**WaterStrategyMan**
**EVK1-CT-2001-00098**

# MANUAL OF THE INTEGRATED DECISION SUPPORT SYSTEM

Chapter One

Architecture and Operational Aspects


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# Chapter 1: Architecture and Operational Aspects

When running the Decision Support System for the first time, after the Splash Screen (Fig. 1), a small window appears, showing the flags of the case study countries of the WaterStrategyMan Project. The user is prompted to choose the flag/country where the region he wants to study is, and add this region, as a new one. In order to load a region, he has to browse for the regional Geodatabase, containing all information needed by the DSS to run properly, and for a folder containing a set of maps in raster and shapefile format, including the Digital Elevation Model (DEM), climatic and soil data.

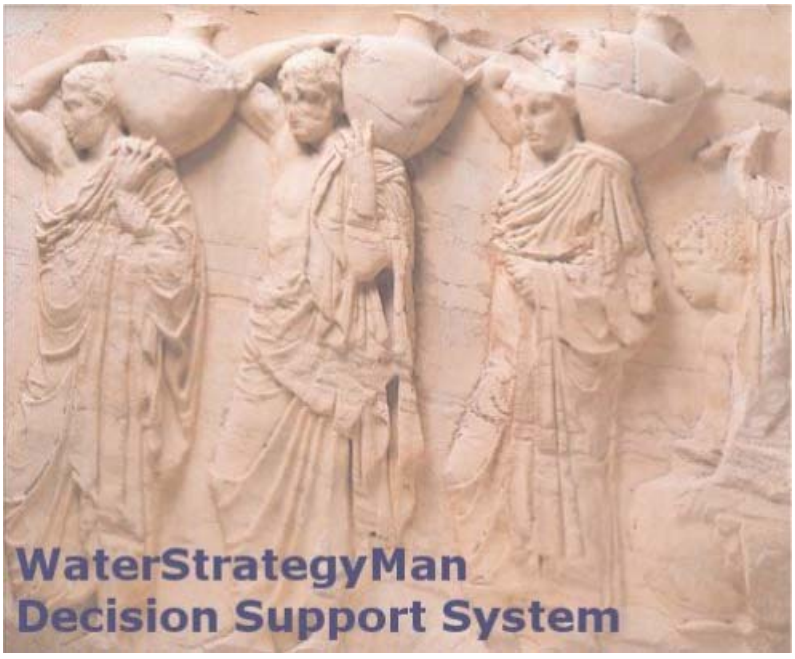


**Figure 1. The Splash Screen Image of the DSS**

Then the main graphical user interface opens, with the **Navigation Panel** on the left. This panel is always loaded, whatever functionality or sub-module is running, and presents the Base Case and the list of Water Management Schemes. The Base Case represents the regional case study as it is when loaded to create the region. So, its geodatabase contains all the most recently measured data that characterize the actual current water management of the case study. The Base Case is not simulated within the DSS tool; however it can be edited to update the available information and the conceptual network of nodes and links which schematize the water system of sources, demand uses and treatment plants. The data entry or network modifications can be done in the relevant windows accessed by the *Edit Base Case Data* menu of the Base Case, in the Navigation panel.

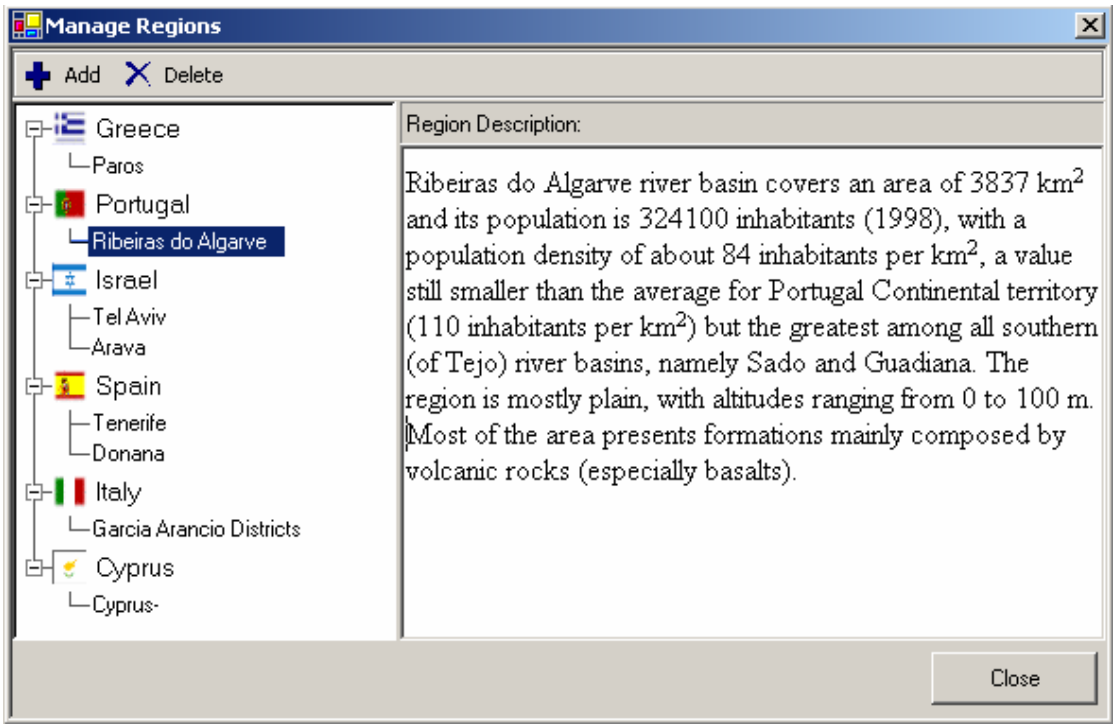


**Figure 2. The Window for managing the case study regions loaded on the DSS**

The Water Management (WMS) Schemes are based on the Base Case, in the sense they are created as copies of it, and are the actual object of the DSS analysis. For each scheme, the water allocation from sources to demand sites will be simulated under user-generated scenarios of water availability and/or demand, and strategic options selected and applied to particular time periods. Each WMS works with the data of the base case at the beginning (when created), but both data and the water network can be modified, thus customizing the scheme according to the type of analysis and objectives of the Decision Maker.

The two main menus of the graphical interface are *Main* and *Basic Data*. The latter is described in the data editor paragraph. The *Main* menu is responsible for opening the *Manage Regions* window to add or remove case study regions, choose which country and related region to work with, and create, rename or delete new or existing water management schemes. As already said, the WMSs the user generates appear listed in the Navigation panel, just under the Base Case. The selection of one of them provokes the opening of its connected geodatabase and the loading of all the network maps and information needed to run the simulation. Then a tree view expands under the scheme name, presenting the menus that will support the user throughout modelling and evaluation. Three are the categories of commands: *Create Scenario*, divided into *Availability* and *Demand* sub-menus, *Create WMS*, including the *Modify Map*, *Modify Data* and *Apply Strategy*, and *Simulation*, with the *Overview*, *Cost Analysis* and *Detailed Results*. Each menu and the related DSS module are presented in the pertinent sections of this document. Here just the Modify menu is considered, as it loads another important and useful interface panel, the **Object Manager**.

The **Object Manager** is also a tree view form, opening next to the Navigation Panel. It presents the nodes and the links of the water network, classified by type, firstly according to their water function with respect to the allocation (e.g. demand nodes, supply nodes or treatment nodes) and secondly according to their specific water use or resource type (e.g. industrial, domestic, aquifers, storage reservoirs etc). Categories can be expanded by click on the plus sign or collapsed, by clicking on the minus sign, according to the desired level of detail. Each type of node is marked with its own coloured symbol, such as circles, squares or rhombi. This symbol characterizes each node on the regional map that displays the water network and the physical features. Each network node/link has a user-defined name, and its unique identifier (ID) that appears next to the name in brackets. The Object Manager is used to navigate through the network in order to get node or link-specific data or information when used in combination with the Data and Map Editors of the WSM DSS.

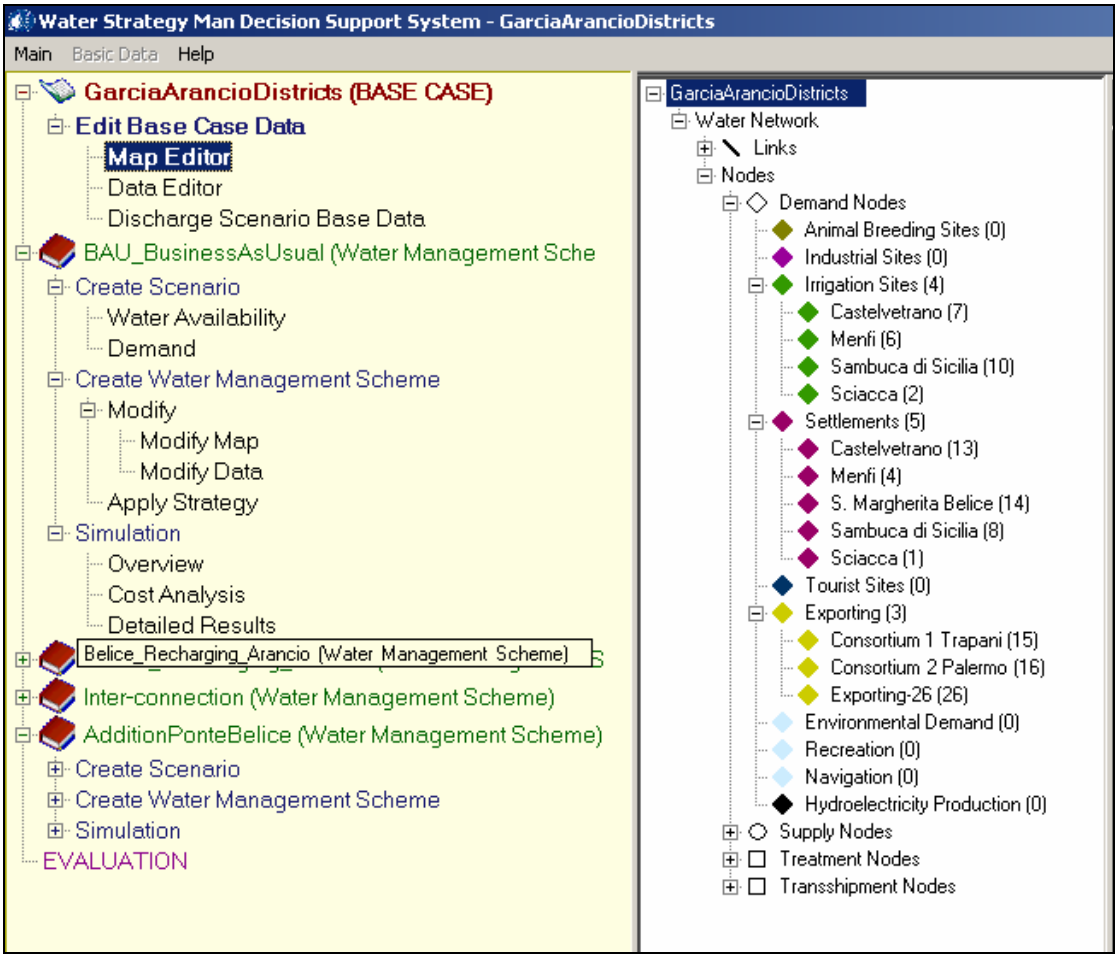


**Figure 3. The Navigation Panel (left) and the Object Manager Panel (right) of the DSS**

The **Data Editor (DE)** of the WSM DSS gives access to the data featuring the region under analysis. The DE has two functions:

- it shows the data that already exist in the regional geodatabase, and have previously been prepared by the user, and
- it allows to change the data or simply to enter the information and numbers for the first time, directly from within the DSS.

The user opens the DE from the Navigation Panel, on the left in the GUI, by clicking on the *Data Editor* or *Modify Data* options, according as to whether he is going to edit the Base Case or a Water Management Scheme. The DE comprises of a series of tabs, grouped together in a dedicated resizable panel in the top-right of the GUI.

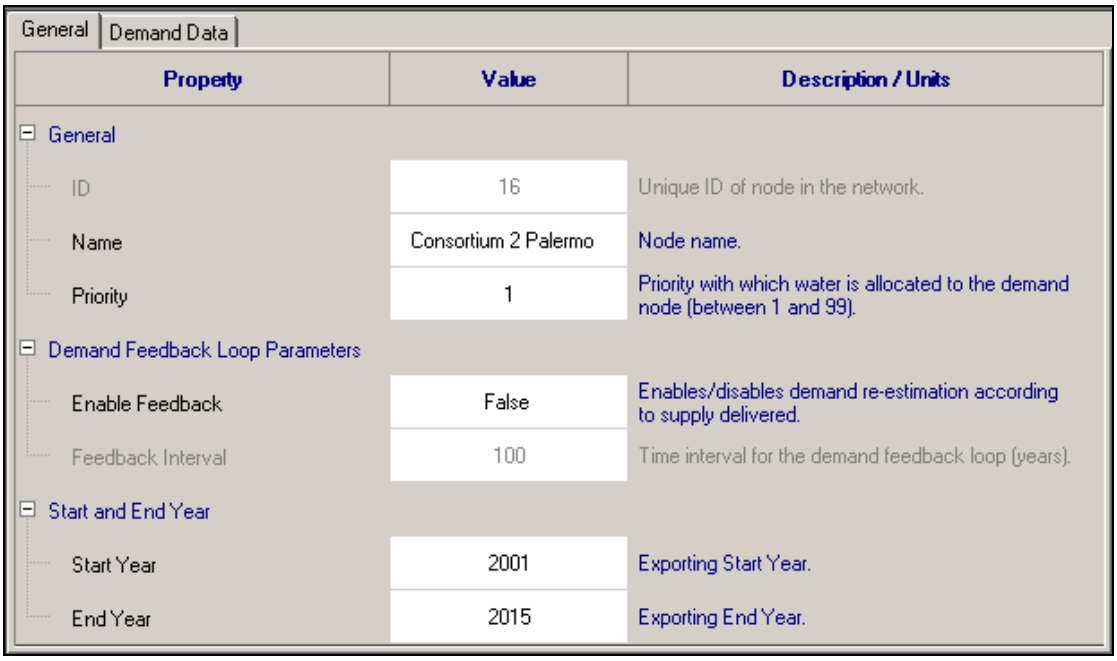


**Figure 4. The General tab of the Data Editor for exporting nodes**

Each tab consists of a list of information addressing specific aspects of the regional element accessed. For instance the first tab, *General,* contains the basic information, such as identifier, name and allocation priority, which are defined by the network element data refers to. This general information is displayed on three different columns: the first presents the type and name of information, the second one its value that can be edited and the third one provides a short explanation of the attribute. The classification of information in other tabs is presented in more detail throughout the document. They mainly concern irrigation activities and methods, permanent and seasonal population, water distribution losses and costs, water resources quality etc.

As already said in the Navigation Panel description, the Data Editor presents the data characterising the elements of the water resource network in the region under study. Those network elements represent available water resources, such as groundwater, river reaches and reservoirs, water uses, among which settlements, irrigation sites and animal breeders, of treatment and transhipment plants and structures, and the connections such as canals and pipelines, linking them all conceptually and physically. All the water

network elements are schematically represented in the DSS in terms of coloured spots and links placed on the region map.

In order to enter the DE of whatever network element, the DSS user can do two things: select the object from the Object Manager panel, which lists the nodes and links of the network in a tree view form, or select the object from the Map window, which displays them on the region map. Both functionalities enable the user to view and manipulate the data associated with the network features. For example, through the Object Manager, the user can navigate through all the list of items and left-click on the one he wants to see the data for. The items' name is highlighted on the Object Manager, and the corresponding feature is selected on the Map. The Data Editor panel is recalled with all the data loaded on it. . If the panel is already active, and displays data related to a previously selected item, the tabs with the data of the new item are simply loaded. On the other hand, if the user is looking at the map and the target item is visible in front of him, it will be much easier to double-click on it directly, rather than read its name on the map, look for its type in the navigation panel and search it by name of identifier. The click on the map element provokes the DE opening in the same way as it opens from the Object Manager panel. The advantage of doing that from the Map View is evident in case the user is well aware of the geographical potion of the target elements and he's panning the map. On the contrary, opening the DE from the tree list may be helpful in case the user needs to edit or compare data related to many items of the same category, all the pipelines for example, because they are all placed in the list one below the other, and not scattered on the map.

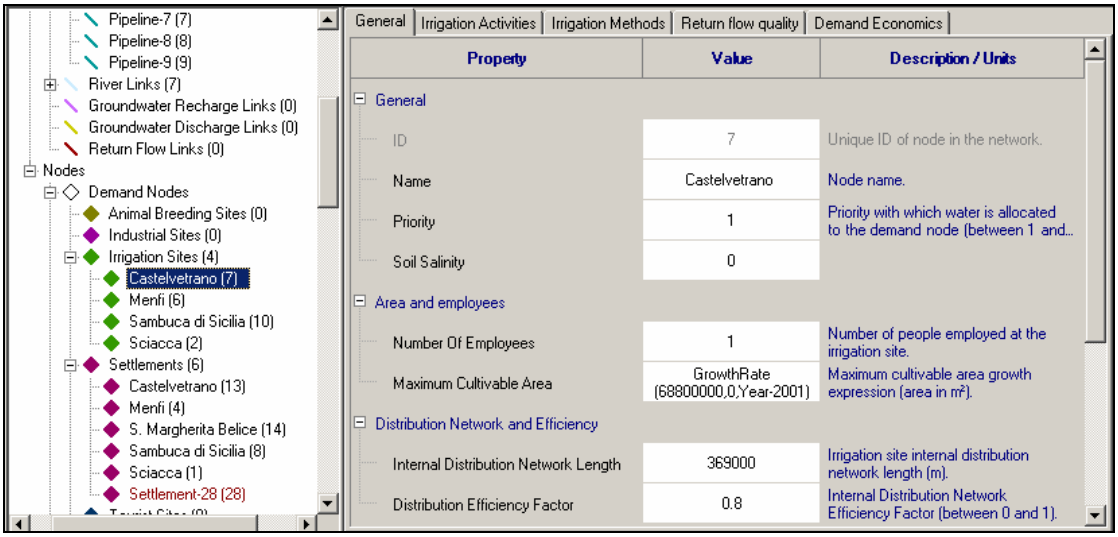


**Figure 5. Opening the DE editor for irrigation site Castelvetrano (on the right) from the Object Manager Panel (on the left)**

The two options to proceed are interrelated. The water network element that is selected by the user from the navigation panel is also automatically selected on the region map in red colour. Vice versa, when the user left-clicks on a node or link in the map the item is also automatically highlighted in the tree view.

When running the DE, either from the Base Case, or a WM Scheme, the panel opens with a preloaded table, showing the priorities associated by default to the various categories of demand nodes. These demand priorities are used by the allocation algorithm of the WSM DSS for distributing water from water sources to uses. They establish the rank of each demand node, assigning each one the right to receive water before all others with lower priorities. Demand priorities are a sort of discriminating factor, being useful and determinant when handling water shortage situations and conflicts between competing uses. A demand node can have a priority ranging from 1, the highest, to 99, the lowest.

The default priorities are associated with categories of nodes according to the demand type: the maximum, one, is for domestic use, thus for settlements and tourist site nodes, a value of two is attached to agricultural and animal breeding use, a value of three to industries and hydroelectricity production and finally values of four and five to the minimum flow requirements in river reaches, either for geomorphology or aquatic life protection and preservation, or for recreation and navigation purposes. A default priority of six is given to export nodes, which account for water transfers towards water demand realities in neighbouring regions.

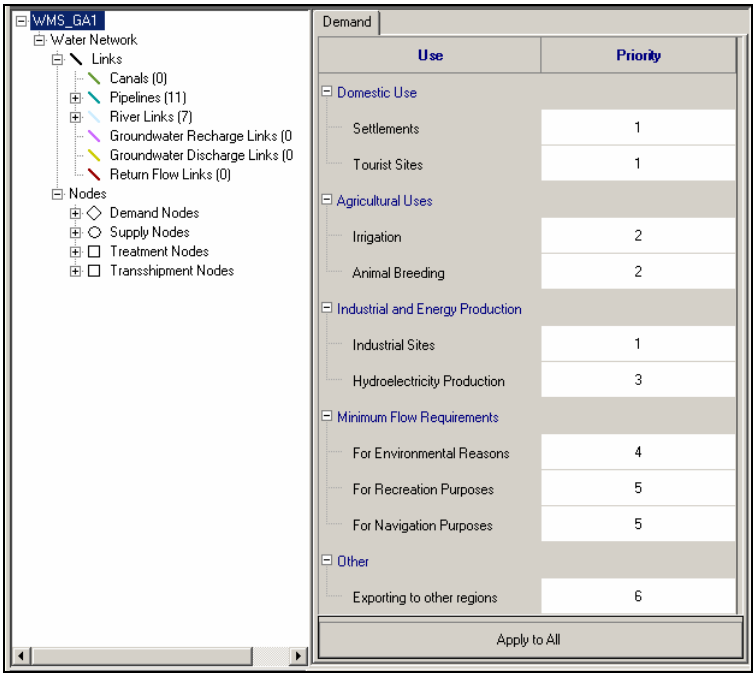


**Figure 6. The Default Priority Window of the data editor**

It is possible to change the default priority value of one or more single demand nodes of the network through the *General* data editor tab of the node. The *priority* property of the node is set to the desired level by double-clicking the current value and editing the new number. Demand priorities can also be modified through the Map Editor: the selection of a demand node either on the map or in the Object Manager panel provokes the opening of a small *Properties window* at the bottom of the Object Manager panel. Here the user can find the name of the node, its' identifier, geographic coordinates and priority.

All information, except the ID (which is generally locked for editing), can also be edited. Every property modification can be verified on the map, through the values appearing between square brackets next to the name of the node.

In case that many demand nodes have been given new priorities and the user would like to go back to the original default priority assignments, he can restore the default priority values for each node category through the *Apply To All* button of the preloaded data editor table. This table is reachable from the Manager Panel*, Modify Data* or *Data Editor* menus, but also from the node navigator, by selecting the name of current water management scheme, placed at the top of the tree view of the Object Manager panel, just above *Water Network*.

As far as the Map Editor is concerned, some of its functionalities have already been presented. The Map Editor (ME) is launched for a WMS from the Manager Panel*, Modify Map* menu. The Map window includes a GIS control where the map of the region is loaded, and two toolbars. The *Network Editing* toolbar is located at the top of the Map Editor View and can be used to place new geo-referenced elements on the network. It contains four drop-down buttons each referring to a category of node/link, which permit the DSS user to select a type of node/link within the category and to position it on the map with a click of the mouse on the desired geographical location. The four buttons are: *Supply Node*, *Demand Node*, *Treatment Node* and *Link*. The new element is highlighted on the map with a red spot/polyline and the small *Properties Window* is loaded in the interface under the Object Manager, showing the geographical coordinates (or the length) and the default allocation priority. When editing network links, they have to be drawn between two nodes following the direction of the water flow: if a new pipeline must be placed, connecting a water source to a demand node, the user has to click the former and then end the geographical feature polyline with click on the latter.

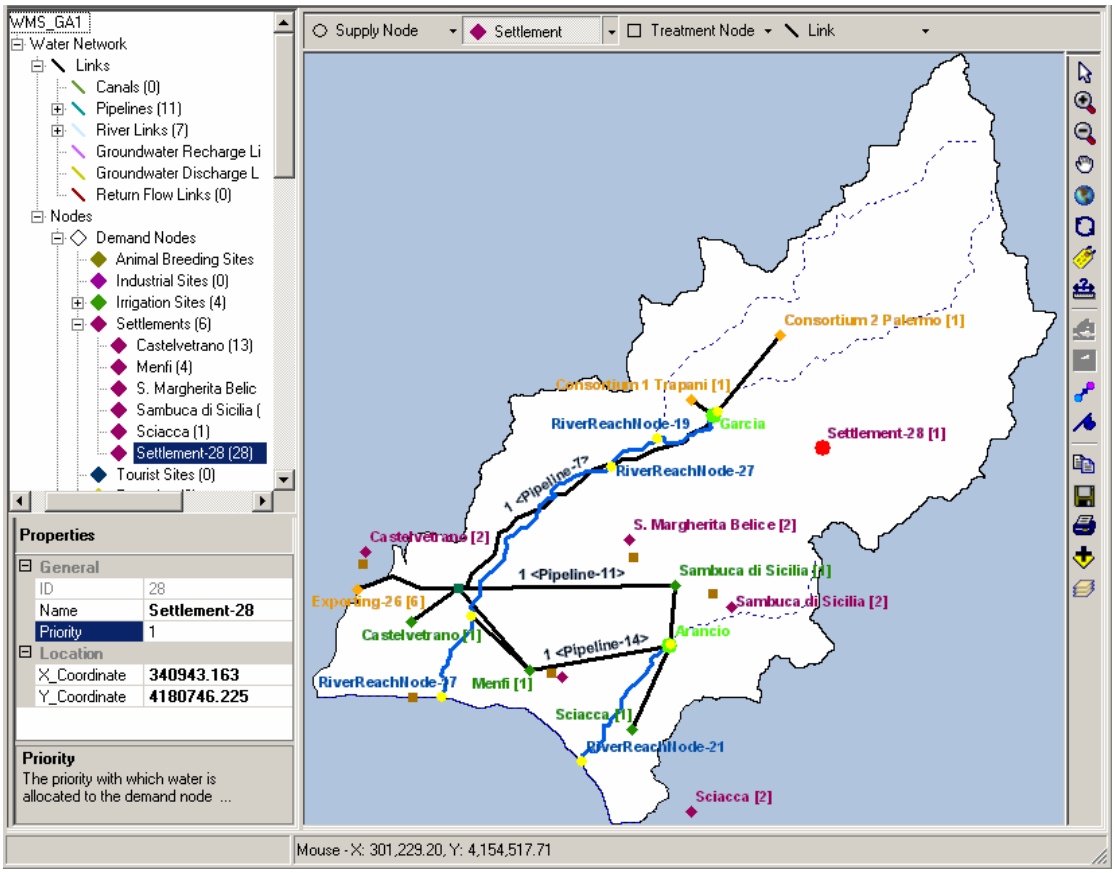


**Figure 7. Creating a new settlement (28) with the Map Editor**

The toolbar on the right of the map window makes available a number of GIS functionalities that are necessary to work with the map. They go from common ones, such as the Zooming, Panning and Labelling to more advanced ones, such as the Flip Tool and the Move Point Tool. Hereunder, the functionalities of the toolbar are shortly presented.

Select: select a network element on the map and load the its property or data table;

Zoom: enlarges or reduces a portion of a geographic dataset to display greater or smaller detail;

Pan: moves the viewing window up, down, or sideways to display areas in a geographic dataset that, at are not visible at the current viewing scale;

View Full Extent: zooms to the full extent of the data in the map;

Refresh Map: redraws the map

Labels: customizes annotation on a map that provides information on the network nodes and links;

Measure Distance: measures a distance on the map;

 Add/Edit Links Vertices: adds or moves vertices on a polyline (link);

 Flip (Reverse Link Orientation): this command reverses the direction of a polyline so that the last vertex of the sketch becomes the first, if such an operation is permitted by the connectivity rules of the network;

 Move Point: moves a point (node) and its attached links on the network;

 Clear Unconnected Network Junctions: deletes all unconnected network junctions[1];

 Add layer (map): used to load additional geographic data in shapefile format or from the regional geodatabase;

 Table of contents: lists the layers/maps loaded in the Map window. Each of them can be switched on /off in order to make it visible or not in the map;

 Copy: copies the map to the Windows clipboard;

 Save: saves a picture of the map in different formats (jpeg, emf, bmp, eps);

 Print: prints the map.

[1] Network junctions are created by default when links are split. They have no modelling functionality but are used to maintain the network connectivity and mass balances. Existence of unconnected junctions may slow down the computational speed during the simulation.