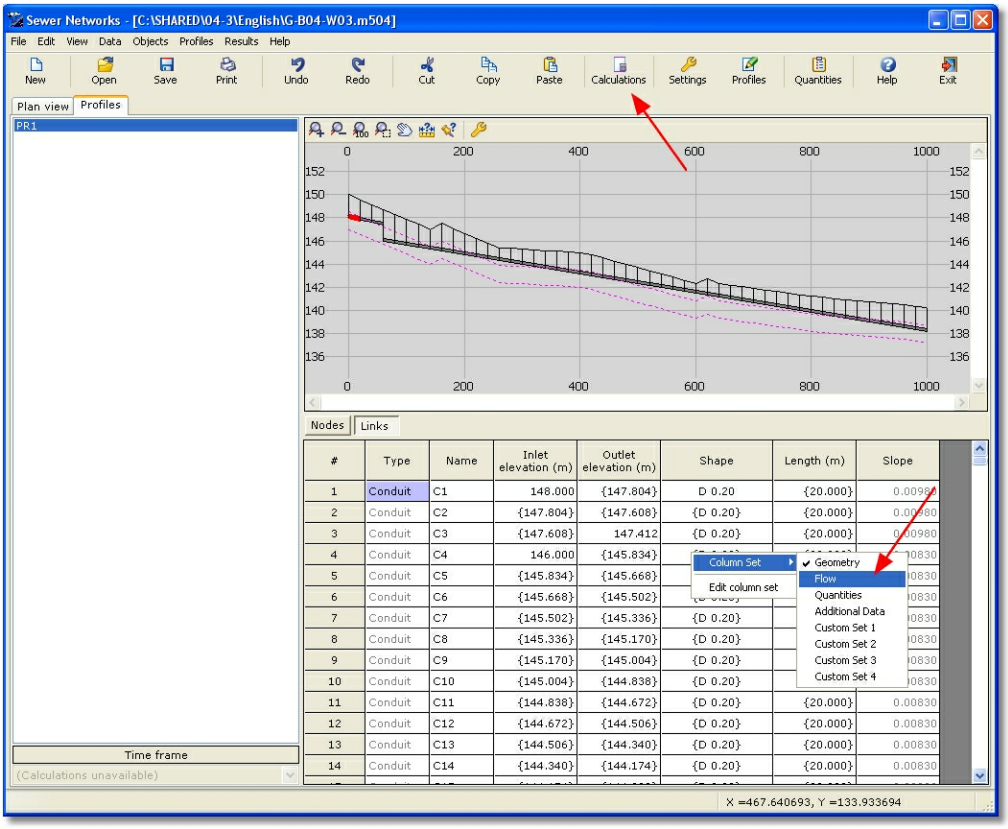
Note that the program performs a host of checks regarding the slopes, maximum/ minimum velocities, capacities etc. All fields that fail to pass a check are displayed in a different (but customizable) color. The default color that is used in these cases is red. Thus, it is obvious that the slope of the conduit C8 is negative.

Press **Undo** to undo the last change.

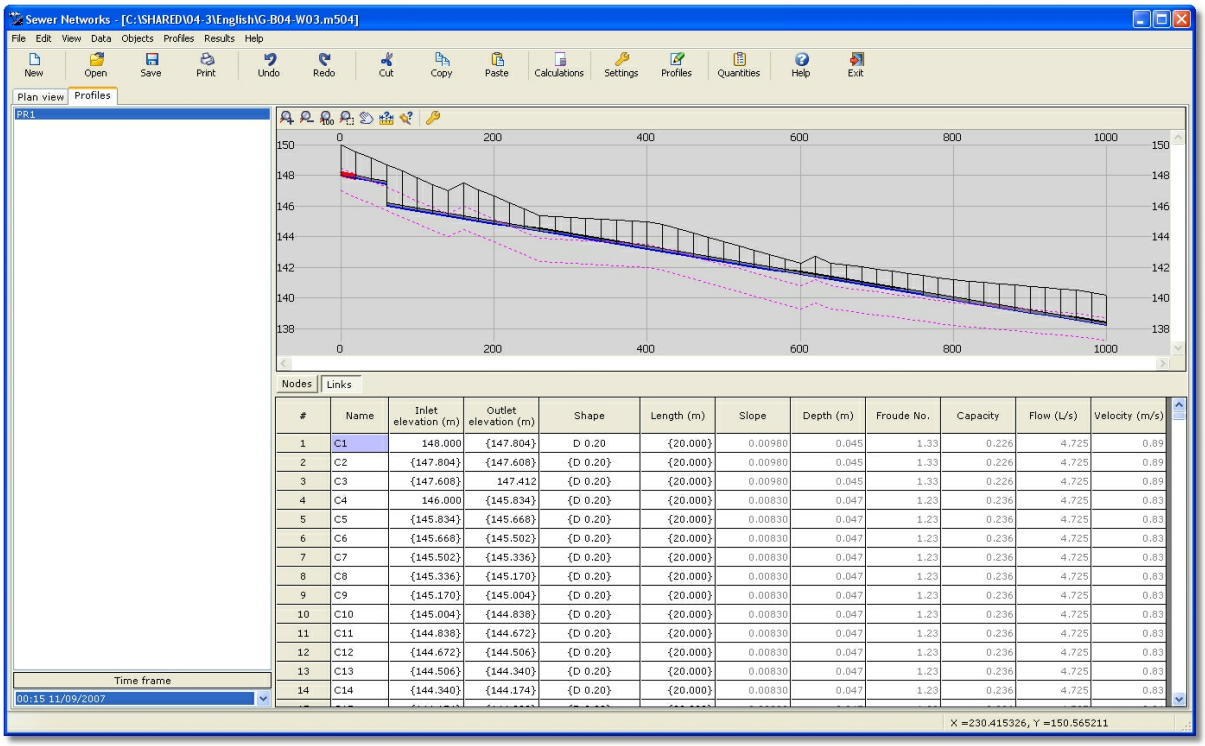
Note that the program auto-fills the outlet elevation of a conduit based on the (known) inlet elevation of the next conduit. This is done in such a manner that the crown elevations coincide. The program is also capable of matching the invert elevations, the axes, the 80% of the conduit height etc. To change this behavior, select **Data > General Data > Design.** In the **Design** tab, make the appropriate selection from the **Conduit placement automation:**



At this point, the first attempt to calculate the network can be made. Press **Calculations** from the toolbar. The calculations will be performed and a form will be displayed that includes information on the calculation errors. Press **Ok.** The profile sketch is updated with the water area that correspond at the specified time frame. To control the time frame, use the drop-down list at the bottom-left corner of the form. To view the results regarding the flow, right-click on the spreadsheet. Select **Column Set > Flow:**



The spreadsheet is filled with the results of the calculations:

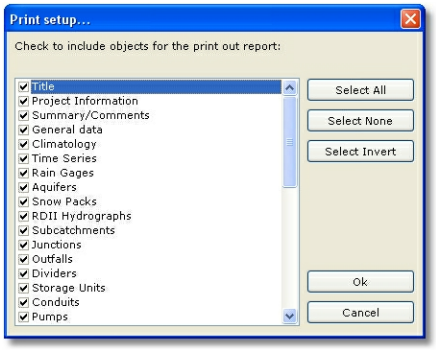


#	Name	Inlet elevation (m)	Outlet elevation (m)	Shape	Length (m)	Slope	Depth (m)	Froude No.	Capacity	Flow (L/s)	Velocity (m/s)
1	C1	148.000	{147.804}	D 0.20	{20.000}	0.00980	0.045	1.33	0.226	4.725	0.89
2	C2	{147.804}	{147.608}	{D 0.20}	{20.000}	0.00980	0.045	1.33	0.226	4.725	0.89
3	C3	{147.608}	147.412	{D 0.20}	{20.000}	0.00980	0.045	1.33	0.226	4.725	0.89
4	C4	146.000	{145.834}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
5	C5	{145.834}	{145.668}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
6	C6	{145.668}	{145.502}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
7	C7	{145.502}	{145.336}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
8	C8	{145.336}	{145.170}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
9	C9	{145.170}	{145.004}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
10	C10	{145.004}	{144.838}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
11	C11	{144.838}	{144.672}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
12	C12	{144.672}	{144.506}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
13	C13	{144.506}	{144.340}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83
14	C14	{144.340}	{144.174}	{D 0.20}	{20.000}	0.00830	0.047	1.23	0.236	4.725	0.83

At this point, the design of the network is concluded.

2.6 Step 06: Printing

Optionally, you may want to print the results to a printer, to Microsoft Word or Microsoft Excel. From the **File** menu select **Print setup:**



Make the appropriate selections and select **Ok**.

From the **File** menu select **Print** or **Print To > Word** or **Print To > Excel** to invoke the corresponding print engine.

Chapter

3 Help

3.1 Technical support

Technical Support

TechnoLogismiki offers technical support 24 hours per day, 365 days per year, through the Web site where you can get information on the latest programs and services.

Support by e-mail

Please use the dedicated e-mail addresses for better customer service:

- for questions regarding sales: sales@technologismiki.com
- for questions regarding the usage of programs: support@technologismiki.com
- for any other question or comment: info@technologismiki.com

The normal response time is within two business days. If your inquiry cannot be answered via e-mail, a customer service representative will contact you via telephone.

Interactive Support

Business days, 09:00 - 17:00 Eastern European Time:

- Telephone [3 lines]: ++30-210-656-4147
- FAX: ++30-210-654-8461
- Address: 5, Imitou str, Cholargos, 15561, Athens, Greece.