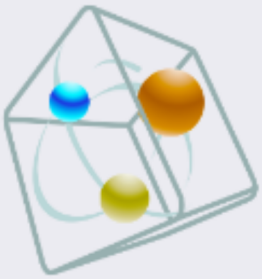
Works 2013

Pump Usage

WHITEPAPER



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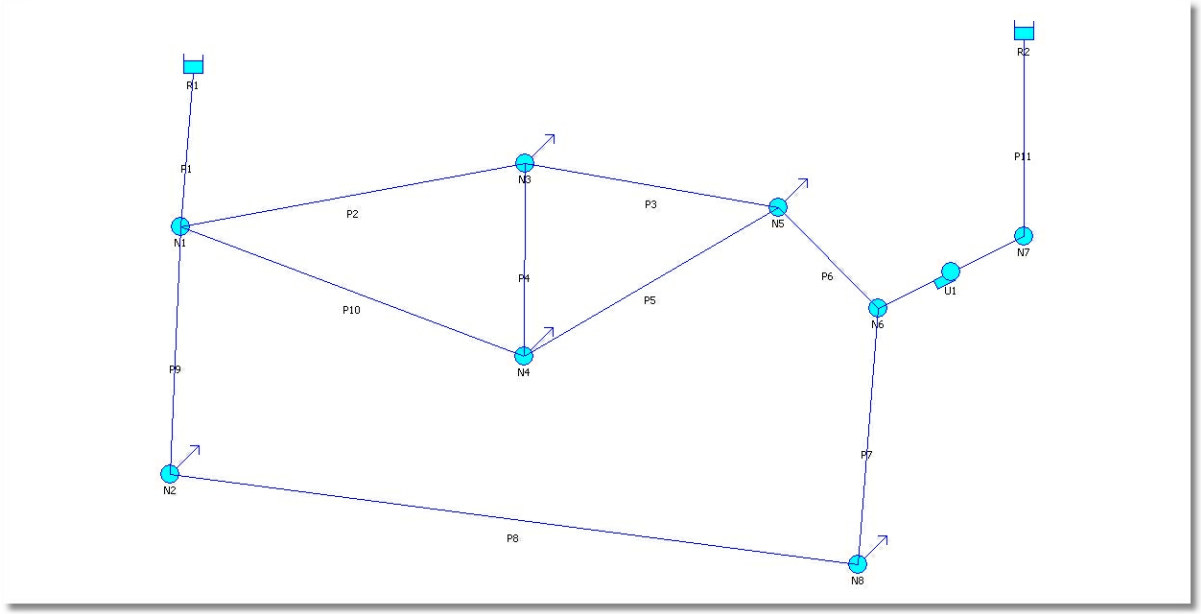
Chapter

1 About the whitepaper

1.1 Purpose

The purpose of this example is to demonstrate the use of a pump in a small water network.



The water is supplied to the network by two reservoirs, R1 and R2 with a water level of 125 m and 85 m respectively.
The pump (**U1**) has the following operating curve:

Flow rate (L/s)	**Height (m)**
10	29
20	26
40	23
80	15

The Darcy - Weisbach friction formula will be used in order to solve the network, with a friction coefficient of 0.0013 for all the pipes and a water temperature of 4 °C.
The nodes have the following, constant, water demand:

Node	**Demand (L/s)**
N2	14.5
N3	4.0
N4	7.0
N5	25.0
N8	20.0

The pipe data are summarized in the following table:

Pipe	Length (m)	Diameter (mm)	Friction coefficient
P1	1100	250	0.0013
P2	350	200	0.0013
P3	400	150	0.0013
P4	80	100	0.0013
P5	360	100	0.0013
P6	210	250	0.0013
P7	420	200	0.0013
P8	500	100	0.0013
P9	350	150	0.0013
P10	90	100	0.0013
P11	1250	300	0.0013

The following data will be calculated:

1. The pressure height at each node.
2. The flow rate and the velocity at each pipe.
3. The above data if the demand is tripled.

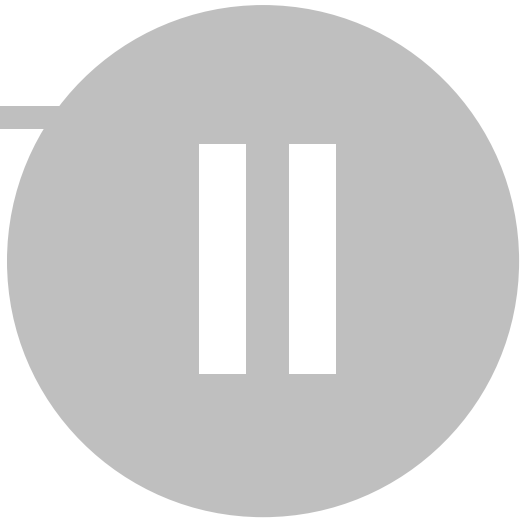
1.2 Software

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

- Water Networks v11.0.

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

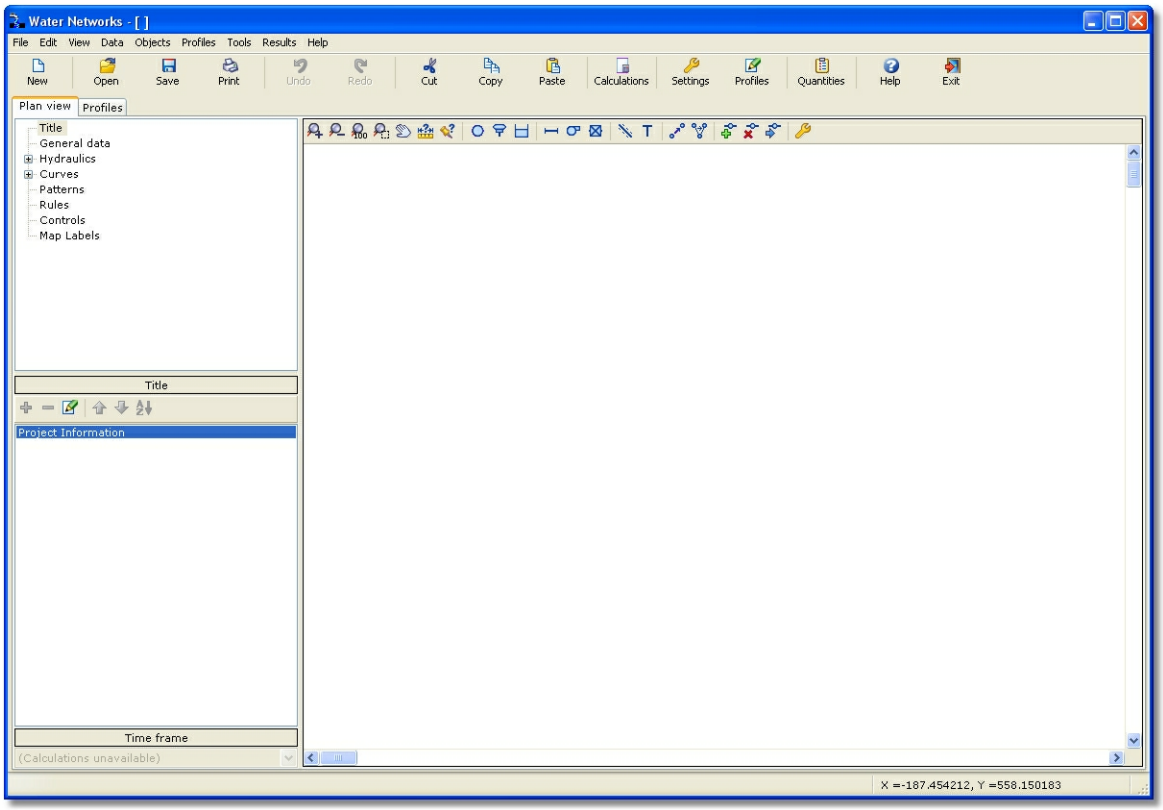
Chapter



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:

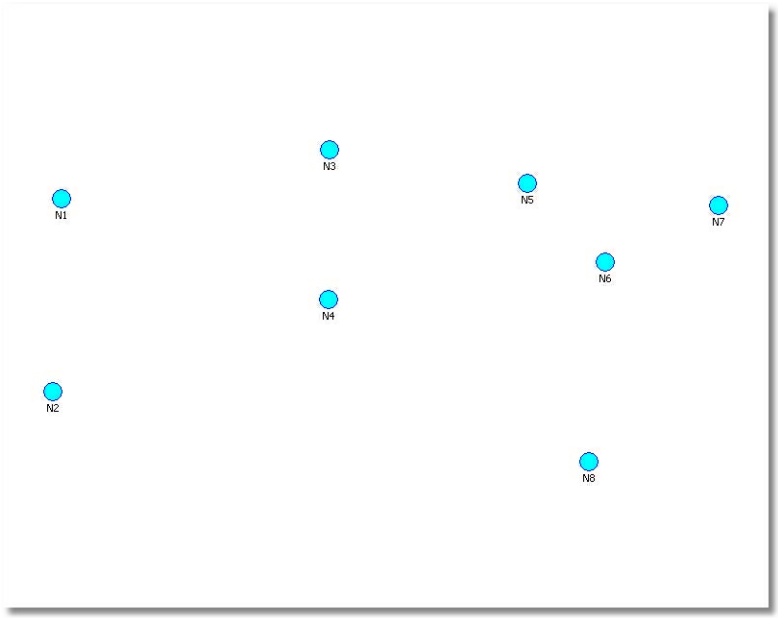


2.2 Step 02: Network Design

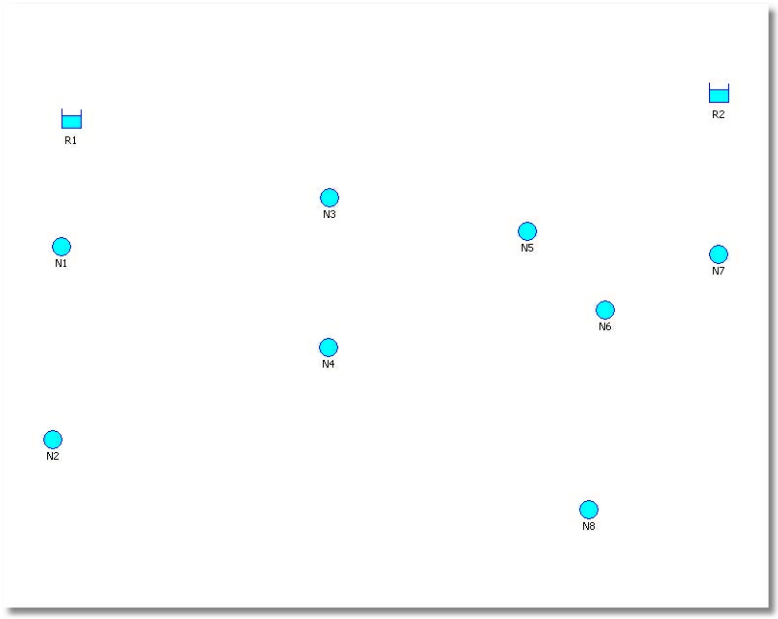
For reasons of simplicity, the design of the network will be schematic, i.e. not considering the exact location of the nodes. The connectivity of the elements will be deducted from the sketch; the actual length of the pipes will be entered manually.

First, you need to check that the correct unit system is used. Select **Data > General Data > Hydraulics**. Select **L/s** as the current flow units and hit **Ok**.

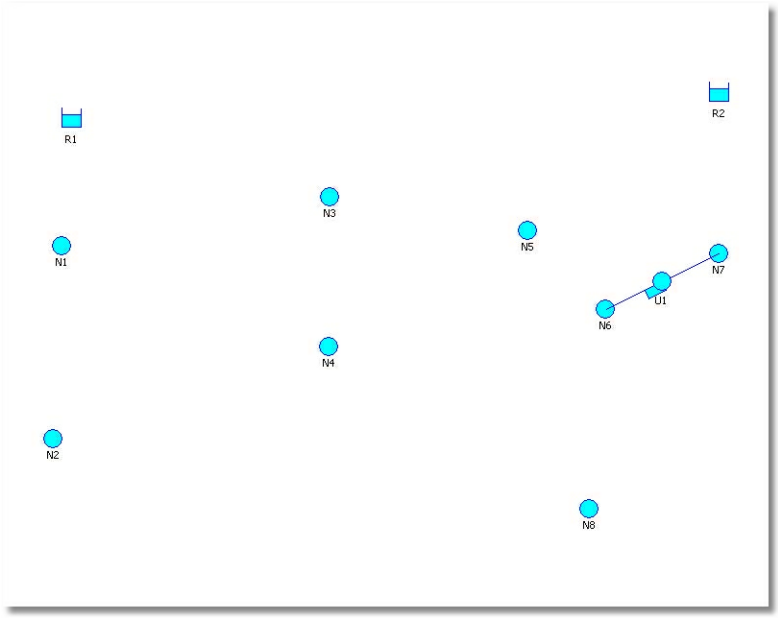
Select **Objects > Add > Node.** Click on the drawing while holding down the **CTRL** key. In this way, you can add more than one nodes consecutively. Click on the drawing to define the approximate position of nodes:



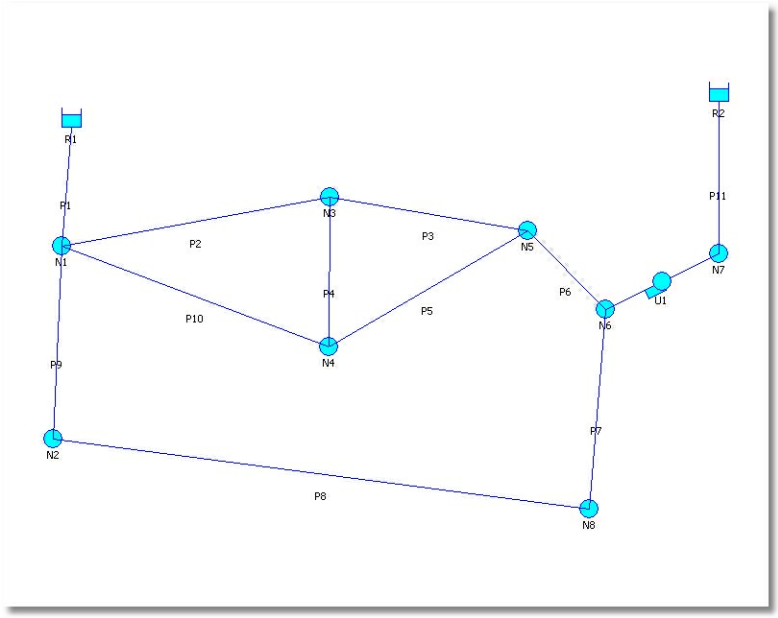
Select **Objects > Add > Reservoir.** Click on the drawing while holding down the **CTRL** key. In this way, you can add more than one reservoirs consecutively. Click on the drawing to define the approximate position of reservoirs:



Select **Objects > Add > Pump**. Click on nodes N7 and N6 consecutively (this way you can designate the direction of the pump):

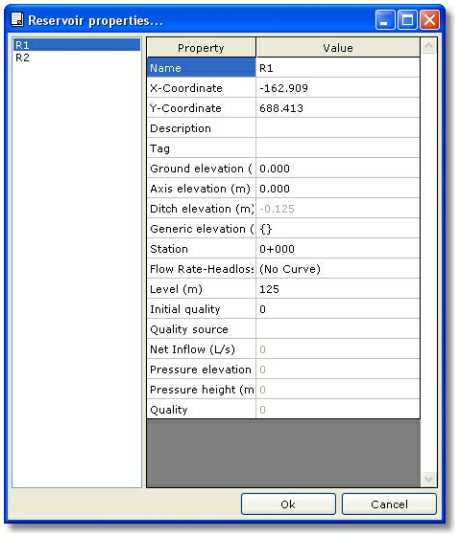


Select **Objects > Add > Pipe.** Click on the drawing while holding down the **CTRL** key. In this way, you can add more than one pipes consecutively. Click on the start and end nodes of each pipe consecutively:



When finished, hit **ESC**.

Double-click on a reservoir to modify its properties. The reservoir properties form will appear:



Select reservoir R1 from the list on the left. Make the following changes:

- **Level:** Enter "125".

Select reservoir R2 from the list on the left. Make the following changes:

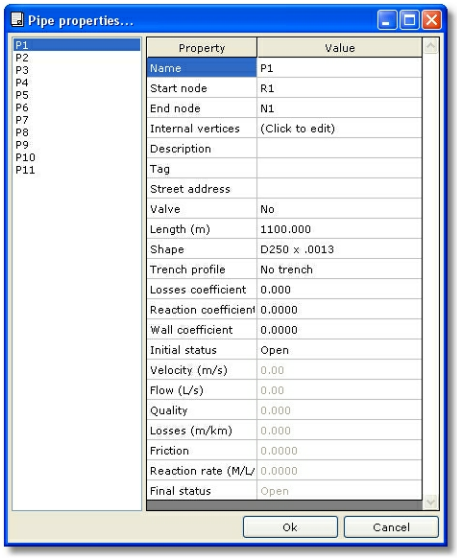
- **Level:** Enter "85".

Select **Ok.**

Create pipe shapes according to the data of the following table:

Pipe Shape	**Internal Diameter (mm)**	**Darcy-Weisbach friction coefficient**
D300 x .0013	300	0.0013
D250 x .0013	250	0.0013
D200 x .0013	200	0.0013
D150 x .0013	150	0.0013
D100 x .0013	100	0.0013

Note that the internal diameter must be entered in m. Next, double click on a pipe to show the pipe properties form:

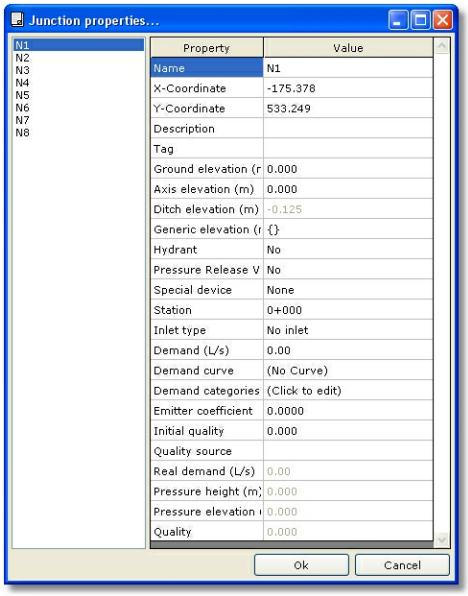


Select the appropriate **Shape** and **Length** for each pipe, according to the following table:

Pipe	**Length (m)**	**Diameter (mm)**	**Friction Coefficient**
P1	1100	250	0.0013
P2	350	200	0.0013
P3	400	150	0.0013
P4	80	100	0.0013
P5	360	100	0.0013
P6	210	250	0.0013
P7	420	200	0.0013
P8	500	100	0.0013
P9	350	150	0.0013
P10	90	100	0.0013
P11	1250	300	0.0013

When a property value is common to more than one objects, you can enter it only once as follows: select the objects from the list on the left by holding down the **CTRL** key and then enter the property value.

Double click on a node to show the node properties form:



Select node N2 from the list on the left. Make the following changes:

- **Demand:** Enter "**14.5**".

Select node N3 from the list on the left. Make the following changes:

- **Demand:** Enter "**4.0**".

Select node N4 from the list on the left. Make the following changes:

- **Demand:** Enter "**7.0**".

Select node N5 from the list on the left. Make the following changes:

- **Demand:** Enter "**25.0**".

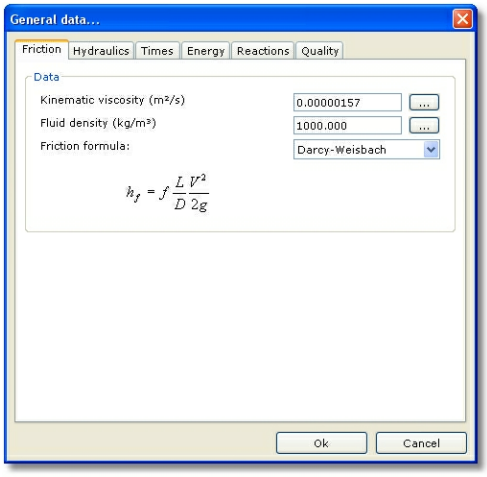
Select node N8 from the list on the left. Make the following changes:

- **Demand:** Enter "**20.0**".

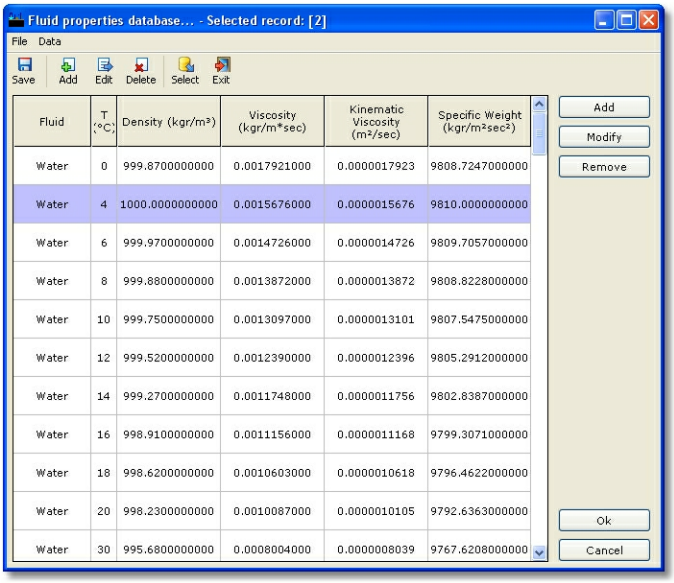
Select **Ok.**

2.3 Step 03: Input Data

Select **Data > General Data > Fluid**. Select **Darcy - Weisbach** from the **Friction formula** drop-down list:



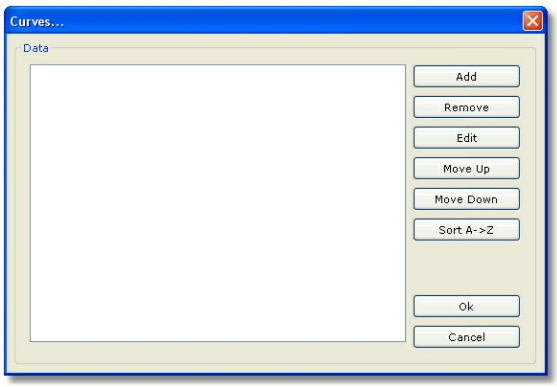
In the same tab, enter the **kinematic viscosity** and the **fluid density** from the database. Click the corresponding button with the ellipses (**...**) on the right. The fluid database form will appear:



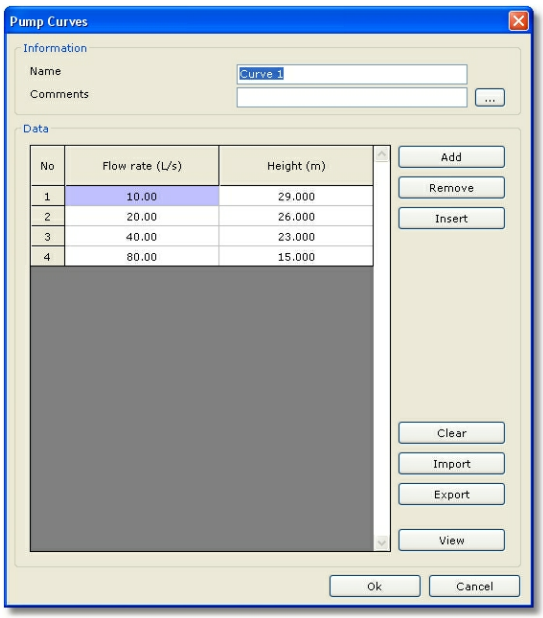
Fluid	T (°C)	Density (kgr/m³)	Viscosity (kgr/m*sec)	Kinematic Viscosity (m²/sec)	Specific Weight (kgr/m²sec²)
Water	0	999.8700000000	0.0017921000	0.0000017923	9808.7247000000
Water	4	1000.0000000000	0.0015676000	0.0000015676	9810.0000000000
Water	6	999.9700000000	0.0014726000	0.0000014726	9809.7057000000
Water	8	999.8800000000	0.0013872000	0.0000013872	9808.8228000000
Water	10	999.7500000000	0.0013097000	0.0000013101	9807.5475000000
Water	12	999.5200000000	0.0012390000	0.0000012396	9805.2912000000
Water	14	999.2700000000	0.0011748000	0.0000011756	9802.8387000000
Water	16	998.9100000000	0.0011156000	0.0000011168	9799.3071000000
Water	18	998.6200000000	0.0010603000	0.0000010618	9796.4622000000
Water	20	998.2300000000	0.0010087000	0.0000010105	9792.6363000000
Water	30	995.6800000000	0.0008004000	0.0000008039	9767.6208000000

In both cases, select **Water** at **4ºC**. Select **Ok.**

Select **Data > Curves > Pump Curves:**



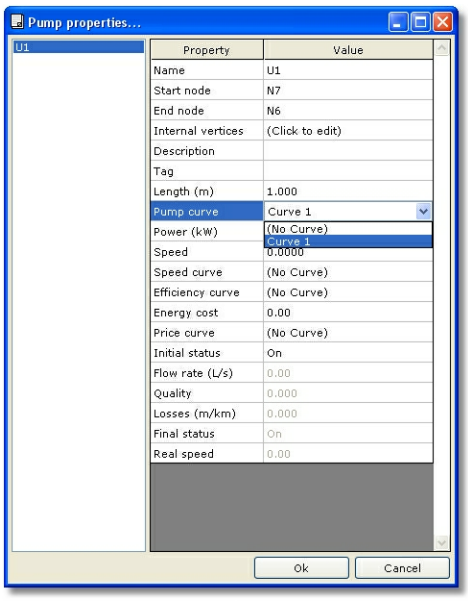
Press **Add:**



Type "**Curve 1**"in the **Name** field.

Press the **Add** button four times to create equal entries. Enter the data by typing directly into the cells. When finished, press **Ok**.

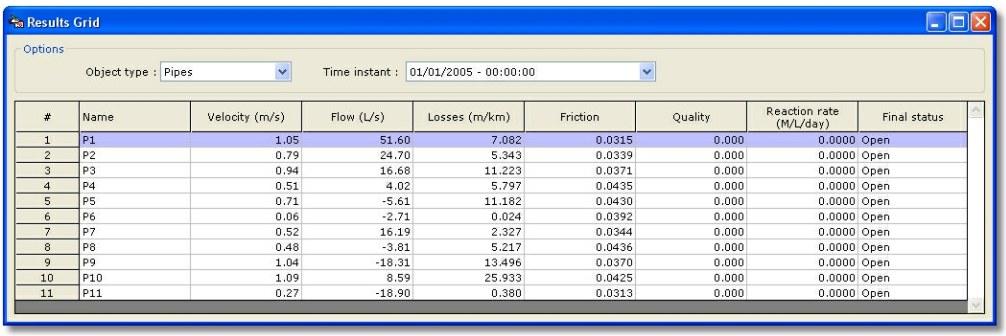
Double click on the pump to modify its properties:



Double click on the **Pump curve** property, select **Curve 1** from the drop-down list and press **Ok.**

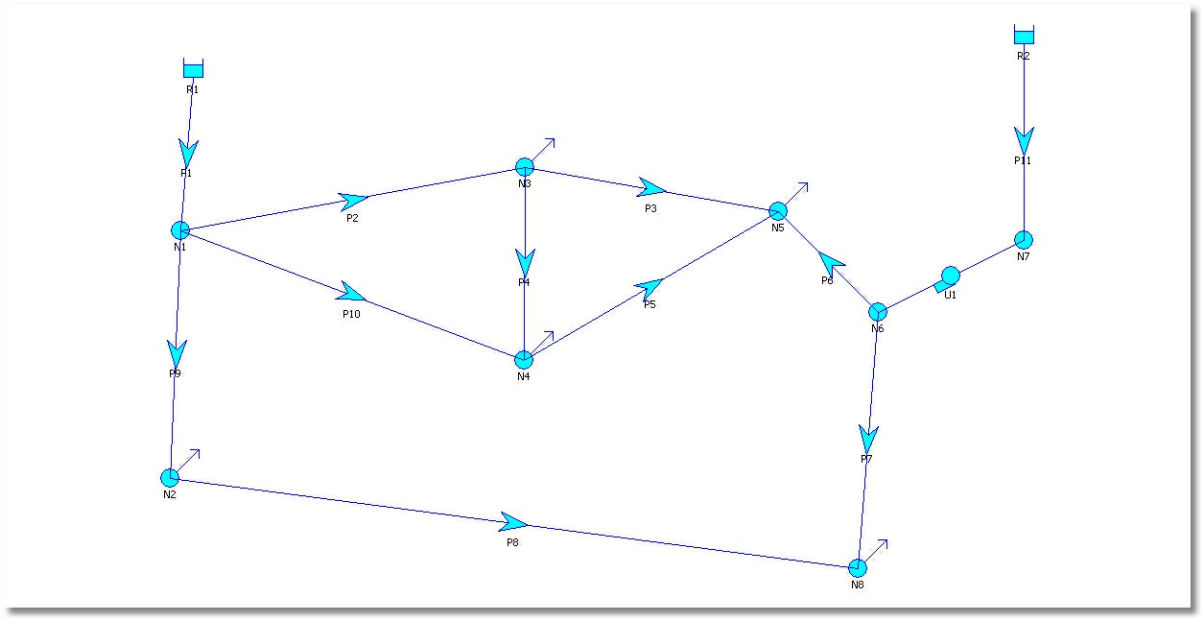
2.4 Step 04: Calculations

In order to perform calculations, hit **F5.** The results are displayed in the following form:

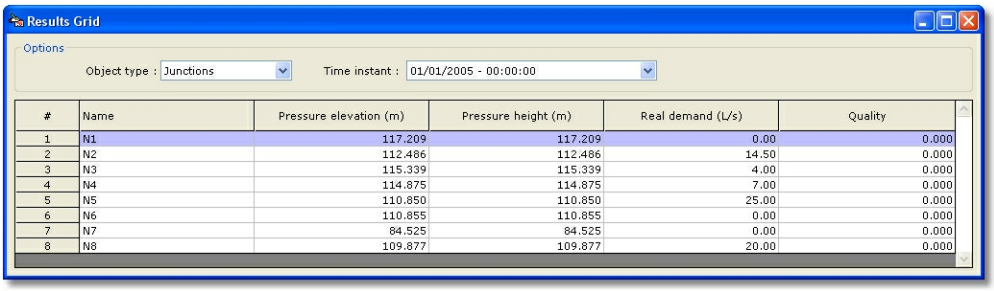


#	Name	Velocity (m/s)	Flow (L/s)	Losses (m/km)	Friction	Quality	Reaction rate (M/L/day)	Final status
1	P1	1.05	51.60	7.082	0.0315	0.000	0.0000	Open
2	P2	0.79	24.70	5.343	0.0339	0.000	0.0000	Open
3	P3	0.94	16.68	11.223	0.0371	0.000	0.0000	Open
4	P4	0.51	4.02	5.797	0.0435	0.000	0.0000	Open
5	P5	0.71	-5.61	11.182	0.0430	0.000	0.0000	Open
6	P6	0.06	-2.71	0.024	0.0392	0.000	0.0000	Open
7	P7	0.52	16.19	2.327	0.0344	0.000	0.0000	Open
8	P8	0.48	-3.81	5.217	0.0436	0.000	0.0000	Open
9	P9	1.04	-18.31	13.496	0.0370	0.000	0.0000	Open
10	P10	1.09	8.59	25.933	0.0425	0.000	0.0000	Open
11	P11	0.27	-18.90	0.380	0.0313	0.000	0.0000	Open

Select **Ok.** The flow direction is now displayed in the main drawing:

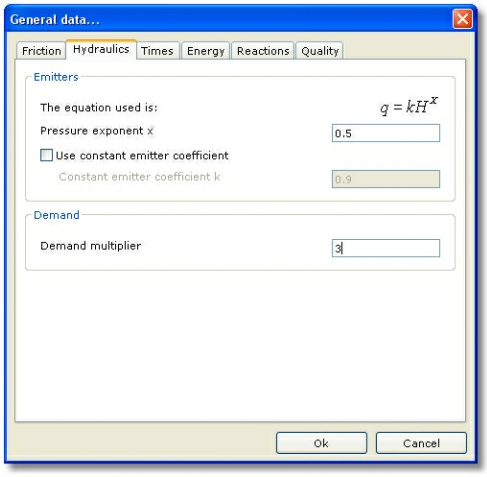


Select **Results > Grid** to display the result once again. Select **Junctions** from the **Object Type** drop down list to view the results:

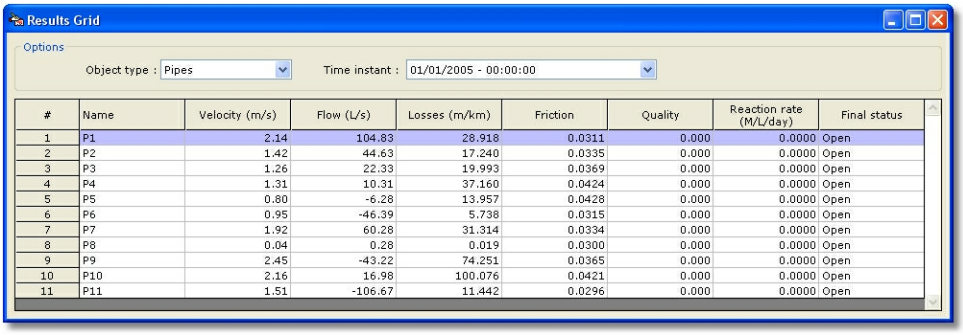


#	Name	Pressure elevation (m)	Pressure height (m)	Real demand (L/s)	Quality
1	N1	117.209	117.209	0.00	0.000
2	N2	112.486	112.486	14.50	0.000
3	N3	115.339	115.339	4.00	0.000
4	N4	114.875	114.875	7.00	0.000
5	N5	110.850	110.850	25.00	0.000
6	N6	110.855	110.855	0.00	0.000
7	N7	84.525	84.525	0.00	0.000
8	N8	109.877	109.877	20.00	0.000

In order to perform the new calculations for triple demand select **Data > General Data > Hydraulics** from the menu. Type "**3**" in the **Demand multiplier** field:



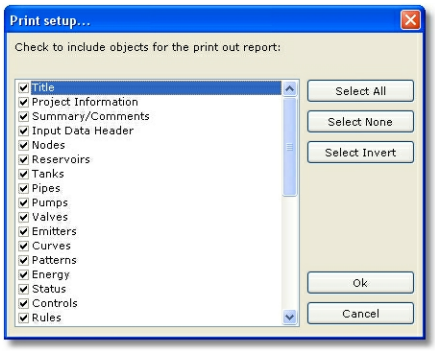
In order to perform calculations again, hit **F5.** The new results are displayed in the following form:



#	Name	Velocity (m/s)	Flow (L/s)	Losses (m/km)	Friction	Quality	Reaction rate (M/L/day)	Final status
1	P1	2.14	104.83	28.918	0.0311	0.000	0.0000	Open
2	P2	1.42	44.63	17.240	0.0335	0.000	0.0000	Open
3	P3	1.26	22.33	19.993	0.0369	0.000	0.0000	Open
4	P4	1.31	10.31	37.160	0.0424	0.000	0.0000	Open
5	P5	0.80	-6.28	13.957	0.0428	0.000	0.0000	Open
6	P6	0.95	-46.39	5.738	0.0315	0.000	0.0000	Open
7	P7	1.92	60.28	31.314	0.0334	0.000	0.0000	Open
8	P8	0.04	0.28	0.019	0.0300	0.000	0.0000	Open
9	P9	2.45	-43.22	74.251	0.0365	0.000	0.0000	Open
10	P10	2.16	16.98	100.076	0.0421	0.000	0.0000	Open
11	P11	1.51	-106.67	11.442	0.0296	0.000	0.0000	Open

2.5 Step 05: 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.

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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

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