



QGIS PLUGIN FOR THE CREATION OF REALISTIC MODELS OF  
WATER DISTRIBUTION NETWORKS

# USER'S MANUAL



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## INTRODUCTION

QGISRed is a tool to help the hydraulic engineer in the task of modelling a water distribution network and in the decision-making process, within the environment of a Geographic Information System (GIS). This tool is designed as a plugin to the free software QGIS. However, QGISRed uses the source code of the GISRed software, an application designed as a desktop tool for the Windows operating system.

The QGISRed plugin is developed with the objective of being able to take advantage of all the tools that a GIS environment can provide in a native way. For example, geo-processing tools, use of satellite images, style management, etc. On the contrary, this plugin will have some limitations against the potential that may include the GISRed tool.

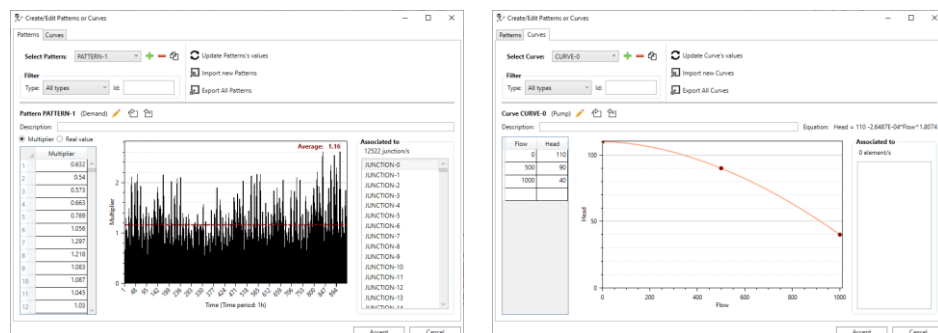
## DETAILS OF CURRENT VERSION

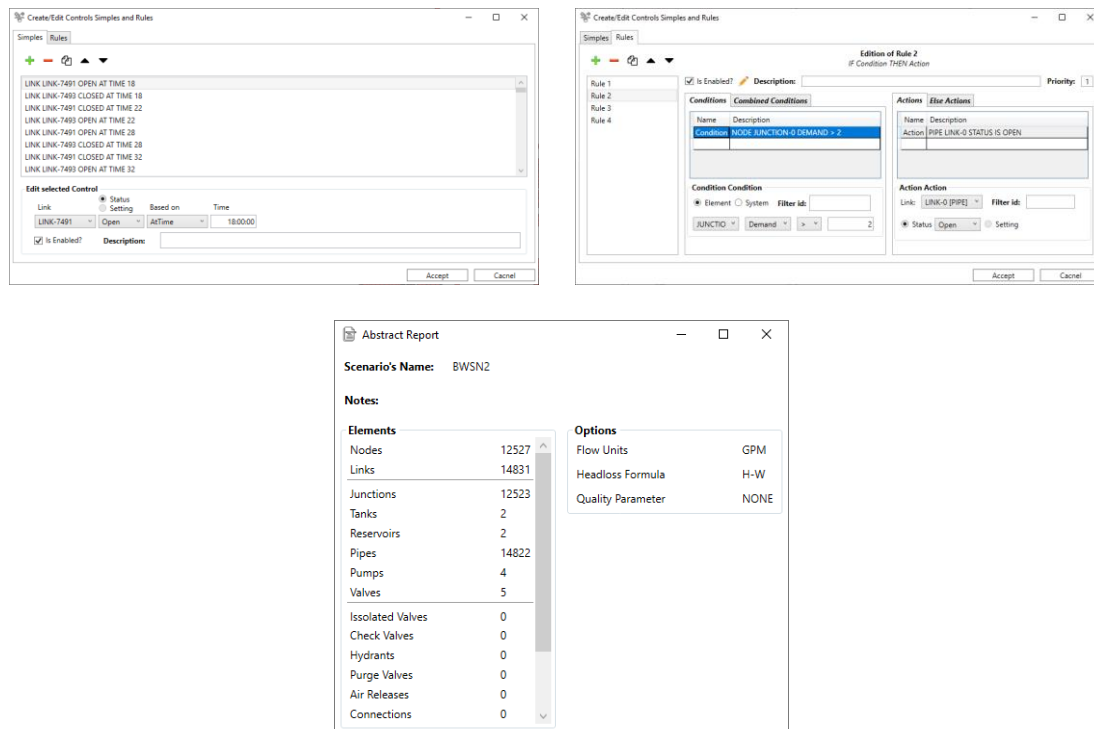
Version 0.7

QGIS versions: **3.0-3.99**

*What's new:*

- Abstract report with the number of elements of each type, as well as the flow units, the pressure loss formula and if any quality parameter is modeled.
- Modulation Curves Manager: Allows you to edit, create, delete, clone, export and import new patterns. Adds the option to define the pattern type. It also indicates which elements are associated with that pattern. Finally, it includes the functionality of working with real values (depending on the base value associated with the pattern) or with a multiplier or factor (traditional form).
- Curves Manager: Allows you to edit, create, delete, clone, export and import new curves. For curves associated with pumps, in the case of 1 or 3 points, the equation of the approximate curve is specified. The elements associated with these curves are also specified.
- Simple Controls Manager: Allows editing, adding, deleting, cloning and ordering Simple control laws. It includes the option of being able to disable a control law.
- Rules Manager: Allows editing, adding, deleting, cloning and ordering Rules. It includes the option of being able to disable a Rule. You can combine different conditions through the OR and AND operators, as well as select the appropriate combined condition to apply to the Rule.
- In both Controls managers its definition is done interactively and not by typing text (traditional way).





## DETAILS OF PREVIOUS VERSIONS

### Version 0.6

QGIS versions: 2.0-3.99

#### Features:

- Manage QGISRed projects. It is possible to open, create, import, clone or delete projects.
- Create or edit a QGISRed project. It allows to create vector layers (SHPs) of the basic elements that the EPANET software works with. If the user removes any of these SHPs, it is possible to recreate them.
- Data import from INP (EPANET) or SHPs files. In the first format you can import complete models developed with the popular EPANET software. Using SHPs, you can create or complete a model specifying for each type of element, the SHP from which you want to import information and which fields contain certain information needed for the model.
- Validation of the model, informing if there has been any error or warning when processing the information contained in the SHPs.
- Export to EPANET INP file, with the option to open this software once the file is generated.
- Simulation with the EPANET Toolkit to show the hydraulic and quality results.
- Plugin includes a set of tools associated with the layout (elimination of overlapped elements, simplification of aligned vertices, creation of T-type connections, pipe union with the same characteristics or analysis of network connectivity), with the properties of the elements (analysis of lengths, diameters, materials, installation dates, change of state of pipes or elevation interpolation), to add components (connections, hydrants, drains) or to sectorize (hydraulic sectors and demand sectors).

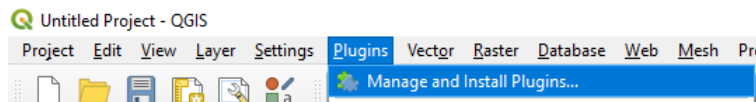
## INSTALLATION

The QGISRed plugin requires the installation of the GISRed libraries (as detailed below). The GISRed libraries work under Windows operating system and require the installation of version 4.5 of the Windows .Net Framework component. Therefore, the QGISRed plugin will only work under these conditions.

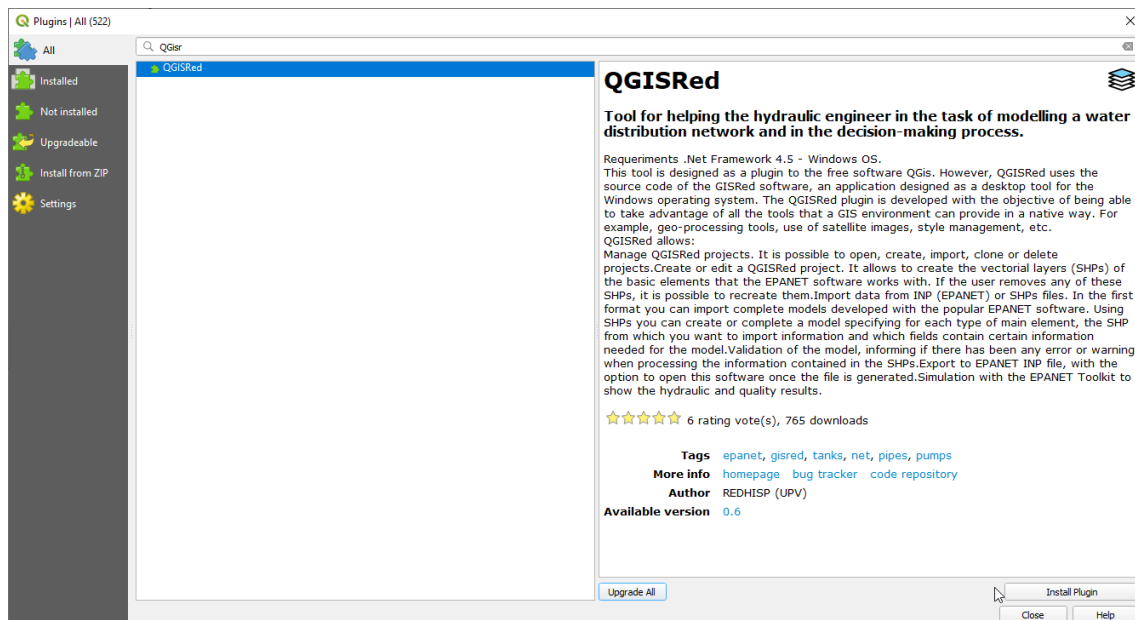
### Repository

To install the plugin or an update from the official QGIS repository, follow these steps:

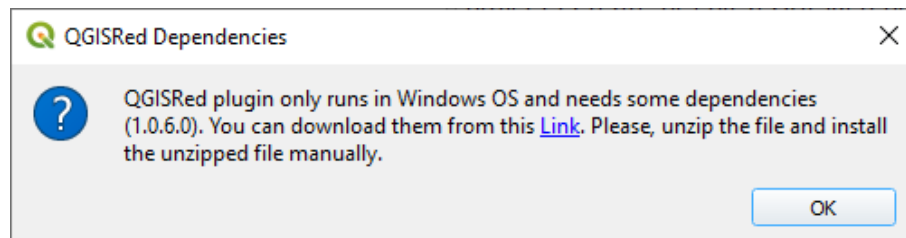
1. Start QGIS v3.x
2. Go to Plugins menu → Manage and Install Plugins...



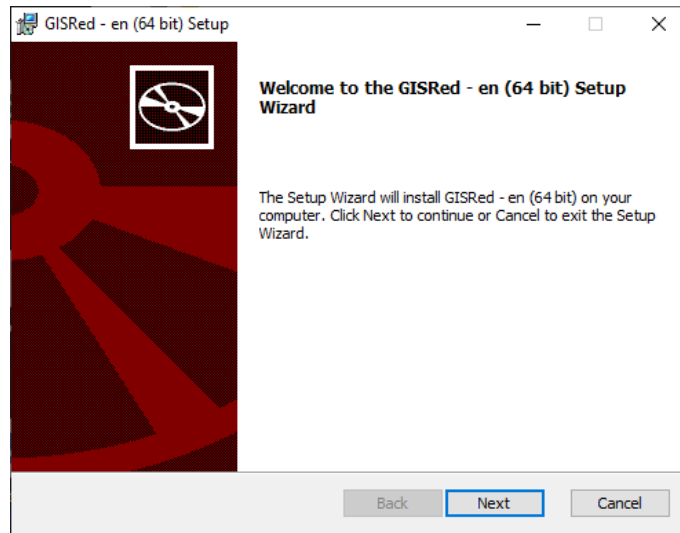
3. Select the "All" tab, in the top bar type QGISRed. Then select the only item that appears and finally press the button to install it in the lower right corner ("Install Plugin").



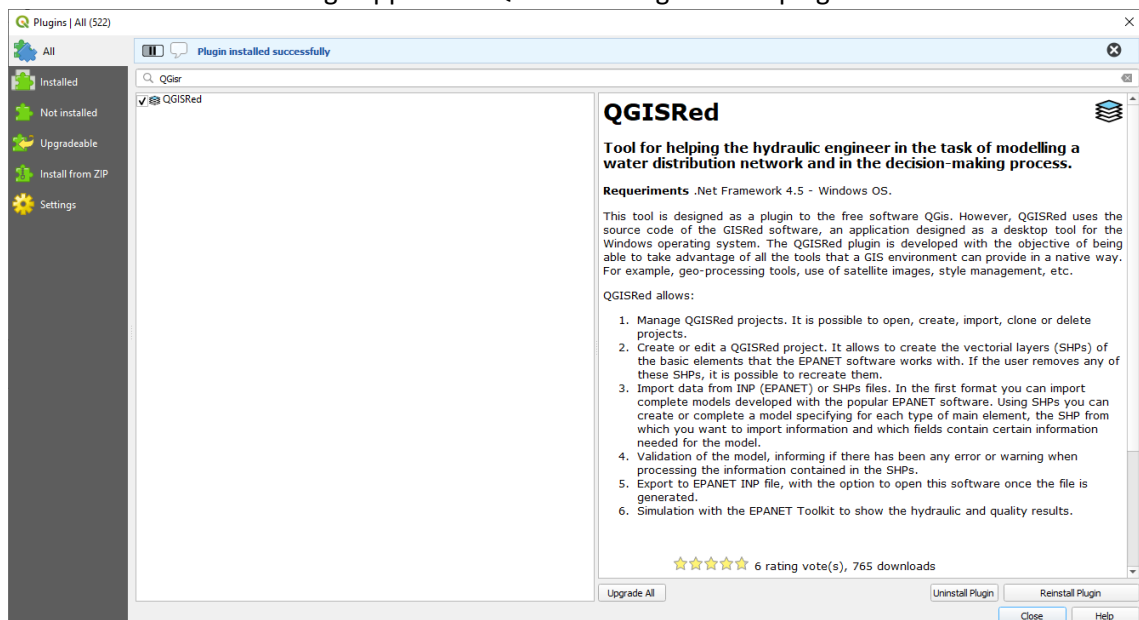
4. Once installed, a message will appear indicating the need to install the GISRed libraries mentioned above.



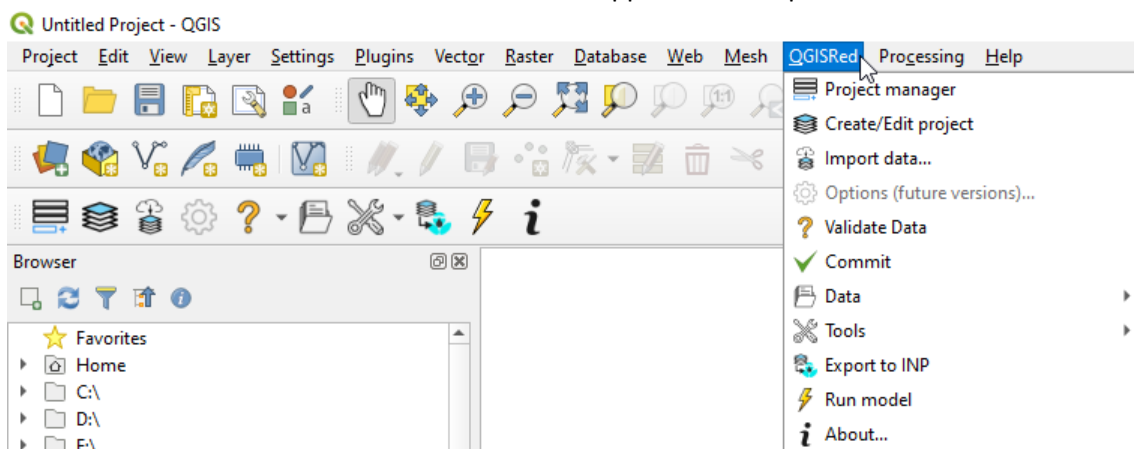
5. Click on the word "Link", which will open a dialog to download a ZIP file. It must be unzipped and then run the resulting file, which will install the necessary libraries.



6. Once the previous file has been downloaded, you can close the message by pressing the "Ok" button. A message appears in QGIS indicating that the plugin has been installed.



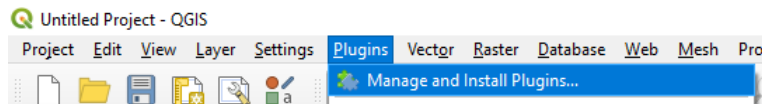
7. Close the window at the end of the process.  
8. A new button bar and a new item should appear in the top menu.



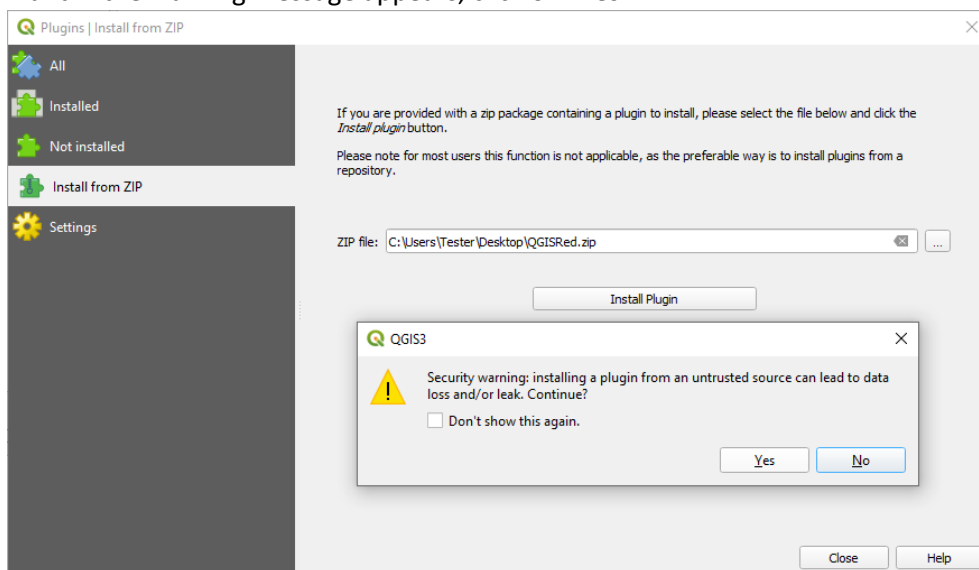
## Local

To install an update of the plugin locally, prior to the steps discussed below, it is necessary to uninstall it. To do this, you can uninstall it from the QGIS plugin manager, or manually deleting the corresponding directory.

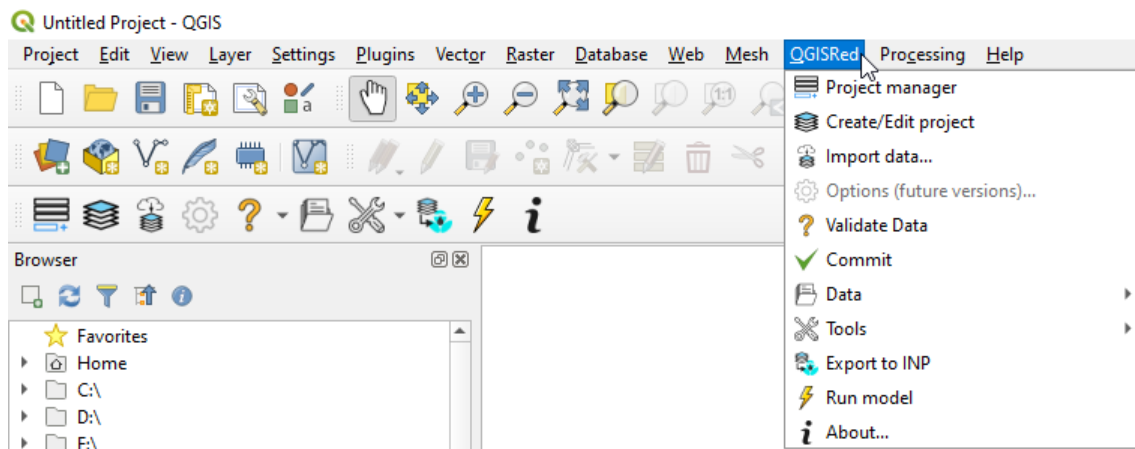
1. Start QGIS v3.x
2. Go to Plugins menu → Manage and Install Plugins...



3. Select "Install from ZIP" tab, select the **QGISRed.zip** file. Then click on "Install Plugin" and if the warning message appears, click on "Yes".



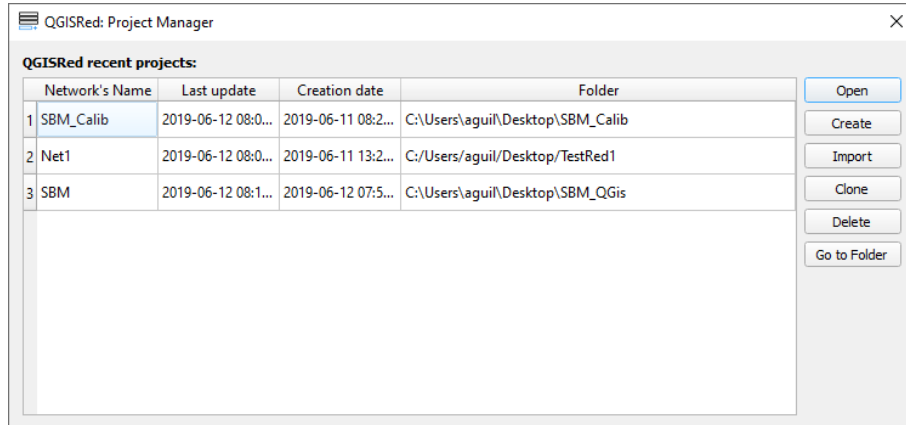
4. As in the installation from the repository you will be asked to download and install some libraries. You must follow the same steps as those detailed in the previous section.
5. Close the window at the end of the process.
6. A new toolbar and a new item should appear in the top menu.



## GETTING STARTED

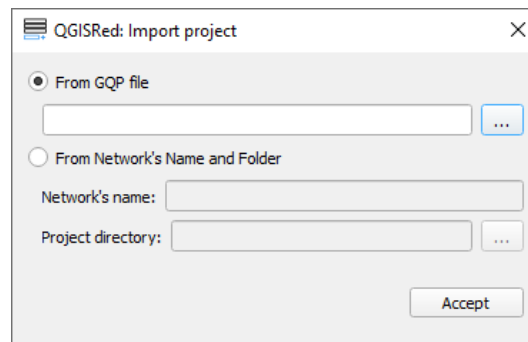
This section briefly introduces each tool available in the plugin. In the following sections more details will be presented.

### Project Manager



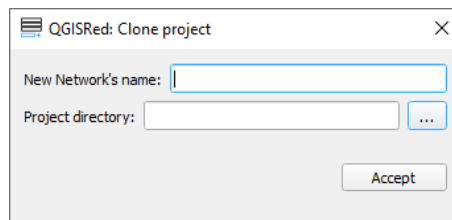
This window allows the user to manage recently opened QGISRed projects, but also to import projects that do not appear in the list, to delete those that the user do not want to appear, to make a copy of one, to create a new project or to access to the project directory.

### Import



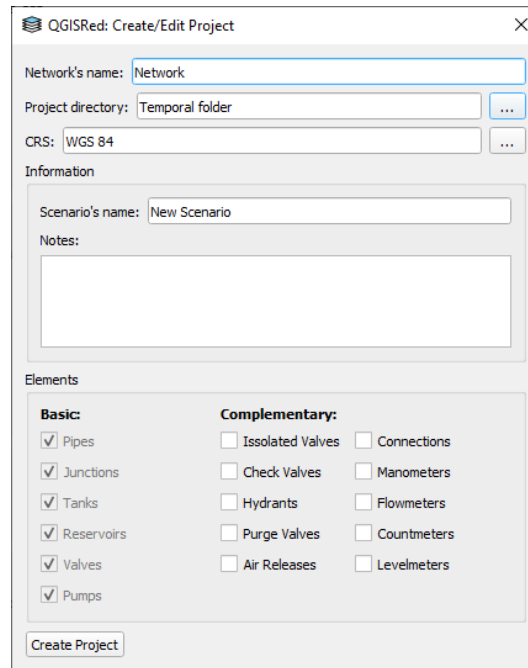
Two methods are available for importing a project. The first method is to select a file (extension ".gqp") that is generated when QGISRed project is created. The second method, specifying the name of the network and the directory where the SHPs are stored.

### Clone



To clone a project, the user must specify the new name of the network and the directory where he wants to copy it. If the network name is different from the original, the directory can be the same. In other words, there can be several QGISRed projects in the same directory.

## Create/Edit Project



The dialog box is titled "QGISRed: Create/Edit Project". It contains the following fields and sections:

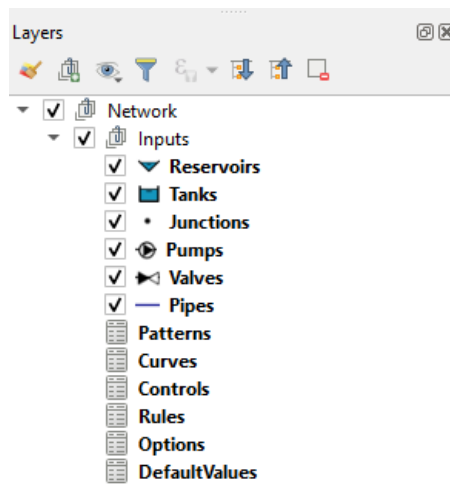
- Network's name:** A text field with the value "Network".
- Project directory:** A text field with the value "Temporal folder" and a browse button (...).
- CRS:** A text field with the value "WGS 84" and a browse button (...).
- Information:**
  - Scenario's name:** A text field with the value "New Scenario".
  - Notes:** A large empty text area.
- Elements:**

Basic:	Complementary:	
<input checked="" type="checkbox"/> Pipes	<input type="checkbox"/> Isolated Valves	<input type="checkbox"/> Connections
<input checked="" type="checkbox"/> Junctions	<input type="checkbox"/> Check Valves	<input type="checkbox"/> Manometers
<input checked="" type="checkbox"/> Tanks	<input type="checkbox"/> Hydrants	<input type="checkbox"/> Flowmeters
<input checked="" type="checkbox"/> Reservoirs	<input type="checkbox"/> Purge Valves	<input type="checkbox"/> Countmeters
<input checked="" type="checkbox"/> Valves	<input type="checkbox"/> Air Releases	<input type="checkbox"/> Levelmeters
<input checked="" type="checkbox"/> Pumps		
- Create Project:** A button at the bottom left.

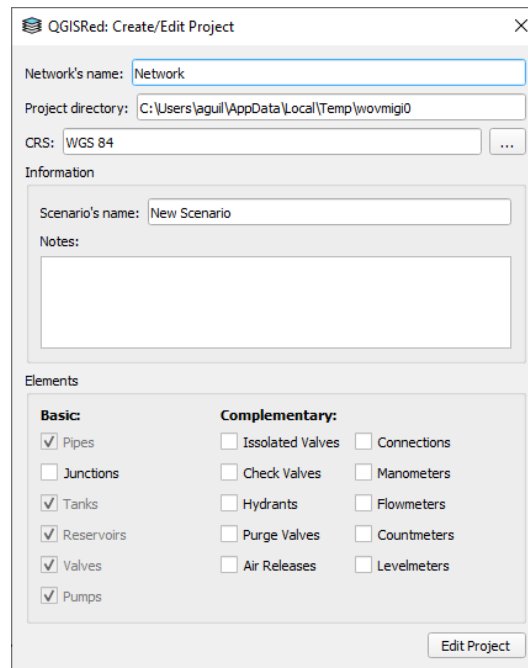
From this window it is possible to create a QGISRed project, i.e. the SHPs needed to build a model of a hydraulic network. It can also be edited, completing in case of missing layers, establishing the reference system (CRS) or providing information of the scenario (name and notes).

The required data to create a project is the name of the network and the directory where the information will be stored. If the default value "Temporary folder" is maintained in the directory field, the program will create a temporary directory that can be consulted in the Project Manager.

Once created, the following content will appear in the legend: A group with the name of the network which, in turn, will include another group titled "Inputs", thus indicating that this information is input data to build the model. Within the group, at least 6 SHPs are included, one for each type of EPANET base element and several tables to complete information such as patterns, curves, control and simulation options. In addition, other elements may appear if some of the complementary elements is marked.



If any of the SHPs (base elements) is removed, when accessing the previous window, you will be able to mark this layer to create it again.



The 'QGISRed: Create/Edit Project' dialog box contains the following fields and sections:

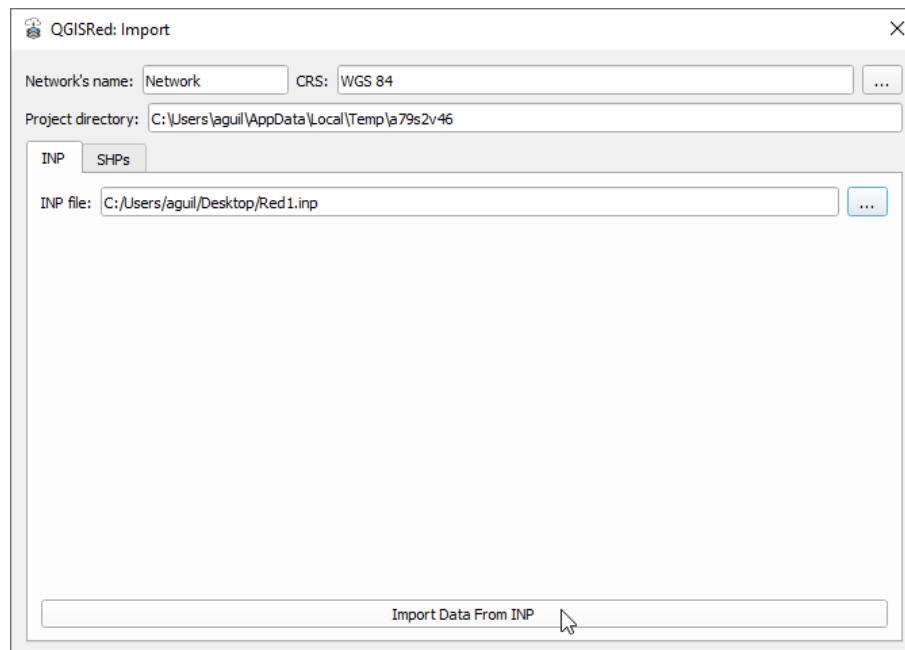
- Network's name:** Text field with 'Network' entered.
- Project directory:** Text field with 'C:\Users\aguil\AppData\Local\Temp\wovmigl0' entered.
- CRS:** Text field with 'WGS 84' entered and a browse button (...).
- Information section:**
  - Scenario's name:** Text field with 'New Scenario' entered.
  - Notes:** Large empty text area.
- Elements section:**

Basic	Complementary:	
<input checked="" type="checkbox"/> Pipes	<input type="checkbox"/> Isolated Valves	<input type="checkbox"/> Connections
<input type="checkbox"/> Junctions	<input type="checkbox"/> Check Valves	<input type="checkbox"/> Manometers
<input checked="" type="checkbox"/> Tanks	<input type="checkbox"/> Hydrants	<input type="checkbox"/> Flowmeters
<input checked="" type="checkbox"/> Reservoirs	<input type="checkbox"/> Purge Valves	<input type="checkbox"/> Countmeters
<input checked="" type="checkbox"/> Valves	<input type="checkbox"/> Air Releases	<input type="checkbox"/> Levelmeters
<input checked="" type="checkbox"/> Pumps		
- Edit Project** button at the bottom right.

## Import data

QGISRed allows to import a complete model from an EPANET INP file or import data from SHPs files. In the first case, you only need to select the INP file. In the second case, it is necessary to select the directory where the layers are stored, and then, for each type of element, select the corresponding layer and the fields to be imported.

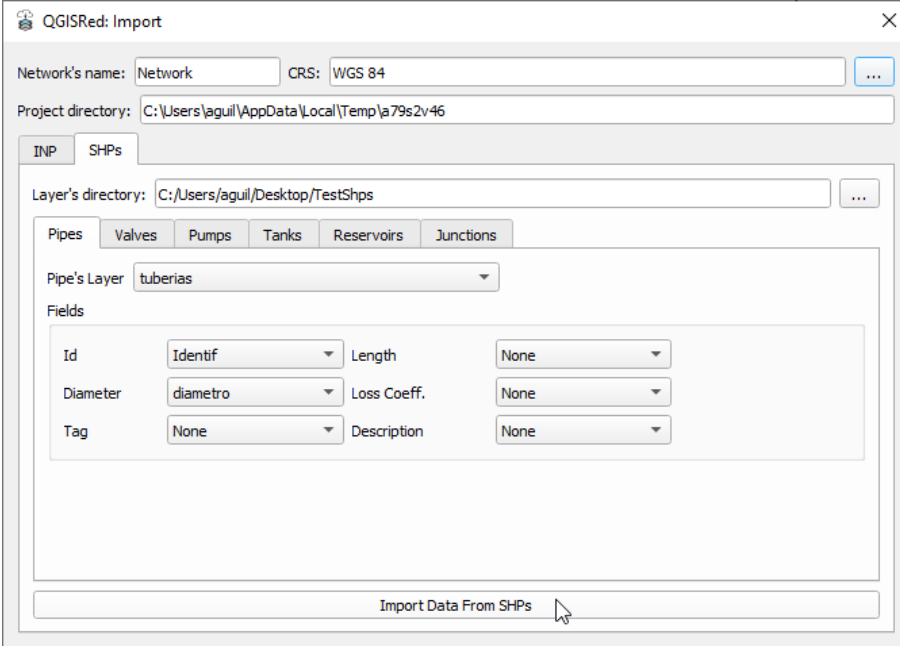
- From INP:



The 'QGISRed: Import' dialog box contains the following fields and sections:

- Network's name:** Text field with 'Network' entered.
- CRS:** Text field with 'WGS 84' entered and a browse button (...).
- Project directory:** Text field with 'C:\Users\aguil\AppData\Local\Temp\ja79s2v46' entered.
- Import Method:** Two tabs, 'INP' (selected) and 'SHPs'.
- INP file:** Text field with 'C:/Users/aguil/Desktop/Red1.inp' entered and a browse button (...).
- Import Data From INP** button at the bottom.

- From SHPs:



QGISRed: Import

Network's name: Network CRS: WGS 84

Project directory: C:\Users\agui\AppData\Local\Temp\79s2v46

Layer's directory: C:\Users\agui\Desktop\TestShps

Pipes Valves Pumps Tanks Reservoirs Junctions



Pipe's Layer: tuberias

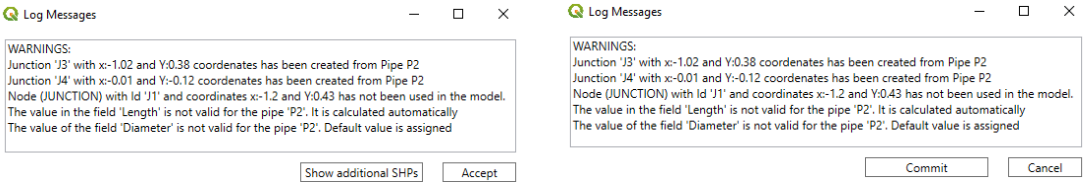
Fields

Id	Identif	Length	None
Diameter	diametro	Loss Coeff.	None
Tag	None	Description	None

Import Data From SHPs

## Validate/Commit data

Validation  and Commit  are two similar tools. Both validate that the data entered in the layers and in the auxiliary tables (Options, Rules, etc.) are correct, showing a report with all the incidents that have occurred in the process of building the model with this information. The difference between the two options is that the first only shows the list of issues and allows to load them in SHPs, while the second also rewrites the files with the necessary changes (adding or deleting of elements, changing values of the attributes, etc.).



Log Messages

WARNINGS:

Junction 'J3' with x:-1.02 and Y:0.38 coordinates has been created from Pipe P2  
 Junction 'J4' with x:-0.01 and Y:-0.12 coordinates has been created from Pipe P2  
 Node (JUNCTION) with Id 'J1' and coordinates x:-1.2 and Y:0.43 has not been used in the model.  
 The value in the field 'Length' is not valid for the pipe 'P2'. It is calculated automatically  
 The value of the field 'Diameter' is not valid for the pipe 'P2'. Default value is assigned

Show additional SHPs Accept

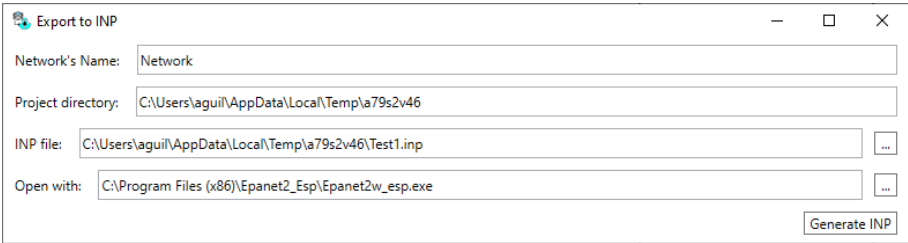
Log Messages

WARNINGS:

Junction 'J3' with x:-1.02 and Y:0.38 coordinates has been created from Pipe P2  
 Junction 'J4' with x:-0.01 and Y:-0.12 coordinates has been created from Pipe P2  
 Node (JUNCTION) with Id 'J1' and coordinates x:-1.2 and Y:0.43 has not been used in the model.  
 The value in the field 'Length' is not valid for the pipe 'P2'. It is calculated automatically  
 The value of the field 'Diameter' is not valid for the pipe 'P2'. Default value is assigned

Commit Cancel

## Export model to INP



Export to INP

Network's Name: Network

Project directory: C:\Users\agui\AppData\Local\Temp\79s2v46


INP file: C:\Users\agui\AppData\Local\Temp\79s2v46\Test1.inp

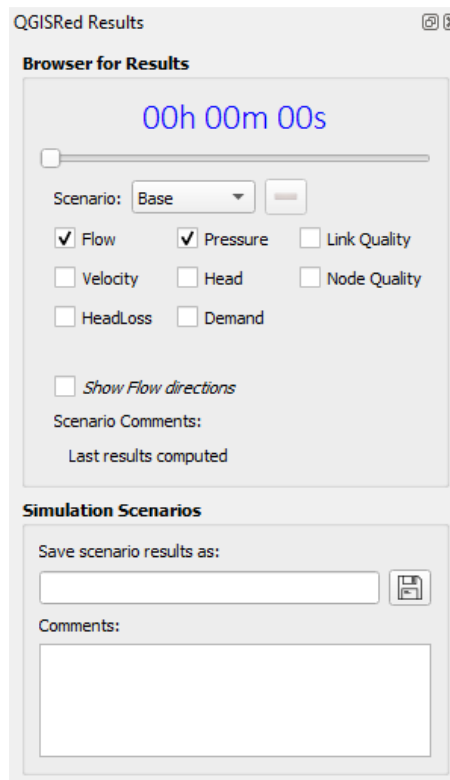
Open with: C:\Program Files (x86)\Epanet2\_Esp\Epanet2w\_esp.exe

Generate INP

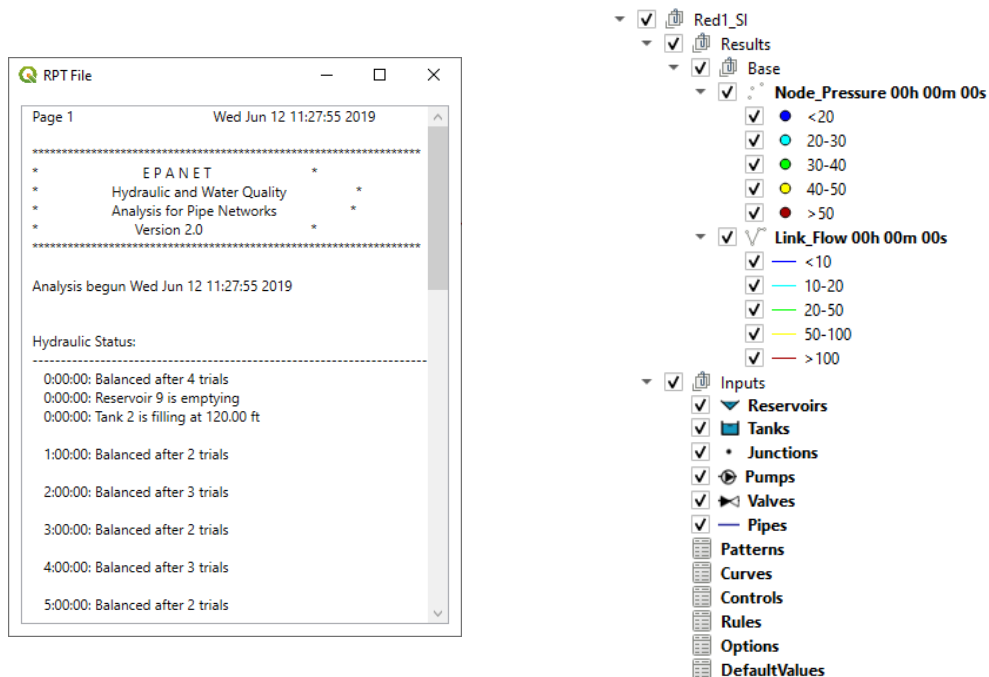
This window allows to export to an INP file the model generated from the information contained in the QGISRed project. It also has the option of specifying with which program to open the generated file.

## Run Model and Show Results

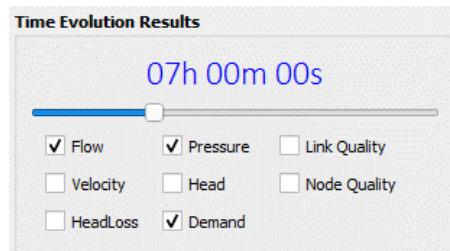
Clicking on the button  simulates the network and a Result dock (like the following image) is opened. In this dock which results and which time interval to show can be selected.



Once simulated, a window appears containing the simulation report generated by the EPANET Toolkit and the result marked in the "Browser for Results" group are opened as layers.




From the Result dock it is possible to open or close the different types of results, as well as change the instant of time to be displayed.



In addition, it is possible to save the simulation results by specifying a scenario name (corresponding only to the results and not to the data) and comments to indicate, for example, what characteristics that scenario has or what data has been changed.

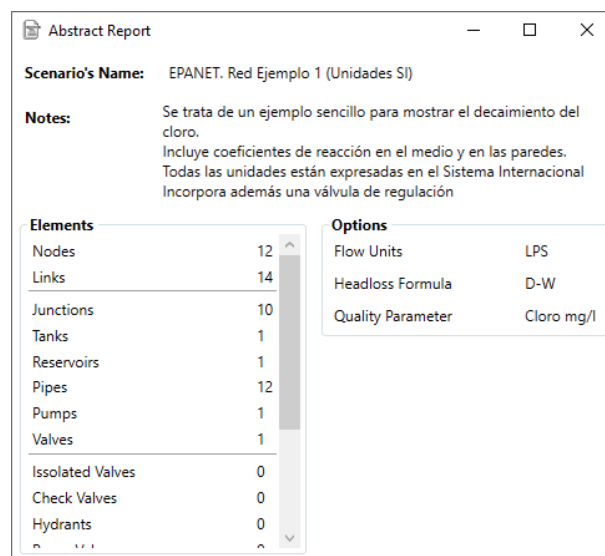
## Data

From the button  or from the plugin menu you can show or hide the button bar to access the data query or edition tools.




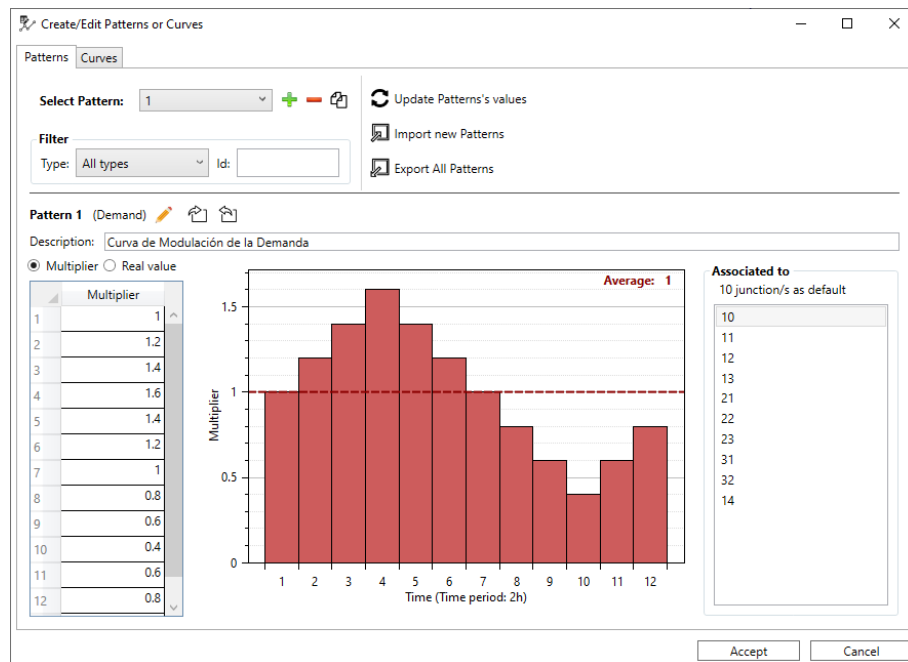
## Abstract report

The first button gives access to a window where the elements contained in the model are summarized, as well as some units and formulas of interest.



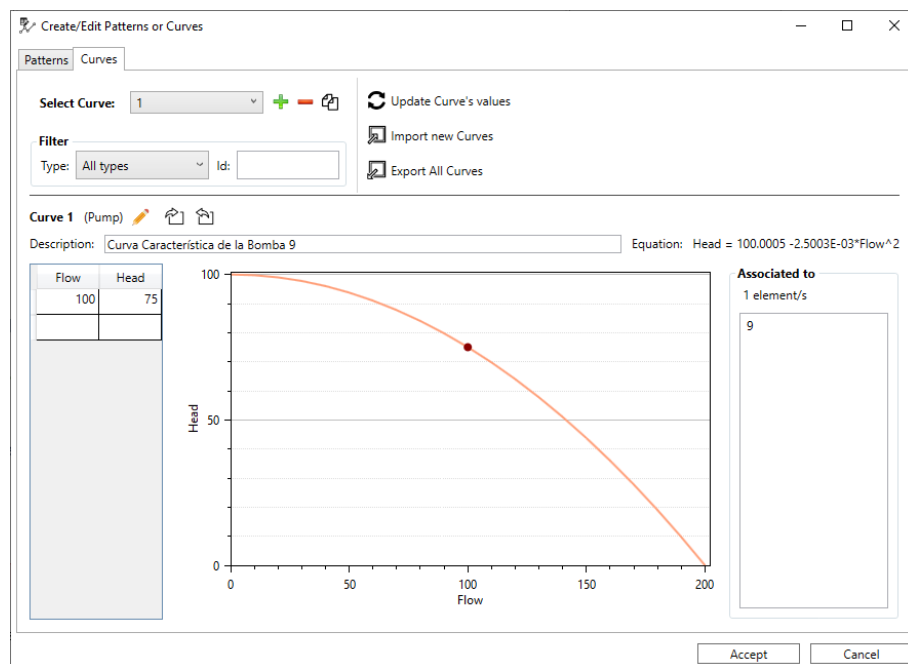
## Patterns

The button  gives access to edit Patterns and Curves. In the first tab of the window it is possible to manage the Patterns.




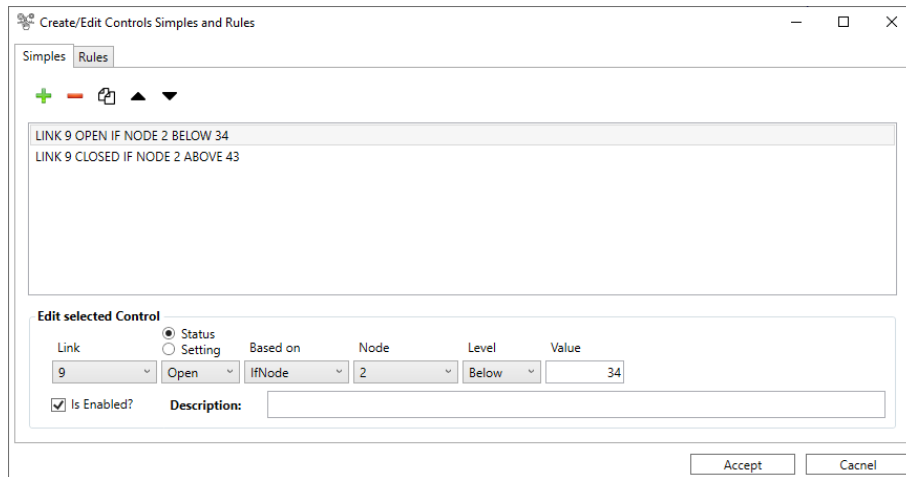
## Curves

From the same button, but in the second tab, you can manage the Curves.



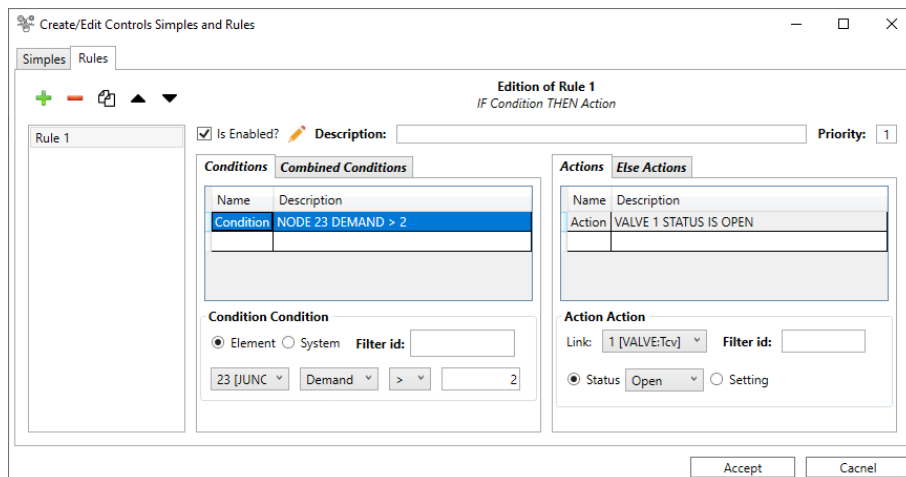
## Simple Controls

The button  gives access to the editing of the different types of controls (Simple or Rules). In the first tab of the window you can manage the Simple controls.




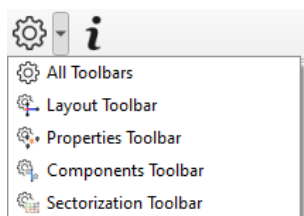
## Rules

From the same button, but in the second tab, you can manage Rules.



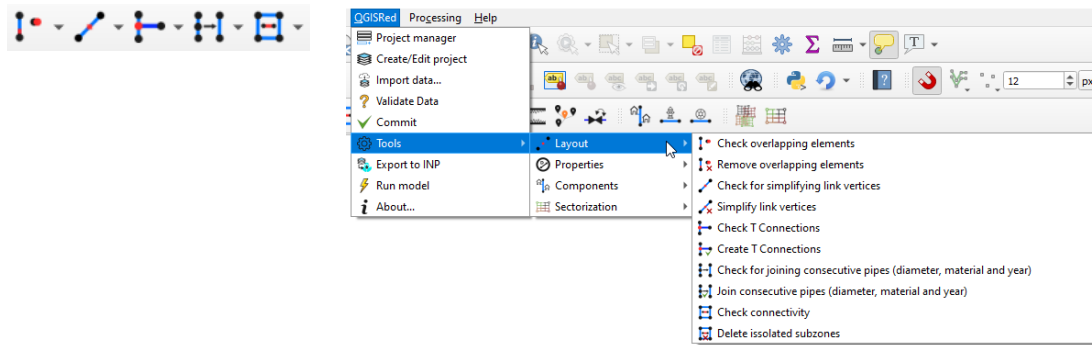
## Tools

From the button  or from the plugin menu you can access a series of tools, which will increase as new versions of the plugin are published.



## Layout

This section contains tools associated with the layout of the network being designed. Normally, each tool has two options: analysis to see a report or SHPs of warnings or application of the requested changes, in an analogous way to the validation or commitment of data explained before. The tools are present both in the button panel and in the plugin menu.

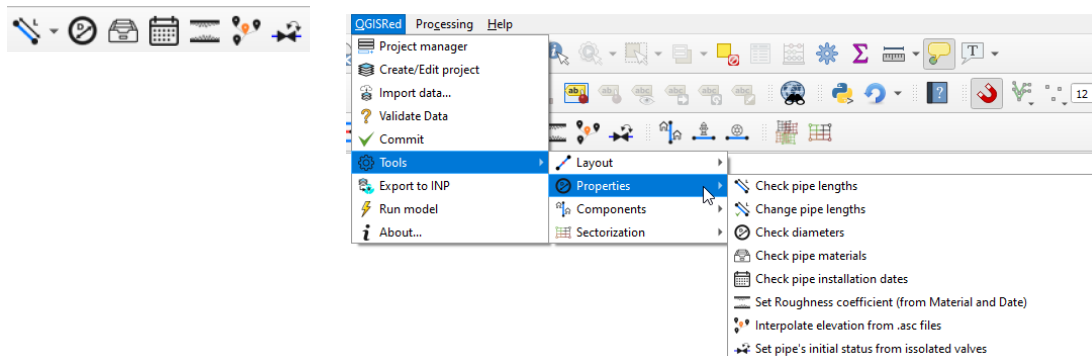


The current features allow:

- Search for overlapping elements (and delete them).
- Simplify aligned vertices in linear elements.
- Create T-type connections, that is, if a node with connectivity one coincides on a pipe, the last one is divided into two new pipes and connected all together.
- Simplification or union of pipes with the same diameter, material and year of installation.
- Analysis of network connectivity, showing isolated areas. This tool allows to eliminate subzones with less than a specific value of pipes indicated by the user.

### Properties

This set of tools is associated with some of the properties of network elements. In this case, only some tools have the analysis/commitment option commented previously.

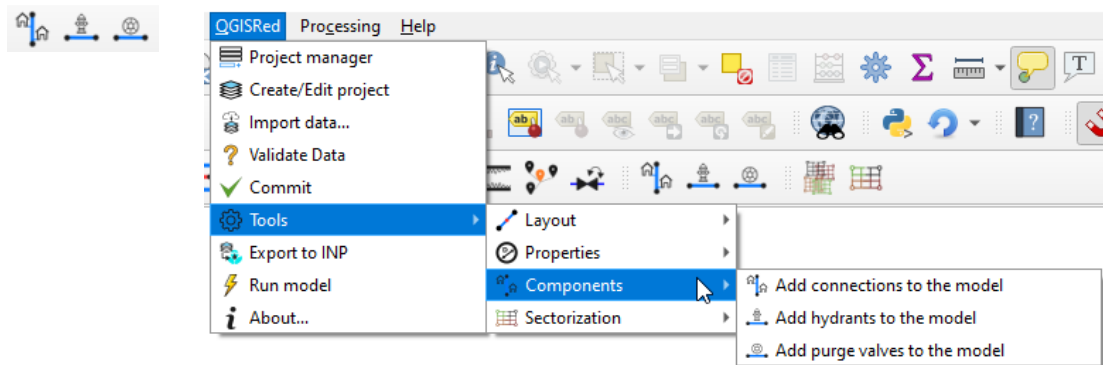


The current features allow:

- Analysis of pipe lengths. Compare the length assigned as an attribute with the Euclidean length. Displays a message if the difference is greater than a percentage specified by the user. There is the option of automatically modifying the length value with the Euclidean value if the user so indicates.
- Diameter analysis, indicating those higher or lower than pre-established thresholds.
- Analysis of materials, indicating those not recognized or unknown.
- Analysis of pipe installation dates, indicating incorrect or future dates.
- Assignment of the roughness coefficient according to the material and the year of installation.
- Massive interpolation of the elevations of node elements (junctions, tanks and reservoirs) from ASCII files.
- Assignment of the initial state of a pipe according to the state of the isolated (or cut) valves.

## Components

These tools allow you to add complementary elements to the final model of the network such as pipes or nodes.

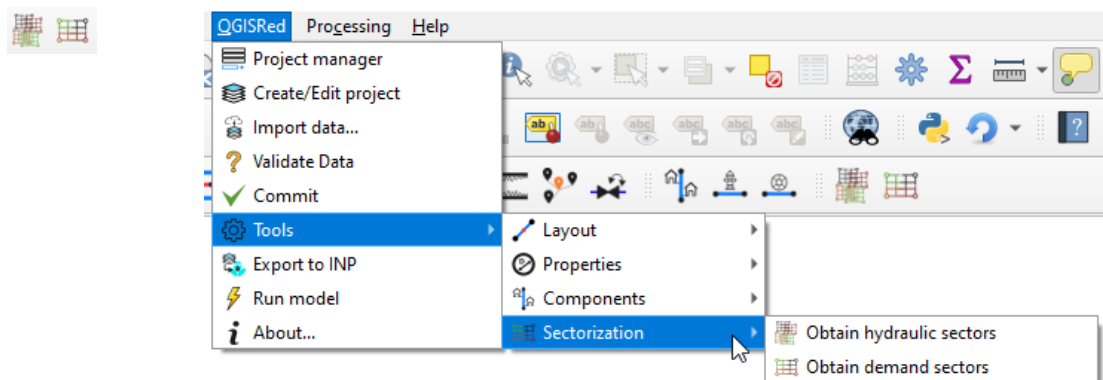


It is currently allowed to add:

- Connections, both as a punctual node or as a link (pipe)
- Hydrants, assigning the name of this one to the nearest node or in its defect creating one on the pipe in which spatially it is located.
- Drainage, assigning the name of this one to the nearest node or in its defect creating one on the pipe in which spatially it is located.

## Sectorization

This block contains tools associated with the sectorization of the network.



It is currently possible to create:

- Hydraulic sectors: the tool tries to identify whether all demands can be supplied from available sources, tanks and reservoirs.
- Demand sectors: it allows the identification of areas of the network delimited by flowmeters and regulating elements that allow a pipe to be opened or closed.

## INPUT DATA

This section details which values must be entered in the different fields that exist in the attribute tables of the elements that appear in the QGIS legend and that are part of the QGISRed project. All data that must be entered with the same values as in EPANET will not be commented (check the EPANET manual).

### Pipes

In the table of attributes of this type of element two additional fields appear with respect to those of EPANET, in this case, the field *Material* and *InstalDate*. The first corresponds to the material of the pipe and the values that can be defined are:

- GREY CAST IRON
- DUCTILE CAST IRON
- STEEL
- FIBER CEMENT
- GALVANIZED IRON
- CONCRETE WITH SHEET METAL JACKET
- CONCRETE WITHOUT SHEET METAL JACKET
- PRESTRESSED CONCRETE
- LEAD
- POLYETHYLENE
- ORIENTATED PVC
- UNPLASTICIZED PVC
- COPPER
- HIGHT DENSITY POLYETHYLENE
- LOW DENSITY POLYETHYLENE
- MEDIUM DENSITY POLYETHYLENE
- UNDETERMINED
- UNKNOWN

In the case of the *InstalDate* field, this corresponds to the date of installation of the pipe. The input format is *yyyyMMdd*, where *yyyy* corresponds to the four digits of the year, *MM* is the month number with two digits (adding a 0 before if necessary) and *dd* is the day (20190715, for July 15, 2019). With these two fields it is possible to estimate the roughness of the pipe.

### Links

Unlike EPANET or other tools, GISRed and, therefore, QGISRed does not require the definition of the topology, that is, for each line it is not necessary to define the Id of the initial and final node. This process is done automatically by spatial analysis.

### Patterns, Curves, Controls, Rules

From version 0.7 onwards, new tools are available for entering this information (see the corresponding section). This data is stored in data tables (DBF) that can be edited from QGIS. To modify this type of information directly from the tables, it is entered very similarly to the EPANET INP file, but rather than separated by spaces, it is separated into different columns.

In the case of Patterns, an additional field is added indicating the order of the factors within the same modulation pattern or curve.

For the Rules, there are three new fields (*RuleOrder*, *LineOrder* y *Name*). If we import from an INP file that contains Rules, the first time we open the attribute table it will be unordered (depending on the QGIS version).

	RuleOrder	LineOrder	Clause	Object	IdObj	Attribute	Operator	Value	Name
1	1	6	AND	PIPE	2	STATUS	IS	OPEN	a2
2	1	5	THEN	PIPE	1	STATUS	IS	CLOSED	a1
3	2	1	RULE		2				
4	1	7	ELSE	PIPE	3	STATUS	IS	OPEN	ea1
5	2	3	THEN	PIPE	2	STATUS	IS	OPEN	Action
6	2	2	IF	NODE	2	PRESSURE	>	20	Condition
7	1	2	IF	NODE	1	PRESSURE	>	20	c1
8	1	1	RULE		1				
9	1	4	OR	NODE	2	PRESSURE	>	15	c3
10	1	3	AND	NODE	1	DEMAND	>	1	c2

In this case, it is necessary to sort by the *LineOrder* column and then by *RuleOrder*. In this way, we will see an aspect very similar to how Rules are written in EPANET, but as two additional columns at the beginning. These columns will allow us to add or modify components of a specific Rule. We will have to assign the same *RuleOrder* for all the rows that correspond to the same Rule and then specify the appropriate order for each row in the *LineOrder* field.

	RuleOrder	LineOrder	Clause	Object	IdObj	Attribute	Operator	Value	Name
1	1	1	RULE		1				
2	1	2	IF	NODE	1	PRESSURE	>	20	c1
3	1	3	AND	NODE	1	DEMAND	>	1	c2
4	1	4	OR	NODE	2	PRESSURE	>	15	c3
5	1	5	THEN	PIPE	1	STATUS	IS	CLOSED	a1
6	1	6	AND	PIPE	2	STATUS	IS	OPEN	a2
7	1	7	ELSE	PIPE	3	STATUS	IS	OPEN	ea1
8	2	1	RULE		2				
9	2	2	IF	NODE	2	PRESSURE	>	20	Condition
10	2	3	THEN	PIPE	2	STATUS	IS	OPEN	Action

The last column "Name" allows you to name each of the conditions or actions defined, so that through the interface they can be easily recognized.

## Default Values

DefaultValues are a set of attributes that are used in the process of reading, building, or validating the model to correct or complete information. For example, the prefixes of new elements that are created, the minimum or maximum separation at the time of introducing an element on a pipe or the default values of some of the attributes of each element. The user can modify these data making a coherent use of them.

## TIPS

This section discusses some interesting points to the QGISRed user:

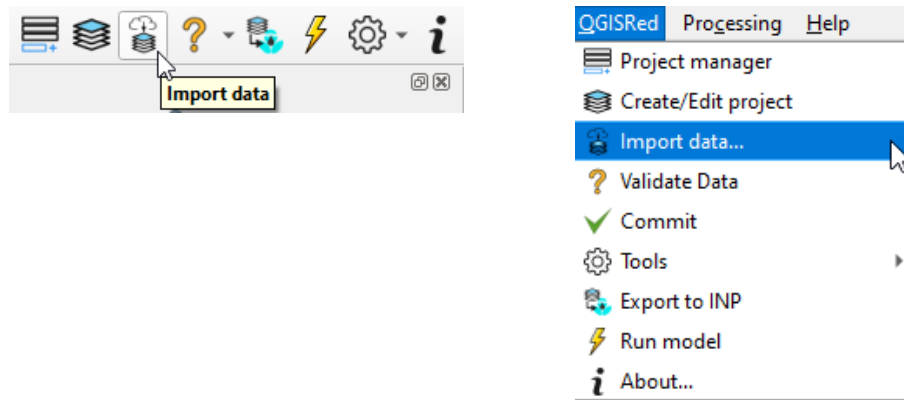
- In the Project Manager, to open a recent project it is enough to double-click on it.
- Importing a model from INP file replaces any previous information. However, the import of SHPs is incremental, i.e. you can import one layer and then another, obtaining at the end a combination of both.
- Any tool of the plugin that is used will take the information contained in the project directory, not only the open layers in QGIS.
- When exporting the model to INP, if the user does not want to open the generated file, it is possible to right-click on the program path, leaving it blank.
- Saving the QGIS project allows that when reopening the QGISRed project or directly the QGIS project, everything appears as the user left it when saving.
- When “Show Map Tips” option is active, it requires selecting a specific layer for the labels appear.

## EXAMPLES

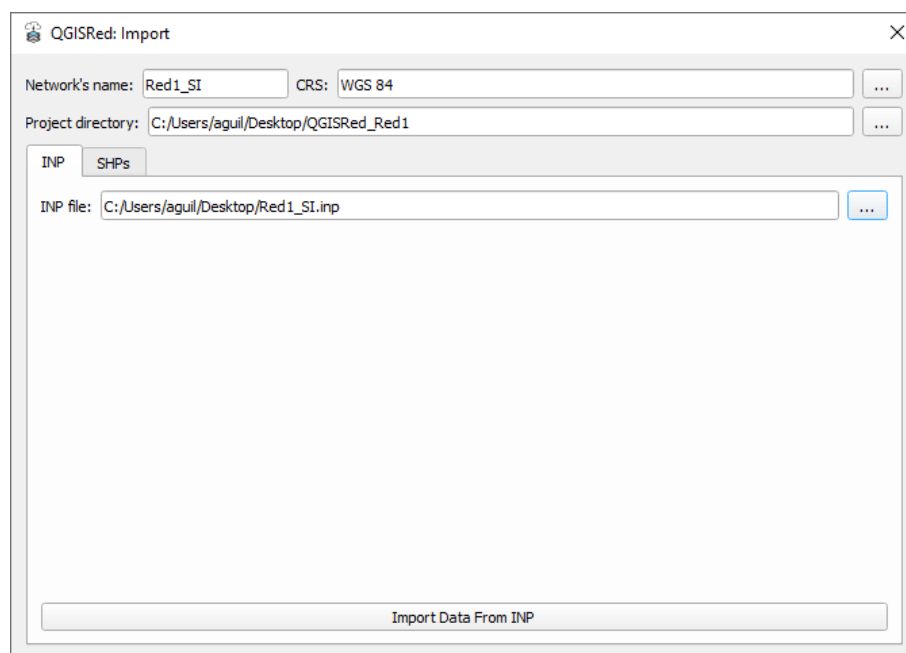
### Example 1

The first example illustrates the ease of importing a previous model available in an EPANET INP file and perform a hydraulic and quality simulation.

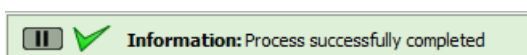
With the INP file ("Red1\_SI.inp") and QGIS opened, click on the import button (in the toolbar or in the upper menu):



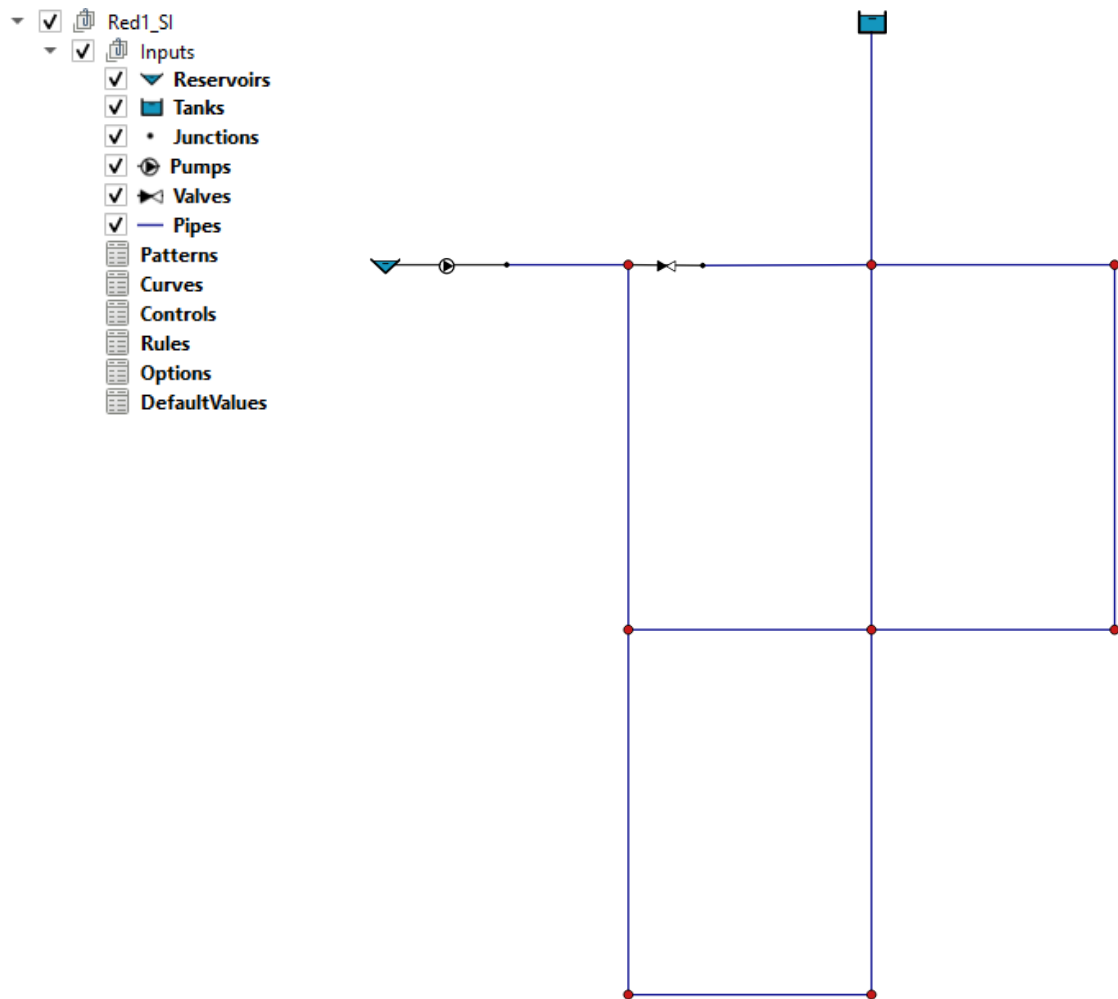
The following window will be opened, in which the user must define the name of the network, the directory where the SHPs will be stored, as well as the reference system (CRS) and the INP file. Once this information is indicated, press the "Import Data From INP" button.





In this example there is no warning in the import process, but if there were, a pop-up window would appear with the log.

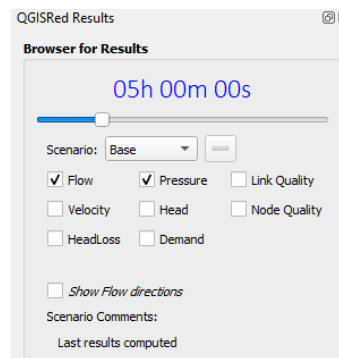
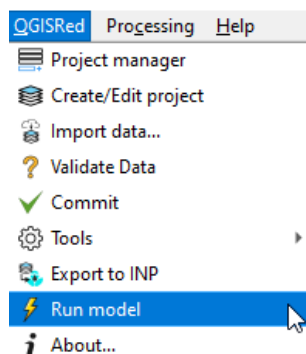


In the main QGIS window the model layers and tables with non-spatial information will appear:

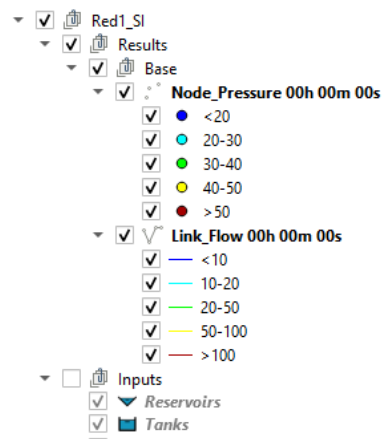
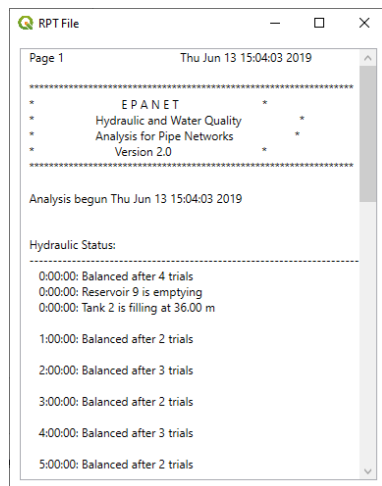


The data contained in each of the items that appear in the legend can be consulted by accessing its attribute table (secondary button on each layer or with the button available on the top toolbar ). If you want to modify any value, you must enable the editing mode  for the selected layer or table, change or even add some element and finally save the changes.

Assuming in this example that the model is completely defined, the hydraulic and quality simulation could be run. To do so, click on the "Run model" button and a right menu will appear.

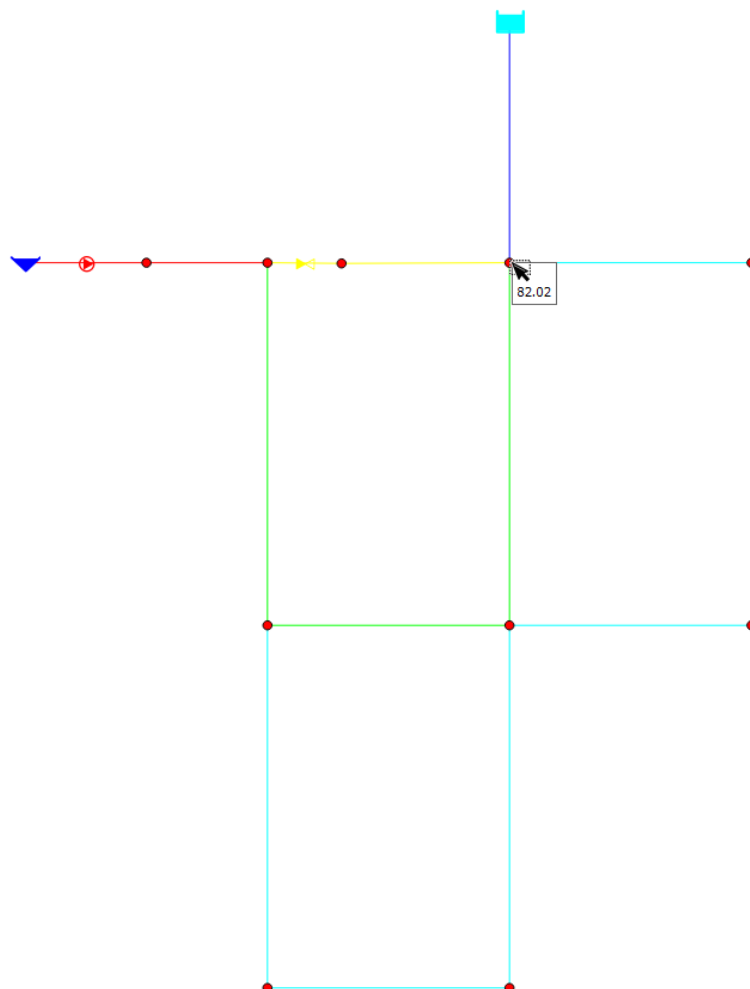



After performing the simulation, instantaneously for this example, a pop-up window appears with the report generated by the EPANET ToolKit, at the same time that the selected results are loaded (Flow and Pressure) in QGIS legend.



From the right menu that appears when clicking on the simulate button, it is possible to show the different results, as well as change the instant of time to represent.

It is recommended to deactivate the Inputs group visualization, so that the representative colors of the results are better appreciated.

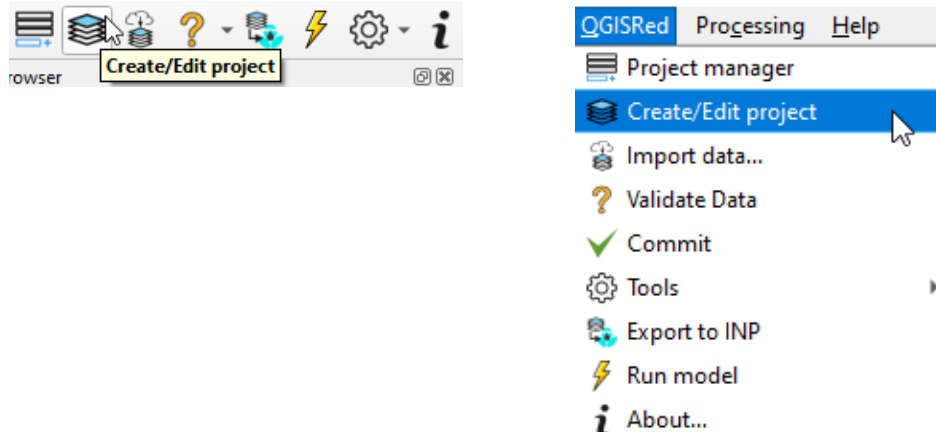


If the "Show Map Tips" option  is activated, selecting a layer of results and holding the cursor over an element displays the value associated with that variable for the selected time.

## Example 2

This example shows how to build the model of the previous example (*Red1\_SI*) from the beginning, without importing, that is, creating the different elements in QGIS.

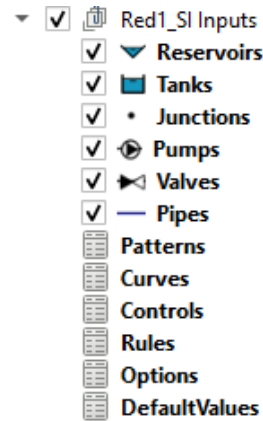
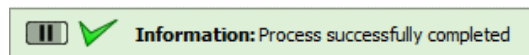
The first thing to do, once QGIS is opened, is to click on "Create/Edit Project". This can be done from the top menu or from the QGISRed plugin's own toolbar.



A window will be opened where the user must fill in the network name, the working directory and the reference system (CRS). For this example, that does not have a specific spatial location we can select the WGS 84. Then click on the "Create Project" button.

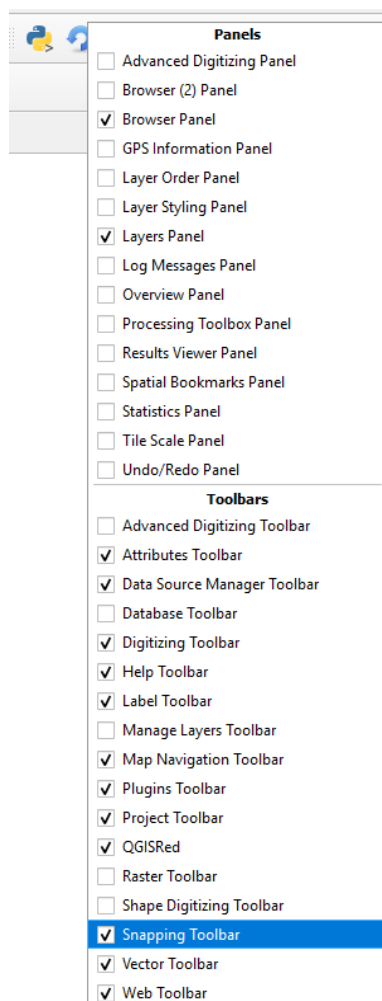
The image shows the 'QGISRed: Create/Edit Project' dialog box. It has several input fields: 'Network's name' with the value 'Red1\_SI', 'Project directory' with the value 'C:/Users/aguil/Desktop/QGISRed\_Ejemplo2', and 'CRS' with the value 'WGS 84'. Below these is an 'Information' section with 'Scenario's name' set to 'New Scenario' and a 'Notes' text area. At the bottom is the 'Elements' section, divided into 'Basic' and 'Complementary' columns. The 'Basic' column has checkboxes for Pipes, Junctions, Tanks, Reservoirs, Valves, and Pumps, all of which are checked. The 'Complementary' column has checkboxes for Isolated Valves, Check Valves, Hydrants, Purge Valves, Air Releases, Connections, Manometers, Flowmeters, Countmeters, and Levelmeters, all of which are unchecked. A 'Create Project' button is at the bottom left of the dialog.



A message will appear showing that the process has been successfully completed and the legend will include the layers and tables (empty or with default values).



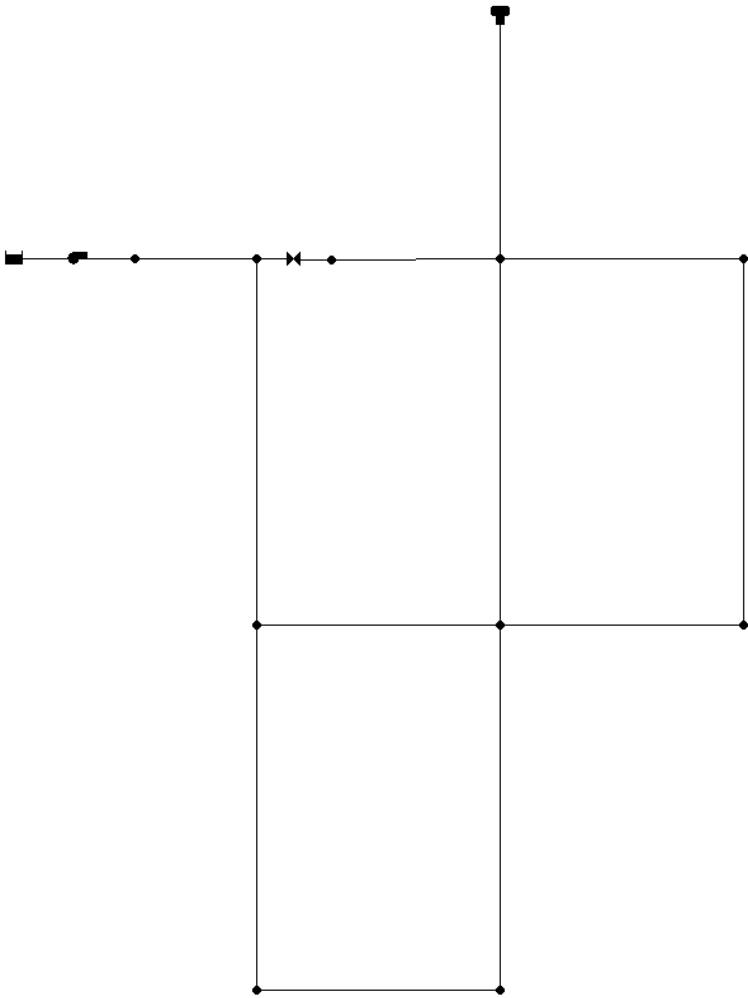
Before continuing and, as the process of create the network can take time, it is advisable to save the project with QGIS. Thus, the next time we want to continue, whether we open the QGIS project or the QGISRed project, everything will be the same as we left it the last time we saved it.

Before starting to draw the layout of our model it is convenient to activate the option of "Snapping" of QGIS. This option will facilitate the creation of an element from a previous point of our model. To do this, show the "Snapping Toolbar" and activate the first button.

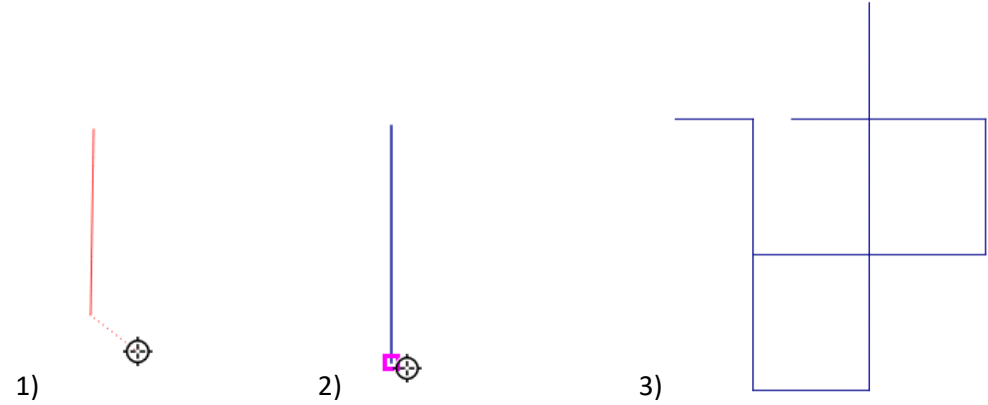


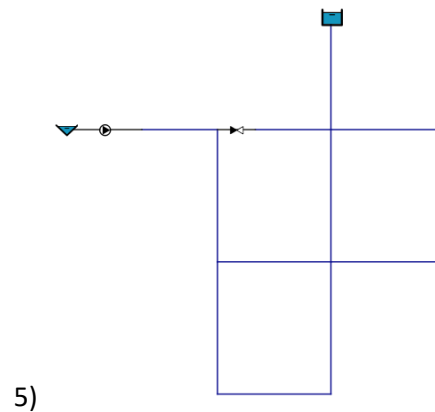
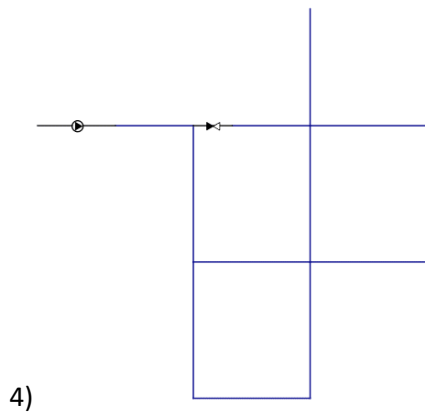
At this point we can begin to draw the layout. Possibly the most convenient thing is to begin with the pipes, then valves and pumps and, finally, tanks and reservoirs. Therefore, we should activate the Pipes layer in edit mode , select the button  to create a new line.

The model we must build is the following. As a starting point we can choose the pipe that starts from the upper tank.



First steps:




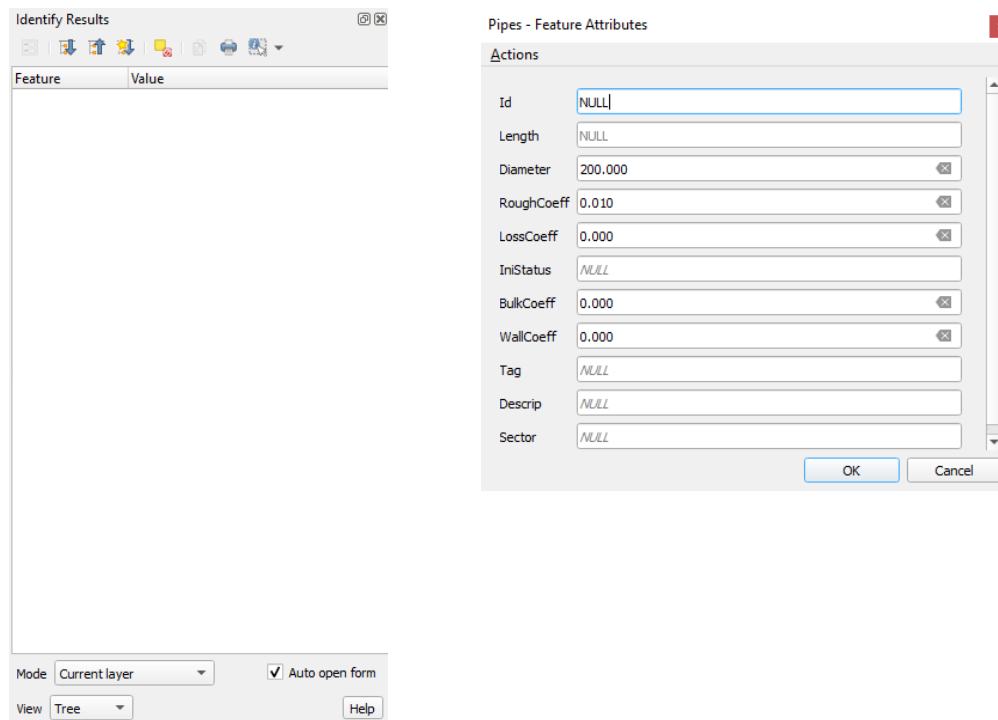



- 1) After selecting the second point of our pipe, we press right button to accept that link. At that moment a window appears to introduce the data associated to the model and that are contained in the table of attributes. In any case, when we generate or consolidate the model, the necessary empty data will be filled in.

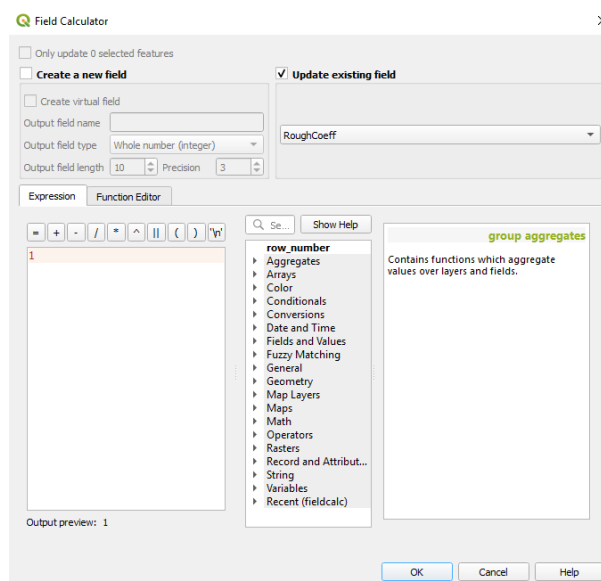
Pipes - Atributos del objeto espacial	
Acciones	
Id	NULL
Length	NULL
Diameter	200.000
RoughCoeff	0.010
LossCoeff	0.000
IniStatus	NULL
BulkCoeff	0.000
WallCoeff	0.000
Tag	NULL
Descrip	NULL
Sector	NULL
<div style="text-align: right;"> <span>Aceptar</span> <span>Cancelar</span> </div>	


- 2) The fuchsia square facilitates the selection of the end of the previous pipe.
- 3) We finish drawing the rest of the pipes.
- 4) Draw the pump (activate layer edition) and the valve (activate layer edition).
- 5) Draw the tank (activate layer edition) and the reservoir (activate layer edition).

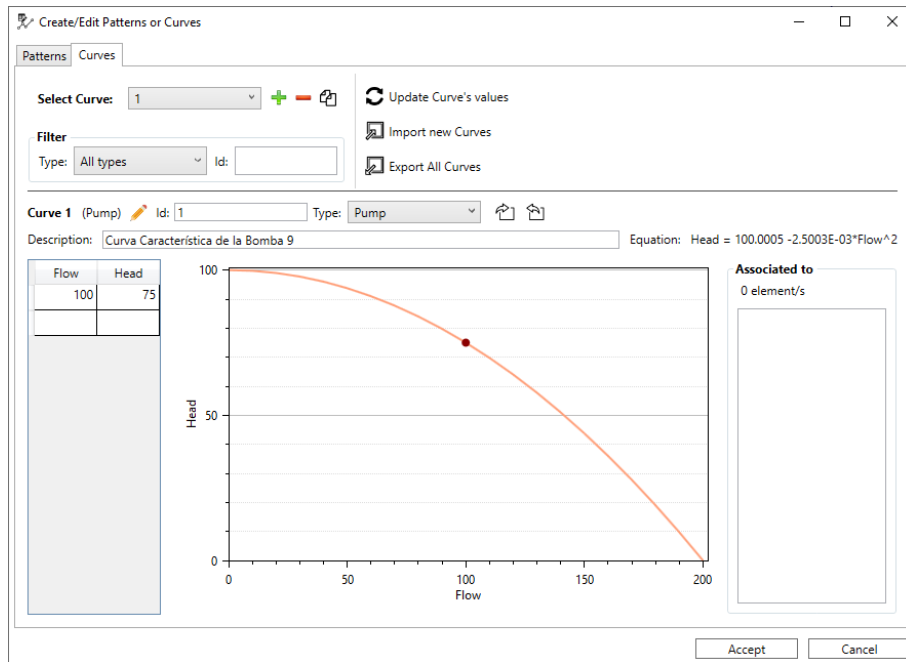
Once the topology has been built, the data for each element must be filled. To do this, maintaining the editing mode we can open the table of attributes of a type of element, in which all the elements created for that type appear and complete the information. Another option is to use the object identifier  by selecting the "Auto open form" option from the right menu. This allows clicking on an element to open a pop-up window to enter data for that element only.




An additional option when the value of a field is repeated in all or almost all elements (e.g. the roughness coefficient of the pipes in the example), it is possible to use the field calculator . Select the option to update existing field, select the field and complete the desired value.

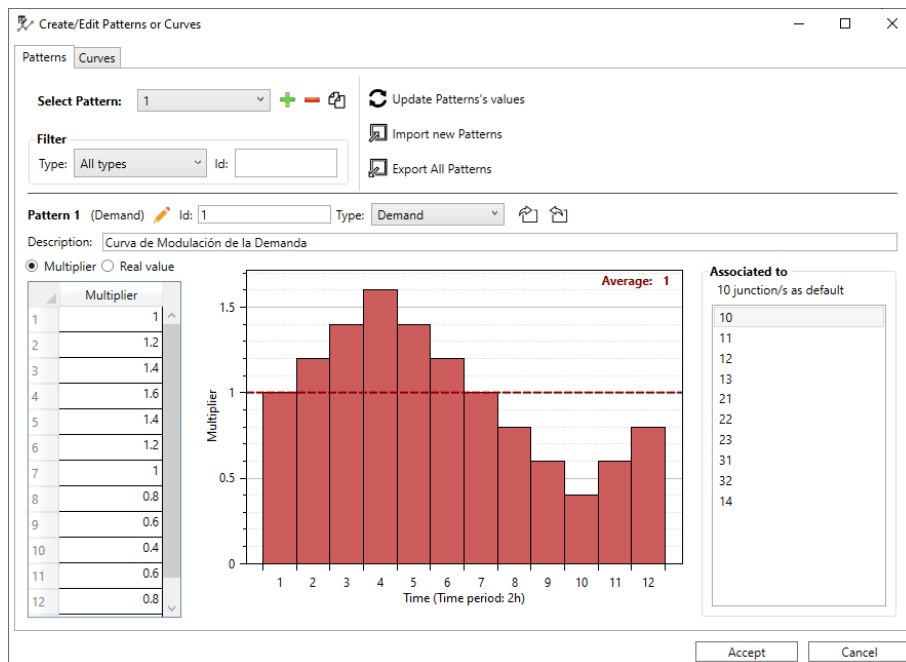


Once all the element data has been entered, the pump characteristic curve data must be completed. To do this, press the button  and we access the edition of curves. In this example it is only necessary to enter a point of the curve and specify the type of curve.





The procedure is: add a new curve, edit the curve type with the icon , select the PUMP option and then add the corresponding pair of Flow-Head values.

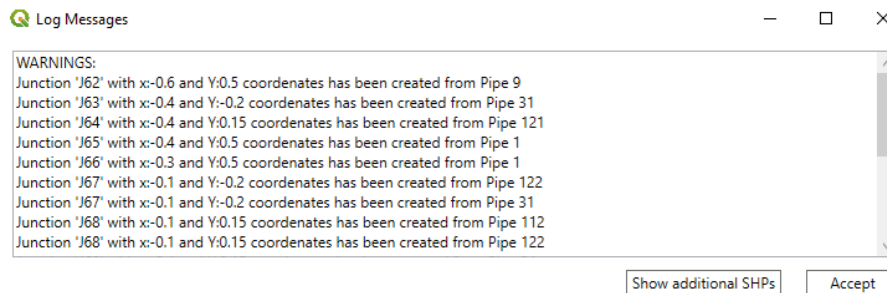
It is also necessary to enter the modulation curve data. From the same window, but in the corresponding tab, enter the values of the example.




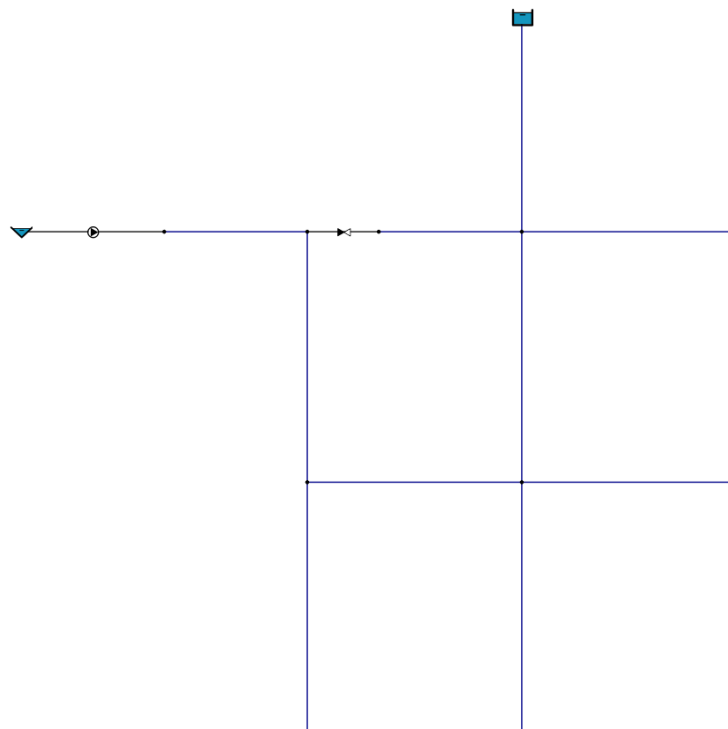
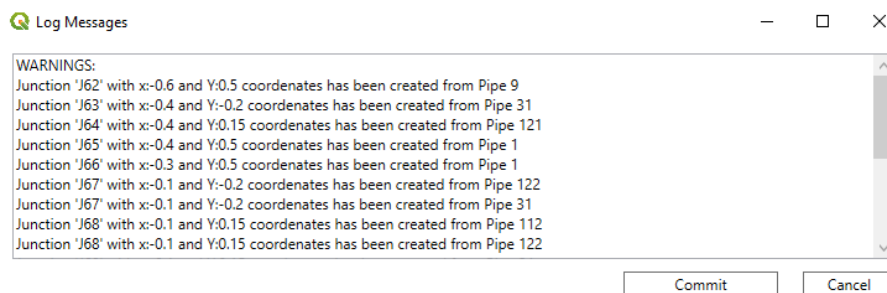
Once you have finished entering these data, click on the "Accept" button to save these changes. Then, it will be necessary in the pump to specify the Id of the curve in the *IdHFCurve* field.

As the reader will have observed, no junctions have been introduced at this time. They could be added manually one by one and complete their information or, once we validate and commit the model, these elements will be created and it will be enough to complete the data such as, for example, those related to the base demand.

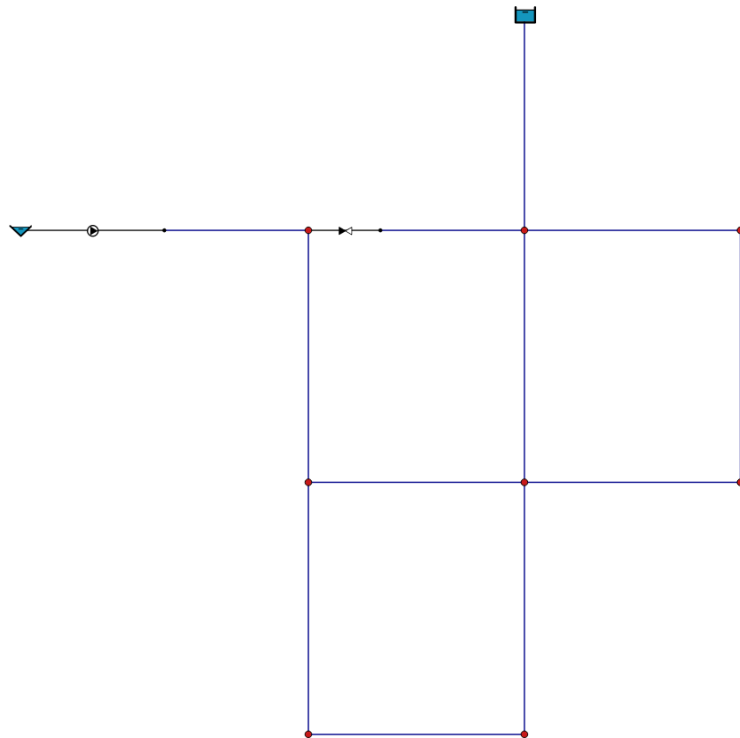
At this point, we can validate the topology and data entered. Pressing the button  will show a list of messages, corresponding only to the creation of nodes (*junctions*) from pipes. However, we can see in QGIS how these elements have not been created. This is the difference with the Commit button , which, apart from showing the corresponding warnings, applies the changes to our SHPs files.



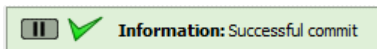
If we therefore proceed to commit , the same list of messages will appear. If we consider it correct, when clicking on the Commit button (pop-up window), we will see how the missing nodes have been created in the layout.




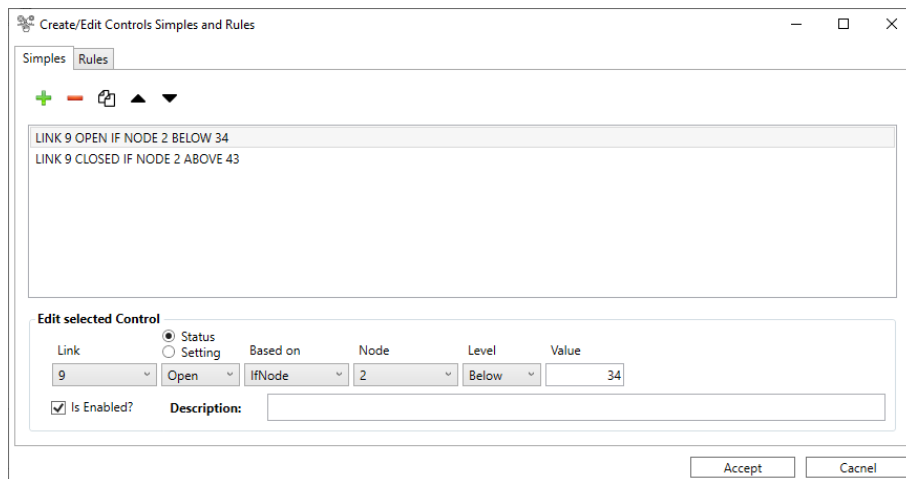
Once we have the nodes, we can complete their data, as has been done with the rest of the elements. Now we must visualize our scheme with the following figure.



If we validate again, we'll see how no messages appear in the log pop-up window.



Another aspect to complete are the simple controls that are defined for this example. It is accessed with the button  and, in the first tab, we create the two simple controls.



To finish, before proceeding with the simulation, it is necessary to modify the relevant options, to do so we access the attribute table of the Options element of the legend.

HEADLOSS	D-W
UNBALANCED	CONTINUETO
CONTINUETO	10
QUALITY TYPE	CHEMICAL

CHEMICAL LABEL	Cloro
CONCENTRATION UNITS	mg/l
DURATION	24:00
QUALITY TIMESTEP	00:05
STATUS	YES
SUMMARY	NO

It should be mentioned that, the PATTERN by default that appears in the options is the Id 1. In this example corresponds to the Id of the pattern that has been created. Otherwise, it would be necessary to change it if we want to assign to all the junctions that curve or, to specify the corresponding Id in each node.

If we simulate in the same way as in the Example 1, we will see that the same results are obtained.