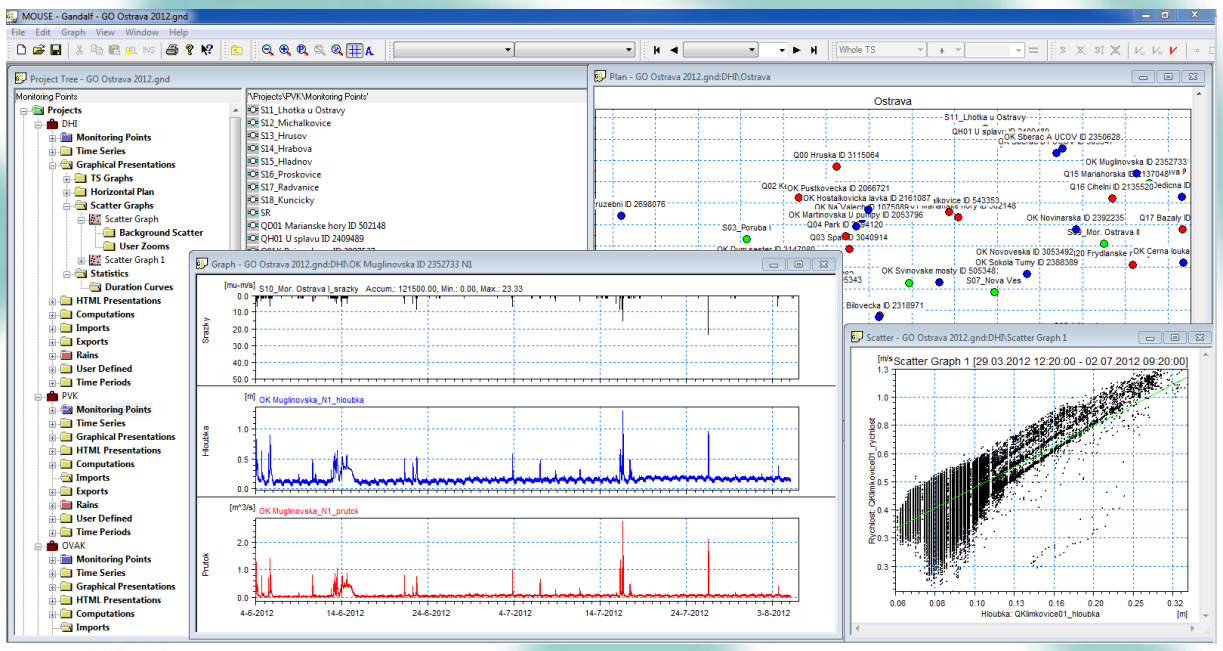
GANDALF

SW tool for time series data processing, management and reporting



USER GUIDE - DRAFT

Version 2023

Content:

PART I - INTRODUCTION TO GANDALF

1 ABOUT GANDALF MODULE

1.1 Key features and application domain

The GANDALF software is developed for processing, control and presentation of time series data. The main part of the software is focused on urban drainage data processing. There are procedures for particular data types rating which use hydraulic figures and regression relations. Software supports various data formats of different monitoring devices, such as water level monitors, flow meters, rain gauges etc. Both, raw and processed data can be stored in different formats. All-time series can be browsed and edited in text and / or graphical form. Graphs combining particular time series could be prepared for the purposes of the final presentation. All of the tools and/or user-defined links can be organized as separate projects equivalent to monitoring campaigns. The system is designed to treat the enormous size of data files. Time series, containing data from several years, stored with one or two-minute time step, can be handled in the system easily.

1.2 Software Implementation

GANDALF is stand-alone software. For details about the DHI's copy protection system and the license update procedure, please refer to the *DHI Installation and Update Guide*.

2 ABOUT GANDALF USER MANUAL

This manual provides information related to the principles and techniques for the preparation and processing of time series data related to the urban hydraulics and hydrology. Fundamental knowledge of hydrology and hydraulics also facilitates the successful use of GANDALF.

The User Manual contains detailed information for usage of the GANDALF, specific instructions for input of the required data and calculation.

Usage of the standard MOUSE and its' other add-on modules is described in respective user manuals & tutorials.

This manual is divided into three units:

- **Part I: Introduction**
  This part contains general information about GANDALF and this document.
- **Part II: Getting started**
  This part contains information about the installation and usage of GANDALF.
- **Part III: GANDALF User Manual**
  This part contains basic information about GANDALF principles and techniques for time series data analysis and processing.

3 GANDALF USER SUPPORT

3.1 Product Support

If you have questions or problems concerning GANDALF, please consult the documentation (GANDALF User Manual) first. Secondly, look in the README files that came with your installation. Other information can be found online at following link:

https://worldwide.dhigroup.com/cz/monitoring/software.

If you cannot find the answer to your queries, please contact your local agent.

In countries where no local agent is present you may contact DHI directly, by mail, phone, fax or e-mail:

DHI a.s.: Na Vrsich 5/1490, 100 00 Prague 10, Czech Republic
Phone: +420 267 227 111
Telefax: +420 271 736 912
email: office@dhi.cz

When you contact your local agent or DHI, you should prepare the following information:

- The version number of GANDALF that you are using.
- The type of hardware you are using including available memory.
- The exact wording of any messages that appeared on the screen.
- A description of what happened and what you were doing when the problem occurred.
- A description of how you tried to solve the problem.

3.2 DHI Training Courses

DHI software is often used to solve complex and complicated problems, which requires a good perception of modelling techniques and the capabilities of the software.

Therefore, DHI provides training courses in the use of our products. A list of standard courses is offered to our clients, ranging from introductory courses to courses for more advanced users. The courses are advertised via DHI Home Page on the Internet (http://www.dhigroup.com).

DHI can adapt training courses to very specific subjects and personal wishes.

If you have any questions regarding DHI training courses do not hesitate to contact us:

e-mail: mike.cz@dhigroup.com, office@dhi.cz

3.3 Comments and Suggestions

Success in a perception of the information presented in this document, together with the user's general knowledge of urban sewer systems and experience in monitoring is essential for getting a maximum benefit from GANDALF. This implies that the quality of the documentation, in terms of presentation style, completeness and scientific and engineering competence, constitutes an important aspect of the software product quality. DHI will, therefore, appreciate any suggestion in that respect, hoping that future edition will

contribute to the improved quality of GANDALF. Please give your contribution via e-mail, fax or a letter.

PART II – GETTING STARTED

1 IMPORTANT NOTE

It is not recommended to install a different version of DHI software on one PC, otherwise functionality is not guaranteed.

2 INSTALLATION OF GANDALF

How to Install GANDALF

A There is no installation of DHI software on your computer, use guide below.

B There is some installation of MIKE by DHI software on your computer, please use the process described in chapter 2.2.

In order to browse the installation CD, it is necessary to run any Internet browser, such as Microsoft Internet Explorer.

The Internet browser should launch automatically when this CD is inserted into your computer. If not, open the “home.htm” file by your Internet browser.

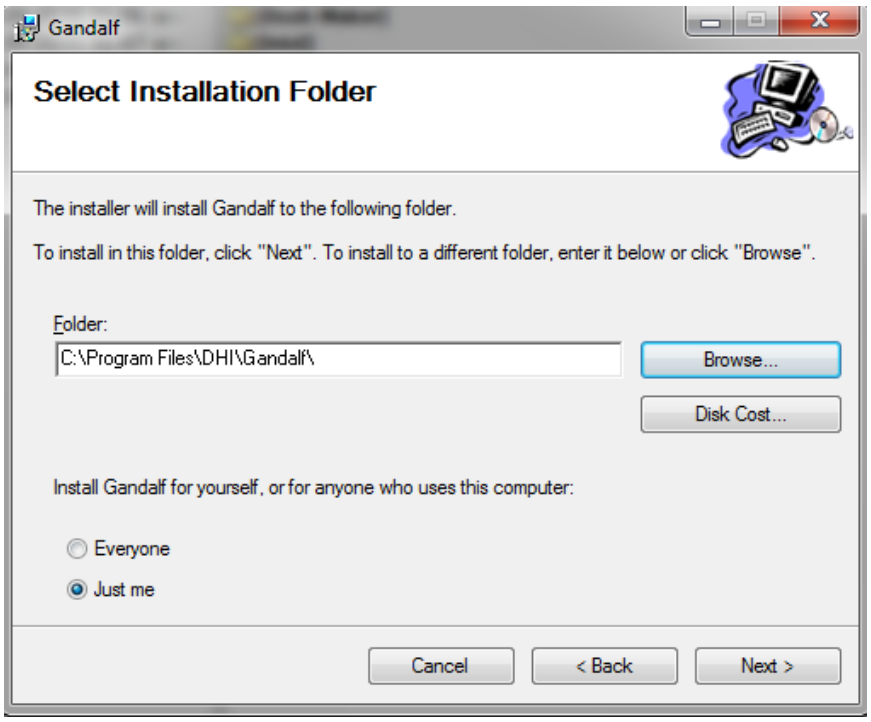
Open the page of GANDALF installation and then choose the destination of the program.

In order to install your GANDALF software, run the SOFTWARE (“SETUP.EXE” file). The process starts with the Visual C++ installation which you must complete prior to the main installation process.

The process now will guide you through the rest of the installation of GANDALF software.

Picture 1 : Gandalf Setup Wizard

Install to a different directory than DHI SW e.g. "c:\Program files\DHI\Gandalf"



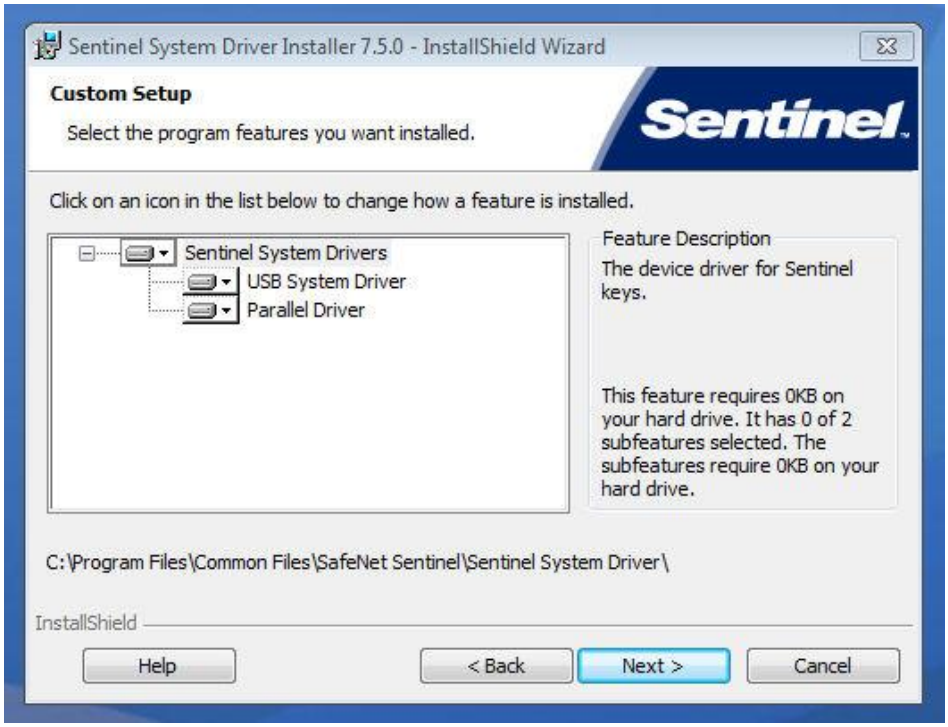
Picture 2 : Select Installation folder

And finish the Gandalf installation.

During the GANDALF installation, you may be asked to complete the Sentinel Driver software installation. This part is important to activate the hardware key driver on your computer.

You can find the installation file also on CD: GANDALF/setup/setup_file/ Sentinel System Driver Installer 7.5.7.exe.

Picture 3 : Sentinel system driver Installer

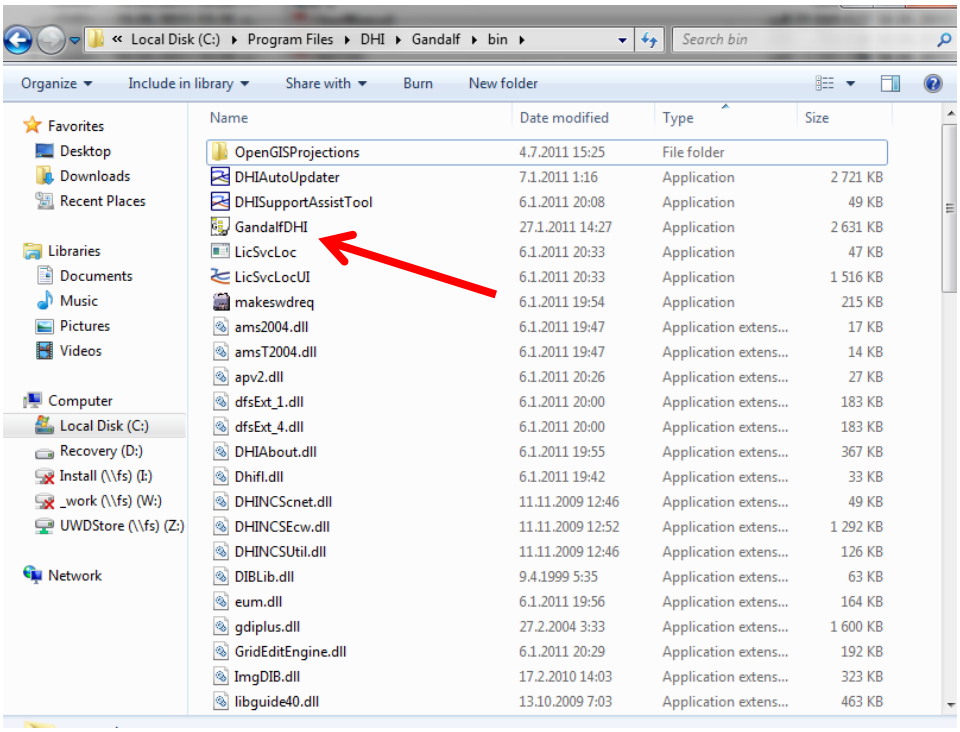


Picture 4 : Sentinel - Custom Setup

Now your GANDALF software is ready to use.

2.1 How to install HOTFIX

For installation of hotfix file (and for installation on a computer with MIKE by DHI software) copy and replace the GandalfDHI.exe in the directory, where software is installed e.g. "c:\Program files\DHI\Gandalf\bin".



Picture 5 : Placement of file GandalfDHI.exe

2.2 How to install Service Pack

For installation of Service Pack run SETUP.EXE file in the directory where you unzip the downloaded file.

3 LICENCING

3.1 Licence GANDALF

The license service may be in one of two modes dependent on your license type

1. License service within your organization (local or network based)
2. Internet Based License (will not be described in the manual, see Internet Licence Guide 2023, that comes within your order)

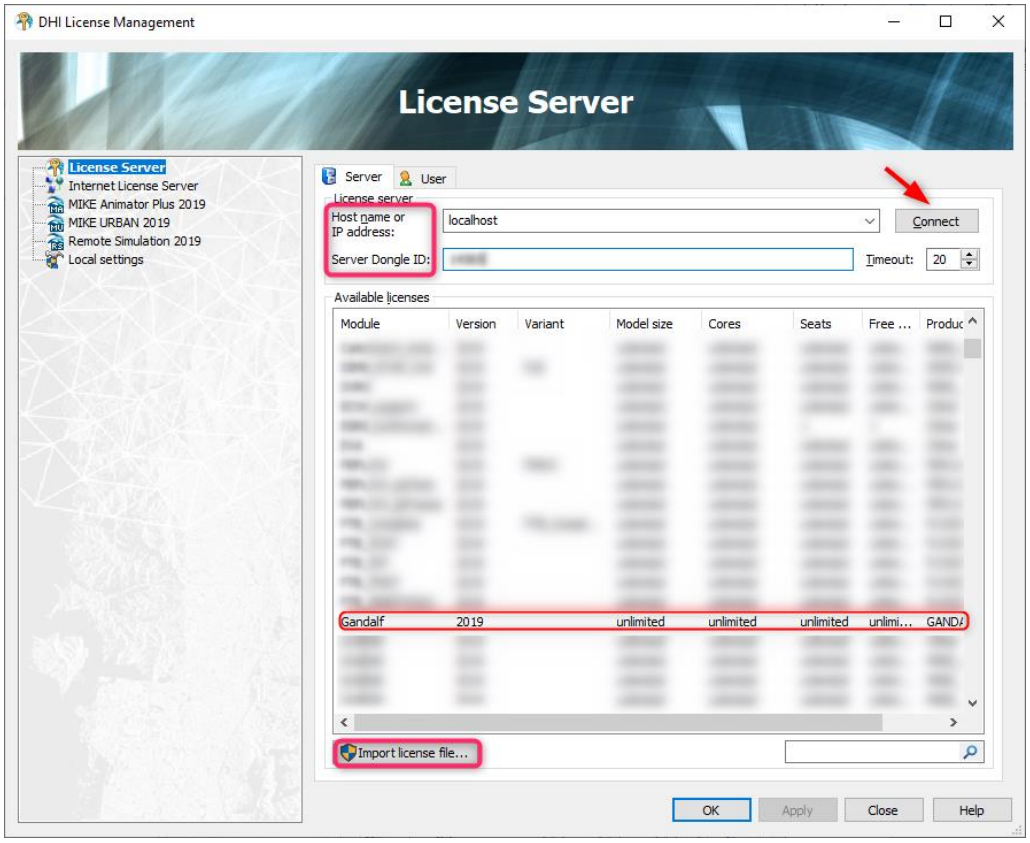
Depending on which of the above licenses you have acquired within your organization the connection procedure varies.

3.1.1 License service within your organisation

Gandalf needs access to a license service for requesting the required license modules. On the PC where the dongle (hardware key) is inserted and DHI Licence Management is installed, go to: *Start => DHI Licence Administration => DHI Licence Management*

Picture 6 : Path from Start Menu to DHI Licence Management

- Select the *License Server* node in the left panel
- In the right panel, specify the Host as *localhost*.
- Click *Connect*
- Import license file (*.dhilic)
- Press *Apply*



Picture 7 . Setting up a Licence Server

3.2 How to Start GANDALF

During the installation, DHI GANDALF 2023 group is placed in the Start Menu (in the default of a user-selected folder) and the GANDALF shortcut is placed on the Desktop as well.

To start GANDALF, select the *GANDALF2023* icon under the *GANDALF group* on the Start Menu or the *GANDALF shortcut* on the Desktop.

3.3 Support

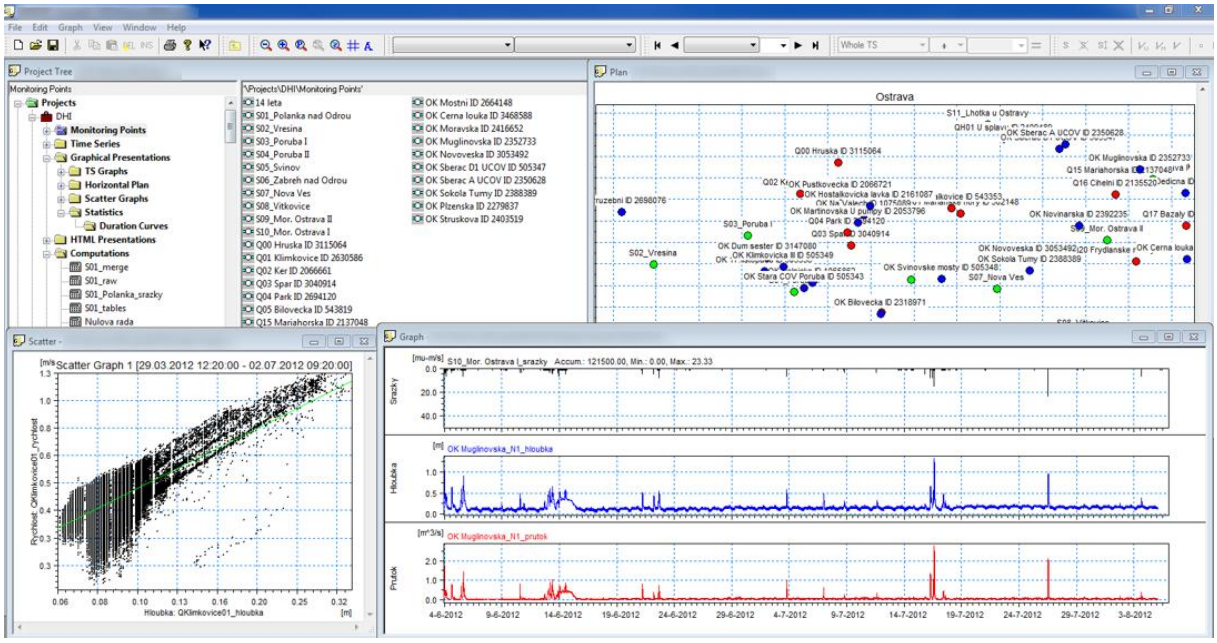
e-mail: mike.cz@dhigroup.com, office@dhi.cz

PART III – GANDALF USER MANUAL

1 GANDALF APPLICATION WINDOW

The GANDALF main application window is the work field for efficient editing and display of the loaded GANDALF data. The main window is divided into five zones:

- the title bar,
- the main menu bar,
- the toolbars,
- the work area,
- the status bar.



Picture 8 : Example of Gandalf Application Window

1.1 Title Bar

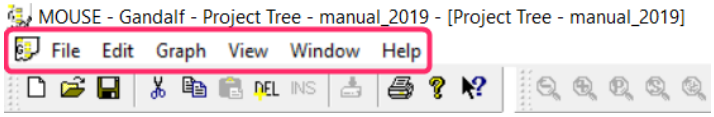
The title bar provides standard Windows functionality for moving, sizing and closing the GANDALF application window.

1.2 The Main Menu

The GANDALF pull-down menu contains the following items:

- **File**: new file can be opened, closed, saved, printed or converted from version 2009 or 2011;
- **Edit** set of general editing functions such as Cut, Copy and Paste;
- **Graph** access to Graph operations such as Zoom In/Out, Redraw, Grid etc.;
- **View**: displays toolbars and status bar;
- **Window**: standard control of the windows arrangement;

- **Help** displays information about license, version, contains help and log file (possibility to set custom log directory path)

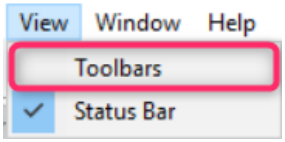


Picture 9 : The Main Menu

In addition, local menus can be activated for any active graphical window by clicking the right mouse button inside the plan or profile windows.

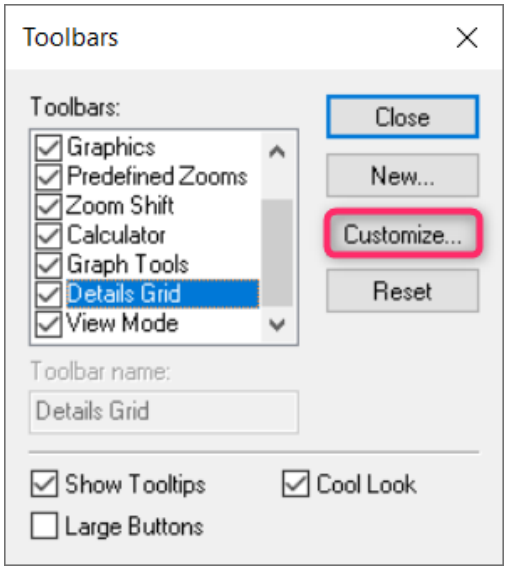
1.3 The Toolbars

GANDALF toolbars are placed just under View in the Main Menu bar. The toolbars provide shortcuts for important program functions. For any tool on a toolbar, the same functionality can always be found in one of the main pull-down menus.



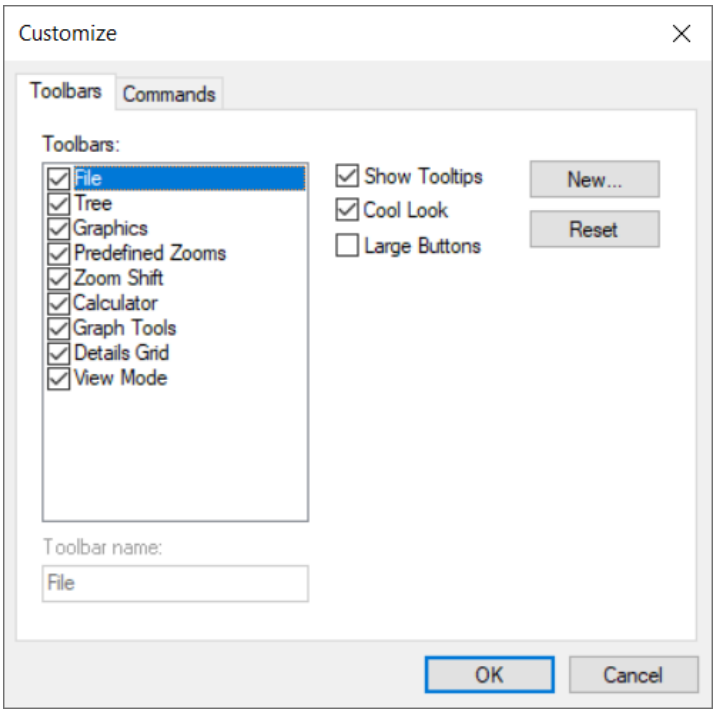
Picture 10 : Path to Toolbar

Individual toolbars can be switched ON and OFF (View | Toolbars) and placed on the screen as convenient. GANDALF “remembers” the current toolbar combination for the next GANDALF session. The displayed toolbars get automatically activated or de-activated (greyed-out) according to the presently active graphical window or Data Dialog Box.



Picture 11 : Toolbar Menu

There are several default toolbars as shown at the picture below.



Picture 12 : List of Toolbars

1.3.1 File

File menu contains commands for opening, saving and printing data files

Table 1 : File Toolbar

Icon	Description
	New – Creates an empty Project
	Save – Saves the active Project
	Open – Opens an existing Project
	Cut - Cuts the selection in the Project Tree a put it on the Clipboard
	Copy – Copies the selection in the Project Tree and puts it in the Clipboard
	Paste – Inserts Clipboard contents in the Project Tree
DEL	*Delete* – Deletes the selection in the Project Tree and deletes TS's rows in edit mode
INS	Insert TS's rows in edit mode
	Makes backup of TS
	Prints the active document
	Displays program information, version number and copyright
	Display help for clicked on buttons, menus and windows

1.3.2 Tree

Table 2 : Tree Toolbar

Icon	Description
	*Up one level* - Moves up one level in the tree

1.3.3 Graphics

Graphics Icons are active only when viewing Graphical Windows, which are explained in separate chapter **1.5 Graphical Windows**. It facilitates an operation and a navigation when editing or viewing Time Series.

Table 3 : Graphics Toolbar

Icon	Description
	*Zoom in*
	*Zoom Out*
	*Zoom to Previous*
	*Zoom to Selected*
	*Zoom to Full Extent*
	*Grid Off/On*
	*Font* – Setting up a font in Graphical Windows
	*Help* – puts vertical aid line with information window (TS, Time, Value, coord.). Press Tabular or click next TS to move to next Time Series. It is active only in Graphical Windows

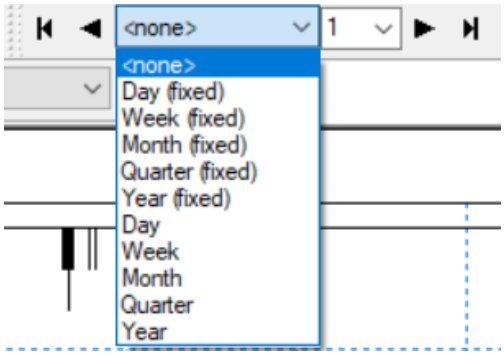
1.3.4 Predefined Zooms

Toolbar Predefined zooms displays user zooms and time periods. These functionalities are exclusively used in Graphical Presentations. See chapter **9.2** Zooming for more detailed information.

1.3.5 Zoom Shifts

Time shift of Time Series according selected Time Period. There are 2 shift modes:

- **Fixed** starts at the beginning of selected time period, e.g.- *Week (fixed)* always starts on Monday 0:00 Midnight and ends on following Monday 0:00 Midnight
- **(Non – Fixed)** starts at the selected time (selected by a user at actual zoom and follows particular time pattern

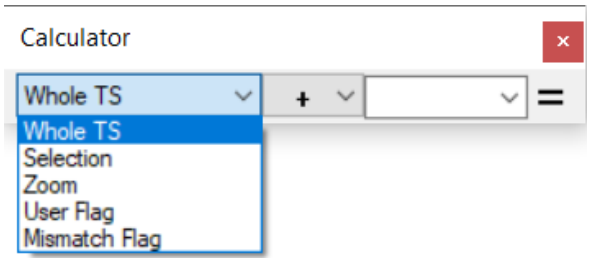


Picture 13 : Zoom shit Options

1.3.6 Calculator

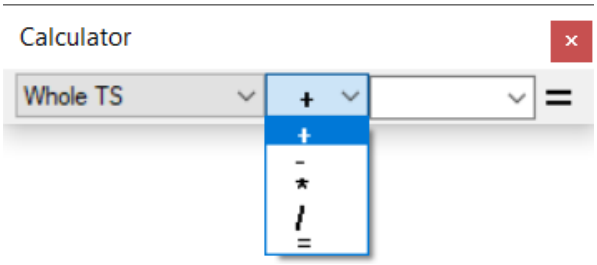
The calculator bar is designed to calculate the values of TS in edit mode. This bar consists of 4 buttons: *Item, Operation, Value and Execute*.

- **Item** determines values to be modified by calculation



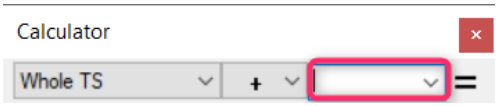
Picture 14 : Item button (Calculator)

- **Operation** selects math operator to a calculation (plus minus, multiply, divide, equal)



Picture 15 : Operation button (Calculator)

- **Value** the value is added/subtracted/ multiplied/divided by operator or set equal to selected Item of TS



Picture 16 : Value button (Calculator)

- **Execute** Clicking on the equal sign runs the computation and changes are immediately depicted in TS edit mode.

Note: Values modified in calculator are tagged by Flags (See chapter **8.2.3 Flag editor**). It is only used in TS editor.

1.3.7 Graph Tools

Graph tools are used for editing TS. Icons are listed below with a functionality description.

Table 4 : Graph Tools

Icon	Description
	Selection
	Clear Selection
	Move Selected points
	Delete Selected Points
	Mark user Flag
	Mark Mismatch Flag
	Show Flags
	Clear All Flags
	Mark Flag/Select by Point
	Mark Flag/Select by Rectangle
	Mark Flag/Select by Polygon
	New Selection
	Add Flag/Selection
	Remove Flag/ Selection
	Invert Flag/Selection

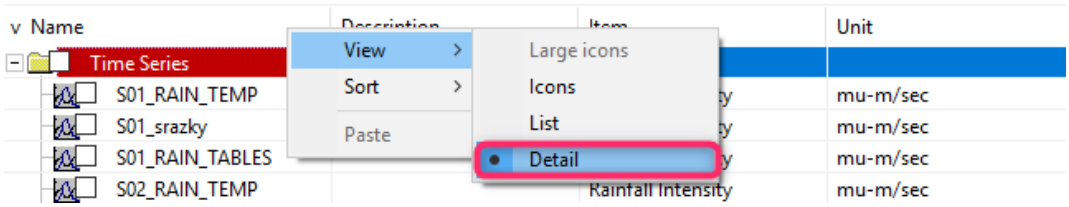
1.3.8 Details Grid

Details Grid serves to organize TS Properties. For more information see chapter **8.5 TS Properties**

Table 5 : Details Grid Toolbar

Icon	Description
	Show all nodes in a grid
	Show only checked nodes in a grid
	Uncheck all nodes in a grid

These icons are active only in right side of panel in *Detail* View. In order to use it, it is necessary to view the Window in *Detail* as shown below.



Picture 17 : Details Grid - Detail View

1.3.9 View Mode

View Mode changes View in right panel of Window. It contains 3 Icons as shows following table:

Table 6 : View Mode Toolbar

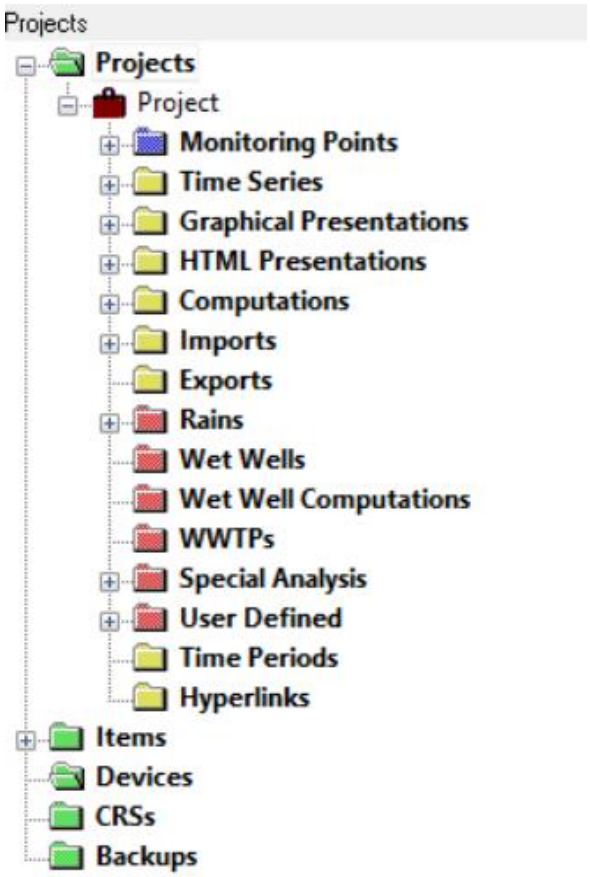
Icon	Description
	Show right panel in mode Icon
	Show right panel in mode List
	Show right panel in mode Detail Grid

1.4 Gandalf Tree

The basic operating spot of the software is the splitter (Multiple Document Interface) View. In the left part of the view there is a tree corresponding to the software structure, in the right part there are data corresponding to the branch selected. The handling of the structure is the same as in the view in different software, e.g. Window Explorer, Internet Explorer, etc. The tree in the left part can be developed to various levels. The software identifies names of branches, in other places the system of embranchment is directed by the user. The local menu for every active view can be displayed using the right mouse button. The menu differs with the type of selected element. In each menu can be found command for Expand All/Collapse All items at tree structure.

Items text in the structure can be bold (these are created by the system) or normal (i.e. created by the user). Items are distinguished by colours for easy navigation. Colours used are:

- **green** **for general categories available across all project,**
- **yellow** **for a general data store,**
- **red** **for analytics tools**
- **blue** **for Monitoring Points.**



Picture 18 : Gandalf Tree

1.5 Graphical Windows

The following graphical windows are used in GANDALF.

- **Time Series and Flag Editor** data and flags are displayed and edited here
- **Time Series Graph** displays a graph of one or more time series.
- **Horizontal Plan** displays the horizontal and spatial extent of the network. Various types of associated data can be displayed in different presentation modes. Various display options, zoom, query and graphical editing facilities are available. Click the right mouse button to access the local menu.
- **Scatter Graph** displays a scatter graph of two selected time series.
- **Duration Curve** displays a duration curve of particular time series.

More graphical windows of each type can be opened at a time.

1.6 Data Dialog Boxes

Several various Data Dialog Boxes can be opened inside the work area. Each Data Dialog Box is designed as a fixed-size window that can be moved around the GANDALF main window and minimized or closed in a standard Windows fashion. Any number of different Data Dialog Boxes can be opened simultaneously, but only one copy of each Dialog Box can be open at a time.

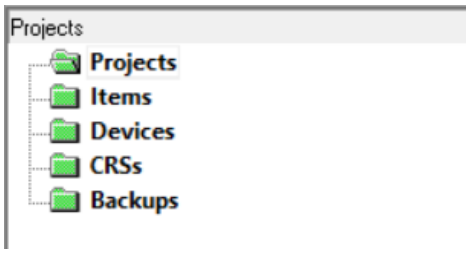
1.7 The Status Bar

The GANDALF status bar is located at the bottom of the GANDALF application window. The left part of the status bar provides information about the program status or some basic supporting information while selecting Menu options.

In the right section of the status bar, the coordinates of the cursor are placed and displayed. Depending on the type of the active window, the coordinate system may be of the X-Y, X-Z or Time-Value type. The status bar can be switched *ON* and *OFF* under the *View* | *Toolbars menu*.

2 Tree Structure

Five basic categories of the system are available*: Projects, Items, Devices, CRSs and Backups*.



Picture 19 : Project Categories

2.1 Structure of Data

In general, there are two possibilities how to store data. Data could be stored as:

- **File storage** — data are stored on your local hard drive as DFS files for each Time Series separately. Path is defined either in Properties of the Project for all TS connected to it or individually in Time Series Properties
- **MIKE IPO data storage** — project is connected to a database, all Time Series are stored there then.

2.1.1 Projects – file storage

The GANDALF data are organized on your hard drive in the following way:

- **Time series data** — stored as ***.dfs** files = binary files. Each DFS file contains data of one time series
- **A project tree / project structure** — stored as a ***.gnd** file = a text file structured in PFS data format. In *.gnd file all the tree structure, visible when open the project = all necessary settings for time series data management, computations, presentations, etc are stored there.

  More than one Project can be stored in one .gnd file.

Monitoring_campaign	15.01.2020 14:21	GND File	56 KB
Q_TOTAL.dfs	05.11.2019 10:41	DFS File	5 340 KB
Q_DN400.dfs	05.11.2019 10:41	DFS File	5 366 KB
H_DN400.dfs	05.11.2019 10:02	DFS File	359 KB
Q_DN300.dfs	05.11.2019 9:14	DFS File	5 342 KB
H_DN300.dfs	05.11.2019 8:56	DFS File	5 342 KB

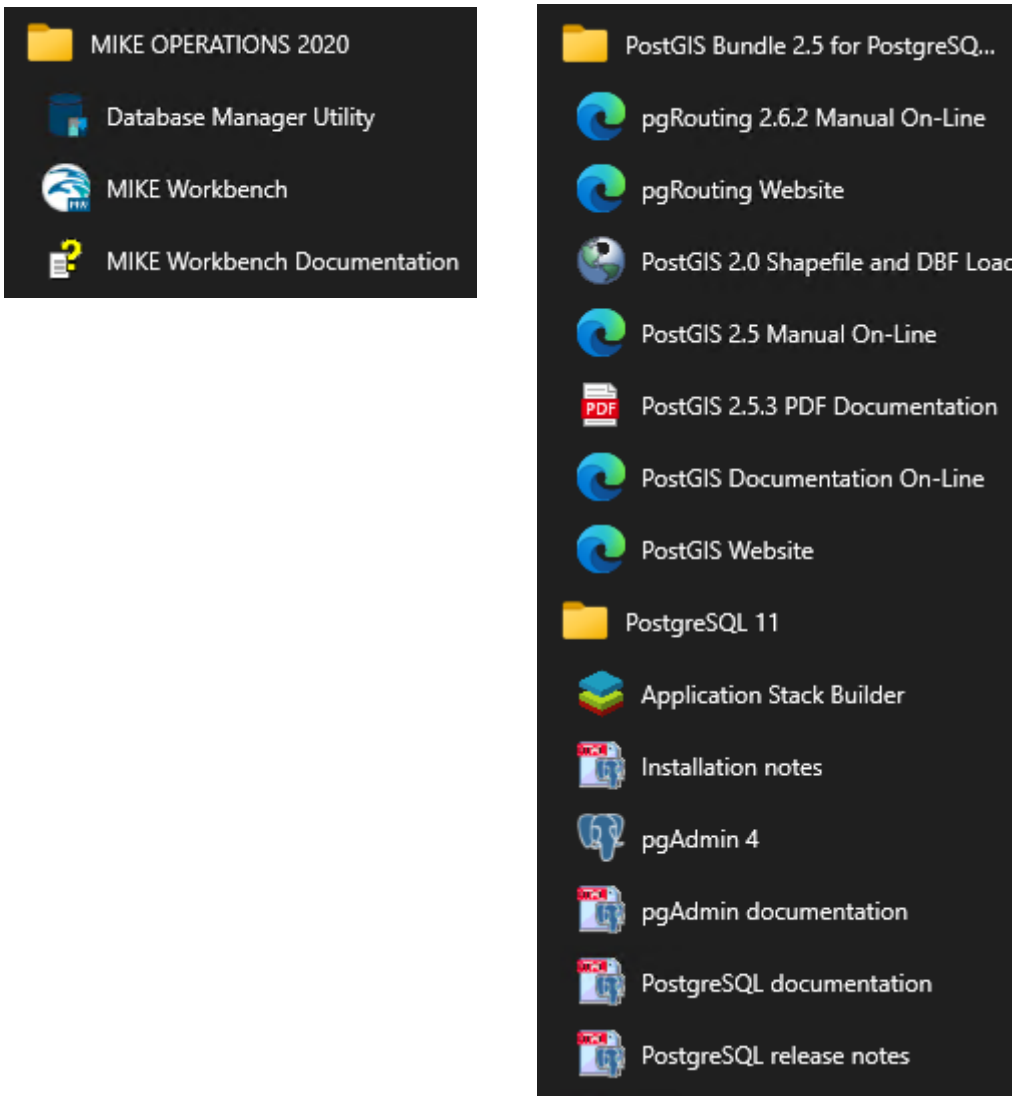
Picture 20 : Example of File Data Storage

2.1.2 Projects – MIKE OPERATION data storage

MIKE OPERATION platform is designed to collect, store and process data, ensuring that reliable data are available online

The application can link the various modules (GIS, Analyses, Time series, Documents, spreadsheet, etc.) with the existing business tools. The program architecture is based on PostgreSQL database.

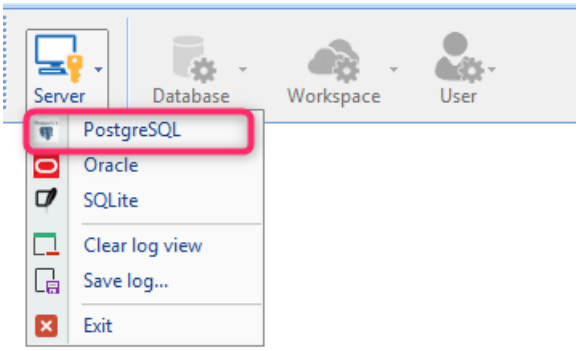
- Database Manager Utility
- MIKE Workbench
- PostgreSQL
- Documentation



Picture 21 : Software components

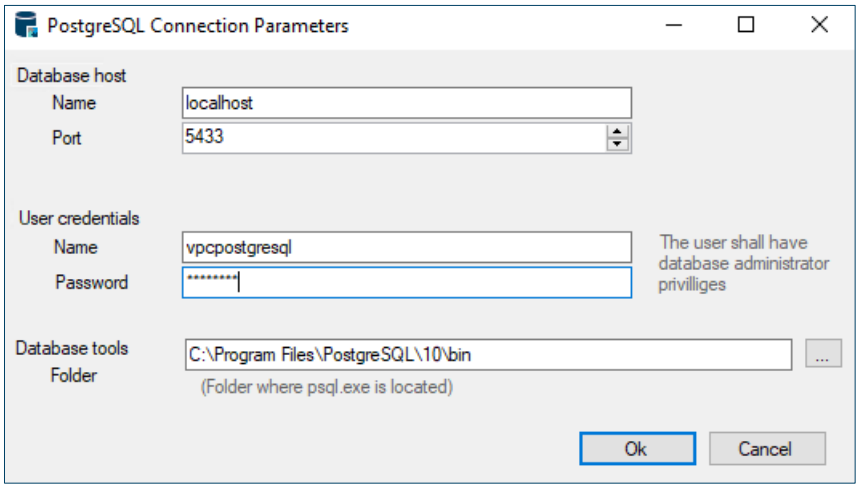
2.1.2.1 New PostgreSQL database

- For a new database where data will store, open *Database Manager Utility*
- Select *PostgreSQL* below *Server* Icon



Picture 22 : Database Manager Utility – Server

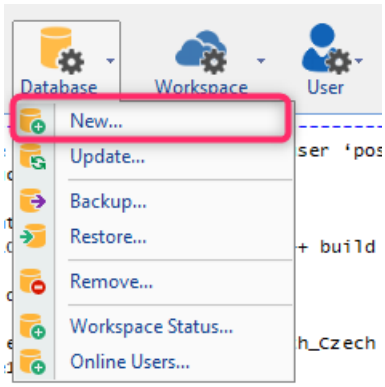
- Fill in Connection Parameters and Click *OK*



Picture 23 : PostgreSQL Connection Parameters

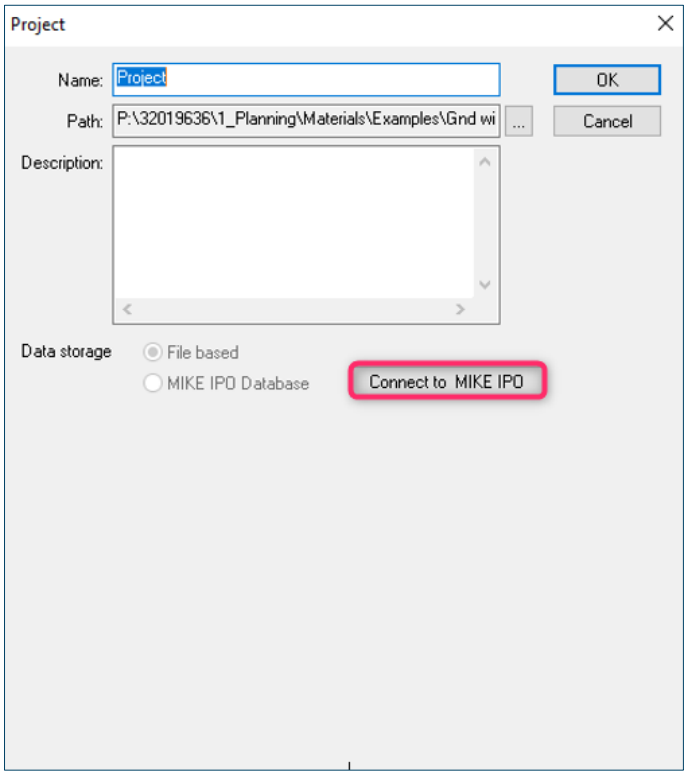
Note: This process of connecting to PostgreSQL is by using remote desktop connection. User credentials will be given by your DHI IT administrator

- Next click on *Database* Icon and *New*…to create a database



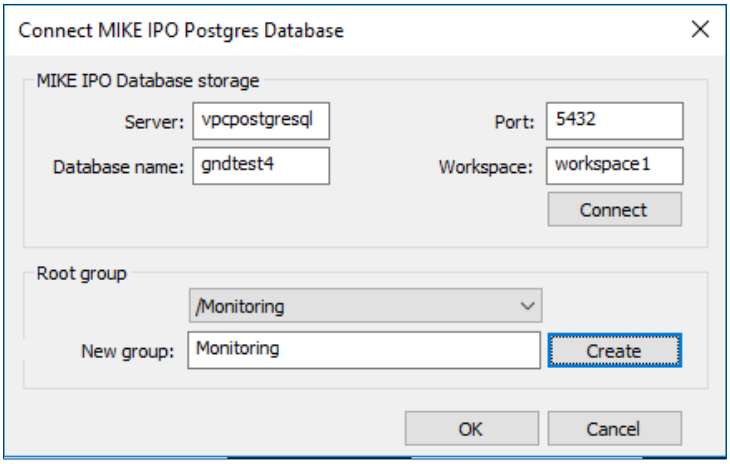
Picture 24 : Database Utility Manager -New Database

- Database on server is generated and ready to connect. Now go back to Gandalf.
- In project properties set *Connect to MIKE IPO*.



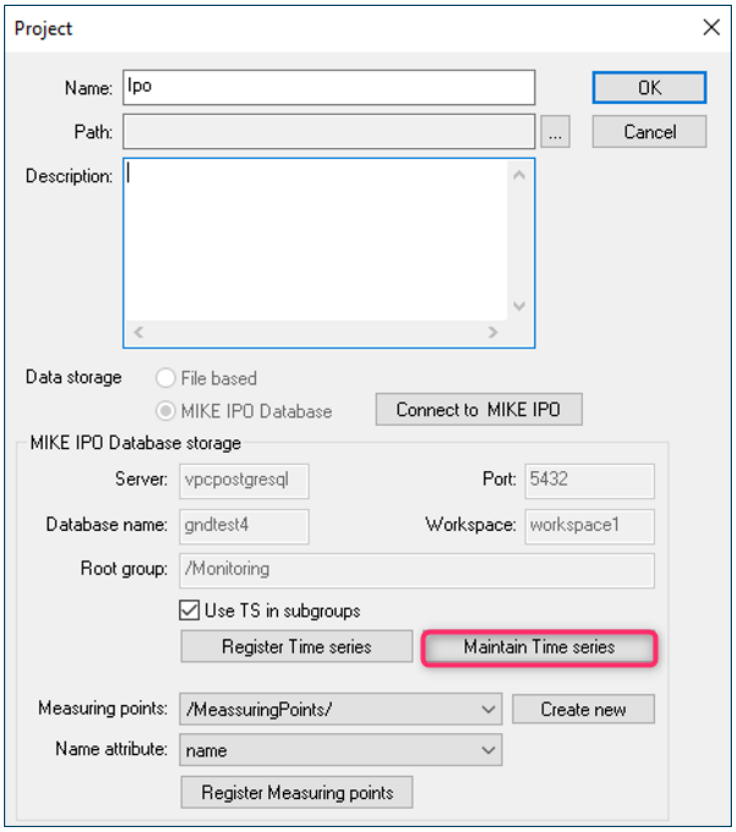
Picture 25 : Connect MIKE IPO

- Insert the server name and PostgreSQL database name based on previous server settings. Root group is a folder, shell, for time series in MIKE WorkBench.

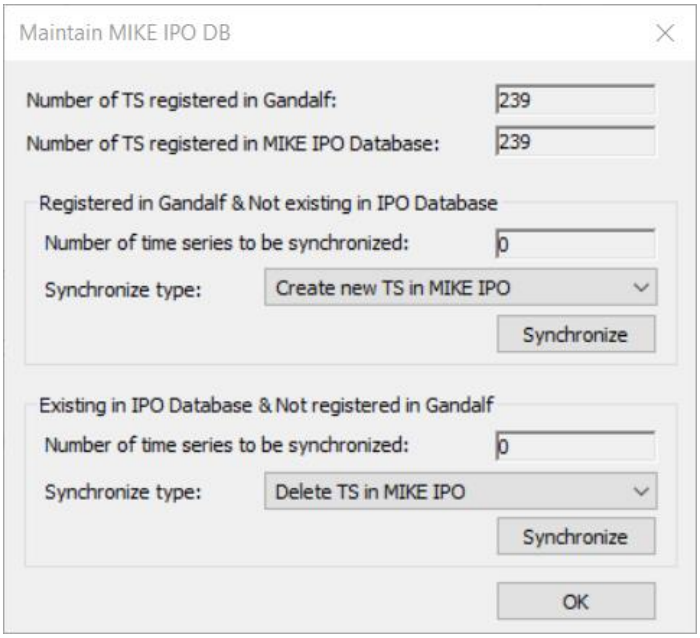


Picture 26 : Connect MIKE IPO Postgres Database

- Now Gandalf project is connect to PostgreSQL database for storage time series.



- Open Project properties and Maintain Time series dialog to synchronize with database.

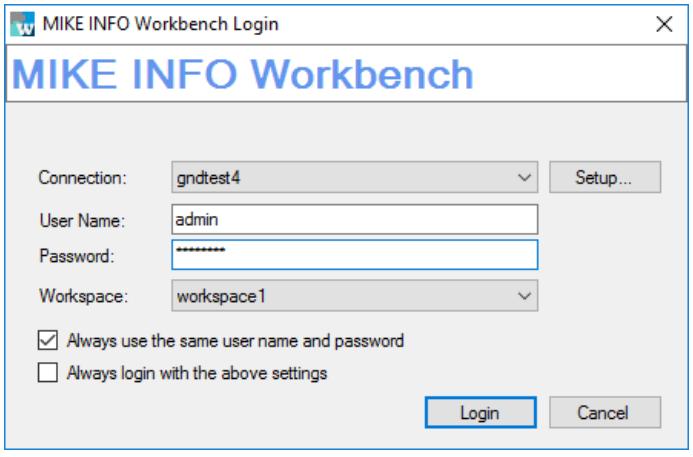


Picture 27 : Maintain MIKE IPO DB

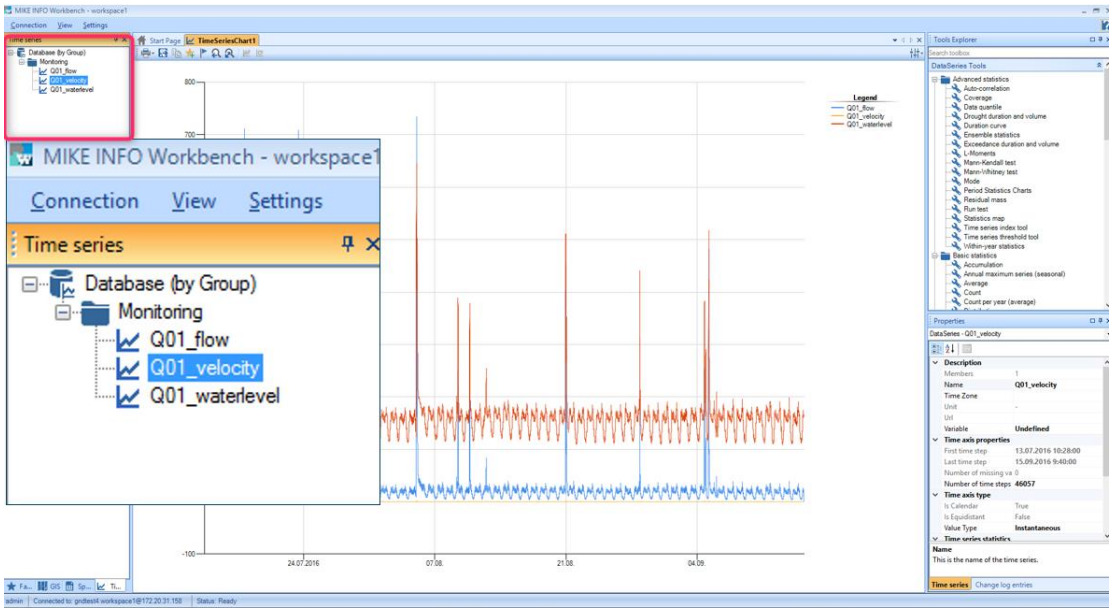
2.1.2.2 Mike Info Workbench (DHI.Solutions.Shell32.exe)

Workbench is an advanced desktop client, designed for expert users who apply data analysis and process tools interactively and can configure automated workflows, scripts and custom-made data reports.

To work with time series in Mike Info Workbench it is necessary to create a new connection / access to the database.



Picture 28 : Mike Workbench Login

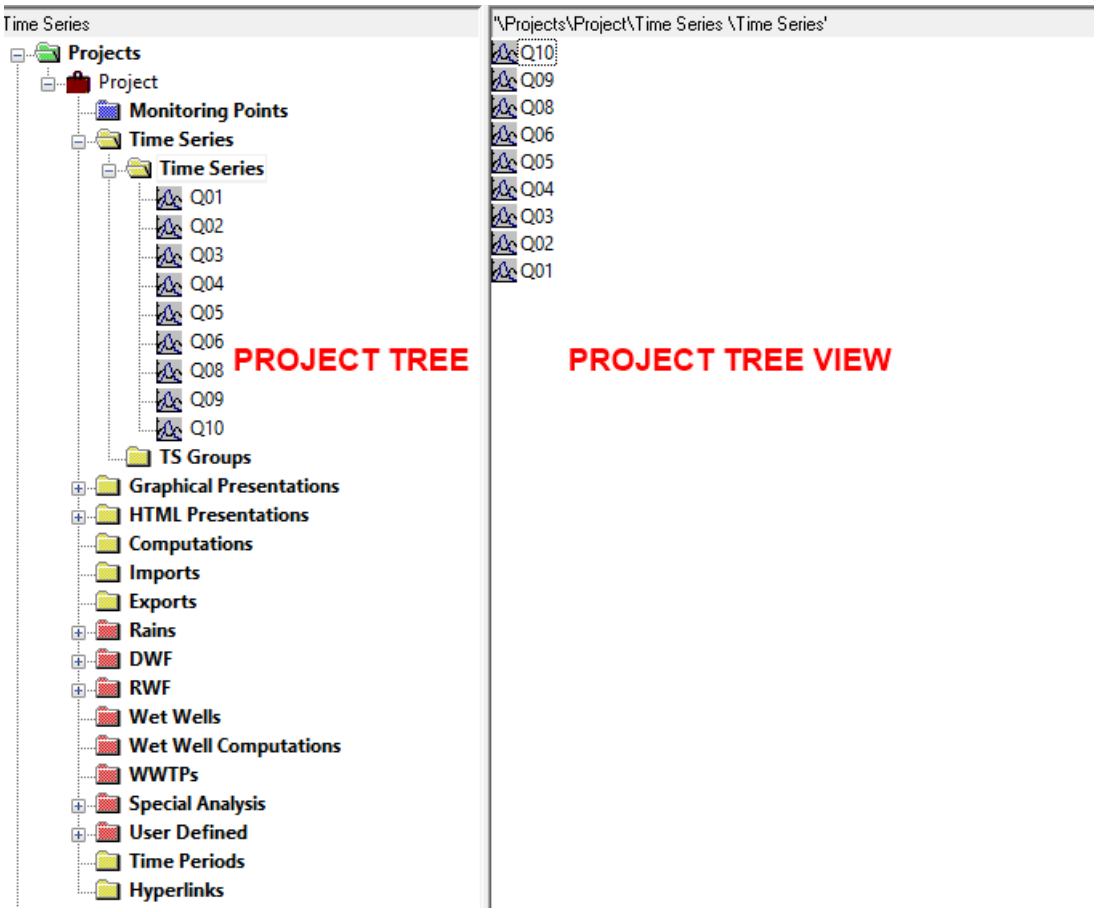


Picture 29 : MIKE INFO Workbench - Workspace

2.2 GANDALF data management

The main working area is divided into 2 windows.

- **Project Tree**
- **Project Tree View**

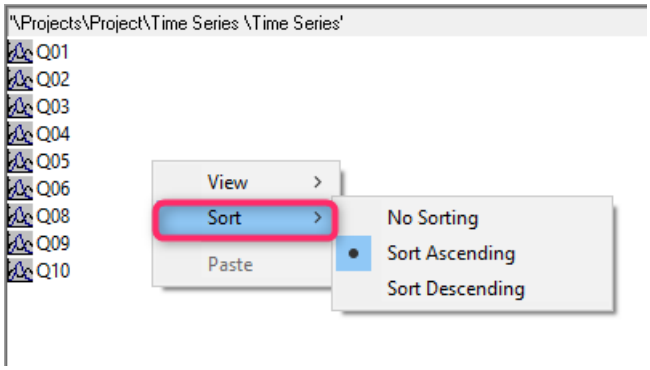


Picture 30 : Working Area Division

User can organize data at the *Project Tree View* in 3 ways:

- **Icon View**
- **List View**
- **Detail View**

General function for *Icon View* and *List View* is sorting items. It is available using the right mouse button in the *Project Tree View* and it supports Ascending and Descending sorting



Picture 31 : Sorting in Project Tree View

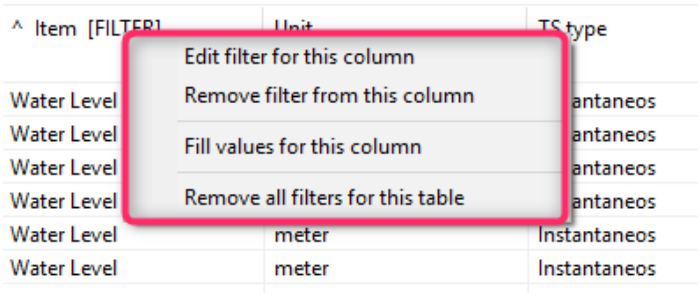
Best practice to organize and add general information about data is to set *Project Tree View* to *Detail View* (see chapter **1.3.8 Details Grid**).

Name	Description	Item	v Unit	TS type
Time Series				
Q01	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q02	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q03	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q04	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q05	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q06	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q08	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q09	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos
Q10	Monitoring Campaign	Discharge	meter^3/sec	Instantaneos

Picture 32 . TS Detail View

Each column in *Detail view* can be filtered according to its content. To do that, right-click the header column and select Add filter for this column. This action opens Filter Condition menu where user can filter the content. To remove the filter of one column, simply click again on the header and select *Remove all filter for this column*. If more filters are in the table, click on *Remove all filter for this table*.

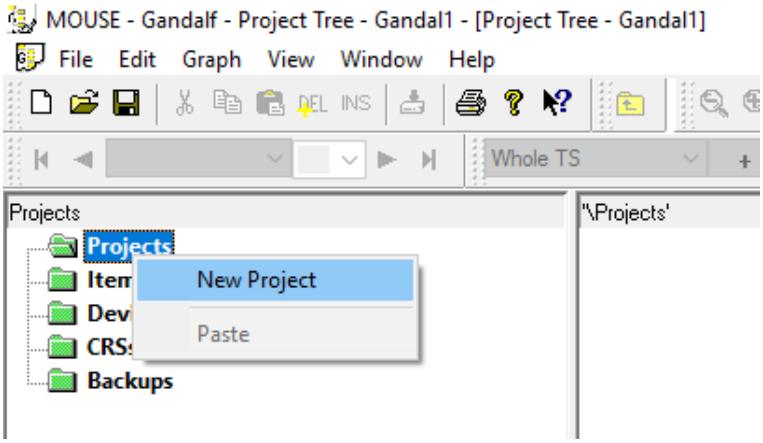
Similarly, you can mass fill values for columns by right-clicking on the column header and select *Fill values for this column*.



Picture 33 : Filtering and Filling in Detail View

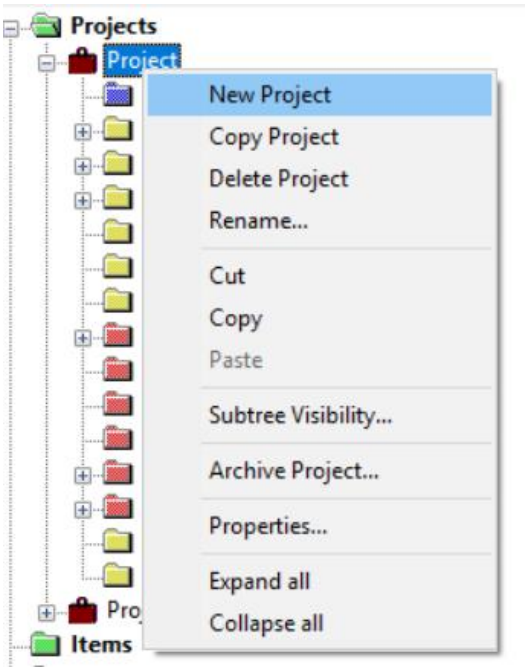
2.3 New project

- The item *Projects* is selected by the mouse.
- Pressing the right mouse button, the local menu appears with options *New Project*.
- Name of the project is automatically generated.



Picture 34 : New Project

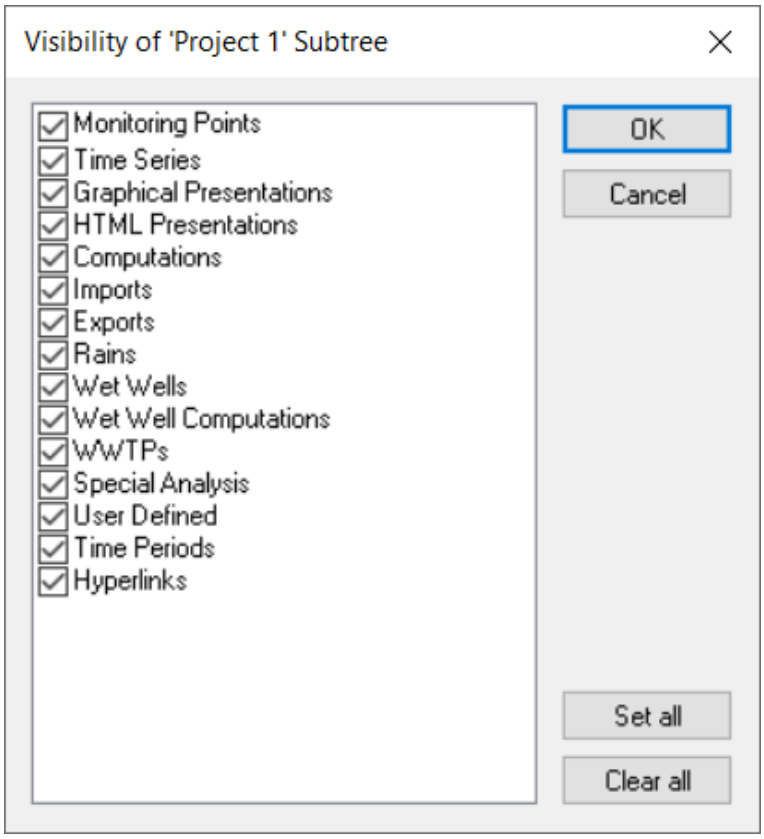
Now Project is created. Right-clicking again on the Icon of a project will pop-up context menu:



Picture 35 : Project Context Menu

- **New project** creates a new project
- **Copy/Delete Project** copies and deletes a project, copied project appears at the end of all projects
- **Rename…** renames a project
- **Cut** removes the project from original position to be pasted in new target
- **Copy/Paste** Copies and pastes project, pasted project appears just under under copied project

- **Subtree Visibility** allows to show / hide individual items from the tree Shows/hides visibility
- **Archive Project** Archives project to selected Folder. Archiving includes gnd. file, dfs files, HTML documents and import data in its original formats
- **Properties** shows name of the Project, default directory (Path) Description and type of Data storage
- **Expand /Collapse all** Shows/hides all the MPs in a subtree menu.



Picture 36 : Subtree Visibility

In case of working on multiple projects, a user can choose from these methods:

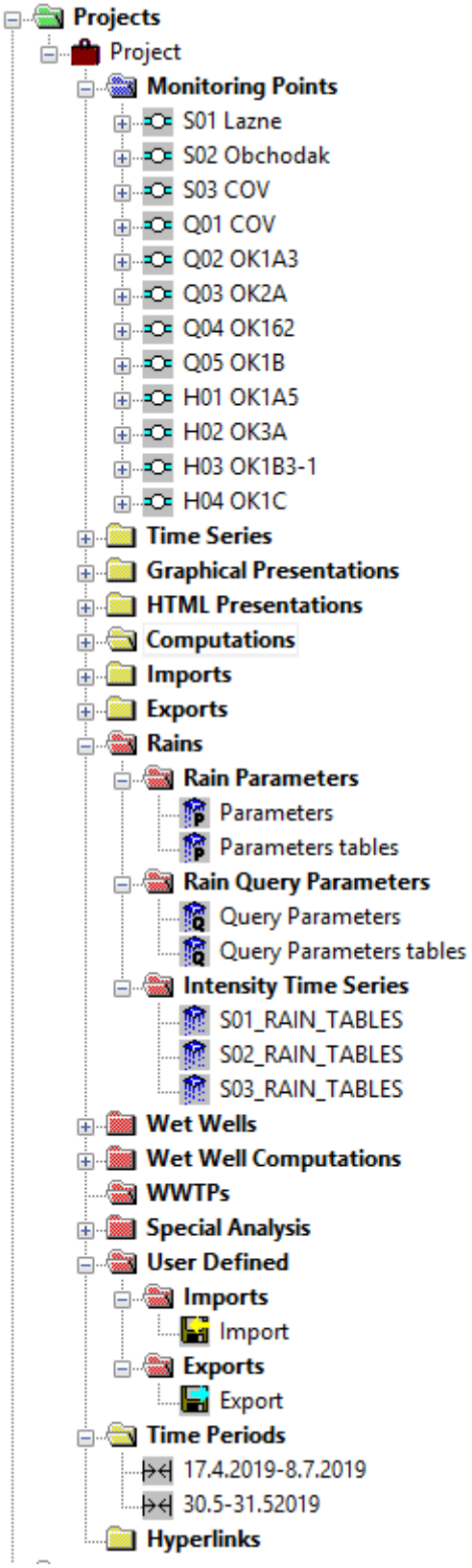
- Create two different GANDALF files with extension GND. Data are completely separated and there is no chance of combining them.
- Create one GANDALF file and organize data into different **Projects**. Data are situated in these projects, but there are methods to connect them (e.g. **Horizontal Plan**).

There are groups defined by GANDALF in every *Project* as follows:

- **Monitoring Points**
- **Time Series**
- **Graphical Presentations**
- **HTML Presentations**
- **Computations**
- **Imports**
- **Exports**
- **Rains**
- **Wet Wells**
- **Wet Wells Computations**
- **User Defined**
- **Time Periods**
- **Hyperlinks**

Items are distinguished by colors – green for basic categories, yellow for general data archive, red for analytics and blue for Monitoring Point.

The description of the features and operating examples of these items are the subject of this manual.

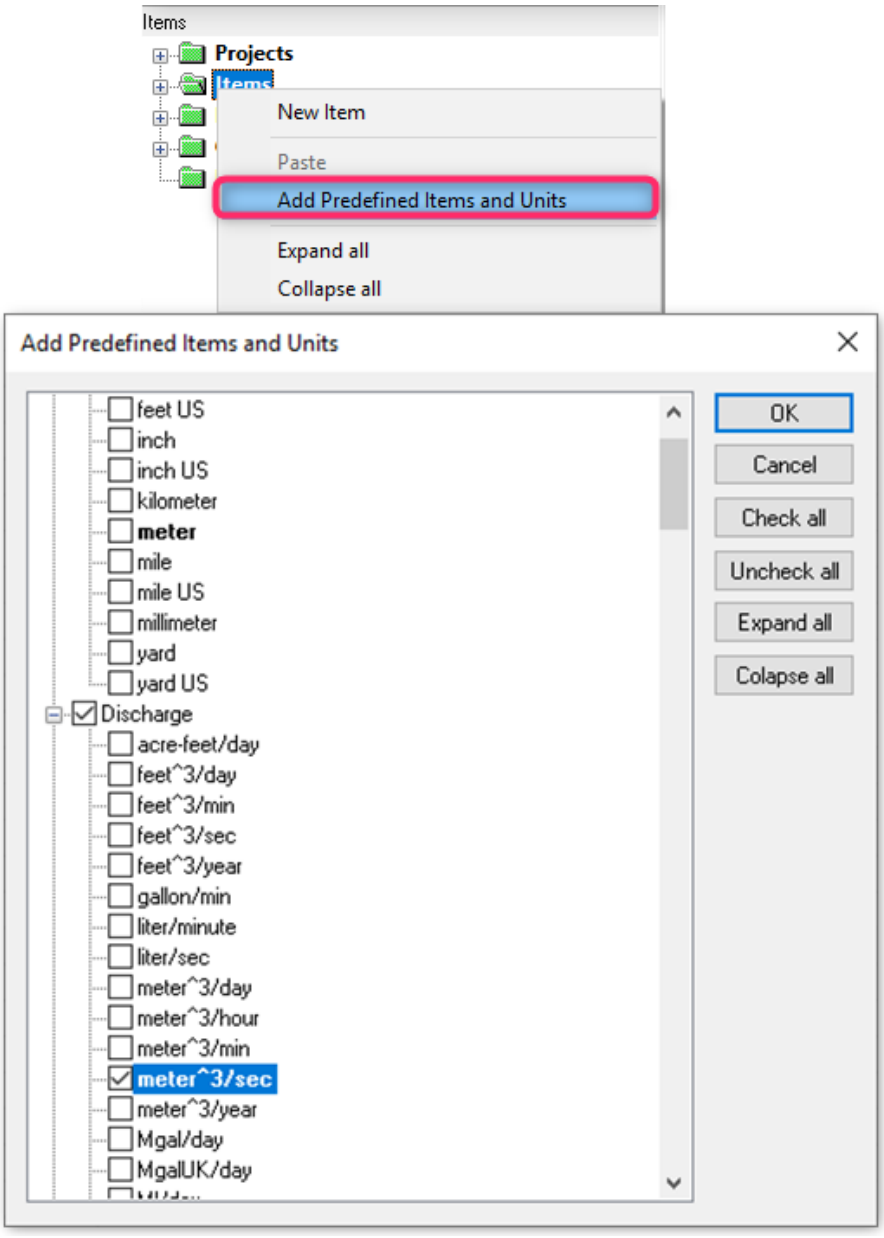


Picture 37 : Project Subtree

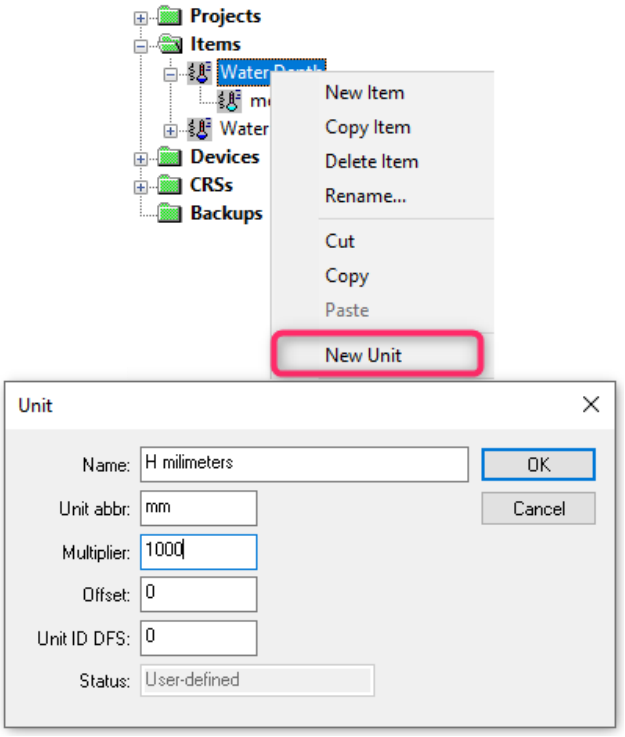
3 Items

The items that will be measured within the monitoring campaigns are predefined in menu **Items** (e.g. water levels, discharge, velocity, rain intensity, concentration, load, etc.). Secondary units for the above-mentioned quantities (l/s, m^3/s, ...), together with the other parameters can be defined here as well.

Item and units can be distinguished by two types - User defined and Predefined by the system, both types can be used combined.



Picture 38 : Adding predefined Items and units

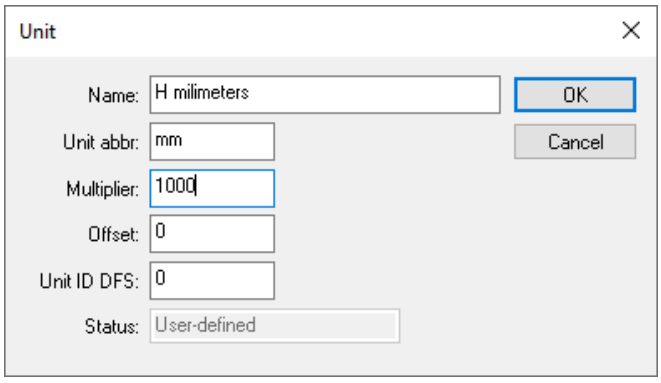


Picture 39 : Adding a New Unit

Type of the unit is in indicated in Properties dialogue. Every item has one so called Default unit, which is the main unit for this item. Default unit can be selected from the list of units available for a particular item. Other units in the list are related to the Default unit by a multiplier and offset, which allows converting data to a particular unit. Items and Units can be assigned to individual Time series, but they must be created in this group first. Units are used in the graphical presentations and the composition of reports.

3.1 Example of Items definition:

If the user would like to define subitem Depth in Millimetres for existing item Depth, then he should create new subitem in the local menu and fill into textbox Multiplier number 1000 (Millimetres are 1000 times smaller than meters). Unit abbreviation is then displayed in the Graphical Presentations and TS Editor.



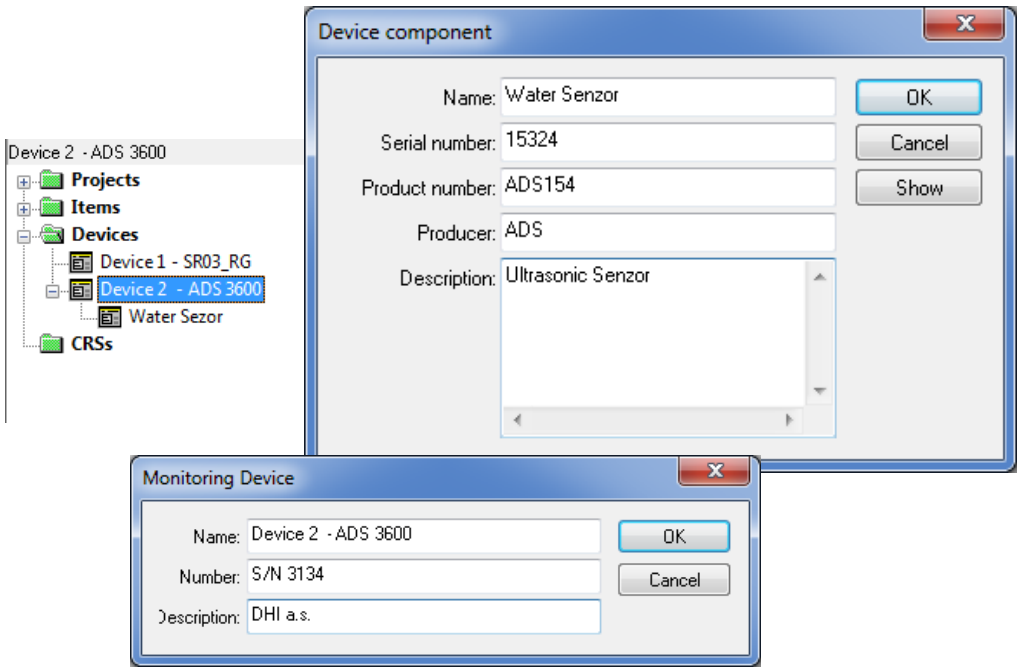
Picture 40 : Unit Definition

4 Devices

A definition of monitoring equipment used in all projects can be found in the menu **Devices**. Before adding the specific device to the *Monitoring Point* , the device must be created in this group. Data under item *Devices* are informal only.

List of monitoring equipment used in all projects can be found in the menu Devices. Before adding the specific device to the *Monitoring Point*, the device must be created in this group.

The user can use a local menu for creating a new device, copying (including all data), deleting and renaming existing devices. Name, serial number and additional information of selected device can be added in its properties. By using the sub-devices, information of sensors and other equipment connected with the device can be easily stored.

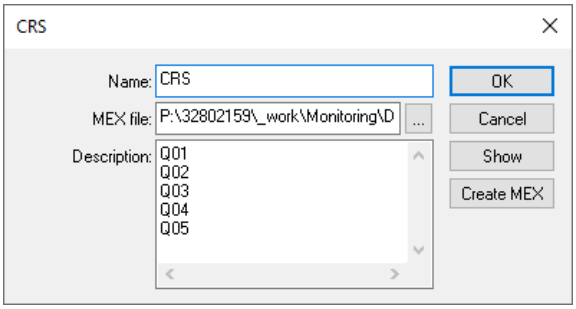


Picture 41 : Setting Up a Device

5 CRSs (Cross-Sections)

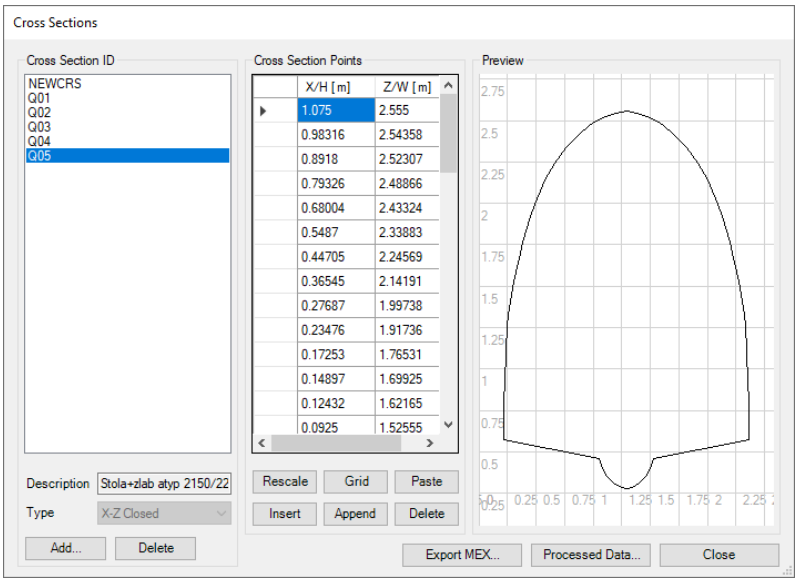
Item CRS (Cross-sections) represents a database of atypical pipe shapes. They are used in relevant computations where data related to pipe shape is required. These CSRs can be added to the monitoring point description in Monitoring Point tree structure.

The CRS data are stored in *MEX data format, which is a text file. The *MEX file is the same format as the original MOUSE/Mike Urban file. CRS profiles can be edited in the current version, this tool serves just as CRSs overview by external CRS viewer. MEX file is chosen in a simple dialog of CRSs Properties menu.



Picture 42 : CRS window

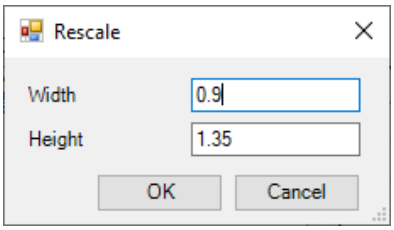
- **Name** name of cross-sections
- **MEX file** shows location of MEX file
- **Description** User's additional information about project
- **Show** shows coordinates of cross- sections, hydraulic parameters and further information
- **Create MEX** creates mex file and save it to a directory



Picture 43 : CRSs - Cross Section Editor

- **Add** creates a new cross-section (Name, Description, Type, Create copy of)
- **Delete** deletes selected cross-section
- **Rescale** rescales a cross-section by multiplying Width and Height by a value

- **Insert** Inserts a new point of coordinates [0;0] above selected row in the Cross-Section Points
- **Grid** adjusts an axis grid in the Preview
- **Append** creates a cross section point of coordinates [0;0] at the bottom of cross-section Points
- **Paste** Inserts points from external table (e.g. MS excel)
- **Export MEX** saves cross-section profile to mex file
- **Processed Data** shows other parameters such as Level, Area, Hydr.Radius, Width, Conveyance



Picture 44 : CRSs – Rescale

5.1 Type of CRS

Cross sections are classified in seven types: three of them are closed cross sections, and four of them are open cross sections. Each of the type has three sub-types, defined by the way hoe the CRS geometry is described. Thus, the Following CRS types are supported:

- **X, Z open** The CRS geometry is described by points defined by co-ordinate pairs (x, z), where 'x' is a horizontal axis, and 'z' a vertical axis. The points are specified in a counterclockwise direction

- **X, Z closed** The CRS geometry is described by points defined by co-ordinate pairs (x, z), where 'x' is a horizontal axis, and 'z' a vertical axis. The points are specified in a counterclockwise direction. The first and last points are connected to close the cross section

.

- **H, W open** The CRS geometry is described by pairs (h, w), where 'h' is relative height, and 'w' is the corresponding cross section width. The pairs are specified in an upward direction.
- **H, W closed** The CRS geometry is described by pairs (h, w), where 'h' is relative height, and 'w' is the corresponding cross section width. The pairs are specified in an upward direction. The last specified (h, w) pair defines the top of the closed cross section.

- **Processed open** The CRS geometry is described directly through their hydraulic parameters; Length (L), Width (W), cross section area (A) and hydraulic radius (R). For this type of CRS a graph is not available.
- **Processed closed** The CRS geometry is described directly through their hydraulic parameters; Length (L), Width (W), cross section area (A) and hydraulic radius (R). For this type of CRS a graph is not available.
- **X-Z-R-M open** The CRS geometry is described by points defined by co-ordinate pairs (x, z), where 'x' is a horizontal axis, 'z' a vertical axis, the relative resistance (R) and the marker (M). The points are specified in a counterclockwise direction.

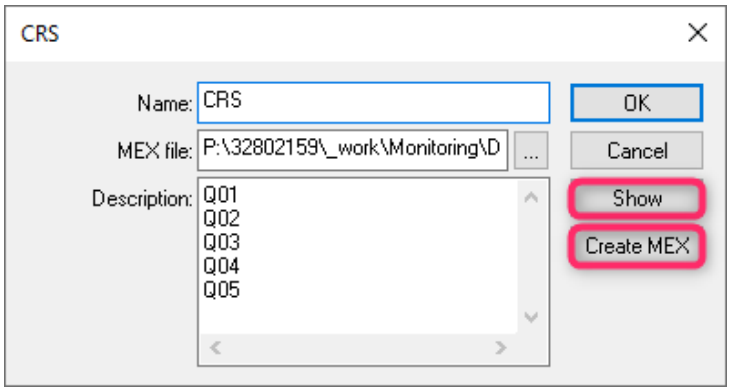
Note: The X, Z types are appropriate for all irregular cross sections, while H, W for symmetrical cross sections only.

5.2 Example of Creating CRS

Let's suppose in the project is required to involve an atypical profile for example eggshaped profile 900/600 mm, that user has XZ coordinates available.

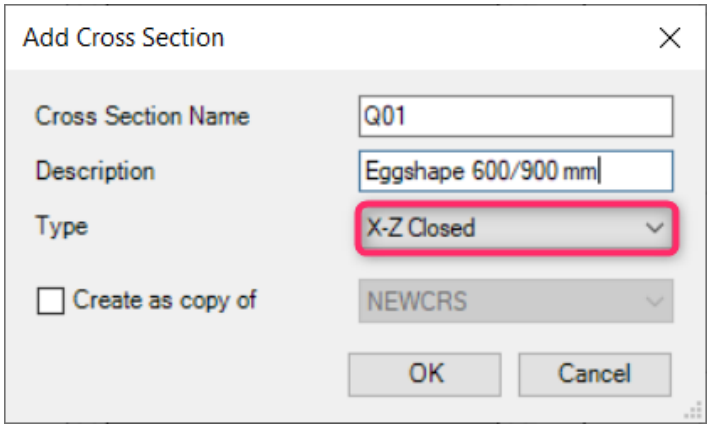
Here are the steps how to import an atypical profile:

- Right-click newly created CRS and go to Properties
- Go to Create MEX and save mex file into your local directory



Picture 45 : Creating a New CRS

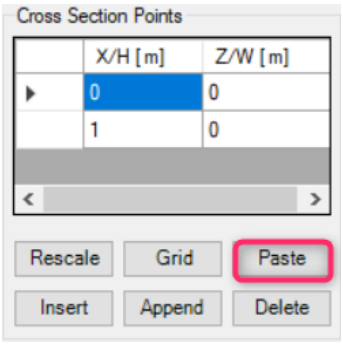
- A new Atypical Pipeline is added by clicking *Add*, new Window opens where further attributes of Cross Section Name are determined



Picture 46 : Adding a Cross Section

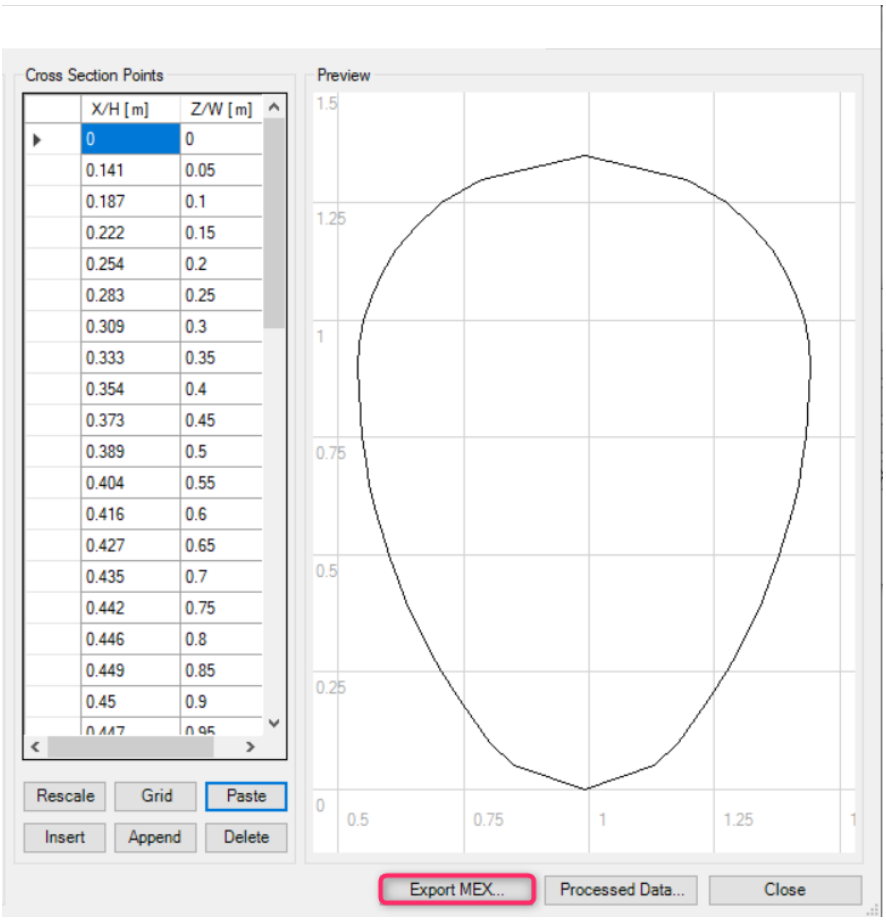
It's important that right *Type* of coordinates is selected accordingly to a user (s given coordinates from Client/Own Measurement. In this example a user has X-Z Closed coordinates.

- Copy Your given coordinates from table (e.g. MS Excel)
- *Paste* Coordinates in Cross Section Window



Picture 47 : Pasting Coordinates

- Next, Select *Export MEX* and save it to already created mex. file



Picture 48 : Exporting Cross-section to a MEX file

- Now the mex file contains one atypical cross-section. Accordingly, a user can add multiple Atypical cross-section into one CR

6 Backups

All the backed up time series within a relation can be found here. Be aware it serves to back up time series while the GANDALF project is opened only. Once the *.gnd file is saved and closed, the category *Backups* is cleaned.

There are two ways how to back up time series:

1. **Manually**

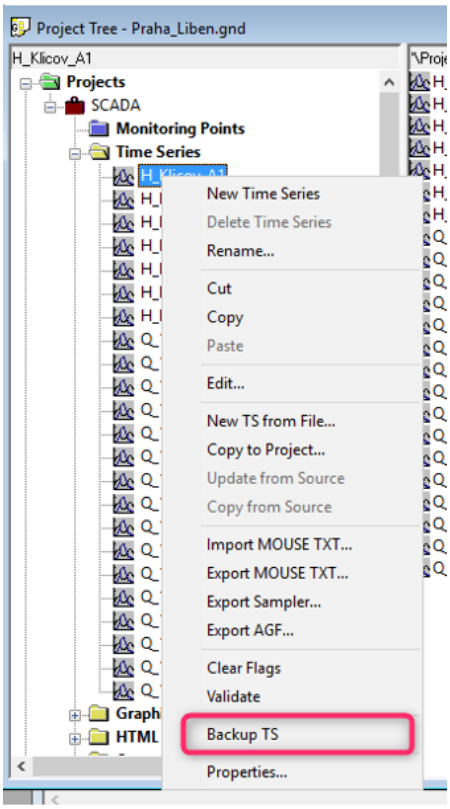
right click at the time series and select command Backup TS. After any edit in TS editor, the backuped TS will be shown in backup folder

2. **Automatically**

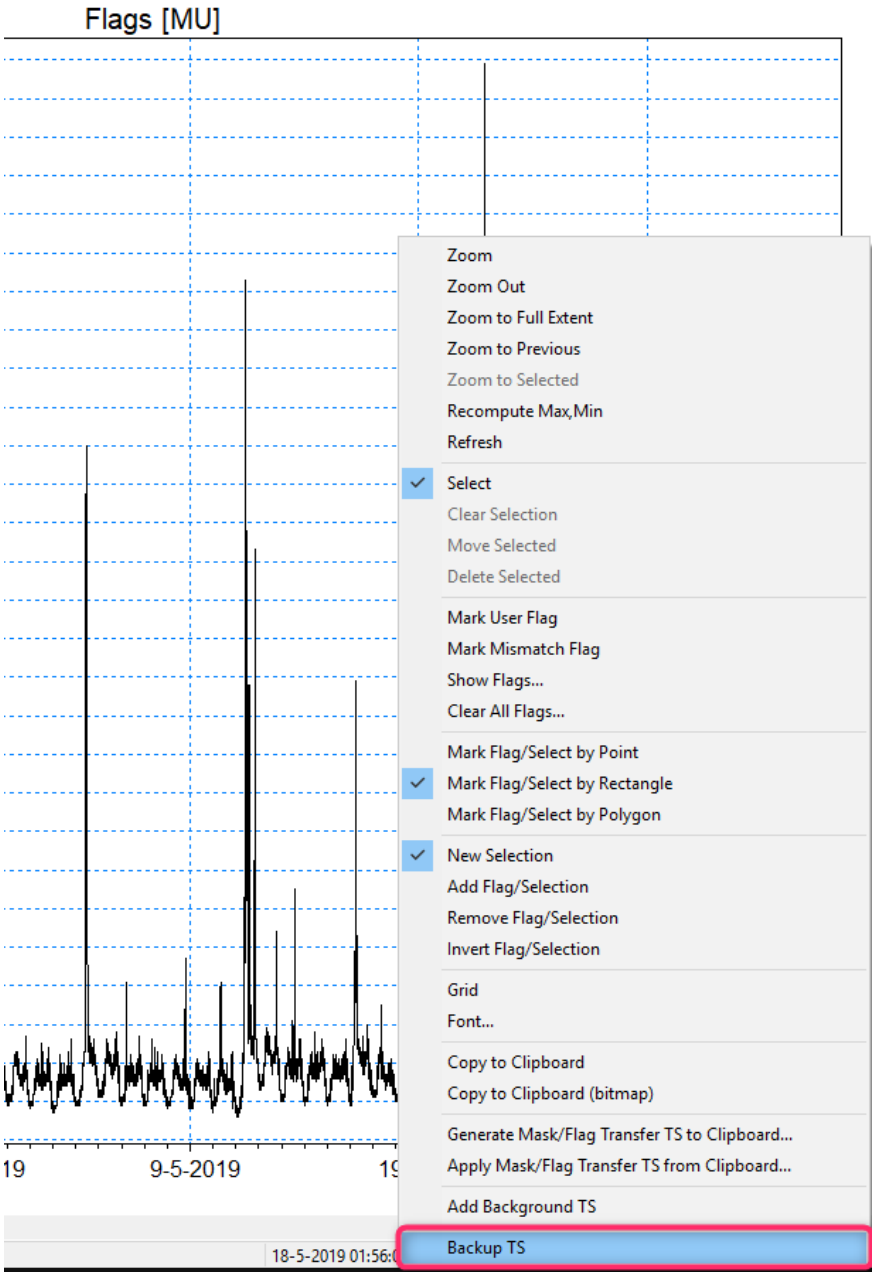
- right click at the time series folder, go to the Properties and then check “Backuping”
- every time TS is being edited, new back up is created in Backup Folder at the Project tree

3. **Via Computation**

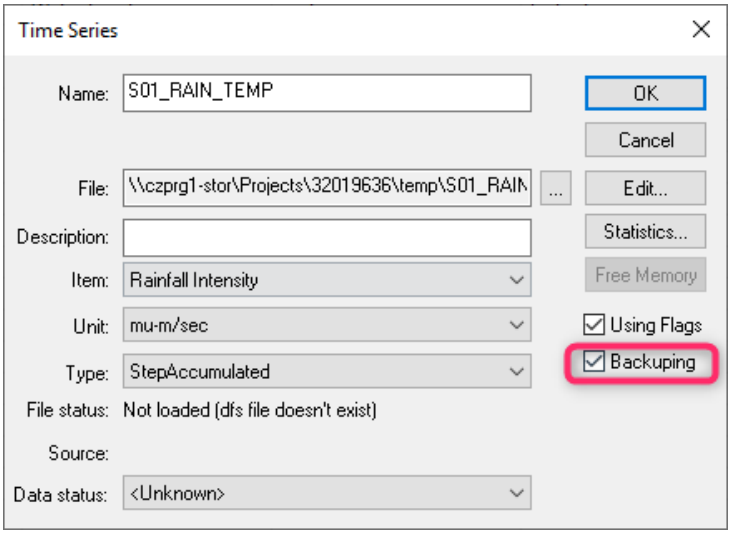
- right click at the time series, go to the Properties and then check “Backuping”
- every time TS is edited, new back up is created in Backup Folder at the Project tree



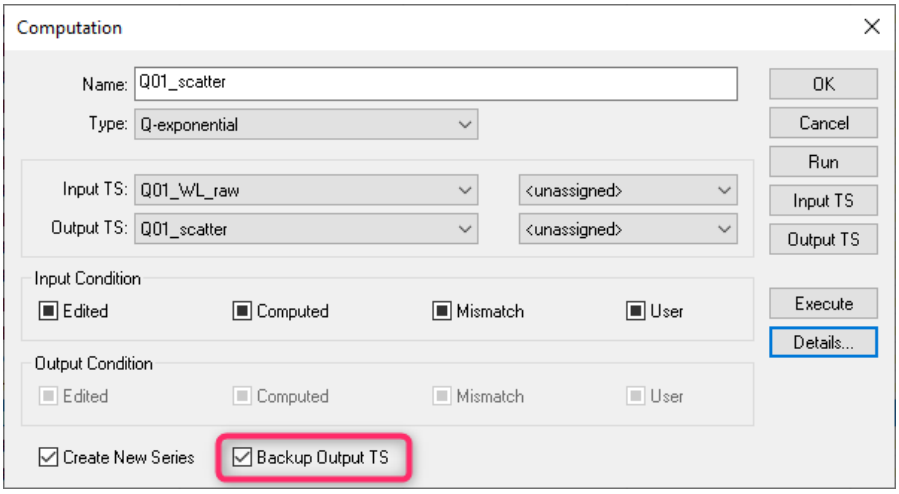
Picture 49 : Backing Up Manually I



Picture 50 : Backing Up Manually II



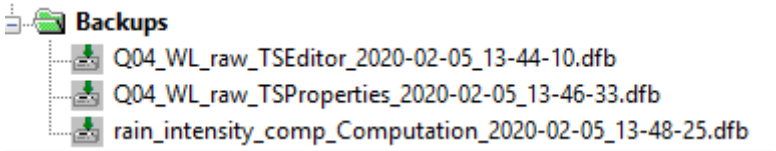
Picture 51 : Backing Up Automatically



Picture 52 : Backup via Computation

There is also a possibility to make a backup manually while TS is edited by clicking the button *Backup TS.*

All Backups are found in Backup Folder in the Subtree Project Menu. Their automatically generated name refers to TS that was backed up and exact time it was created. A User can delete and restore Backup or Restore to New Time Serie. Please note that backing up is not supported when Project is connected to the database.



Picture 53 : Location of backups

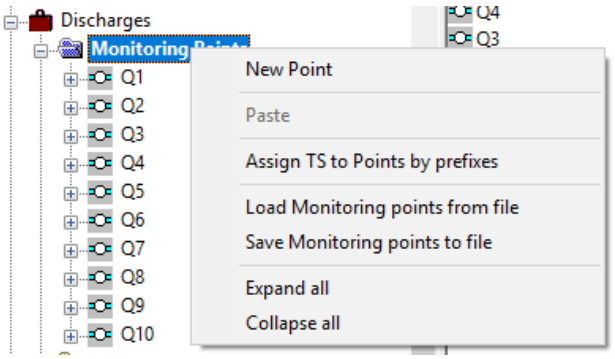
The name of backup file (.dfb) consists of 3 parts:

- Name of backuped TS
- Location where the back was created
- Time backup was created

Note all backup files and links that all backups are erased when Gandalf project is re-opened.

7 Monitoring Points

The basic control elements of GANDALF are **Monitoring Points** (MP). GANDALF is not only system for data presentation and computations, but it also serves as a basic organization of the whole measuring campaign. Each element of **Project** (e.g. Time Series, Computation, Export, etc.) could be assigned to a real monitoring site to make the organization of monitoring campaign more comfortable. To link individual items to the Monitoring points is possible using a pulldown menu or drag and drop from the Project Tree View Window.



Picture 54 : Monitoring Points Context Menu

- **New point** — Creates new Monitoring Point (MP).
- **Paste** — Pastes copied MP.
- **Assign TS to points by prefixes** — If any TS has same prefix as in MP properties it will assign TS to relevant MP.
- **Load MPs from file** — Loads a *Measured Points List* to Project tree according to format rules it must follow a format as represented at the Picture 55.
- **Save MPs to file** — Creates *Measured Points List* to a text file with all information available determined in MP Properties.
- **Expand all/Collapse all** — Shows/hides all the MPs in a subtree menu.

```
//Gandalf Measured Points list
//Semicolon separated list of: Name; Prefix; Profile name; Id GIS; X Coordinate; Y Coordinate; Z Coordinate;

Q1; ; ; ; -743387.6890; -1045952.6560; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q2; ; ; ; -744060.8730; -1045209.1900; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q3; ; ; ; -743470.9910; -1045150.9700; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q4; ; ; ; -744217.8840; -1044151.0150; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q5; ; ; ; -744217.8840; -1044151.0150; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q6; ; ; ; -744406.1000; -1048878.1130; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q7; ; ; ; -743932.3260; -1045216.9150; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q8; ; ; ; -741196.1660; -1047007.5330; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q9; ; ; ; -744259.3980; -1044379.1140; 0.0000; ; ; ; ; ; 0; ff0000; 3;
Q10; ; ; ; -741072.3930; -1046980.4530; 0.0000; ; ; ; ; ; 0; ff0000; 3;
```

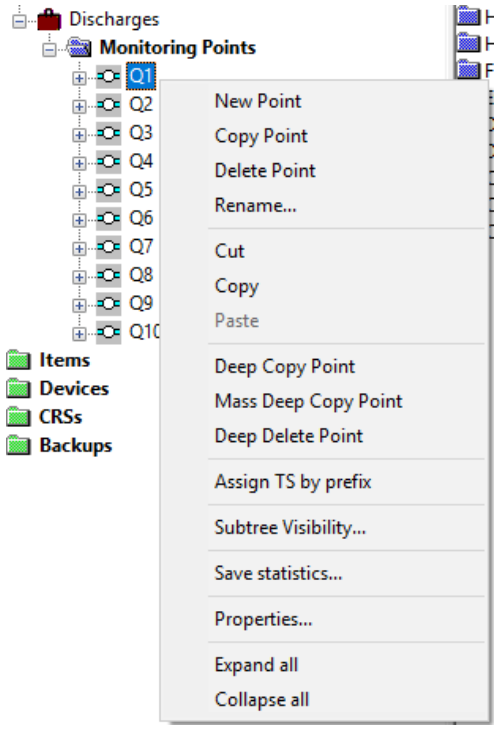
Picture 55 : Measured Points List

In general, Gandalf Measured Points List consists of two sections:

- **Informal Section** , — contains noncompulsory information about monitoring point: Name, Prefix, Profile name, Id GIS, , Street, Town, Sewer Type Structure, Sewer profile, Report File
- **Data section** — contains compulsory information about monitoring point: X coordinates,Y coordinates, Z Coordinates, Marks Type, Colour, Size, Parent

Note: Both Informal and Data section are implemented in Properties of Monitoring Points as shown at the **Chyba! Nenalezen zdroj odkazů.**.

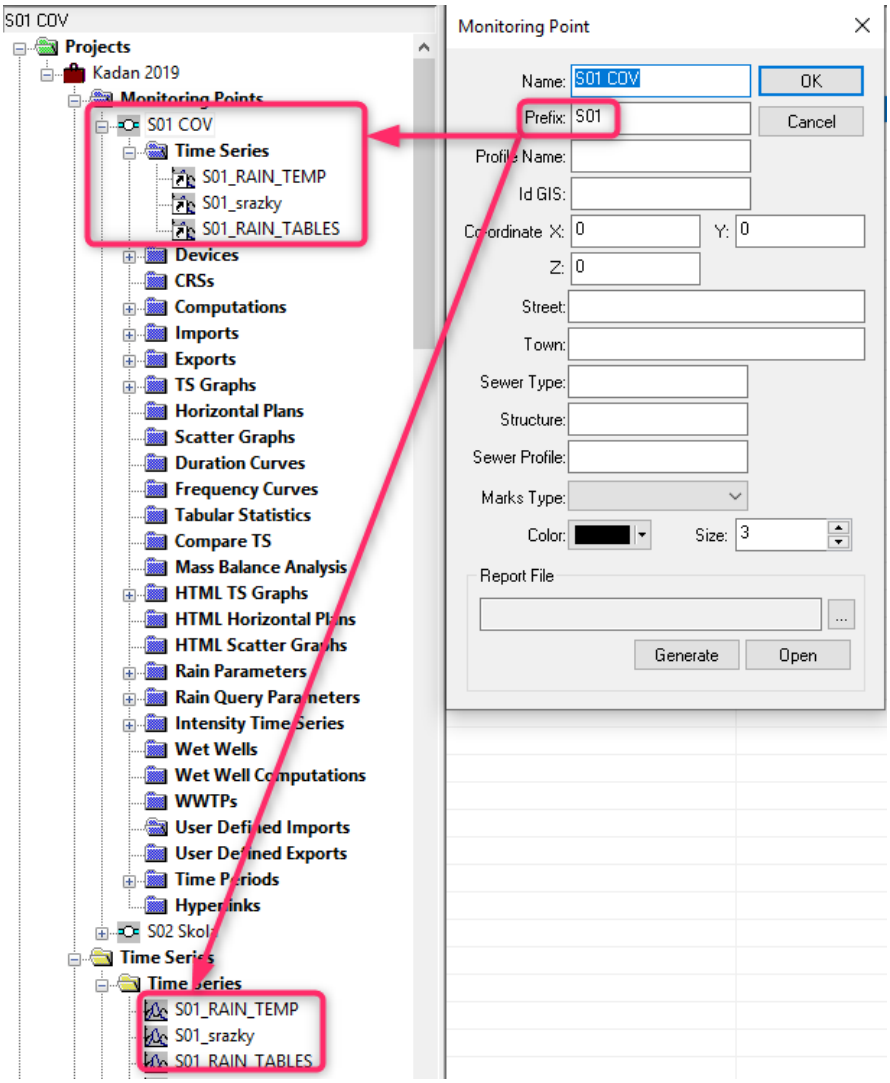
Once *Monitoring Point* is created, right click on the node opens a context menu outlined at the following picture:



Picture 56 : Monitoring Point Context Menu

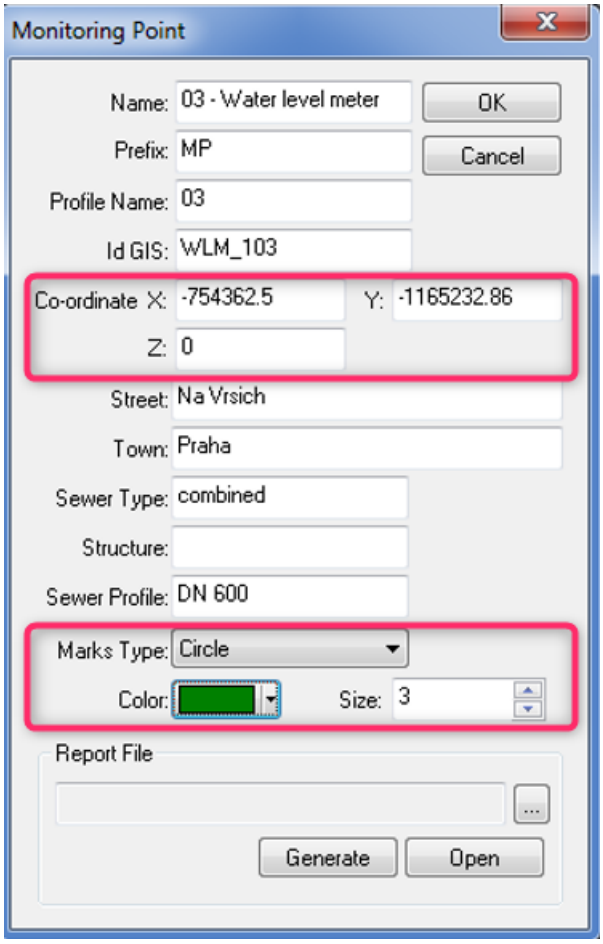
- **Deep Copy Point** — Copies one MP including its structure such as assigned TS computations etc. It is based on a prefix of a New Point
- **Mass Deep Copy Point** — Copies multiple MPs based on Prefixes of New Points
- **Deep Delete Point** — Deletes all information related to deleted MP
- **Assign TS by prefix** — Assigns any TS from TS folder with corresponding prefixes to the Monitoring Point (See Picture 57)
- **Subtree Visibility** — Defines visibility of individual items of MP in the project tree. It can reduce size of the tree in case some items are unused.
- **Properties** — Information about monitoring points can be inserted here. These data consist of Name, Location, Id for GIS, XY co-ordinates used in Horizontal Plan, Sewer Type and Profile, Structure, colour of this Monitoring point in Horizontal Plan and assigned Report Text File with additional information.

Note: Items in Project (Time Series, Devices, CRSs, Computations, Imports, Exports Graphical Presentations, etc.) are not only located in Project tree under each related file, but links to these items can be assigned to Monitoring Point as well



Picture 57 : Prefix of Monitoring Point

Special function for global operation Imports, Exports, Computation, HTML Presentation and User defined Import Export is implemented. This allows user to run all Imports, Computation, etc. automatically in order as they are organized in Monitoring Point. The function is available all the time using right mouse button on particular item.



Picture 58 : Properties of Monitoring Point

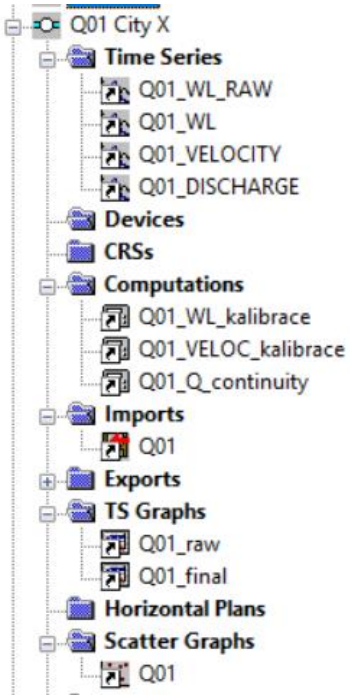
The following items can be filled in Monitoring Points Properties:

- **Name** Name of Monitoring Point (MP)
- **Prefix** Prefix in the name of MP (optional)
- **Profile Name** Profile name of MP
- **Id GIS** Location of GIS ID
- **Co-ordinate** X and Y coordinates used to show this MP in Horizontal Plan
- **Street** Location of MP
- **Town** Location of MP
- **Sewer Type** Sewer Type of MP
- **Structure** Structure of MP
- **Sewer Profile** Sewer Profile of MP
- **Marks Type** Type of mark used for this MP in Horizontal Plan
- **Colour** Colour used for this MP in Horizontal Plan
- **Size** Size of mark used for this MP in Horizontal Plan
- **Report File** Location, where is Monitoring Point Report saved

Note: Red labelled features are compulsory data information and can be also found in Measured Points List (See Picture 55 above). This information is propagated further in Horizontal Plan (Chapter 9.4)

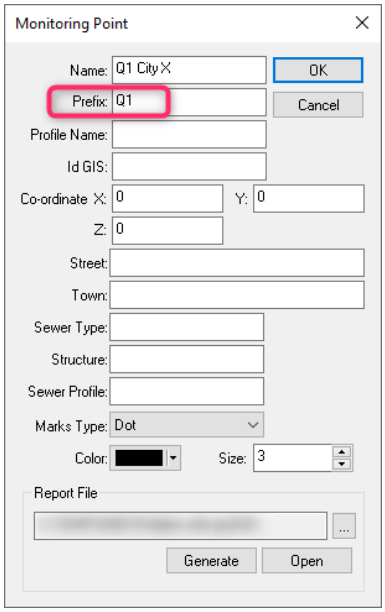
7.1 Example of using Deep Copy Point

At first, if you want to use Deep copy Point, you need to create “Master Sample” that will contain all features that will be propagated into the deep copied points. Let’s suppose Monitoring point **Q1** is defined including all *Time Series, Devices, Computations, Imports, Exports* and *TS Graphs* as followed:



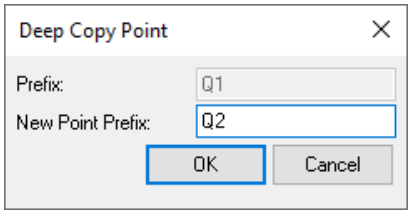
Picture 59 : Deep Copy Point - Master Sample

Now when “Master Sample” was created you need to determined *Prefix* in MP Properties…



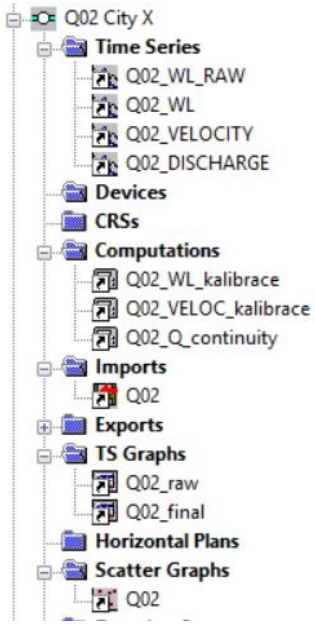
Picture 60 : Prefix of Master Sample

In order to Deep Copy Point based on previously created profile Q1, Go to *Deep Copy Point* located in *Monitoring Point* context Menu (right-click on the MP node) and specify *New Point Prefix.* Then click *OK.*



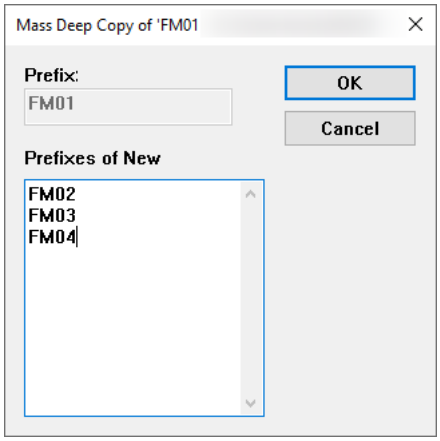
Picture 61 : New Point Prefix

The structure of Point **Q2** is fully copied according to Point **Q1**. The Profile is now ready to be imported with data and to do analysis. Please check picture bellow to see the structure.



Picture 62 : Deep Copied point

In order to create more MPs based on Master Sample use Mass Deep Copy Point. Works the same way, but with the list of Prefixes defined.

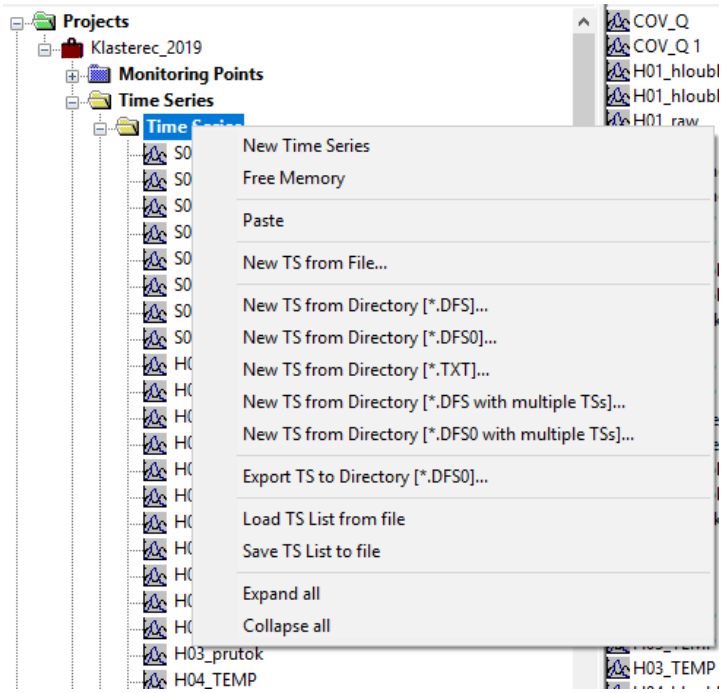


Picture 63 : Mass Deep Copy Point - Prefixes

8 Time Series (TS)

Each time series is saved into separate file with DFS extension. Every time series must be created in the TS branch before its first use. User creates new (empty) TS using the local menu – item *New Time Series* or importing TS from existing DFS / DFS0 file.

New TS can be also created from existing files stored in a directory with one step - by selection of *New TS from Directory*. This command loads all TS in the directory.



Picture 64 : Time Series context menu

- **New Time Series** creates an empty Time Series node
- **Free Memory** frees inner memory of GANDALF, should be used regularly when dealing with large amount of data
- **Copy/Paste** Copies the TS and Inserts it as new file in the TS branch as well as creates the separate dfs file on a hard drive for it
- **New TS from File** Loads single TS (dfs file) from file, assigns existing dfs files to the Gandalf project. TS name is taken from the DFS file

New TS from Directory:

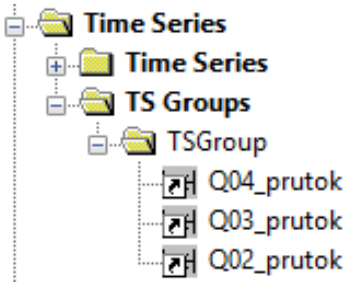
- **[*.DFS]** Loads multiple TS (dfs) from Directory
- **[*. DFS0]** Loads multiple TS (dfs0) from Directory
- **[*.TXT]** Loads MOUSE.TXT from directory (data must be without headers)
- **[*. DFS with multiple TSs]** Loads DFS containing multiple TSs, it separates each TS into single DFS
- **[*. DFS0] with multiple TSs]** Loads DFS0 containing multiple TSs, it separates each TS into single DFS
- **Export TS to Directory [*. DFS0]** exports all the TS to Directory in DFS0 format. (For more detailed export functionality see chapter **13 Exports)**

- **Load TS List from file** — creates an empty TS named according to a list of value or text in .txt file and .csv. file in the same order
- **Save TS List to file** — creates Gandalf Time Series list into text or csv file
- **Expand all / Collapse all** — shows/hides all the Time Series in a subtree Time Series folder

New TS from directory is always automatically named according to the name of imported file.

8.1 TS Groups

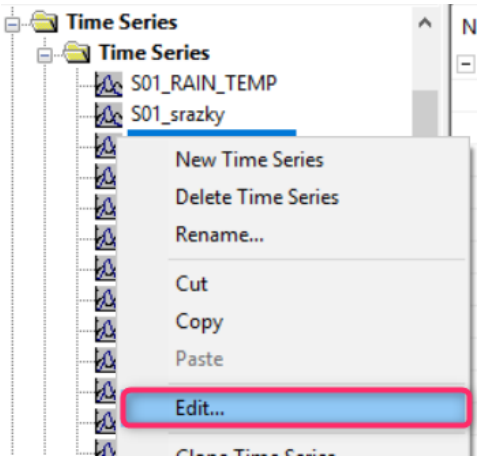
You can Group Time series in separate folder in the Project Tree. TS Groups can be used for Group Exports and Group Computations. Please see chapter **11 Computations and 13 Exports**.



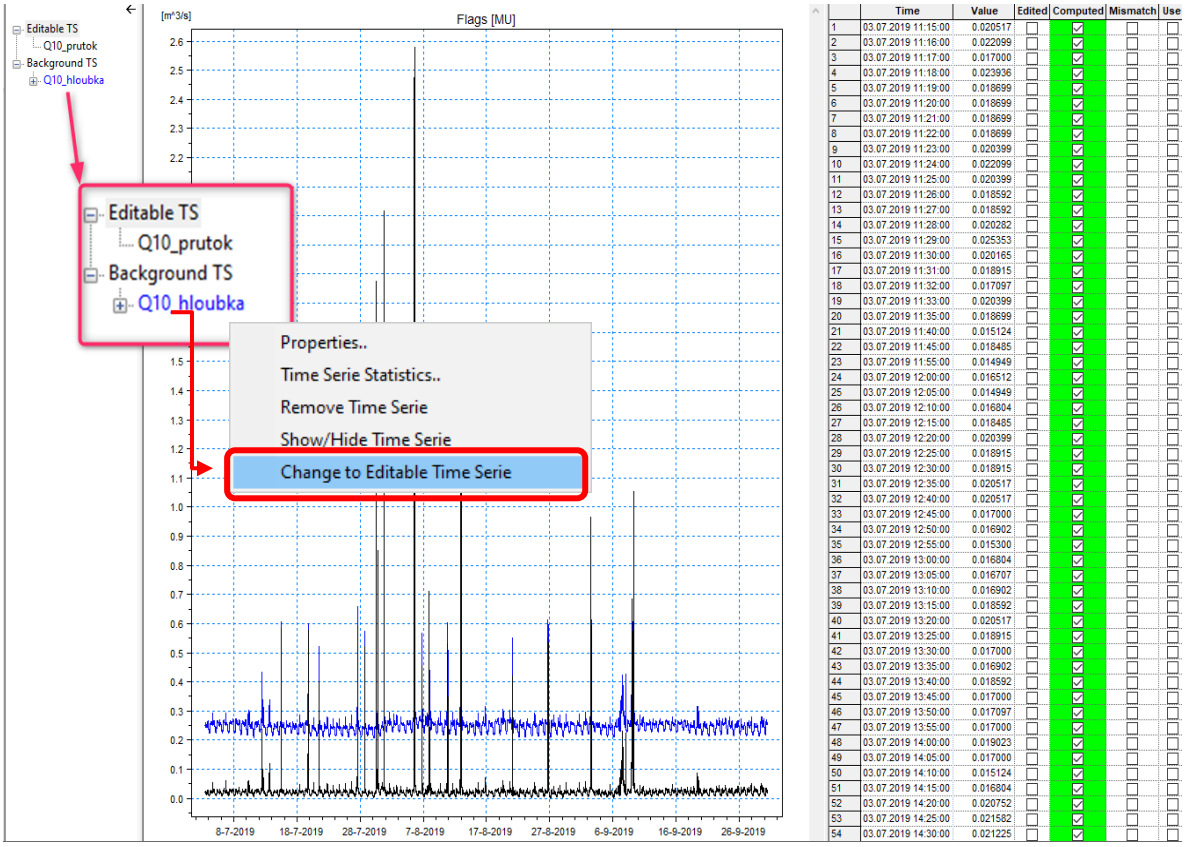
Picture 65 : TS Groups

8.2 TS Editor

In order to edit Time Series, right-click on TS and select *Edit…* in context menu.



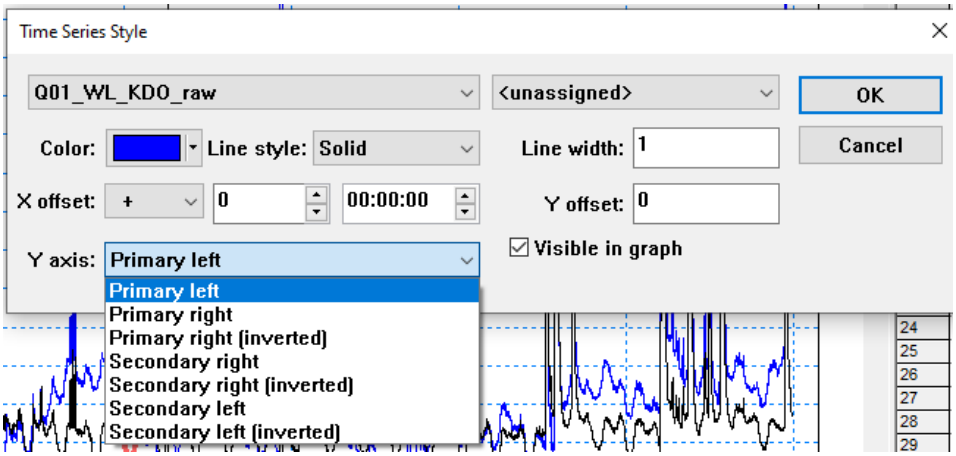
Picture 66 : Edit TS



Picture 67 . TS Editor

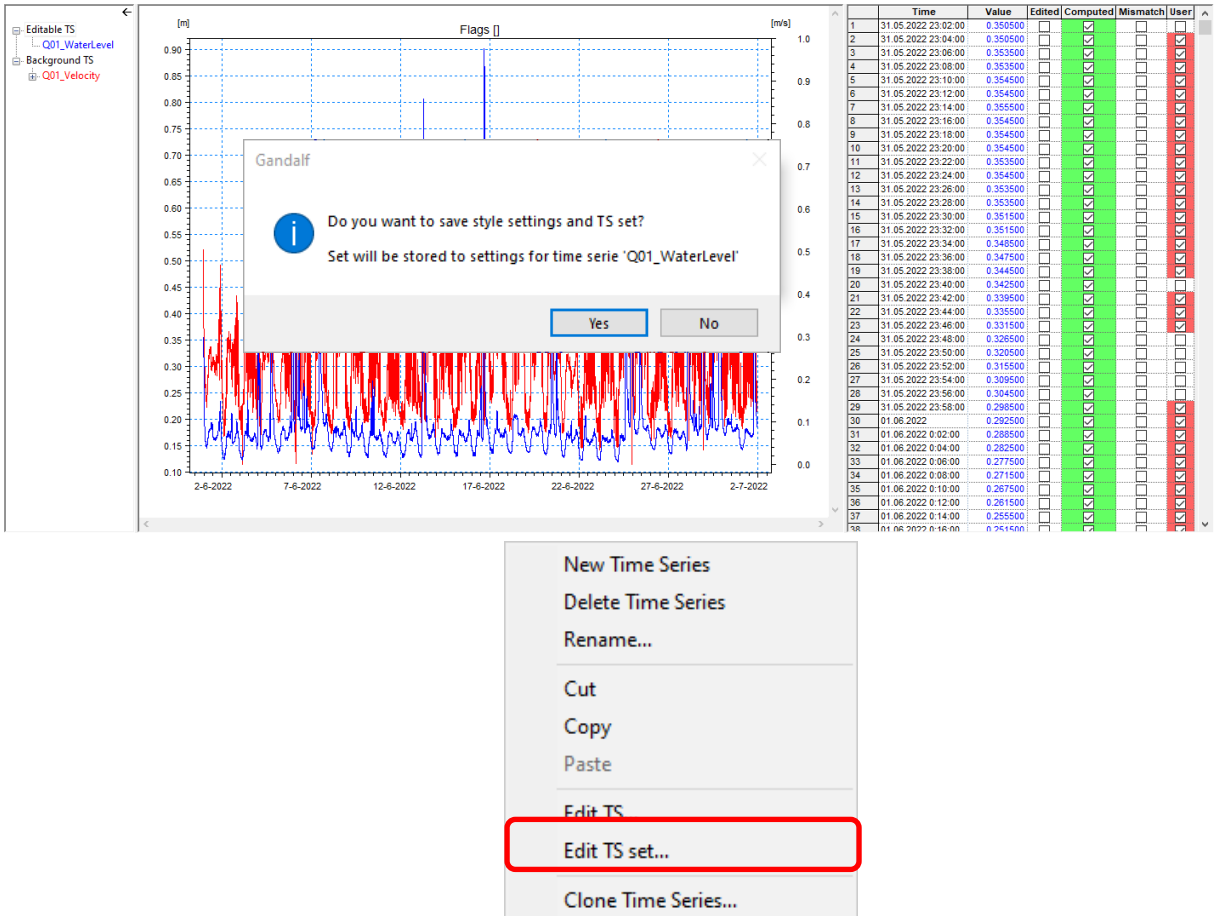
When TS editor is opened it is possible to add one or more Background TS. Background TS are only displayed, not editable, Editable and Background TS can, however, be switched.

User can set Colour, Line width, Line style for both TS, Background TS can be shown on different Y axis. Editable TS is shown always on Primary left Y axis.



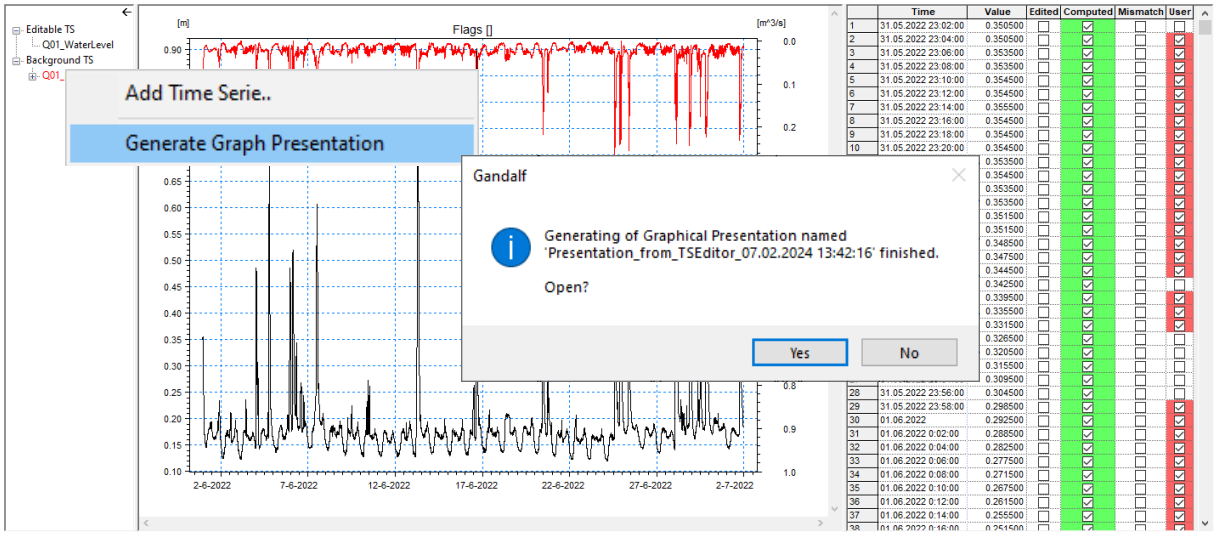
Picture 68 : Background TS Settings

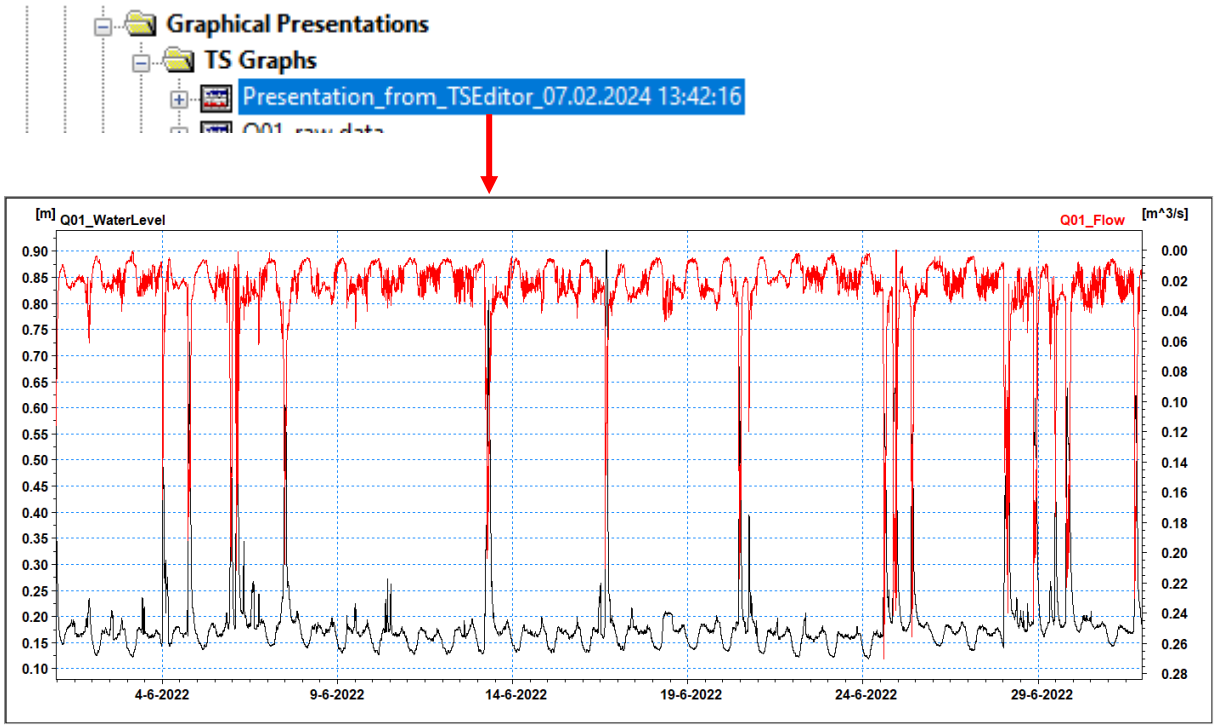
Having more than 1 TS opened in TS editor, e.g. 1 editable + 1 or more background TS, TS editors offers to save the predefined configuration into the editor set. This set is saved to the editable TS and can be re-opened from local menu.



Picture 69 : Working with TS set

It is also possible to Generate TS Graph (TS Graphs Presentation see chapter **9.1 TS Graphs**) directly from the TS Editor - all TSeries will be presented on Primary Axis





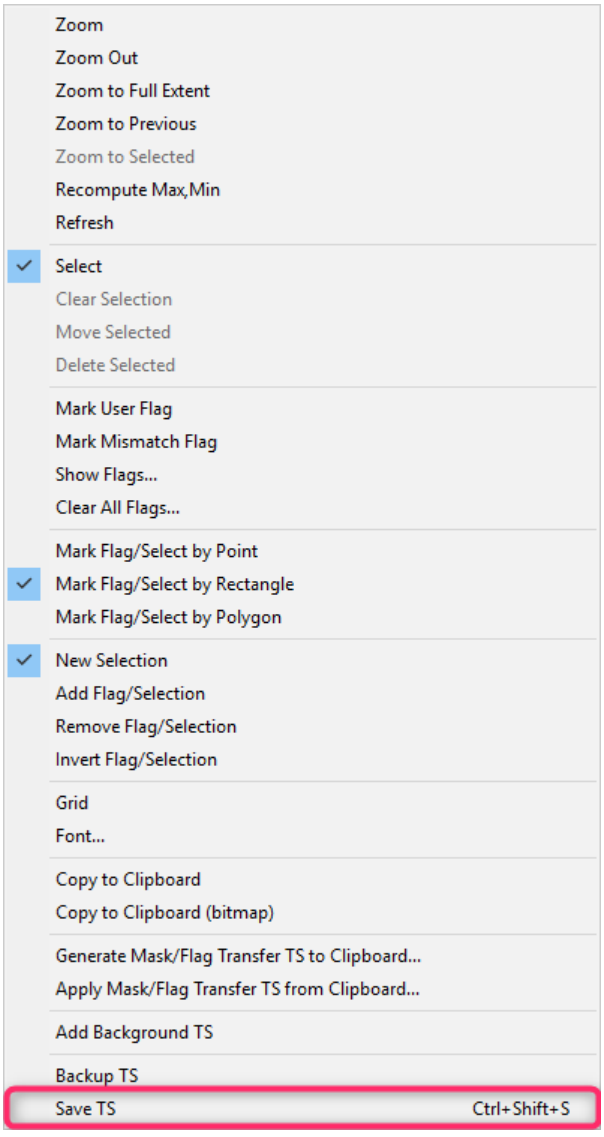
Picture 70 : Generate TS Graph Presentation

When transfer data into TS Graph, all Y-axes are transferred the same way they were set in TS Editor.

Same logic works to transfer a View from TS Graph to TS Editor (Chapter 67 TS Graphs)

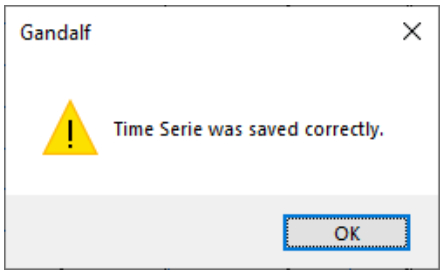
8.2.1 Saving in TS Editor

Currently edited TS can be directly saved using shortcut **Ctrl+Shift+s**. Same function can be reached by right-clicking on the graph part and selecting Save TS. In other cases, when TS editor is closed automatic save is carried out.



Picture 71 : Save TS

After Saving TS, confirmation box dialog will appear.



Picture 72 : Saving TS

8.2.2 Data Selection

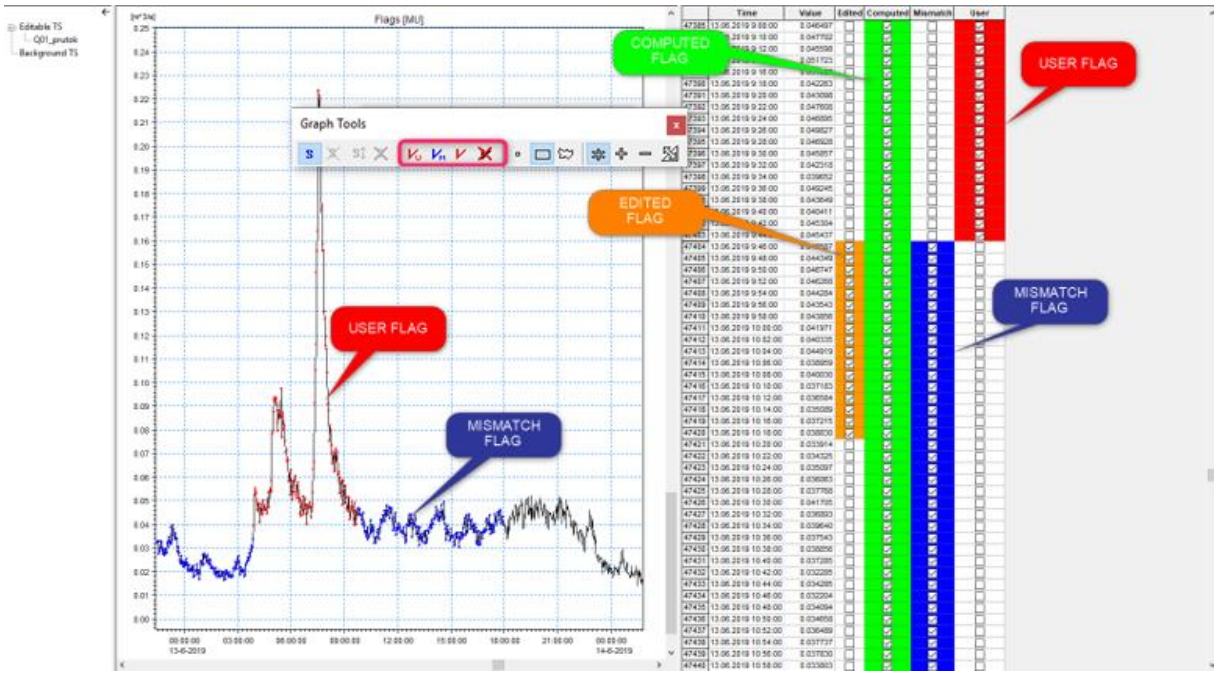
There are some useful tools for TS editing as described in the chapter **1.3.7 Graph Tools**. To recapitulate, it is possible to select data in the graphical window of TS by point, rectangle or arbitrary polygon. Points can be selected by new selection or they can be added or removed to/from current selection and there is also tool for reverse selection and clear selection. Selected points can be moved or deleted. Selection tools can be also used for flag selection (see further).

Selected, flagged or zoomed points can be edited in TS Editor by Calculator (see chapter **1.3.6 Calculator**. It is possible to add, subtract, multiply or divide these values. All modified data are flagged as *Edited*.

8.2.3 Flag editor

The User can tag data with different flags to be conditionally included or excluded into new computations. The Difference compared to data selection and editing, is that original data remain unmodified and the values are tagged by Flags to be used for further data processing.

Command Edit… will open the editor, which is focused to the TS and flag editing. Editor consists of graphical and tabular view. Each individual record (date/time + value) can be labelled by any of the following flags: *Edited, Computed, Mismatch, User*. Flags are distinguishable by colours – Edited (orange), Computed (green), User (red) and Mismatch (blue). Flags can by shown by right click on graphical window and by selection of command Show Flags.



Picture 73 : Using Flags

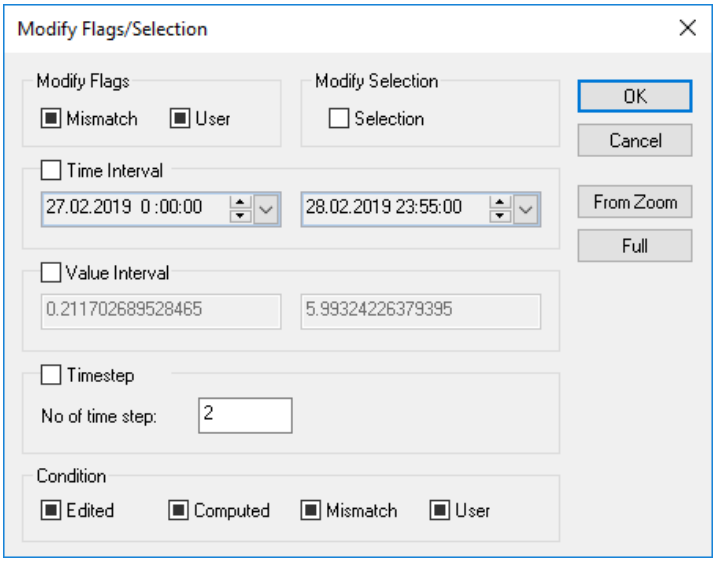
The first (*Edited*) and second (*Computed*) flag are automatically generated by the system in case the user perform editing/computation of the value/time series. User cannot customize those flags. The flag *Mismatch* is generated during the imports (for some of monitoring devices), but the user can edit them. The last flag (*User*) could be fully defined by the user. Flags can be edited individually and/or globally on selected data sets.

Individual editing of data is done by clicking on the particular line of tabular part of the window and typing the new value.

Clicking in the time series in the graph the appropriate value in the table will be highlighted.

The assignment of the flags to the time series and/or its part can be done either using graphical part of the window and/or tabular part.

The dialog for the flag modification can be opened by the click on the right mouse button of the graphical (left) part of the window and selection of Mark Flag command. User can mark either *Mishmash* or *User* flags by *Point*, *Rectangle* or *Polygon*. Date, time and value of the actual point are also shown in status bar when moving mouse over graphical view. If polygon is chosen, it is necessary to press CTRL + left mouse button for finishing marking the area.



Picture 74 : Modify Flags/Selection

More specific (detail) selection can be done by the combination of the time and/or value intervals using tabular part of the editor. Clicking on the right mouse button of the tabular (right) part of the window the window for flags modification appears. The time interval and/or value interval can be set-up in the dialogs. Actual graphical zoom can be used for those intervals after selecting the *From Zoom* button. User can select, which flags [Mismatch or User] and to which status [neutral - blue, selected - checked or unselected - not checked] will be set-up. As the advance option the user can assigned to which group of flags the selection will be applied by selection of flag *Condition*.

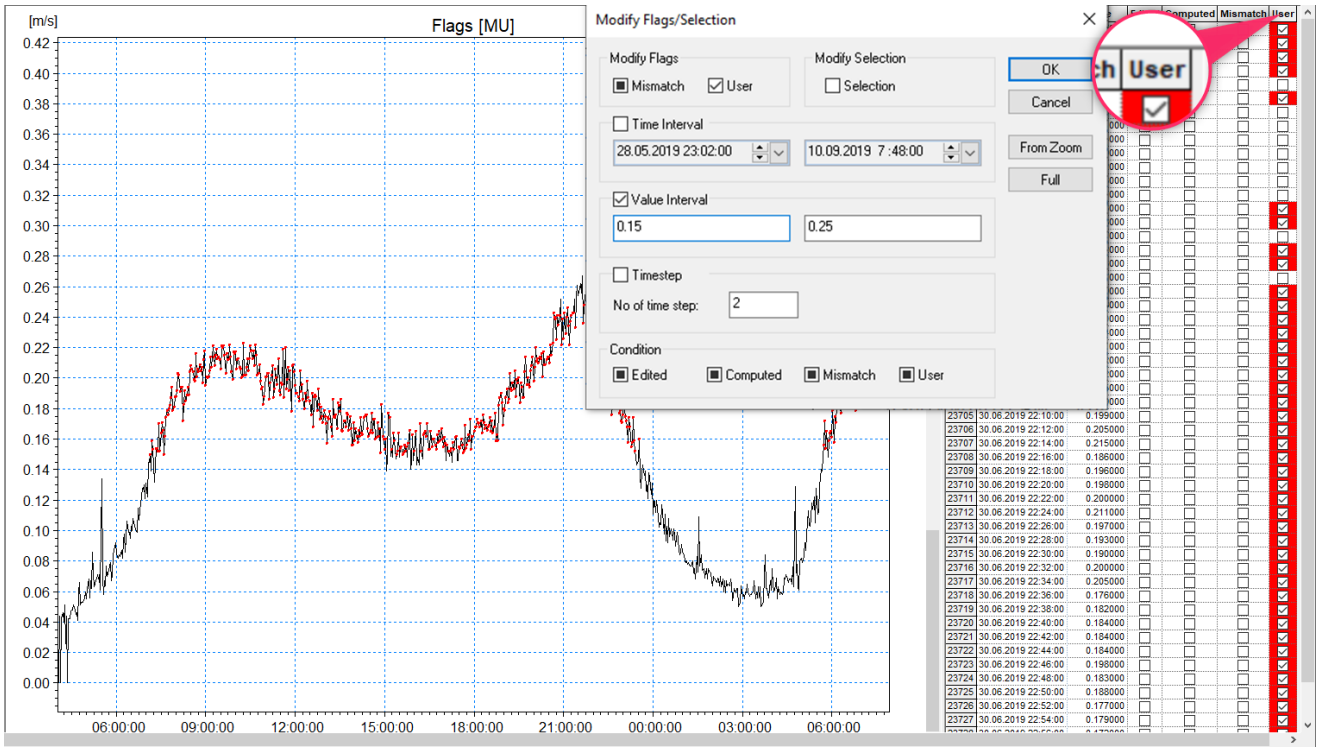
It is also possible to select rows directly in tabular part by pressing CTRL and clicking on rows.

8.2.4 Example of using flags – modify User flags:

If the user will set-up:

- Blue (all) flag for mismatch and checked (define as selected) flag for the user in the Modify flag group.
- Check both Time interval and Value interval check box.
- Set-up desired Time interval and desired values interval (e.g velocity between 0.15→ 0.25 m/s
- Set-up all check box in the Condition group to neutral [black].

Then all measured points from the selected time interval, which were between 0.15 to 0.25, will be now marked also as the User selected. Those selections can be after that used as an export filter and for computation or graphical presentation filter. Flags can be visualized in the graphical part of the flag editor using the command from the local menu *Show Flags*.

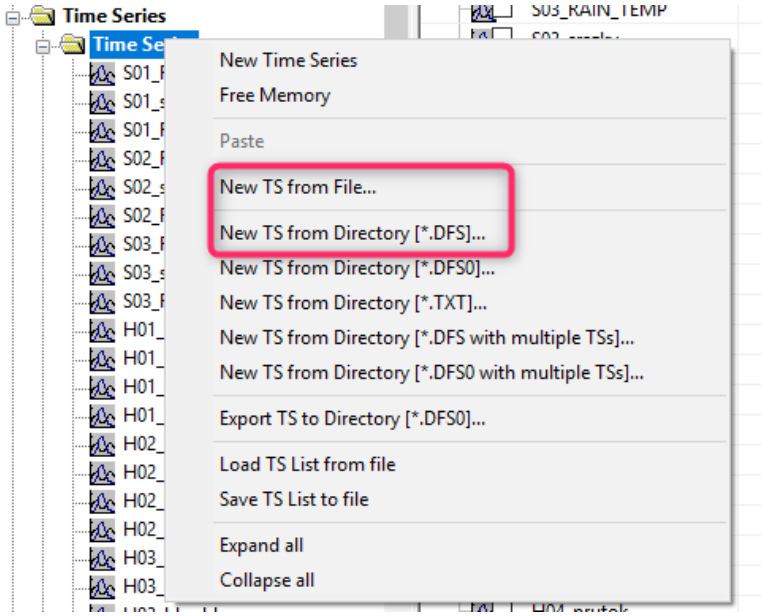


Picture 75 : Example of Using Flags

Remark: Transfers of flags between time series can be done by special computation Mask/Flag Transfer (see chapter *Mask/Flag Transfer* in chapter *Computations*). Mask or Flag Transfer TS (see those chapters) can be generated to clipboard by the click on the right mouse button of the graphical (left) part of the window and selection of *Generate Mask/Flag Transfer TS to Clipboard*… command.

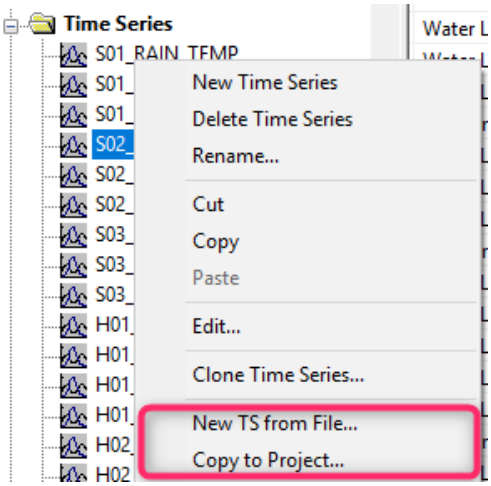
8.3 TS Import/Export

TS can be loaded from an existing file by selection of *New TS from Directory*. This command loads all TS in the directory. For single Import of one TS select *New TS from file.*



Picture 76 : TS Import

Another way to import TS is to go to the level of singular TS in Subtree Menu and right-click TS and Select *New TS from File*



Picture 77 : New TS from File and Copy to Project

Item *Copy to Project* will copy existing time series from actual to selected project (that means creation of the same DFS file in selected project). Binding between these two projects is conserved and when some external time series is imported to actual project, user can update or copy imported time series from source project. *Update* means that if data in actual project are older than data in source project, they will be replaced by source data. *Copy* means just replacing imported time series by source data without detection of dates.

Measured data can be imported into the internal data format from the different range of the file formats. For more information see chapter **12 Imports** and **13 Exports** In order to export/import data directly to MOUSE format there are pre-defined items in local menu.

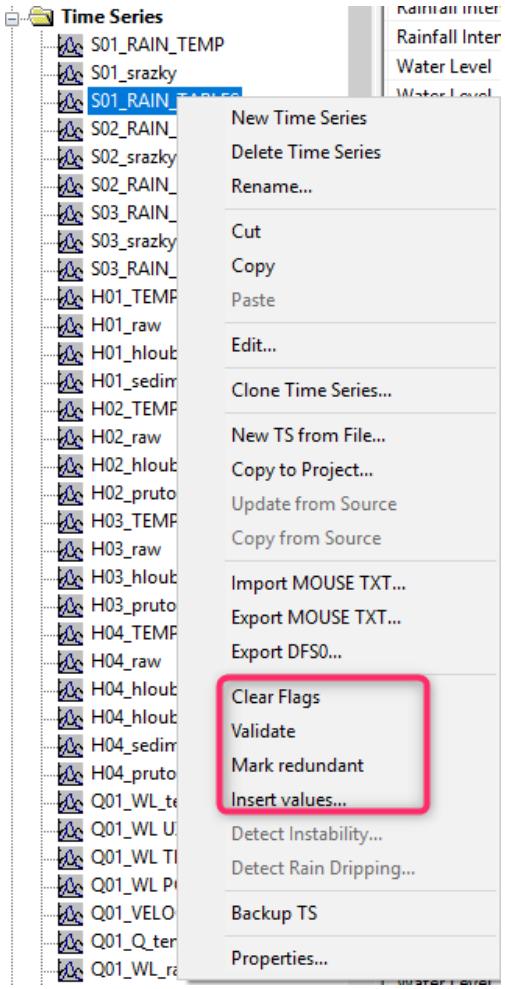
8.4 Clear Flags, TS Validate, Mark Redundant, Insert Values

Item *Validate* check the time series for time overlaps. If any overlap occurs, then it is announced.

Item *Clear flags* will unselect all flags for particular time series. Be aware that it will clear ALL Flags without any other warning!

Item *Mark redundant* finds and tags identical values in a time sequence except first value that is maintained without flag tagging. These values are assigned *by Mismatch Flag*

Item insert Values enables to insert any values of TS given minimal, maximal event Gap or exactly defined event gap. There are 3 modes of inserting values: *Before event, after event* and *Before + after event.* Inserted values are then assigned by a Mismatch Flag.



Picture 78 : Clear Flags, TS Validate, Mark Redundant, Insert Values

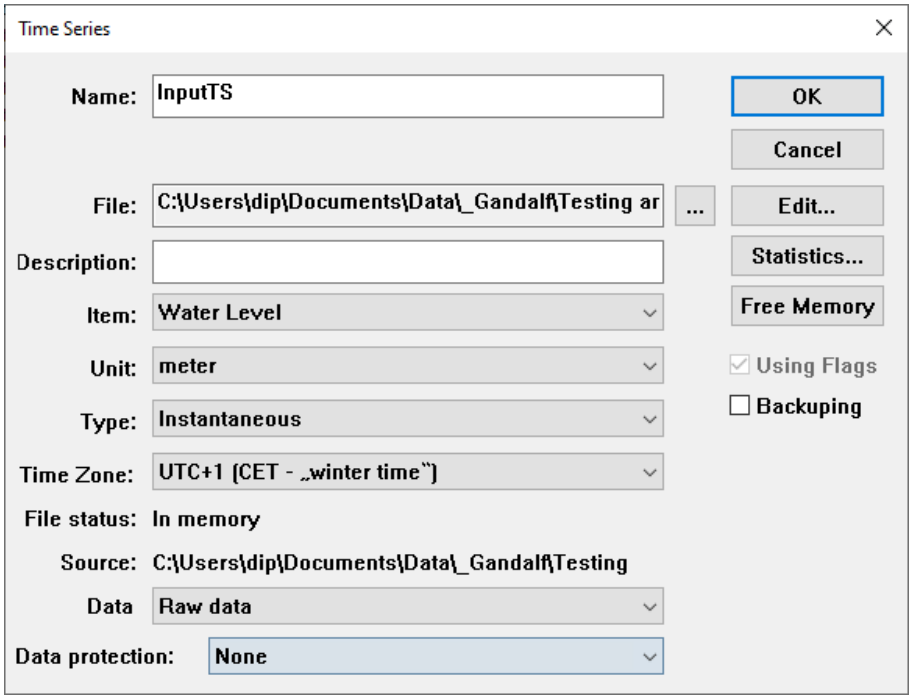
8.5 TS Properties

TS Properties consist of *Name, Source file, Item+Units* (Items and Units can be selected from the list, but they must be predefined first - for details see chapter **3 Items),** *Type,Time Zone, Data, Data Protection.*

Type that can be Step Accumulated (value accumulated since last measure), Mean (average value of time step) or Instantaneous (immediate value). **The type of time series influences some of the computations**.

Checkbox “Using flags” informs if TS is saved without flags (i.e. just moment of measuring and value are saved) or with flags.

“Backuping” informs whether TS is set for automatic backup. If checked, TS is backed up in every moment it is saved with changes. Backups can be found at the end of Main Tree, all Backups are automatically cleared when GND is closed.



Picture 79 : Time Series Properties

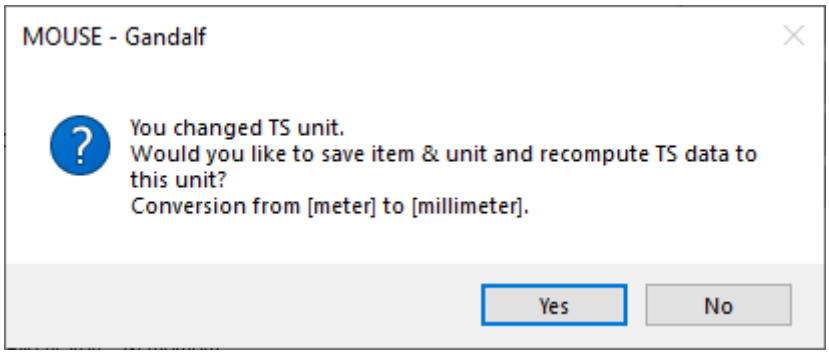
The following items are open to use in TS Properties:

- **Name** Name of TS.
- **File** Source file for TS (DFS or DB).
- **Description** Description of TS (optional).
- **Item** Selection of already defined items.
- **Unit** Selection of already defined units.
- **Type** Type of source data in TS - StepAccumulated, Mean or Instantaneous.
- **Time Zone** UTC, UTC+1, UTC+2, Other (optional) – used to keep the track when working with data in different Time Zones
- **File Status** Shows if data are loaded into memory or not.
- **Source** Path to source data.
- Data Information about status of the data – Raw, Working, Reviewed, Approved, Published

- **Statistics** This will open dialog window TS Statistics – see next chapter.
- **Free Memory** This button will free inner memory of GANDALF. You should use it eg. when having the problem with importing data or re-computation of TS
- **Using flags** This checkbox says if data contain flags or not.
- **Backuping** Backing up TS every time when TS editor is opened

If you change the unit, the system will ask you to recompute data based on the selected unit. There are two possibilities:

- you make a change of the unit only (as a label) – click *NO*
- request for data conversion from original to new unit – click *YES*

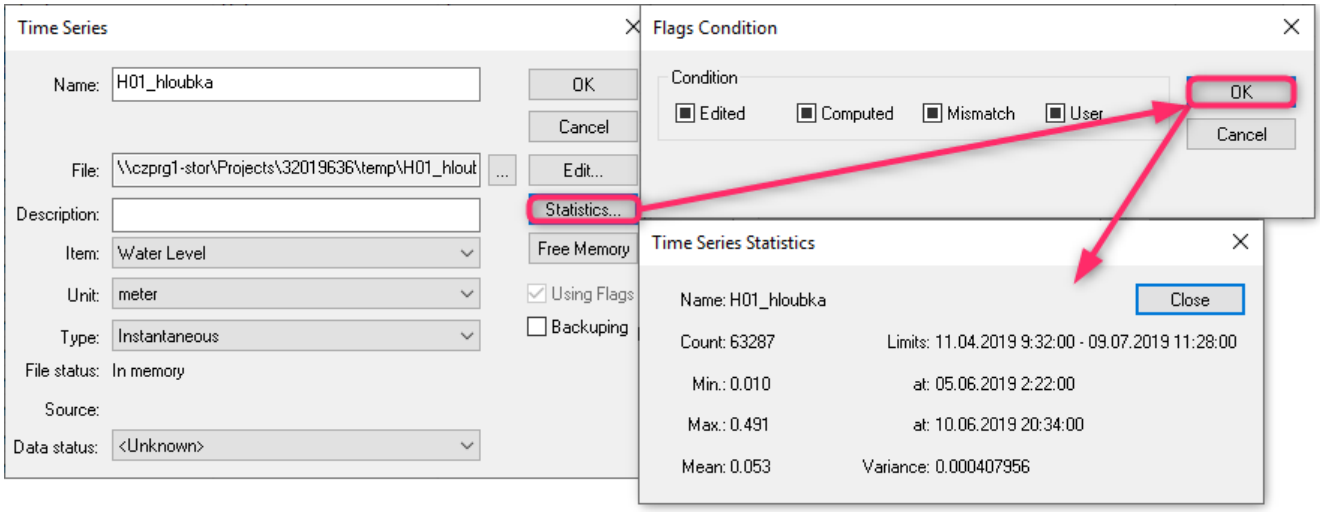


Picture 80 : Conversion of Units

8.6 TS Statistics

The time series statistics can be displayed by selecting the button *Statistics* in TS Properties. Using the flags selection, the Statistics is developed only for values to which the flags were assigned accordingly, otherwise the Statistics for the whole TS is developed.

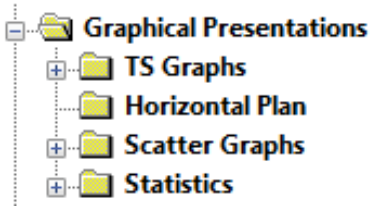
Checkboxes can only have three statements – grey (this flag is not used), white (do not use this flag) or checked (use this flag). After clicking OK button, user can see statistics of the selected time series – number of values in TS - time interval, minimum, maximum and mean value and also the variance.



Picture 81 : TS Statistics

9 Graphical Presentations

Graphical Presentations menu in GANDALF include *Time Series Graphs, Horizontal Plans, Scatter Graphs and Statistics*. User can add new Graphs or Plans by using local menu using the right mouse button over particular item. Item *Open* in local menu opens selected presentation in graphical view. User can zoom in and out, define the default zoom and choose grid and font type of the graphical view.

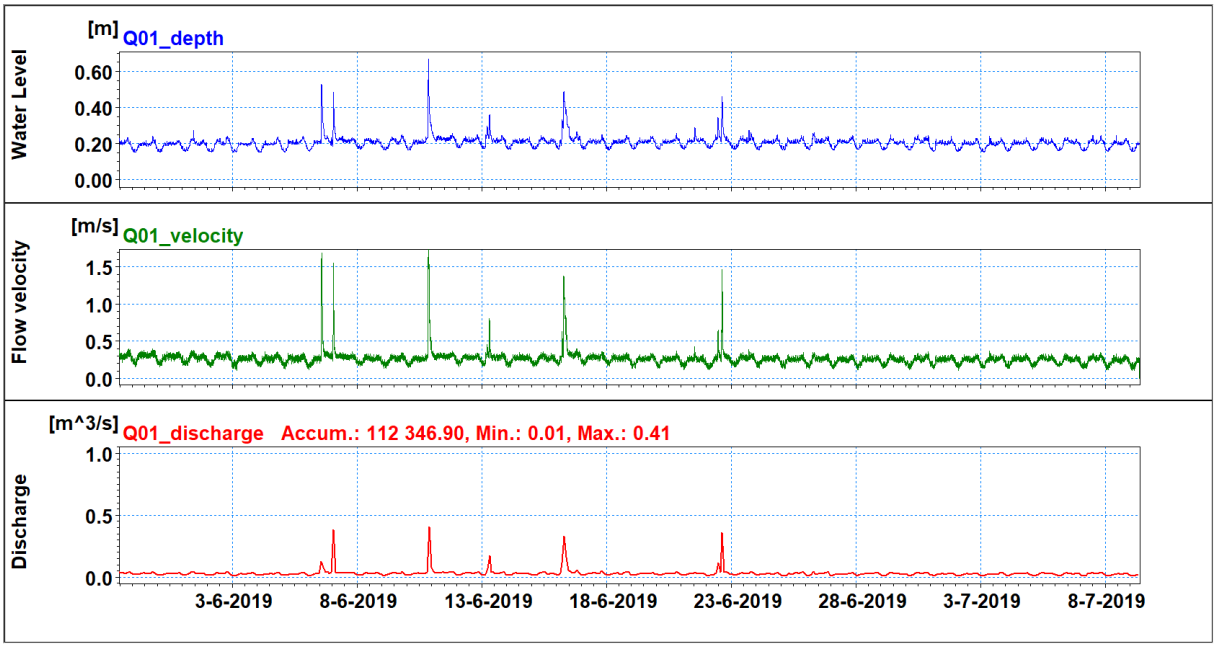


Picture 82 : Graphical Presentation tree structure

9.1 TS Graphs

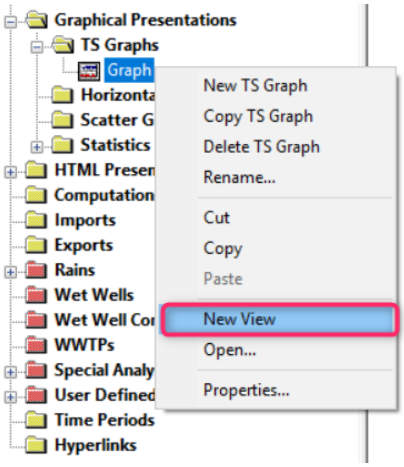
TS Graphs are used for visualization of Time Series in the Project. TS Graphs help users to have Time Series easily and clearly arranged together in one place.

It is designed for quick data check and effective control when handling data, presentation of the final data and together with the HTML Presentation (see chapter 10 HTML Presentation) it gives users strong opportunity to easily create data reports.



Picture 83 : TS Graph - visualization of data

TS Graph is created by right-clicking on the sub-menu TS Graph and selecting *New TS Graph.* Afterwards, *New View* must be created by right- clicking on the graph icon. Each View is one "window" of the TS Graphs.

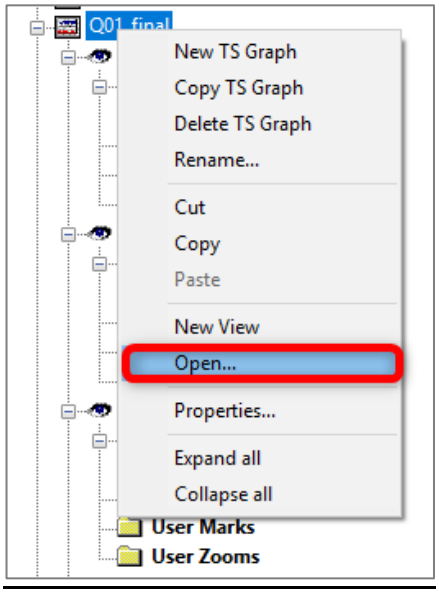


Picture 84 : TS Graphs - New View

Existing time series can be added to the View either from local menu or using the right mouse button on View.

Time Series can be added either to Primary or Secondary Y axis, the appearance is editable in View *TS Properties*. It contains colour, line type, graph type (Linear interpolation, Events, Back step and Sampler), offset and even the basic computation of summaries for selected TS. Number of views for TS Graphs are not limited.

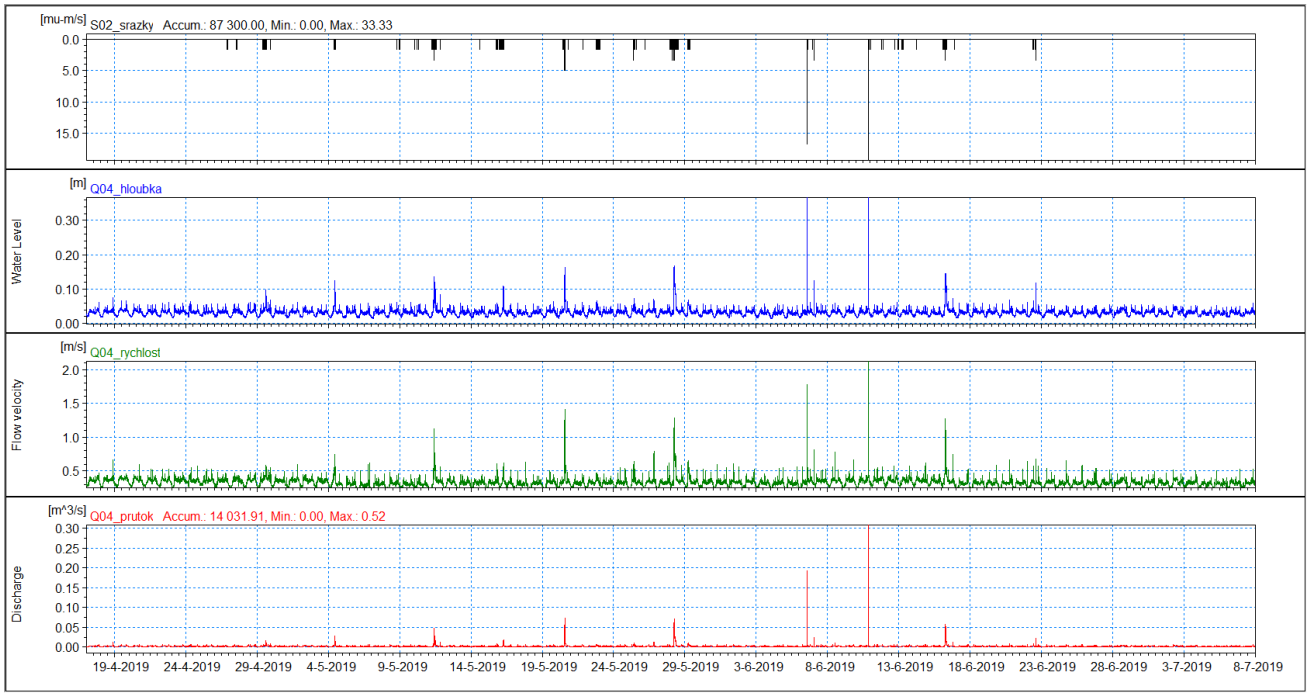
TS Graphs are Viewed by the selection Open from the context menu.



Picture 85 : TS Graph - Open...

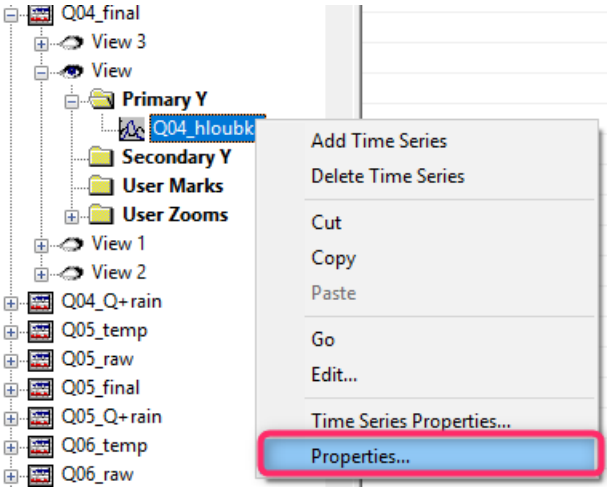
9.1.1 Example of using Graphical Presentation

Different Views can be created for different Time Series or more TS can be added into one View. When Time series are assigned, the graph is displayed by right clicking on the graph icon and selecting *Open…*

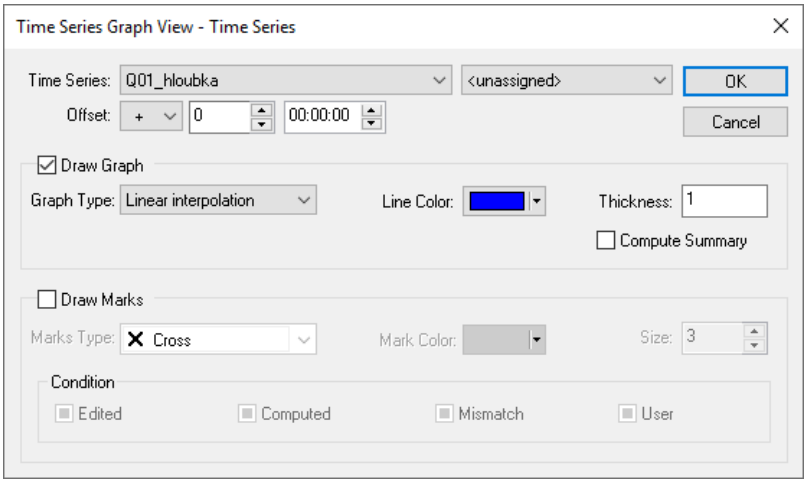


Picture 86 : Example of TS Graph

Features of each TS assigned in Views can be adjusted using *Properties* dialog. It includes *Offset, Graph Type, Line Colour, Line Thickness, Compute Summary, Marks Properties,* and *Conditions (Viewing Flags)* as displayed at the *Picture 88 : Time Series Graph View – Time series.*



Picture 87 : TS Graph Properties

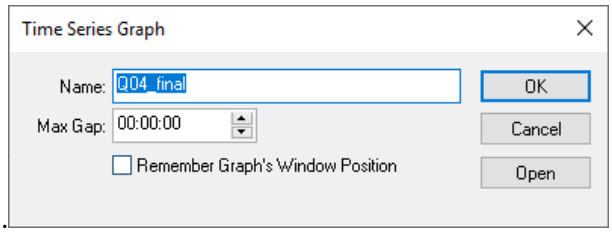


Picture 88 : Time Series Graph View – Time series

The following items are open to use in Time Graph View – Times Series" :

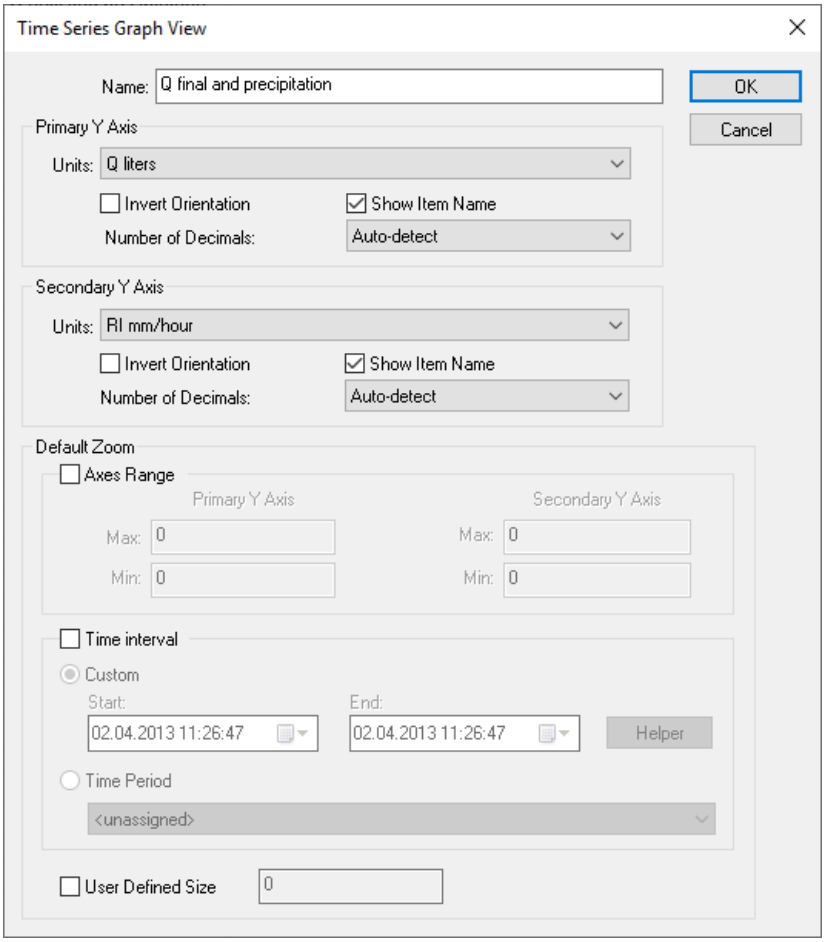
- **Time Series** Selection of already defined TS and its possible assignation to specific Monitoring Point.
- **Offset** Data time offset (only for presentation purposes).
- **Draw graph** Define visibility of the graph line in the view.
- **Color** Color of graph line in view.
- **Graph Type** Type of graphical presentation of the data (Linear interpolation, Events, Back step and Sampler).
- **Thickness** Width of line of TS in view.
- **Compute Summary** If summary will be computed and presented on left top corner of the view (TS name, Volume accumulated, Min and Max value).
- **Draw marks** Define visibility of the data marks on the graph.
- **Colour** colour of marks in view.
- **Mark Type** Type of mark presented in the view (Triangle, Cross, Plus, Circle).
- **Size** Size of mark in graphical view.
- **Conditions** Define conditions when marks are presented based on flags defined in time series.

Properties of Graph (right-click on graph name) contain name of the graph and *Maximum Gap*. If the time distance between two values is bigger than specified Maximum Gap, these values are not connected with line. Remember graph position save size and position of the graph window for next opening.



Picture 89 : TS Graph Properties

The properties of the View such as default zoom, units, orientation and name on axes etc. can be chosen by selection of *Properties* by right-click on item *View*. Some of the properties can be individually for Primary Y axis and Secondary X axis



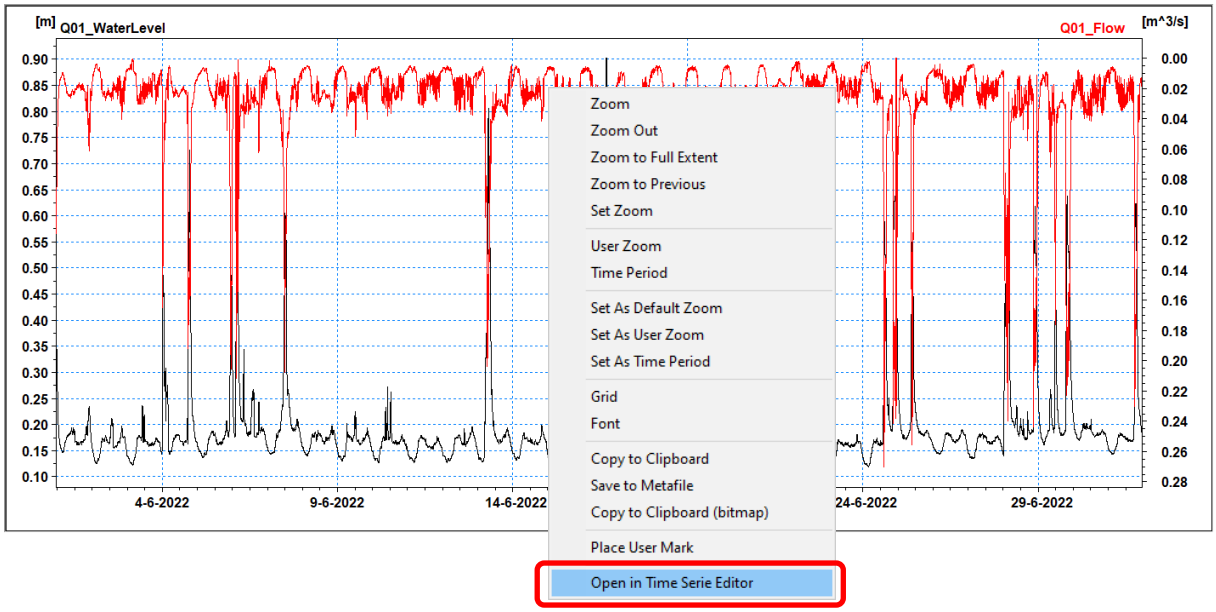
Picture 90 : Time Series Graph View – Properties

- **Name** Name of the View
- **Units** Selection of the name of the unit Predefined in folder Items
- **Invert Orientation** Inverts orientation of the x axis (TS will be shown "upside down")
- **Show Item Name** Shows Item Name only if Item is assigned in TS properties
- **Number of Decimals** Setting allows to use auto-detect of decimal places or range of 0-5. Of decimal places
- **Default Zooms** Defines ranges for default presentation of time series when the presentation is open
- **Time interval** sets zoom according to specified minimum and maximum value for primary and secondary axis and start and end date and time
- **User Defined Size** Selects width for each view. If no user width of any view is filled, then the automatic (same) width for all view is taken The sum of all user defined width in all views in one TS Graph has to be 100. If other sum is calculated, the automatic procedure recomputed the width of all views to match 100 while keeping the ratio of the views.

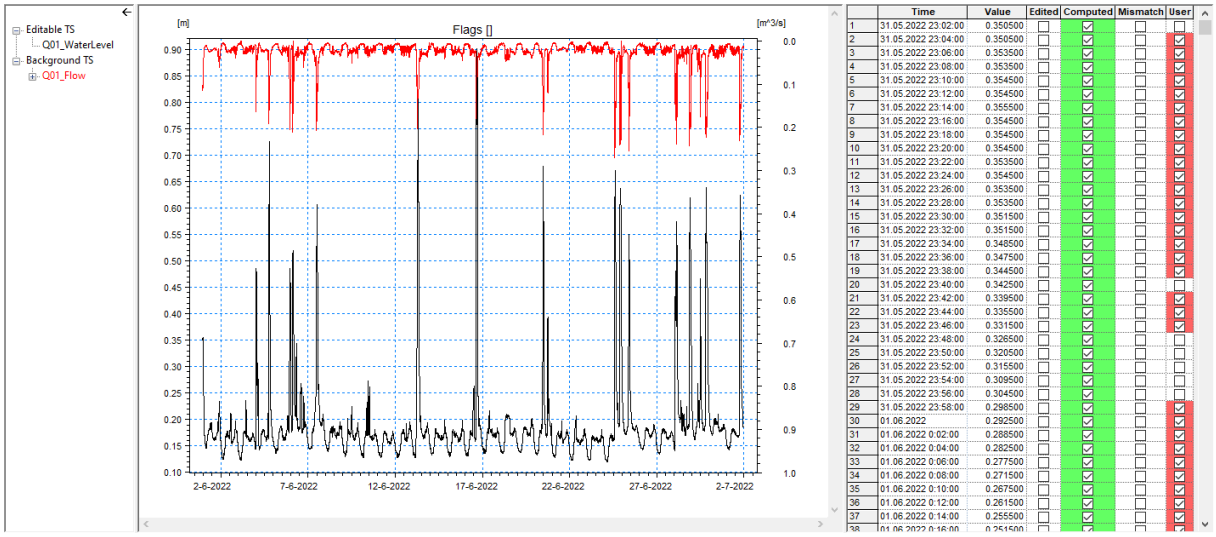
Time series graph supports standard tools for zooming (zoom in, zoom out, previous zoom and zoom to full extend. There is as well available to switch on and off grid over presented data.

9.1.2 Sending data to TS Editor

It is possible to select a View and send it to TS Editor

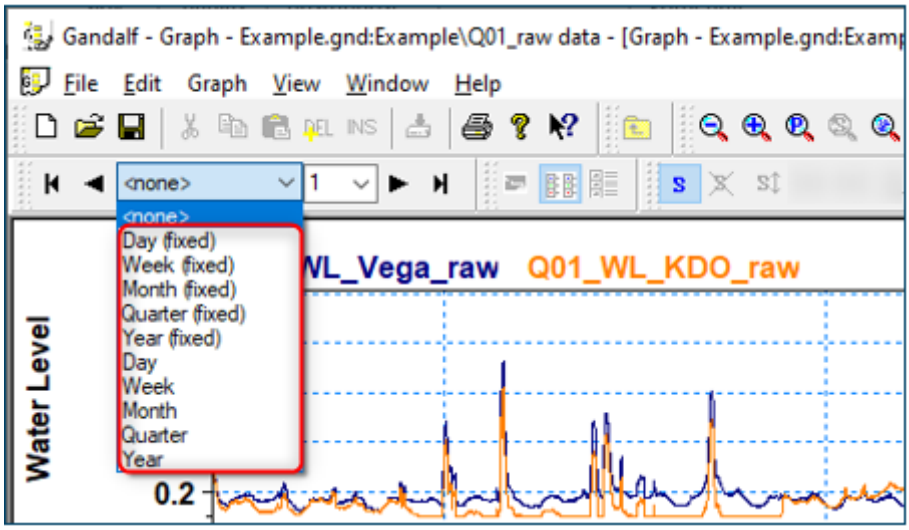


TSeries from the view are transferred into same Y-axes in TS Editor. No Marks or other special TS Graphs tools are transferred.

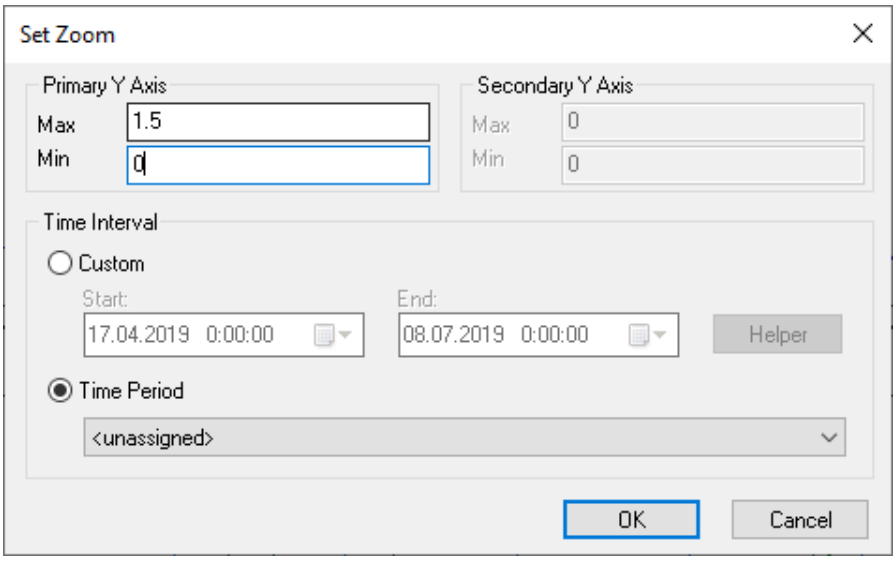


9.2 Zooming

Advanced tools for zooming in *Graphical Presentations* contain the possibility to set *Predefined Zooms* by day, week, month, year, quarter available in toolbar, or you can set your zoom based on exactly defined values – menu is available on right mouse click in the TS Graph.

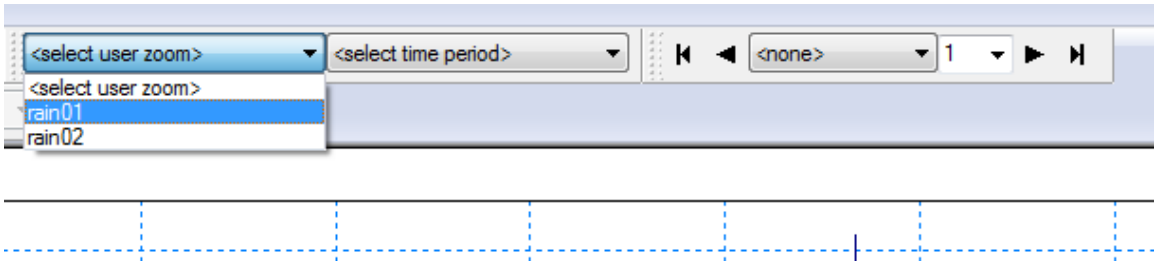


Picture 91 : Fixed Zoom

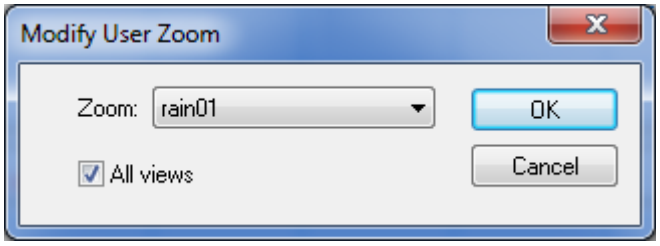


Picture 92 : Setting Up User Defined Zoom

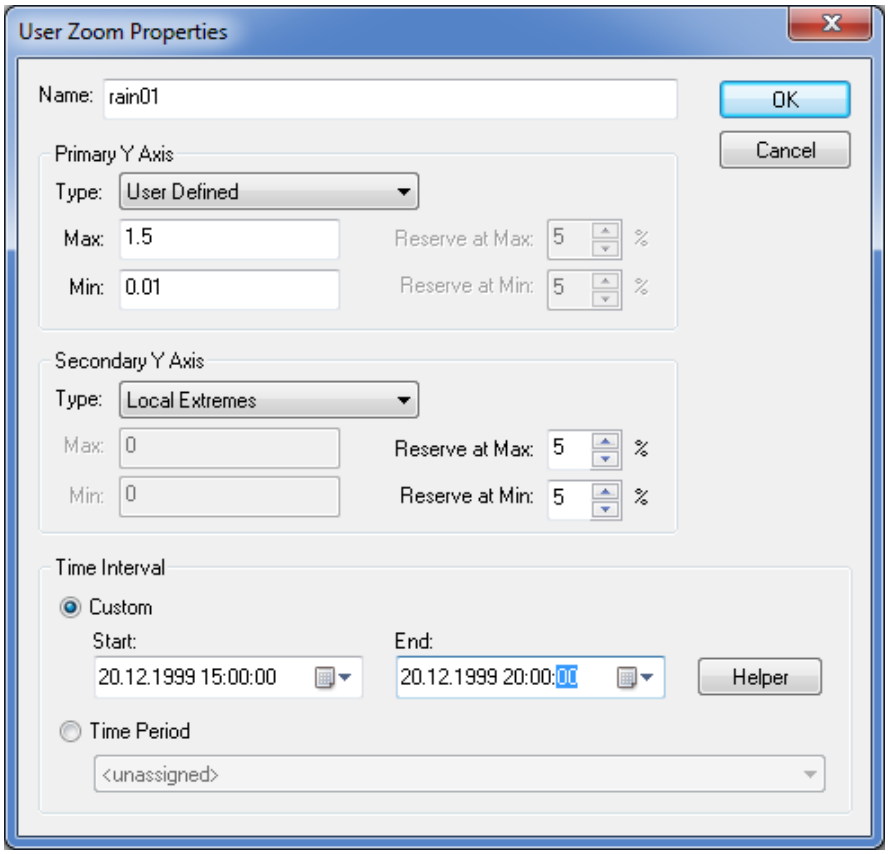
User Zoom allows to create a special Zoom definition which is saved in project and let the user to open the exact Zoom view later. User zoom menu is available from toolbar, right mouse clicks on time series area, or in a project tree. Using this utility it is also possible to copy/delete selected or all defined User Zooms from all Views in TS Graph, in Project or across all Projects. User zoom is valid for particular graph only.



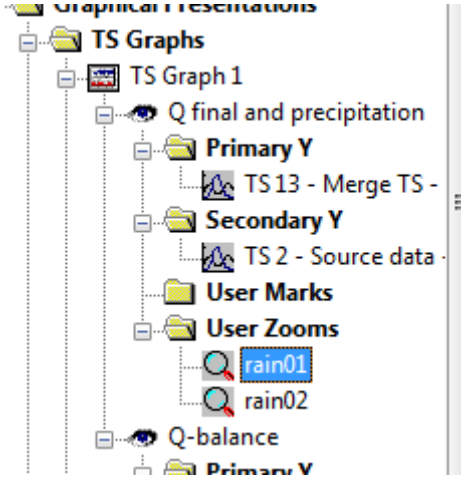
Picture 93 : User Zoom Selection



Picture 94 : Modify User Zoom



Picture 95 : User Zoom Properties

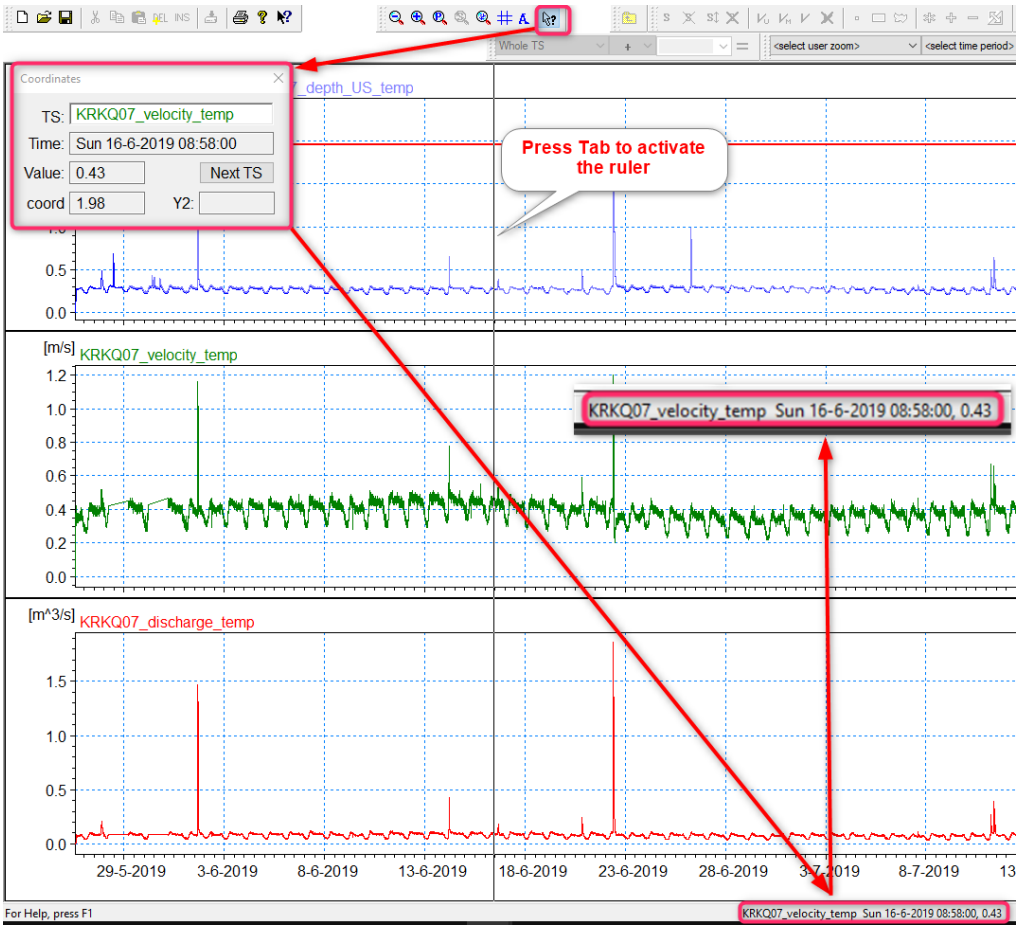


Picture 96 : User Zoom is the Subtree

Similar functionality like *User Zoom* is **Time Period**. The difference between *User Zoom* and *Time Period* is that the Time period is a part of the man tree and is available across all Projects. Time Periods settings are explained in chapter **0**

Time Periods.

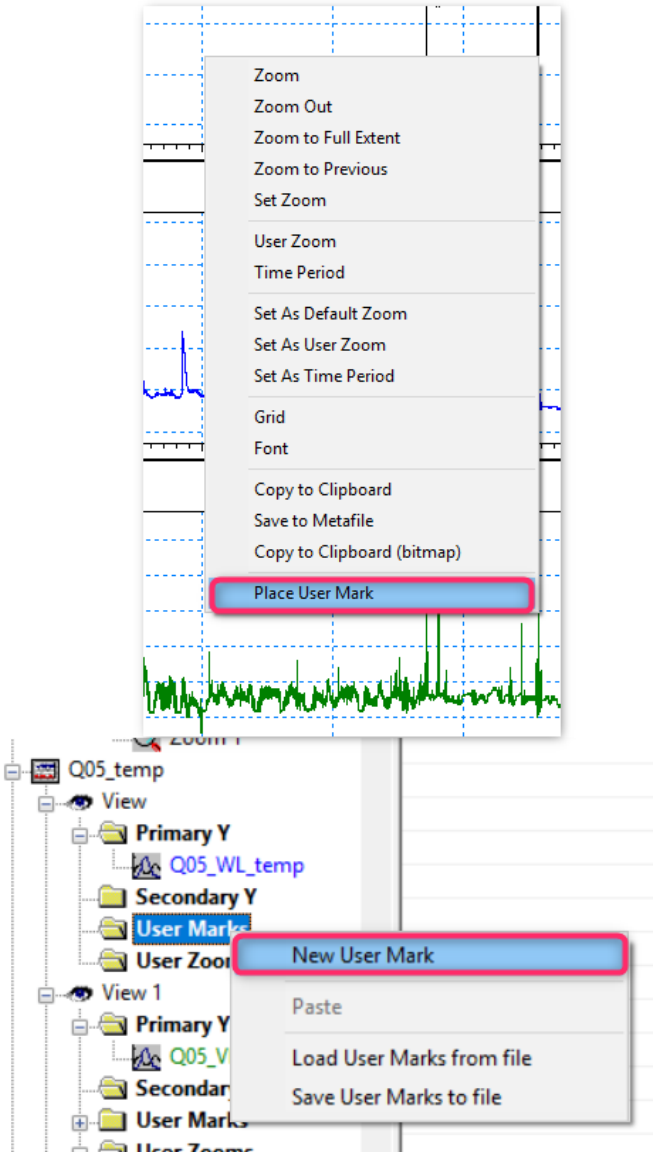
Using Tab key, you can activate a ruler which shows on right down corner of the window particular value in presented time series. Repeating pressing Tab you can move in time series presented in TS graph. Similarly Pressing *Help* Icon pops up Information Window – "Hawk Eye".



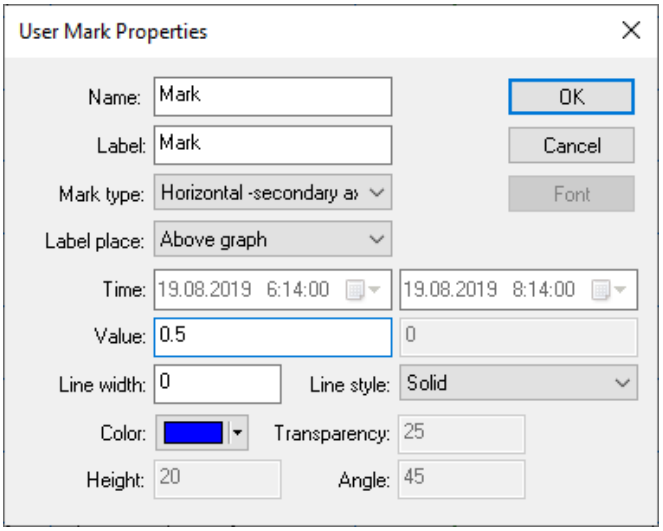
Picture 97 : TS Graph – Help Window and activation of a ruler

9.3 User Marks

To make Remarks into TS Graphs you can apply User marks. There are available Horizontal (line) Vertical (line), XY (arrow), you can define basic parameters for presentation in the menu. Locate XY user mark is possible using the function on right mouse click too. User marks are stored into project tree and they are assigned to particular Time series View. User Marks can be accessed either by right-clicking the View in the Graph and selecting Place User Mark or by right-clicking User Mark folder in the tree structure.



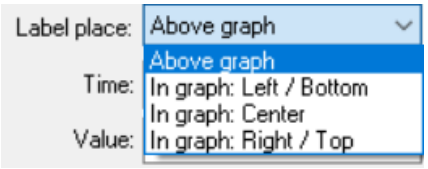
Picture 98 : Creating a New User Mark



Picture 99 : User Mark Properties

9.3.1 Mark Type

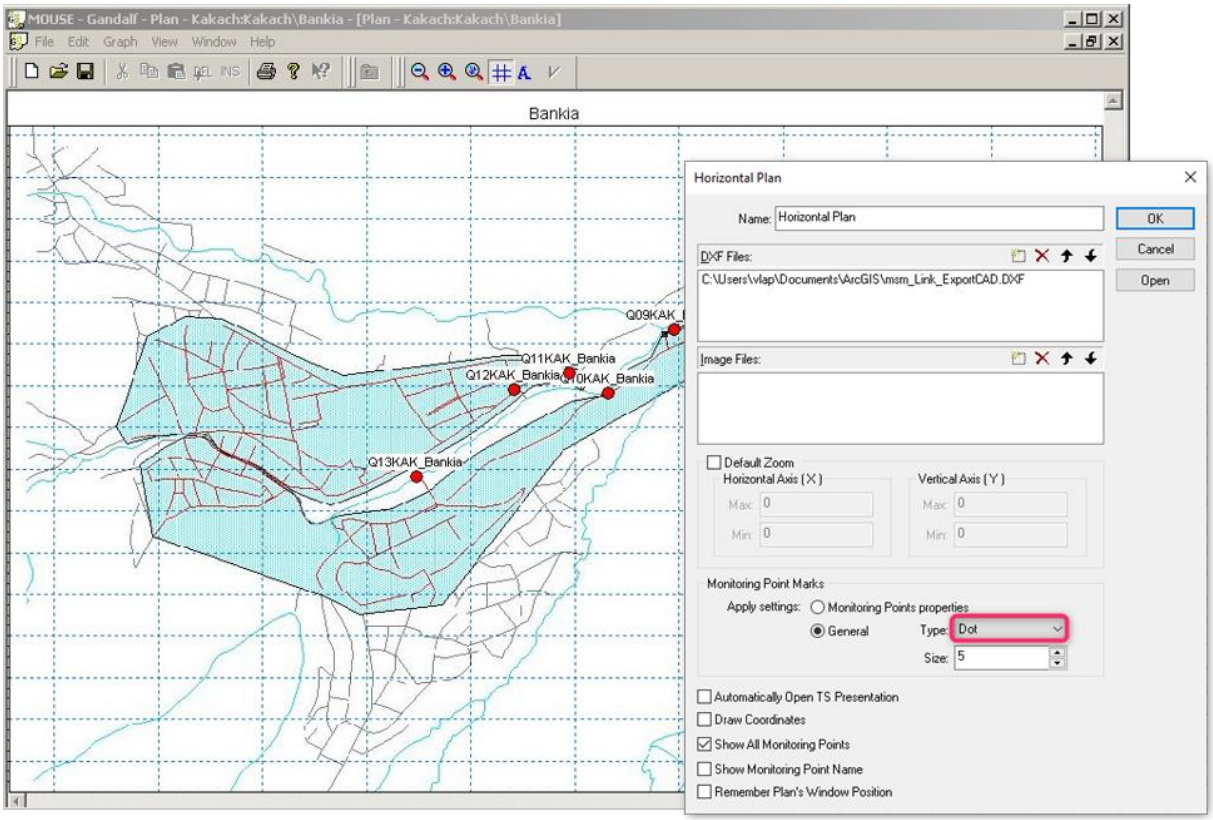
- **Horizontal** displays a horizontal line across whole TS view could be placed on primary or secondary axis, with a label placement possibility
- **Vertical** displays a vertical line across whole TS view, with a label placement possibility
- **Mark** displays a mark to exact time and value
- **Label** displays Label in TS View
- **Period** fills the graph with a colour within defined Time interval (x axis) possibility to set transparency of a colour
- **Interval** Fills the graph with a colour within defined Value interval (y axis), possibility to set transparency of a colour



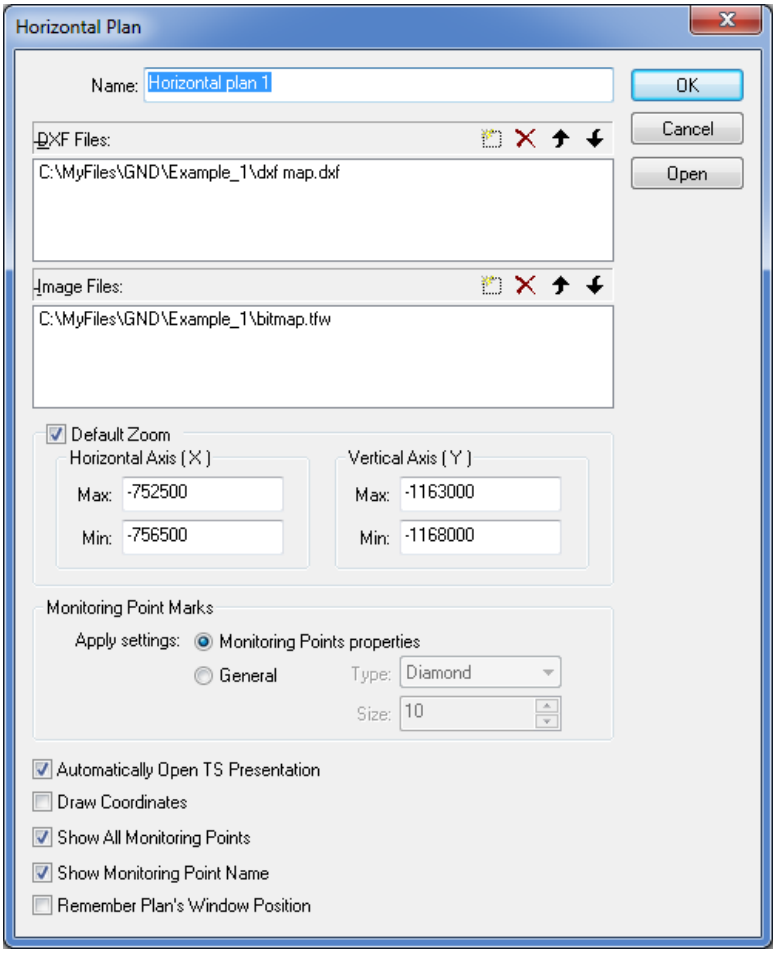
Picture 100 : Label Placement

9.4 Horizontal Plan

Horizontal Plan can serve as basic navigation for whole system. Names, background bitmap image files and DXF files can be added in *Horizontal Plan Properties*. If “Show All Monitoring Points” is checked, horizontal plan contains all defined points, even if they are not used in this project. A Symbology of the Monitoring points can be set at Monitoring Point marks as labelled in the picture below.



Picture 101 : Horizontal Plan



Picture 102 : Horizontal Plan Properties

Monitoring points are shown on graphical view of horizontal plan according to defined co-ordinates. Double-click on Monitoring point will cause returning to this point in basic navigation tree and opening first graphical presentation for this point. That means user can make standard navigation from created Horizontal Plan.

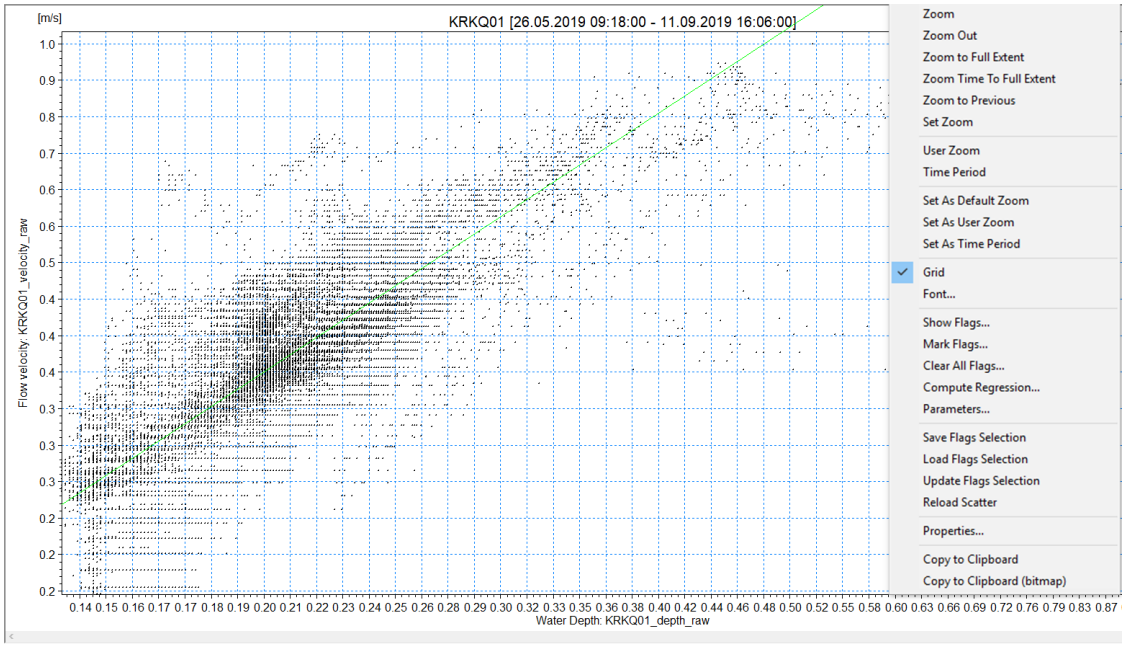
The following items are open to use in Horizontal plan Properties:

- **Name** Name of Horizontal Plan.
- **DXF files** List of used DXF files.
- **Image Files** List of background images of Horizontal Plan.
- **Fixed Zoom** It says if fixed zoom is used in this Horizontal Plan.
- **Monitoring Point Mark** Type of mark of Monitoring Point shown in Horizontal Plan and its size.
- **Automatically Open TS Pres**. It says if GANDALF will open TS Presentation after clicking on Monitoring Point.
- **Draw Coordinates** It says if coordinates are drawn or not.
- **Show All Monitoring Point** If all defined Monitoring Points are shown in Horizontal Plan or not.
- **Show Monitoring Point Name** If the name of Monitoring Point will be shown.

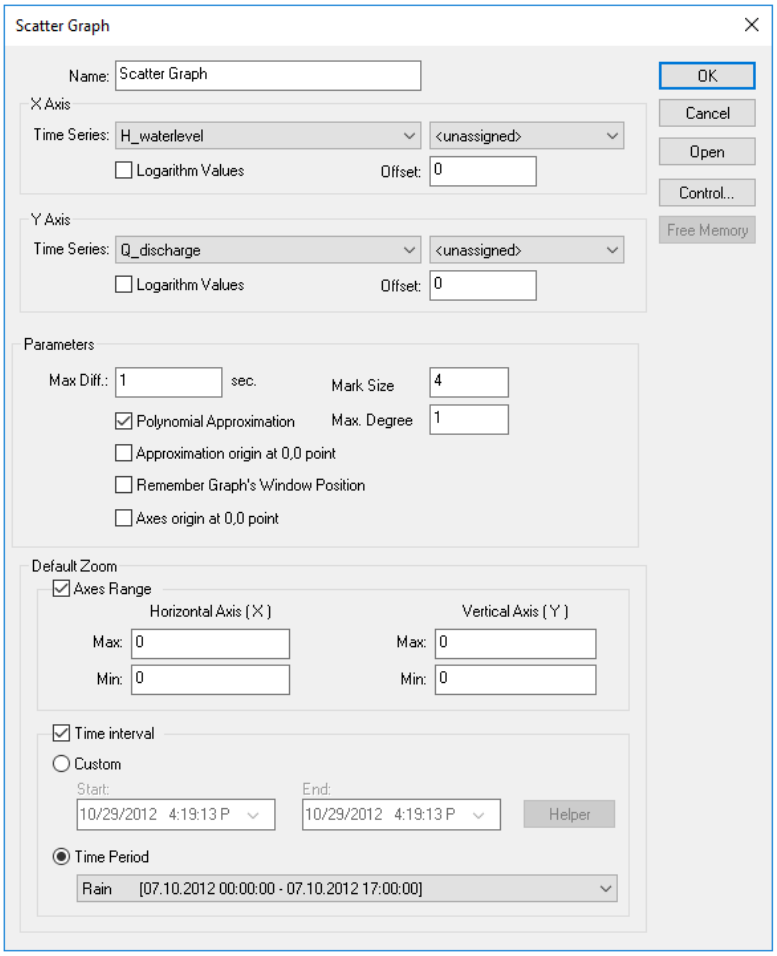
9.5 Scatter Graph

Scatter Graph is graph of two time series, where the values from the same date and time from both time series are shown. Time series likewise their possible offset or converting to logarithm values, maximal time difference in seconds (only values from specified time series, which time difference is smaller than inserted number will be shown) and possibility of using *Linear approximation* can be chosen from the window *Properties*.

The Presentation of the scatter graph allows to use the *User Zoom* functionality and also presents several scatters in one plot. In such kind of the plot first scatter is active and rest is understood as reference – *Background Scatters*.



Picture 103 : Scatter Graph

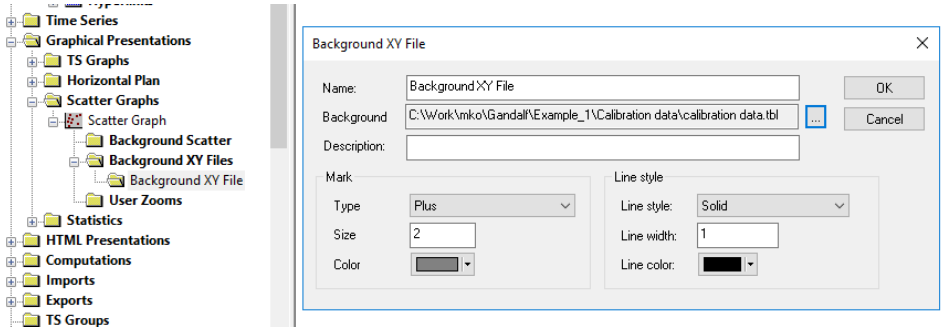


Picture 104 : Scatter Graph Properties

The following items are open to use in Scatter Graph Properties:

- **Name** Name of Scatter Graph.
- **Time Series** Choice of already defined TS and its possible assignation to some Monitoring Point.
- **Logarithm values** If this checkbox is checked, logarithm values will be used for Scatter Graph.
- **Offset** Data offset in Scatter Graph.
- **Max. Diff** Maximal time difference in seconds. Data are checked in both TS and where the time exceeds given interval, values are being taken as independent from each other.
- **Polynomial Approximation** Possibility of using polynomial approximation in Scatter Graph (for linear approximation = 1).
- **Control** This button will open Dialog window Control, where number of values from both time series can be checked.
- **Free Memory** This button will free inner memory of GANDALF. You should use it, when the problem with importing data from MOUSE.TXT file occurs.
- **Default Zoom** Default Zoom defines ranges for default presentation of time series when the presentation is open. Time Interval in graphical view sets zoom according to specified minimum and maximum value for primary and secondary axis and start and end date and time.

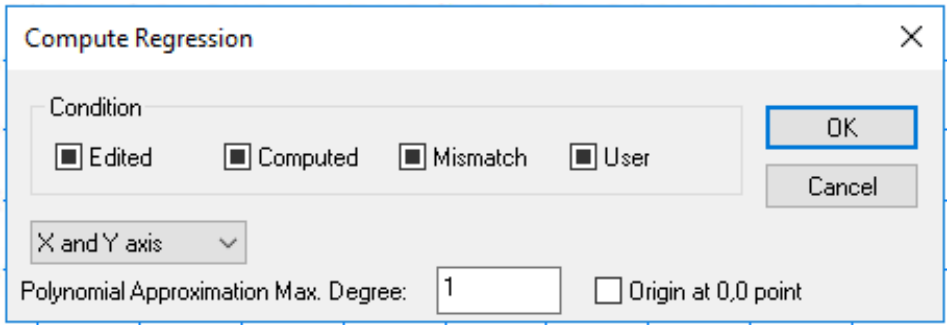
A new feature – *Background XY Files* – substitutes Calibration table in Scatter Graph Properties used in previous version. Now it allows to attach unlimited number of files - it is possible to assign already defined tables of independent data, e.g. calibration data from field tests.



Picture 105 : Background Files

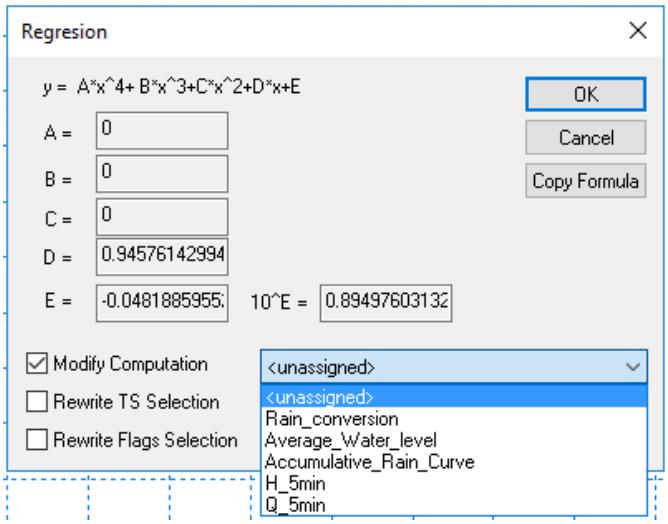
Graphical view of scatter graph can be shown by pressing Open from local menu. Linear approximation can be used also just for selected values in graphical view. User can select specific values by item *Mark Flags* from local menu (just *Mismatch* and *User flags* can be selected – either by rectangle or polygon).

Regression can be computed for values that meet picked flags. GANDALF can use computed parameters of regression for modification of already defined *Computation* and it can also rewrite *Time Series* and *Flags* selections during this modification. Regression curve control is possible directly from Scatter graph.



Picture 106 : Compute Regression

Item “Save/Load Flags Selection” allows to use flags for creating scatters. “Update Flags Selection” update Flags Selection from scatter graph into the source data.



Picture 107 : Regression - Modify Computation

The following items are open to use in Regression:

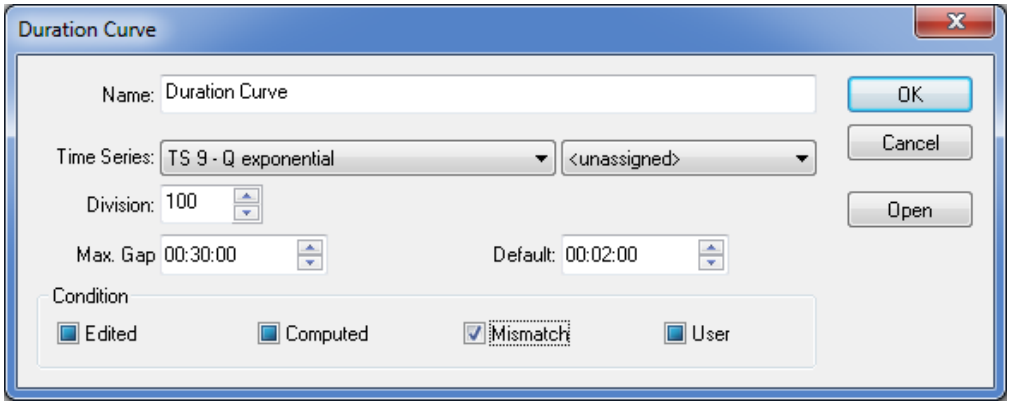
- **A, B, 10B, y** Computed values of regression.
- **Modify Computation** You can modify existing computation by regression.
- **Rewrite TS Selection** Rewrites TS selected by computed values from regression.
- **Rewrite Flags Selection** Rewrites flags selected in TS by flags from Scatter graph.

9.6 Statistics

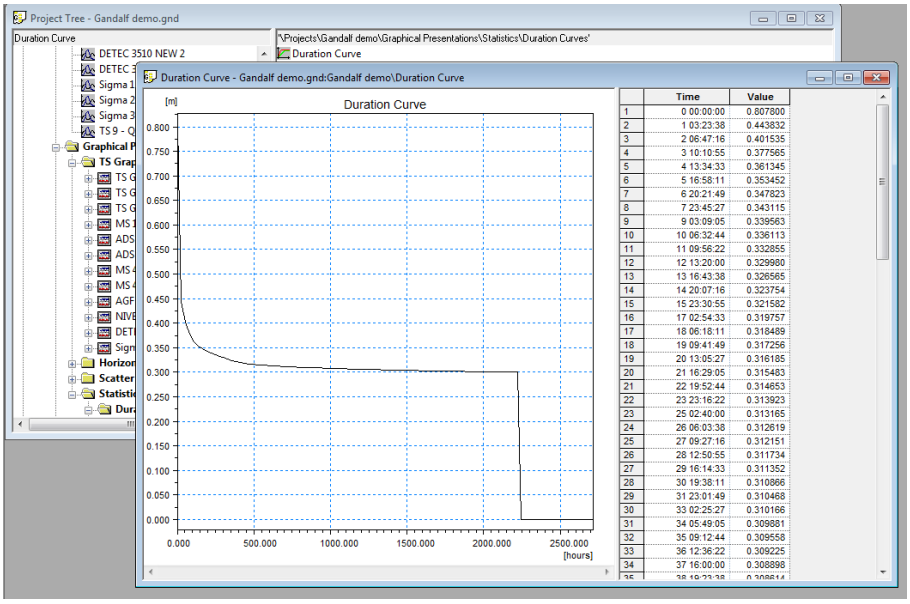
Statistics in Gandalf supports 4 major functionalities*: Duration Curves, Frequency Curves, Tabular Statistics, Compare TS*

9.6.1 Duration Curve

Statistics of any Time Series can be shown by Duration Curve. All parameters for deriving of duration curve of particular TS are edited in *Properties* from local menu. User must choose one of existing time series. Number in item “Division” says to how many time intervals (return periods) will be the entire time series divided. Maximum Gap is maximum period without any measuring, default value says how often user measured what is the time step of particular TS. Statistics can also be restricted for data satisfying flag conditions. The duration curve is going to be computed by clicking button *Execute*.



Picture 108 : Duration Curve



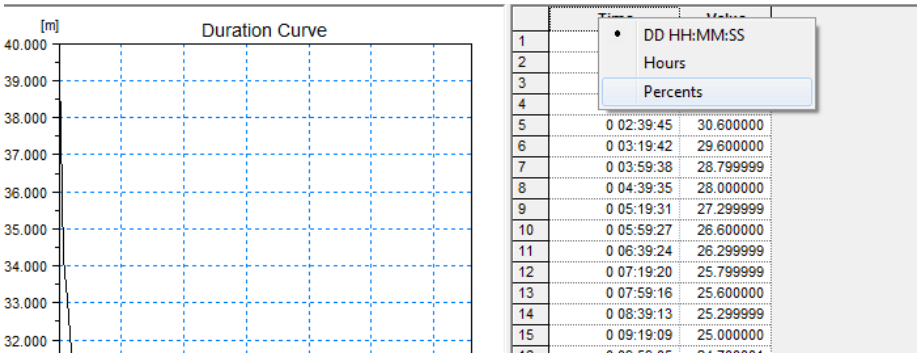
Picture 109 : Duration Curve - TS editor

The following items are open to use in Duration Curve Properties:

- **Name** Name of Duration Curve.
- **Time Series** Select of already defined TS.
- **Division** It says how many parts this duration curve will have.
- **Max. Gap** Maximum period without any data.
- **Default Value** Definition of time step in TS.
- **Condition** Restriction of Statistics by flags.
- **Execute** This button will execute computation of duration curve.

You can modify presentation of Time values based on settings available on right mouse click at header of Time column in tabular part. There are following options available YY DD HH:MM:SS; DD HH:MM:SS, Hours and percentage.

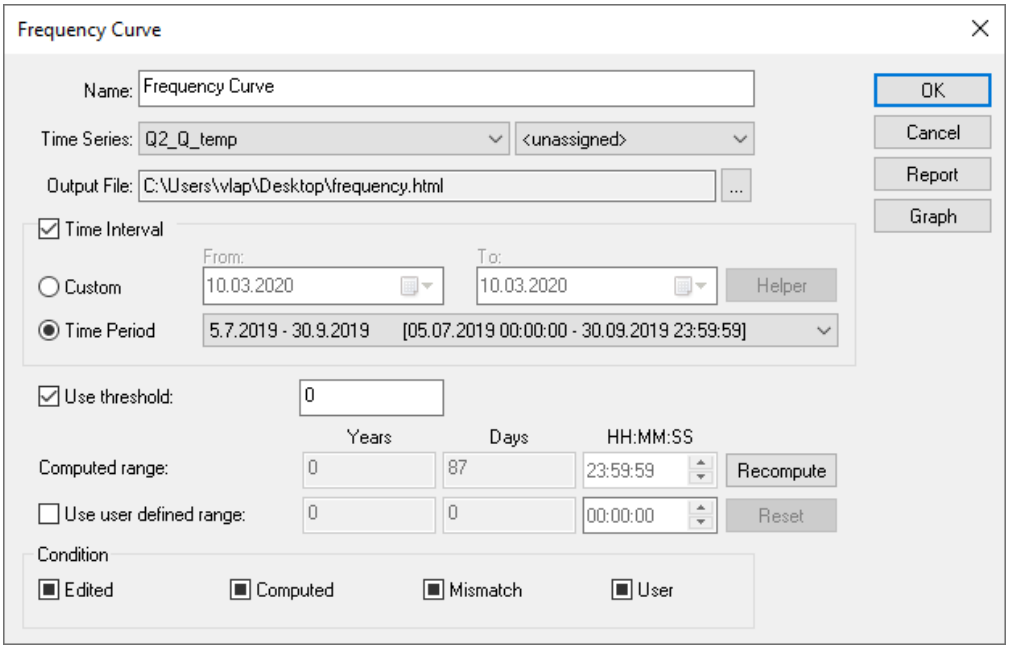
Note: YY DD HH:MM: SS, the year in this option is understood as average years having 365,25 days.



Picture 110 : Modifying values in Duration Curve table

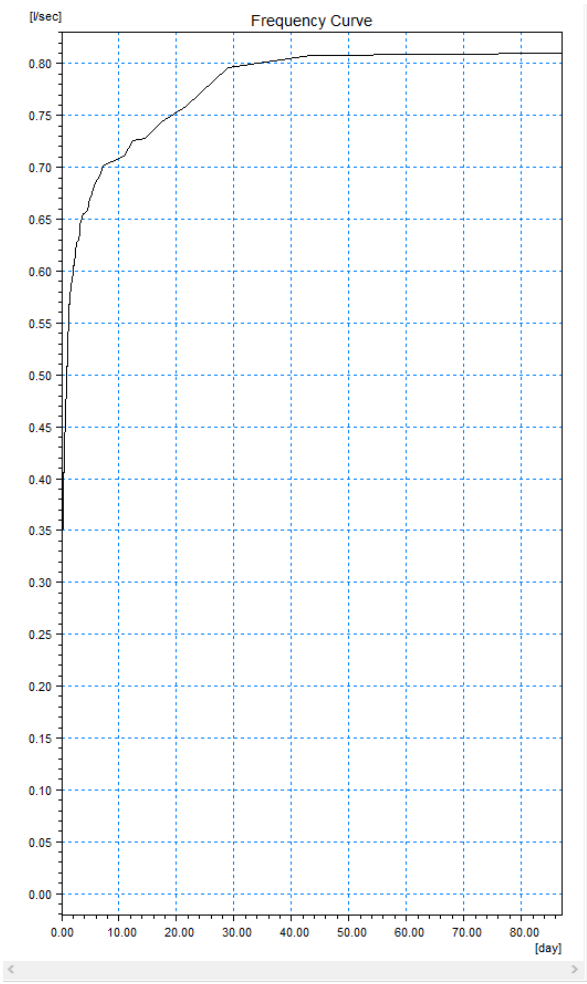
9.6.2 Frequency Curve

Statistical function Frequency curve allows to plot a graph of discharge over recurrence time interval. It also can generate report of Frequency curve analysis.



Picture 111 : Frequency Curve Settings

- **Name** name of the frequency curve
- **Time Series** discharge TS to be analysed
- **Output file** path where HTML report s generated
- **Time interval** custom or based Time Period created in Time Periods
- **Use Threshold** minimum value of discharge that goes into the computation
- **Computed Range** click on *Recompute* to get whole duration of TS or click *Use user defined range* and determine the duration
- **Report** generates HTML report
- **Graph** shows frequency curve graph



	Time	Value
1	87 00:04:38	0.810600
2	43 12:02:19	0.807500
3	29 00:01:33	0.796400
4	21 18:01:09	0.759200
5	17 09:36:56	0.743500
6	14 12:00:46	0.727500
7	12 10:17:48	0.725900
8	10 21:00:35	0.710800
9	9 16:00:31	0.707400
10	8 16:48:28	0.705600
11	7 21:49:31	0.703300
12	7 06:00:23	0.701500
13	6 16:37:17	0.691900
14	6 05:08:54	0.688000
15	5 19:12:19	0.685000
16	5 10:30:17	0.679000
17	5 02:49:41	0.671800
18	4 20:00:15	0.670200
19	4 13:53:56	0.658500
20	4 08:24:14	0.657200
21	4 03:25:56	0.656400
22	3 22:54:45	0.655800
23	3 18:47:09	0.655300
24	3 15:00:12	0.650900
25	3 11:31:23	0.649600
26	3 08:18:38	0.648600
27	3 05:20:10	0.643800
28	3 02:34:27	0.635000
29	3 00:00:10	0.630600
30	2 21:36:09	0.630200
31	2 19:21:26	0.629100
32	2 17:15:09	0.629000
33	2 15:16:30	0.628100
34	2 13:24:51	0.626300
35	2 11:39:34	0.619400
36	2 10:00:08	0.618500
37	2 08:26:04	0.615000
38	2 06:56:58	0.608600
39	2 05:32:26	0.607100
40	2 04:12:07	0.605100
41	2 02:55:43	0.605100
42	2 01:42:58	0.605000
43	2 00:33:36	0.603500
44	1 23:27:23	0.603100
45	1 22:24:06	0.595800
46	1 21:23:35	0.595000
47	1 20:25:38	0.593300
48	1 19:30:06	0.593100
49	1 18:36:50	0.592300
50	1 17:45:42	0.589000
51	1 16:56:34	0.587800
52	1 16:09:19	0.587400
53	1 15:23:52	0.585100
54	1 14:40:05	0.582600

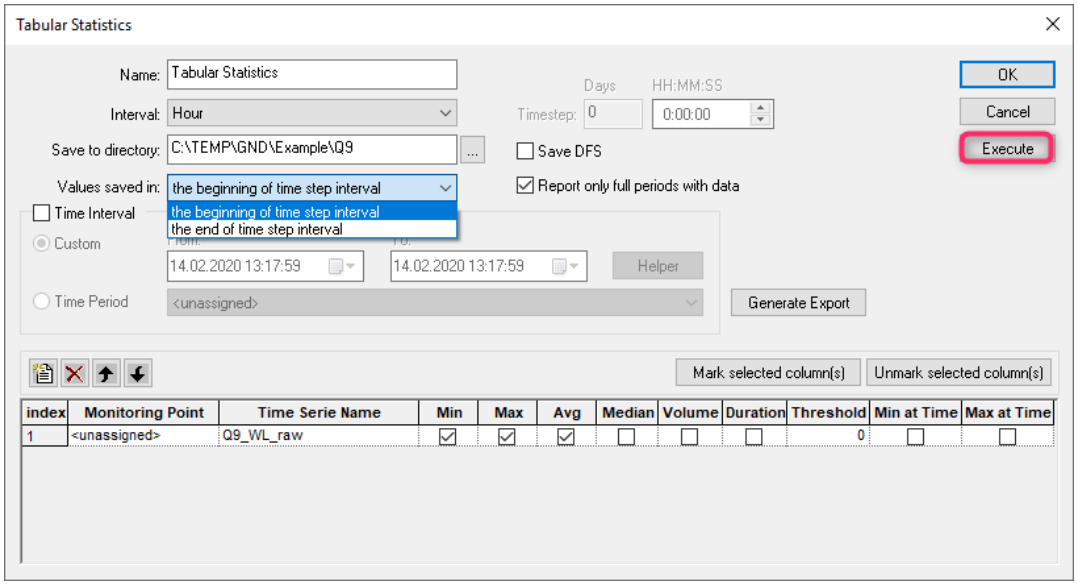
Picture 112 : Frequency Curve

9.6.3 Tabular Statistics

Any Time series can be analyzed by Tabular Statistics tool. Usual statistical function for optional number of TS can be set in *Properties* from local menu. User has to select time interval of the statistics (predefined or set by Timestep), Time Interval of TS (custom or as Time Period) and directory for DFS save (if option “Save DFS” is checked). It is also possible to choose just full periods with data for the report. Each Tabular Statistic can be generated as an Export item.

In is possible to add any TS from the project to the statistic table and it is also possible to select different statistical set for each TS. There are also tools for batch selection or unselect ion of any statistics.

The statistics HTML reports are going to be computed by clicking button *Execute*.



Picture 113 : Tabular Statistics

Tabular Statistics for selected TS include:

- Minimum value
- Maximum Value
- Average Value
- Median
- Volume
- Duration
- Threshold
- Minimum at Time
- Maximum at Time

Table 7 : Tabular Statistics - Report

Statistics for TS 1 - Source data - Temperature

Parameters	
Time Serie	TS 1 - Source data - Temperature (C:\MyFiles\GND\Example_1\TS 1 - Source data - Temperature.dfs)
Time serie start	1.12.1999
Time serie end	31.12.1999 23:00:00
Interval start	10.12.1999
Interval end	11.12.1999
Interval timestep	User Defined (02:00:00)

interval	Minimal value [-]	Maximal value [-]	Average value [-]	Minimum at Time [-]	Maximum at Time [-]
10.12.1999	18.8000	19.0000	18.9000	10.12.1999 1:00:00	10.12.1999
10.12.1999 2:00:00	18.4000	19.0000	18.5303	10.12.1999 2:59:00	10.12.1999 2:00:00
10.12.1999 4:00:00	18.3000	18.9000	18.6000	10.12.1999 4:00:00	10.12.1999 5:00:00
10.12.1999 6:00:00	19.9000	21.5000	20.7000	10.12.1999 6:00:00	10.12.1999 7:00:00
10.12.1999 8:00:00	24.5000	25.3000	24.9000	10.12.1999 8:00:00	10.12.1999 9:00:00
10.12.1999 10:00:00	28.6000	29.6000	29.1000	10.12.1999 10:00:00	10.12.1999 11:00:00
10.12.1999 12:00:00	26.7000	29.9000	28.3000	10.12.1999 13:00:00	10.12.1999 12:00:00
10.12.1999 14:00:00	25.7000	25.7000	25.7000	10.12.1999 14:00:00	10.12.1999 14:00:00
10.12.1999 16:00:00	25.7000	26.1000	25.9000	10.12.1999 17:00:00	10.12.1999 16:00:00
10.12.1999 18:00:00	24.9000	25.0000	24.9500	10.12.1999 19:00:00	10.12.1999 18:00:00
10.12.1999 20:00:00	22.6000	23.5000	23.0500	10.12.1999 21:00:00	10.12.1999 20:00:00
10.12.1999 22:00:00	21.2000	21.9000	21.5500	10.12.1999 23:00:00	10.12.1999 22:00:00

Notes: Rows with Italic text are intervals where are no or incomplete data.

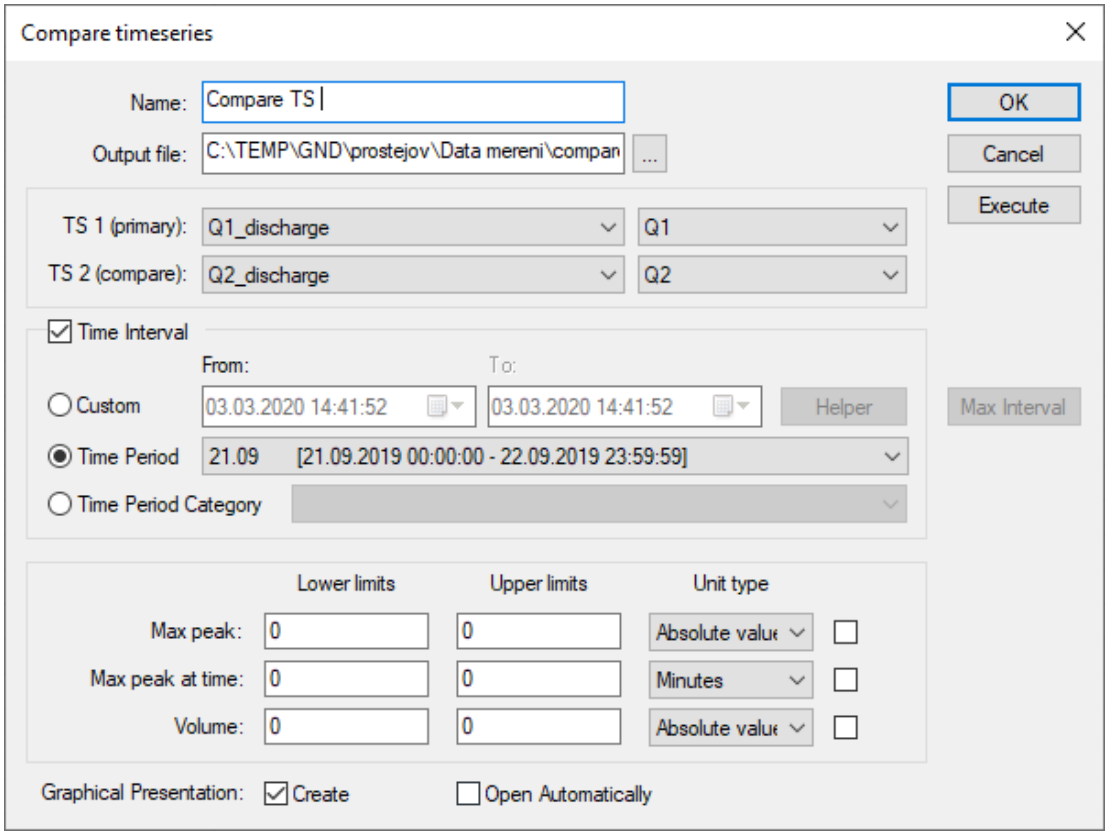
The following items are open to use in Tabular Statistics Properties:

- **Name** Name of Tabular Statistics.
- **Interval** Time step for statistics – predefined or optional.
- **Save to directory** Directory for DFS file.
- **Time interval** Time interval of TS.
- **Generate Export** Generates new export item from Tabular Statistics.
- **Execute** This button will execute the report.
- **Report only full periods with data** Reports only data fully within Time interval.

9.6.4 Compare TS

Compare TS function can perform a comparison analysis of 2 time series in terms of following parameters:

- Max Peak
- Max Peak at Time
- Volume



Picture 114 : Compare Timeseries

- **Name** name of Comparison Analysis
- **Output file** path of generated HTML Report
- **TS 1** primary input TS
- **TS 2** secondary input TS to be compared with TS1
- **Time Interval** custom, Time Period or Time Period Category
- **Max Peak** finds a peak value of TS1 and TS2 at given time period
- **Max Peak at time**
- **Volume** finds a volume TS1 and TS2 at given time period

- **Unit Type** option of displaying results as an Absolute value or as a Percentage (one of selected must be ticked out)

- **Lower, Upper limits** give an expected boundary for Difference of compared TS. If it fits boundaries, it results as *Passed* in generated report. Otherwise it is labelled as *Failed*

10 HTML Presentation

HTML presentation allows to save Time series plots, Horizontal plans and Scatter graphs into HTML file, which can be printed or presented later.

HTML Presentation is based on appropriate Graphical presentation, it means all parameters defined in Graphical presentation are taken in account for HTML Presentation.

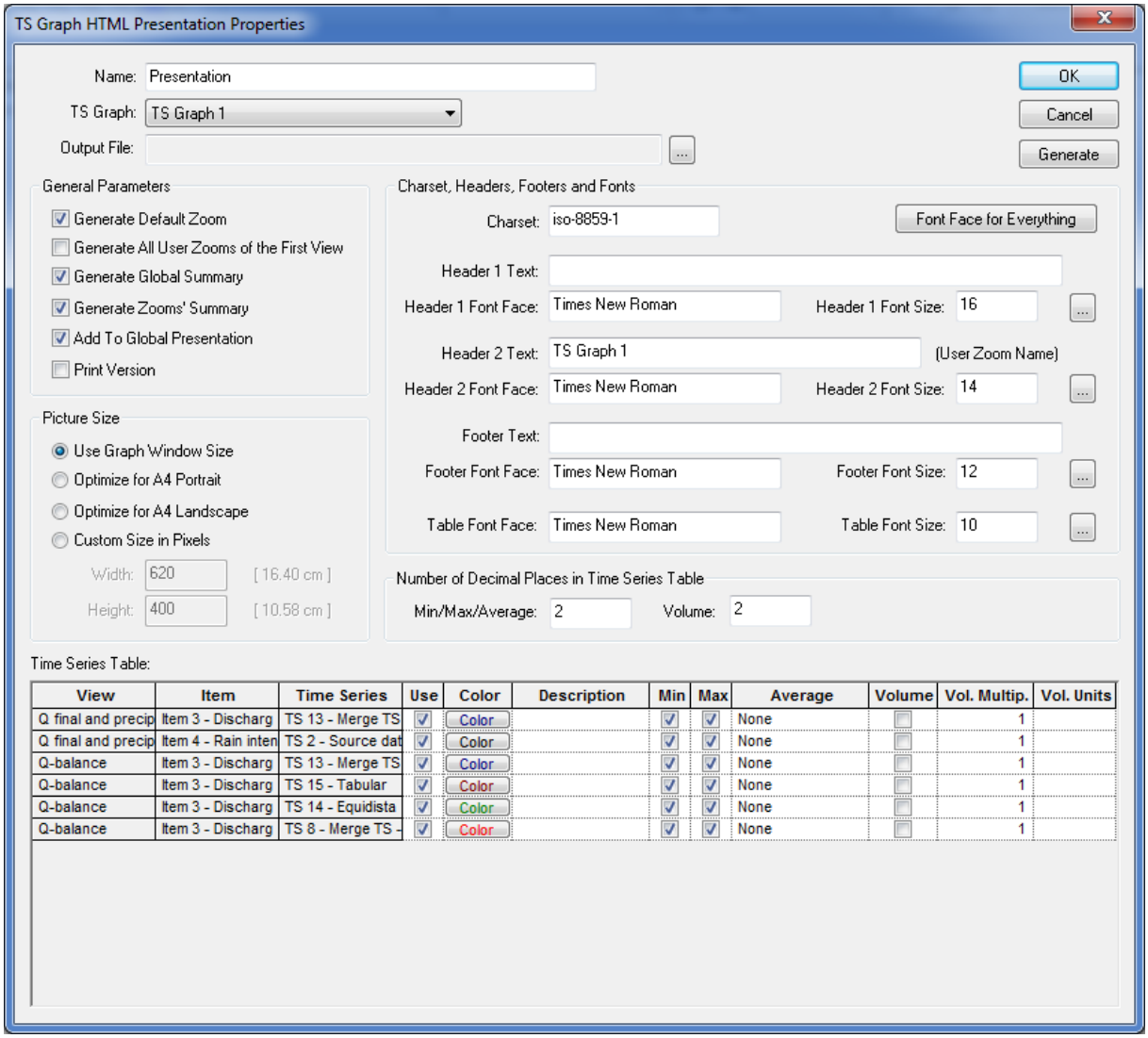
Parameters Name, TG Graph/Horizontal plan/Scatter graph and Output file are basic parameters for HTML presentation.

General parameters define content of the presentation. NOTE the HTML Presentation generate plots on following items:

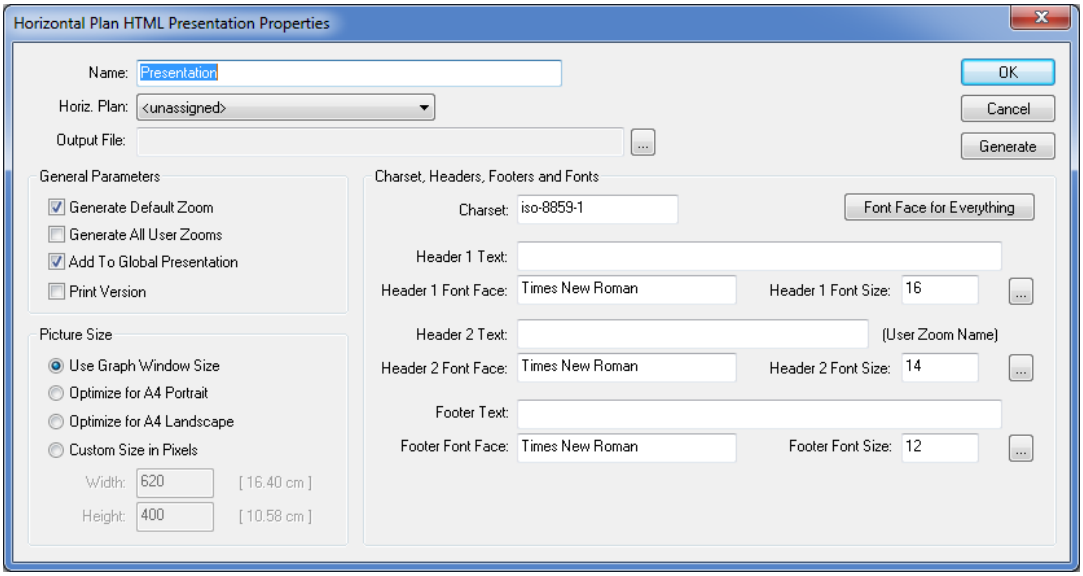
- **Default zoom** makes a print of all data (maximum time and value scale).
- **All User Zoom** from the FIRST view of the Time series.
- **Global/Zoom´s Summary** defines a table with basic parameters such min, max, average, appearance of min, max etc. (valid for Time series only).
- **Add to Global presentation** allows to include current presentation into Global presentation which contains all presentation assigned to it.
- **Print version** adapts output file for printing (remove hyperlinks from the file).

Additional parameters can vary based on type of presented data:

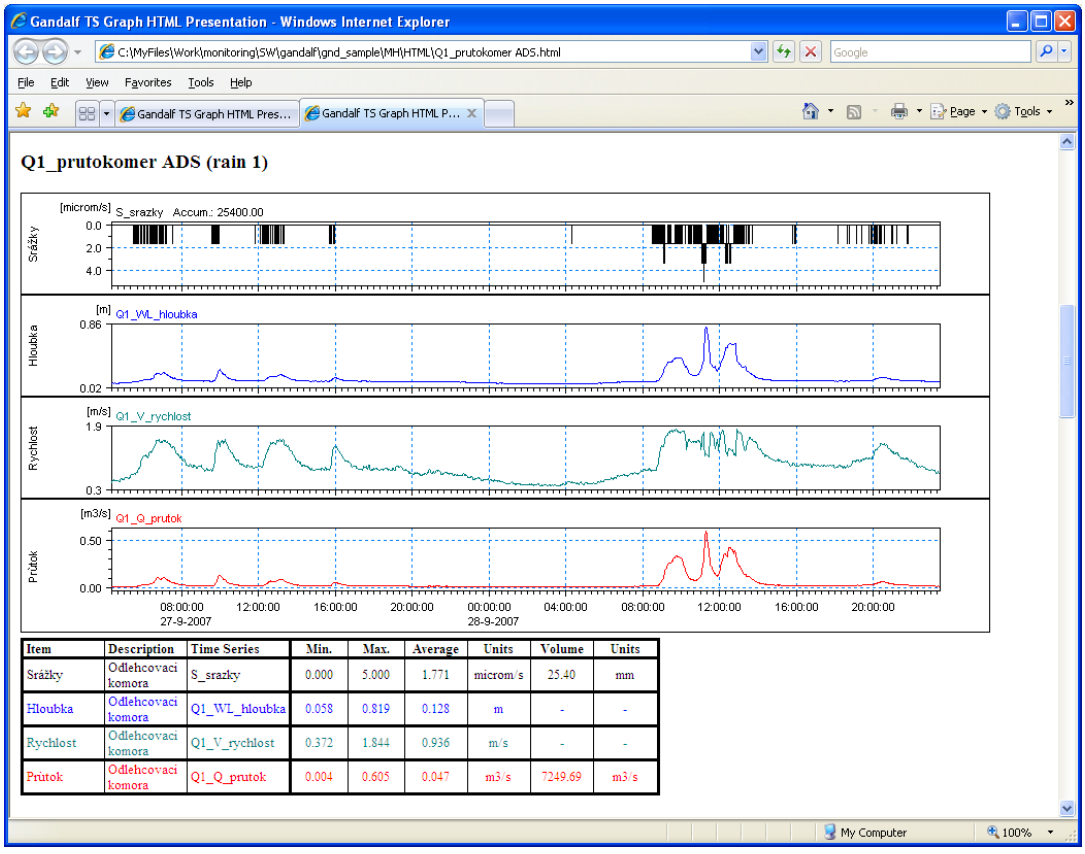
- **Time Series table** can be printed together with the presentation. Printing is managed by check bar Use. In the table values such a Min, Max, and Volume can be presented. In addition, short description can be added to the table (valid for Time series only).
- **TS description** allows to entitle X and Y axes (valid for Scatter graph only).
- **Picture size** optimizes picture based on printing preferences.
- **Charset, Headers, Footers and Fonts** allow define parameters which are included into HTML Presentation page.



Picture 115 : HTML Presentation



Picture 116 : Horizontal Plan HTML Presentation Properties



Item	Description	Time Series	Min.	Max.	Average	Units	Volume	Units
Srážky	Odlehcovaci komora	S_srazky	0.000	5.000	1.771	microm/s	25.40	mm
Hloubka	Odlehcovaci komora	Q1_WL_hloubka	0.058	0.819	0.128	m	-	-
Rychlost	Odlehcovaci komora	Q1_V_rychlost	0.372	1.844	0.936	m/s	-	-
Průtok	Odlehcovaci komora	Q1_Q_prutok	0.004	0.605	0.047	m3/s	7249.69	m3/s

Picture 117 : TS Graph HTML Presentation

11 Computations

Computations "folder" store all defined computations. Standard commands like create new, copy, delete, rename, and execute defined computation can be accessed from local menu.

Computations are based on a relations, where the input data (TS) is recomputed into output data (existing or new TS). Further input data or parameters are held in Computation Details.

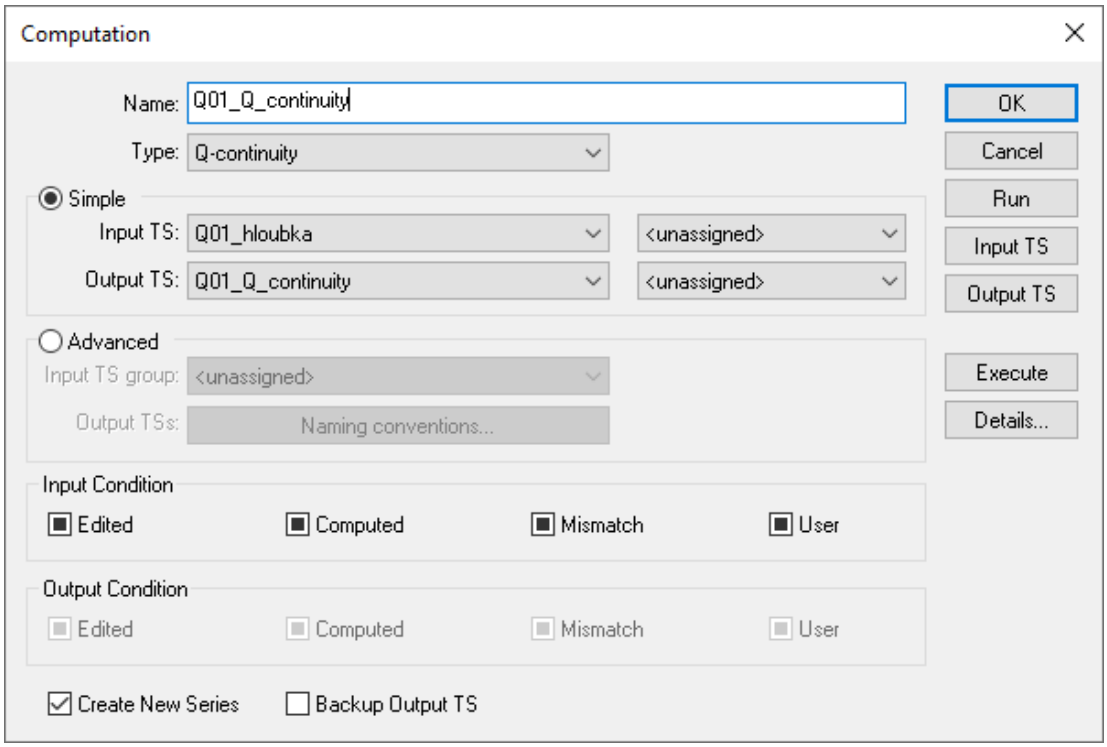
Computations are carried out in two modes:

- **Simple** basic computation only for one Time Series
- **Advanced** defined for TS Group as an input of the computation. The Output TS names are generated based on Naming Conversion.

Properties of computations contain name, type of computation, input and output time series. Input and output TS can be either different or the same one. Input conditions are always accessible, while output conditions are accessible just if the checkbox Create New TS is not checked.

If the checkbox *Create New TS* is checked, output conditions are not accessible, and GANDALF will create new time series. If this new time series has the same name as existing one, existing TS will be replaced with the new one.

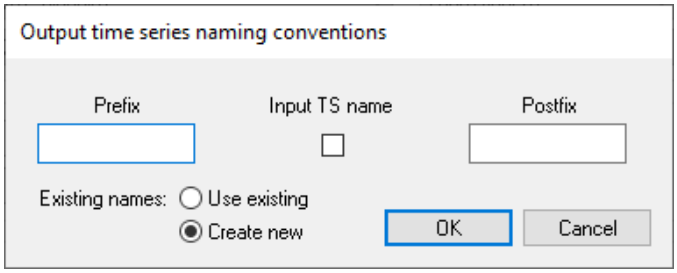
If the checkbox *Create New TS* is not checked, output conditions are accessible, and GANDALF will create new time series (in the case that Output TS does not exist yet). Otherwise system will replace data in existing time series according to output conditions (i.e. if just output condition Mismatch is checked, every value with flag Mismatch will be replaced, other values remain).



Picture 118 : Setting up a Computation

The following items are open to use in Computation Properties:

- **Name** Name of Computation.
- **Type** Selection of defined types of computations.
- **Input TS** Selection of existing TS as an input for computation.
- **Output TS** Selection of existing TS to which the result of computation is written to.
- **Input TS group** Selection of existing TS group to which the result of computation is written to.
- **Output TSs** Follows naming convention according *Prefix*, *Input TS name* and *Postfix,* possibility to use existing names or create new TS



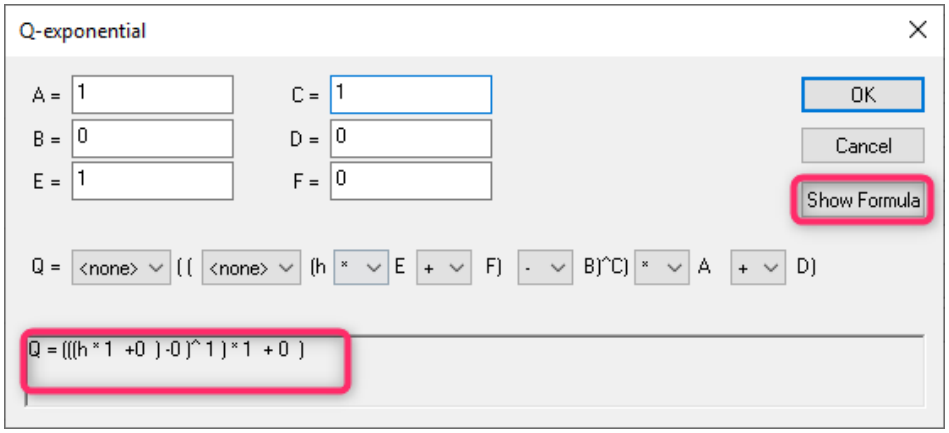
Picture 119 : Group TS naming convention

- **Input Condition** Restriction of Input data in TS by flags.
- **Output Condition** Restriction of Output data in TS by flags. This option is available only if checkbox Create New Series is checked.

- **Execute** Executes the Computation and closes the dialog
- **Run** **E**xecutes the Computation and keeps the dialog open
- **Details** Specifying details (parameters) of selected computation type
- **Backup Output TS** Each type of computation includes different details, which can *Detail* button. Some types can demand filling additional Input and Output TS. The following type of computations are implemented:

11.1 Q-exponential

This function uses an exponential equation for computation in form Q=A*(h-B)^C+D, where h is the value from Input TS, Q is the value of output TS and A, B, C, D are parameters defined in *Details*.

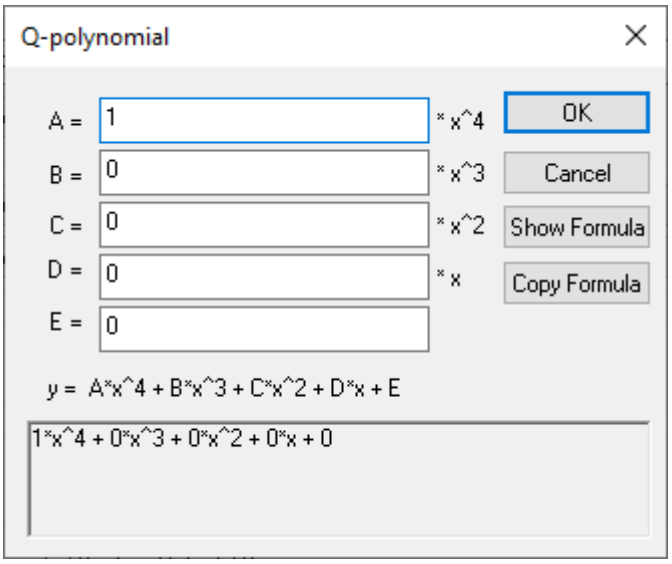


Picture 120 : Q-exponential - Details

Any changes in parameters are projected after clicking on *Show Formula*

11.2 Q-polynomial

This function uses a polynomial equation for computation in form Q=Ax4+Bx3+Cx2+Dx4+E, where x is the value from Input TS, Q is the value of output TS and A, B, C, D, E are parameters defined in *Details*.

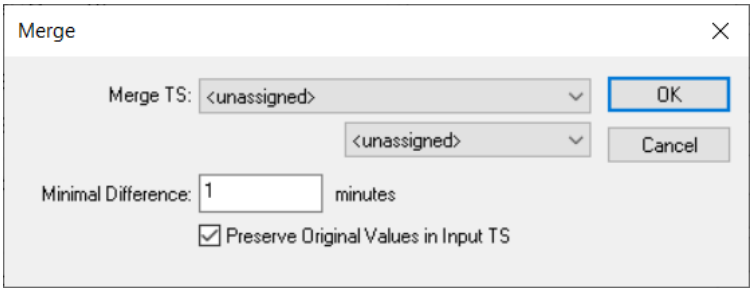


Picture 121 : Q-polynomial – Details

Q-polynomial computation enables to copy Formula to use it in other computation.

11.3 Merge TS

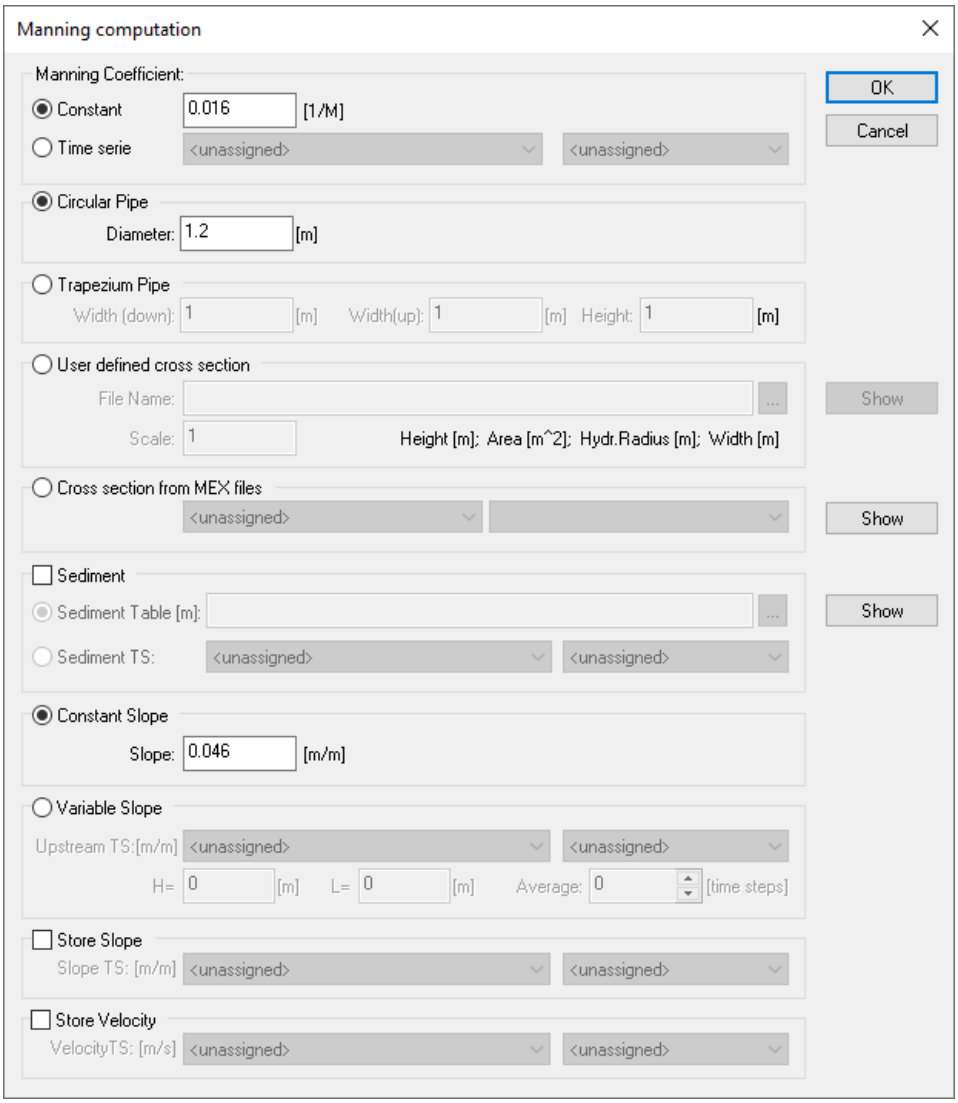
This function is merging the two TS into one. The Merge TS is defined in detail, which is merger together with input TS generating a new one, Output TS. If two values in each TS (input TS and merge TS) are in given interval in Minimal Difference, the only one value will be stored in output TS. Checking the Preserve Original Values, the value from input TS will be stored. If the box is left blank, the value from merge TS will be saved instead.



Picture 122 : Merge – Details

11.4 Q-Manning

This function is using a Manning equation for computation of discharge. The Manning coefficient, cross-section, sediment table optionally the computation using the energy slope is defined in *Details*.



Picture 123 : Q-Manning Details

- **Manning Coefficient** can be expressed either as Constant or as Time series (time dependant coefficient)

Pipe geometry can be entered in 4 possibilities as a:

- **Circular pipe** fill diameter in meters
- **Trapezium Pipe** fill down width, up width and height in meters
- **User defined cross section** direct path to crs file. This file contains rows of height (H), width (W), area (A) and hydraulic radius (R). It has to copy a table format as followed at the picture bellow

H	W	S	R
0.0000000	0.0000000	0.0000000	0.0000000
0.0400000	0.7316856	0.0206636	0.0279040
0.0800000	0.9150563	0.0540519	0.0574384
0.1200000	1.0542195	0.0934374	0.0848228
0.1600000	1.1714725	0.1383812	0.1112355
0.2000000	1.2663049	0.1871552	0.1367983
0.2400000	1.3593174	0.2396662	0.1607641
0.2800000	1.4525788	0.2959042	0.1833738
0.3200000	1.5312298	0.3557102	0.2060823
0.3600000	1.5986887	0.4184026	0.2285194
0.4000000	1.6503114	0.4833826	0.2509595
0.4400000	1.6976935	0.5504275	0.2725873
0.4800000	1.7361872	0.6191051	0.2936862

Picture 124 : User defined cross section - format example

- **Cross section from MEX file** selection from the database of cross- sections stored in one file. For detailed description of this feature see **5 CRSs (Cross-Sections)**

Next section is taking account the possibility of sediment setting. There are two ways how to implement an occurrence of sediment into the computation using:

- **Sediment Table**

If sediment table is attached, *Show* button will open up a table in TXT file or in dfs file. The user is instructed to use following data format as shown below.

EXAMPLE.SLT - Notepad

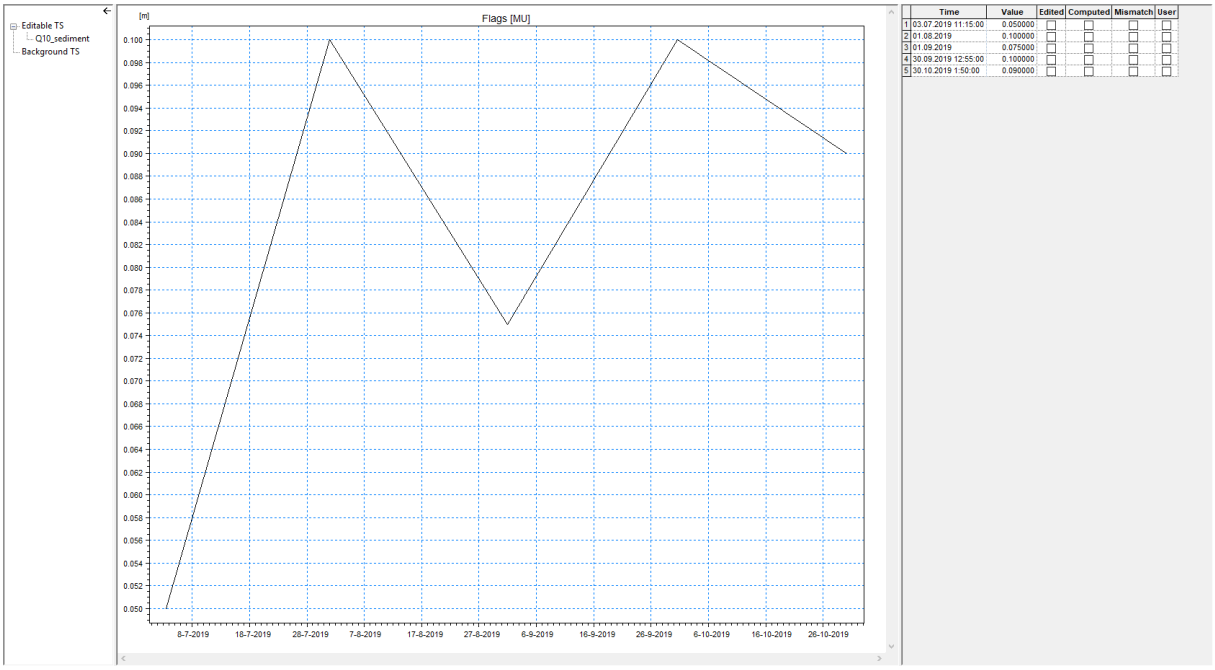
File Edit Format View Help

```
;This file contains data about thickness of silty profile
;Data input into computation of discharge
; SILT DATA
;YYYY  DD   HH   SILT(M)
2019   06   10   0.02
2019   06   30   0.03
2019   07   15   0.06
2019   07   31   0.05
2019   08   28   0.05
2019   09   19   0.02
```

Picture 125 : Sediment Table Format

- **Sediment Time Series**

Sediment Time Series consists of measured values of sediment taken at recorded time at the monitoring site. Other values of sediment are interpolated during the computation
You can see the example of such Time Series at the following picture:



Picture 126 : Sediment TS example

There are two approaches on how to implement the slope of pipe into the computation. User can select:

- **Constant slope** — When the Constant slope approach is used, a water level from one (input TS) is used for calculation. The longitudinal slope of the bottom of the pipe (channel) is defined.
- **Variable slope** — If Variable slope approach is used, the second (upstream) TS must be assigned and the slope of energy is put into the calculation as difference between two water levels (downstream and upstream) in every time step. The distance between the cross section is given as L and elevation between these cross sections is given as H.

At all there is a possibility to store Time Series of slope and velocity

- **Store slope** — creates new Time Series based on input slope
- **Store velocity** — creates new Time Series of velocity based on output discharge (Q -Manning) and on flow area (given input water depth TS and pipe geometry). It uses Q- Continuity equation

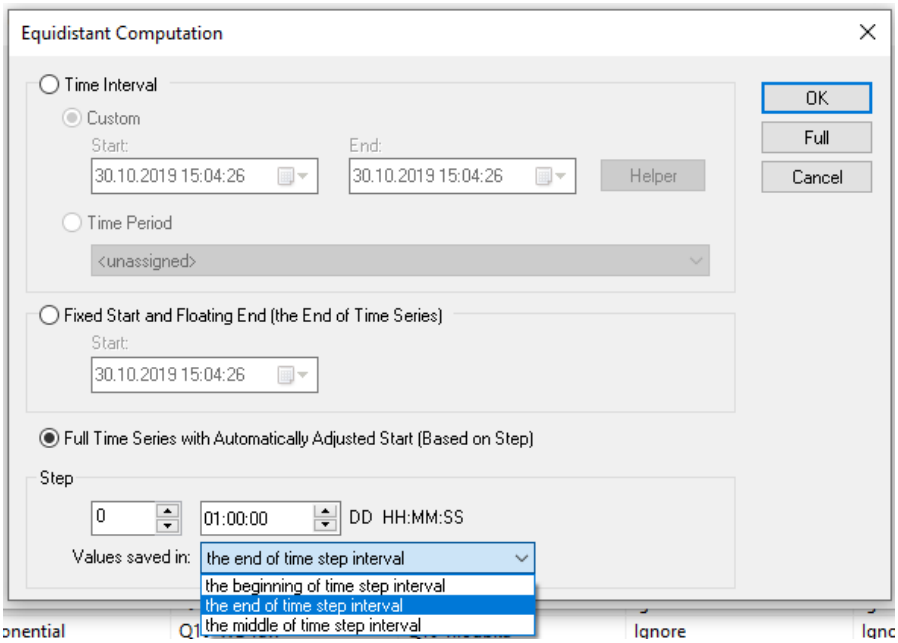
11.5

11.6 Equidistant

This function is computing the output TS with equidistant time step from input TS which in non-equidistant. For selected time interval it computes its average value either by. averaging if values are within the interval or by interpolating if the values are out of the interval. The interval where the computation is being implemented is defined by start and end date and the equid

Equidistant time steps is defined by item Step. The Equidistant computation allows to save values in non-equidistant time step in 3 following options:

- The end of time step interval
- The middle of time step interval
- The beginning of time step interval

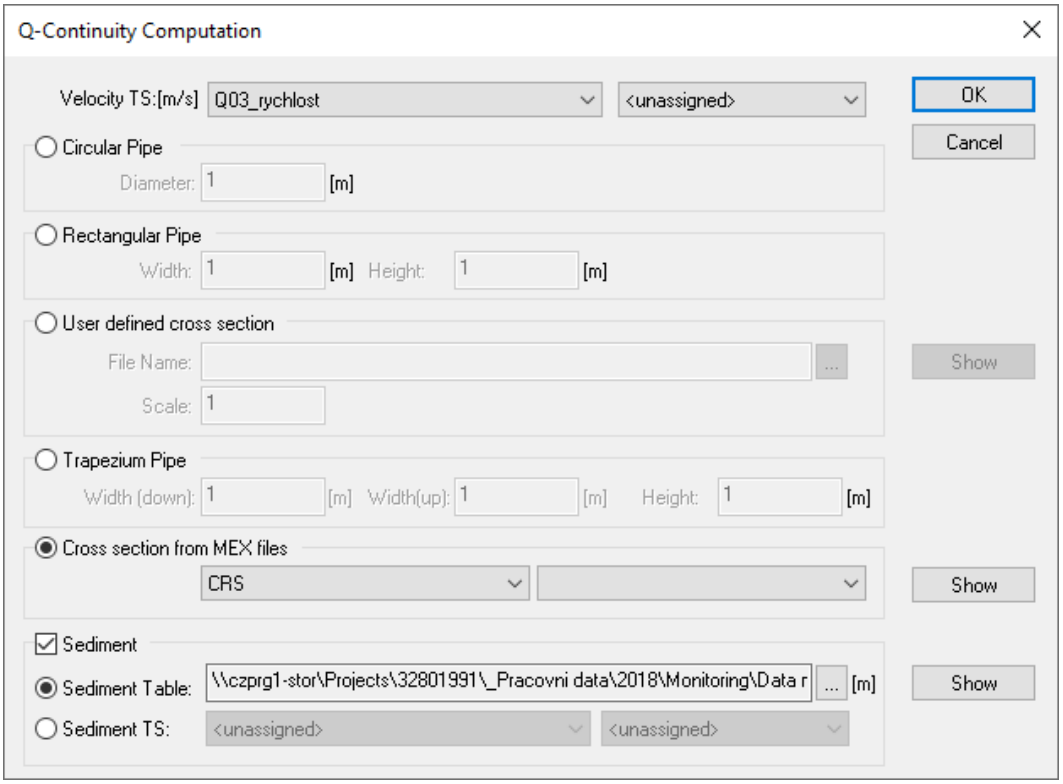


Picture 127 : Equidistant Computation

- **Custom** enables to set the user time interval, if clicked on *Full,* complete Time interval will show
- **Time Period** based on any Time Period created in time Periods
- **Fixed start and Floating End (the End of Time Series)** Based on time step
- **Full Time Series with Automatically Adjusted Start (Based on Step)**
- **Step** Time step of interpolation (from left Days, Hours, Minutes, Seconds)

11.7 Q-Continuity

This function is using continuity equation Q=S*v where S is the actual cross section in time step computed from h (value from input TS) and given cross-section (circular, trapezium, rectangular or user defined) and v is the velocity value from velocity TS assigned in *Details* The sediment table (time series of silt depth) could be optionally defined as a text file or as a Time Series.



Picture 128 : Q-Continuity Details

Identically as in Q Manning computation, *Show* Button (Cross section from MEX file) opens Cross Section editor. More about Cross sections is described in the chapter **5 CRSs**.

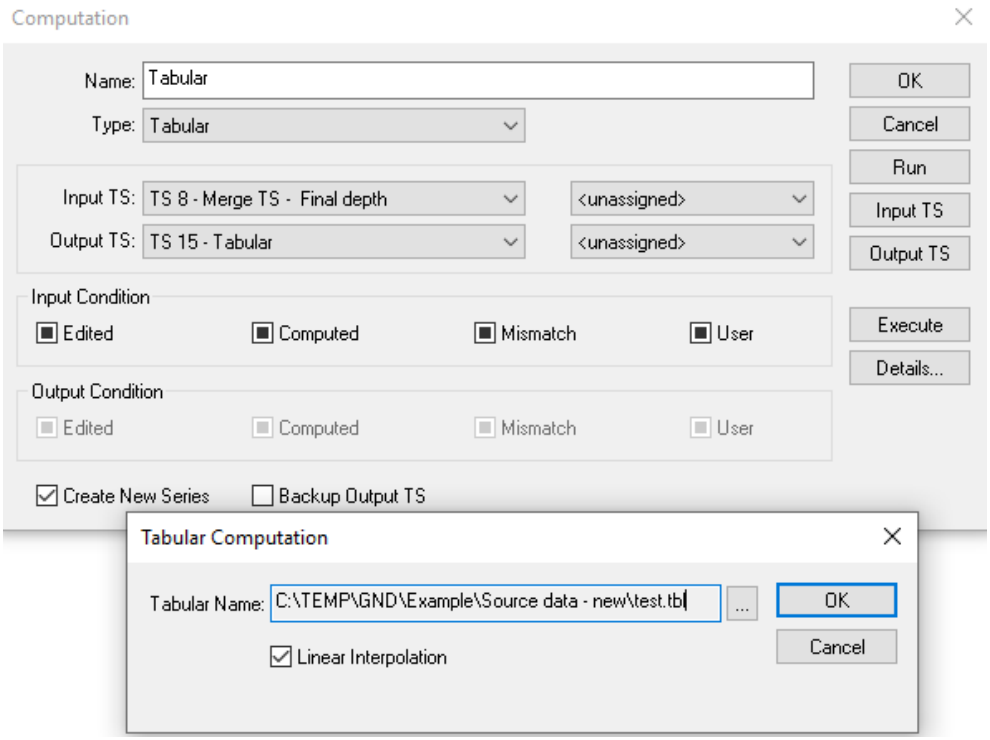
Also, Sediment functionality is identical as in Q-Manning Computation. See chapter **11.4 Q-Manning** for description.

11.8 Tabular

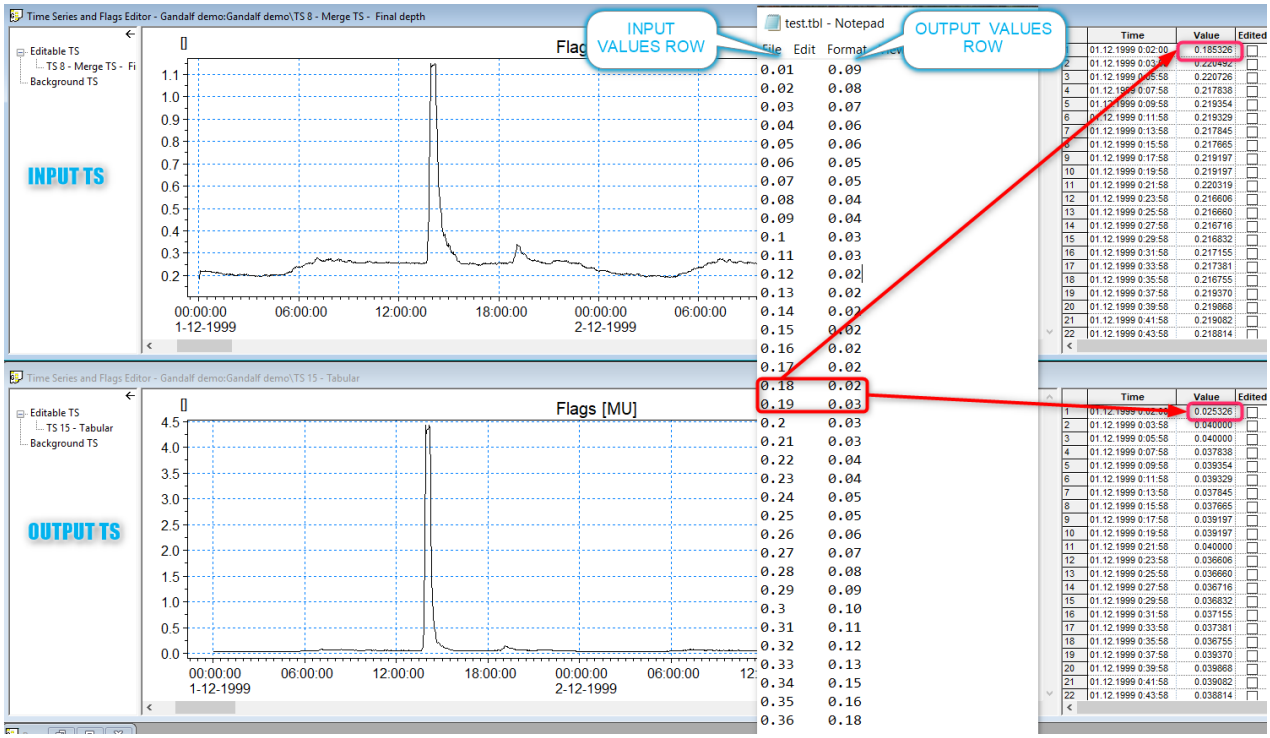
This function is computing the output TS by given table (input/output) as a text file.

computation determines y=f(x) relation by table. The user can choose whether the x,y values given at the table should be linearly interpolated or not.

Tabular Computation is useful when dealing with Q-H Curve.



Picture 129 : Tabular Computation Settings

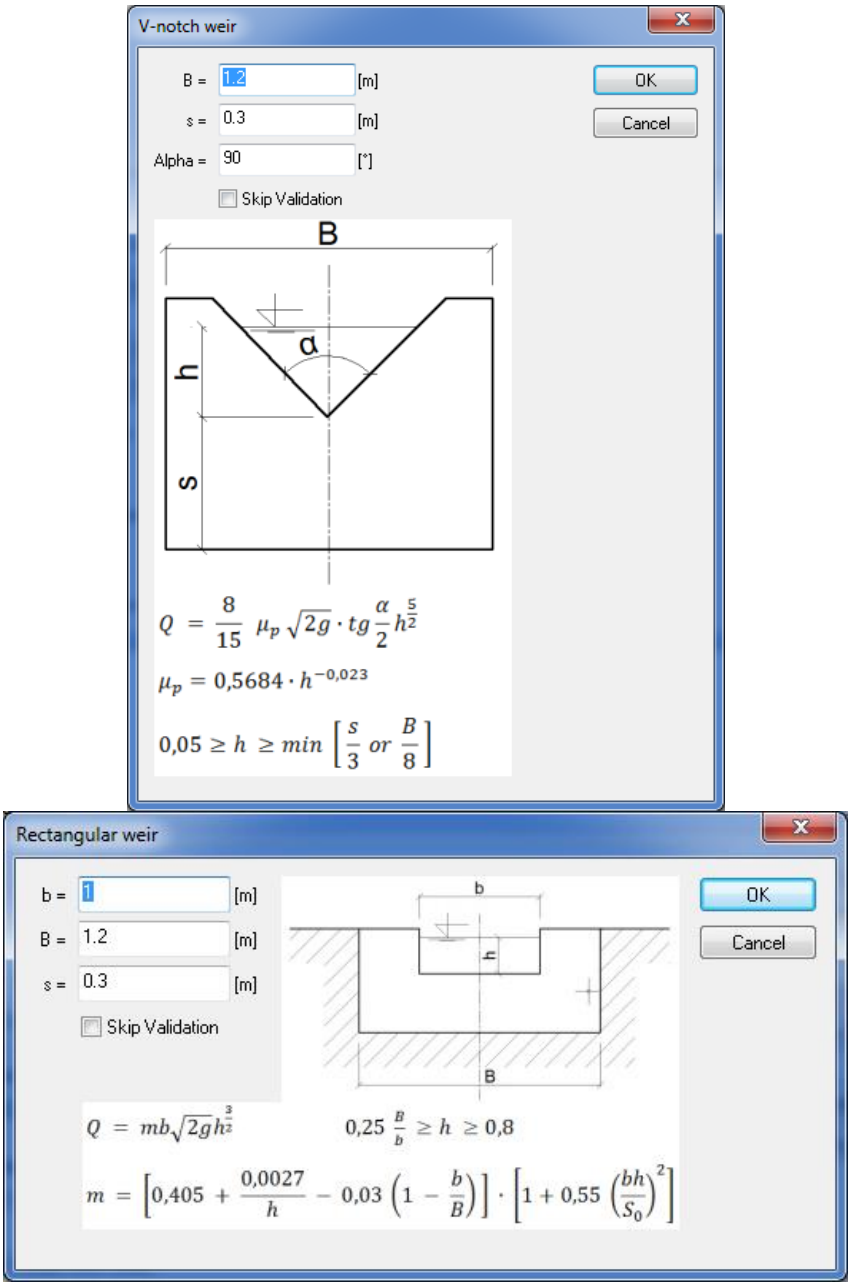


Picture 130 : Tabular Computation Example

If the user selects *Linear interpolation,* it interpolates output TS among two closest values based on input and output values in the attached table (.tbl format)

11.9 V-notch weir and rectangular weir

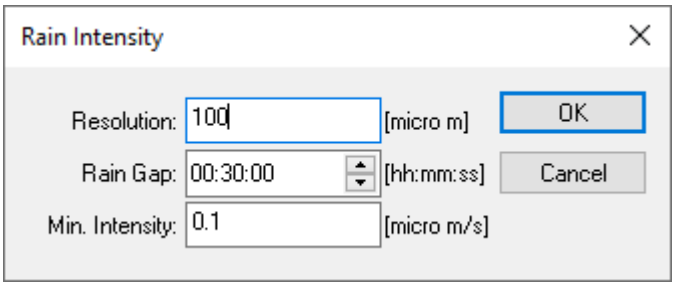
This function is using standard hydraulic equation for v-notch or rectangular weir respectively. Checking the box Skip validation, the discharge can be computed even hydraulic condition are not valid for the weir.



Picture 131 . Weirs

11.10 Rain intensity

This function can convert TS with natural numbers from rain gauge (number of tilts) to rain intensity TS. To use this function, the user needs to insert minimum intensity, resolution and rain gap.



Picture 132 : Rain Intensity

- **Resolution** tilting bucket capacity (Volume) in micrometers
- **Rain Gap** Interval of dry weather period. If the dry weather period (interval containing only zero values) is longer than the given gap the first non-zero value in considered as new rainfall event.
- **Min. Intensity** This value is derived as a ratio between collection area of the rain gauge and the resolution (Collection Area / Resolution)

Input TS must follow this data format at the picture below. The value 1 represents the pulse caused by tilting the bucket.

```
01.01.2019 17:01:43; 1;
01.01.2019 17:36:08; 1;
01.01.2019 17:38:17; 1;
01.01.2019 17:39:17; 1;
01.01.2019 17:40:13; 1;
01.01.2019 17:41:40; 1;
01.01.2019 17:47:17; 1;
01.01.2019 17:59:00; 1;
01.01.2019 20:36:15; 1;
01.01.2019 20:37:00; 1;
01.01.2019 20:38:06; 1;
01.01.2019 20:38:45; 1;
01.01.2019 20:39:51; 1;
01.01.2019 20:45:04; 1;
01.01.2019 21:04:36; 1;
01.01.2019 21:10:06; 1;
01.01.2019 21:13:46; 1;
01.01.2019 21:15:56; 1;
01.01.2019 21:17:31; 1;
01.01.2019 21:18:34; 1;
01.01.2019 21:19:25; 1;
01.01.2019 21:20:30; 1;
01.01.2019 21:21:54; 1;
```

Picture 133 : Rain intensity input TS data format

11.10.1 Example of Rain Intensity

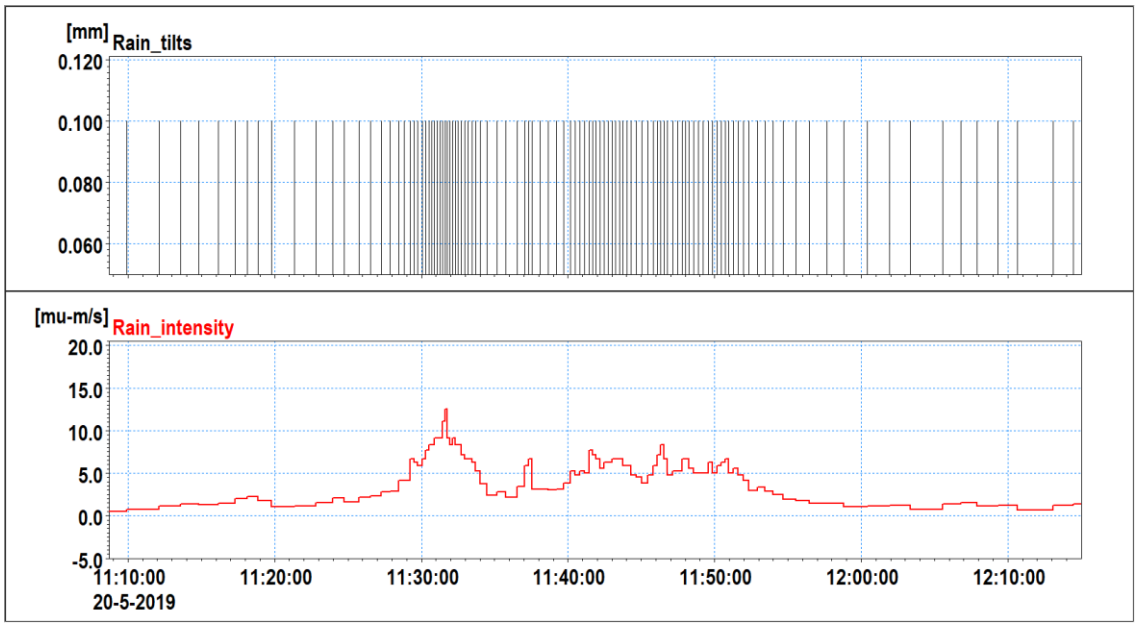
When you have available data in required format as at the Picture 133 and imported, put it as input TS in Computation. Let's suppose parameters of rain gauge parameters are:

- **Collection Area** 500 cm^2
- **Volume** 5 ml
- **Resolution** 0,1 mm

Setting up Rain Intensity (Picture 132):

- **Resolution** 0,1 * 1000 = 100 µm /s
- **Rain Gap** Optional (recommended **30 minutes**)
- **Min. Intensity** (5*10^-6) / (500^-4) = 0,0001 m/s **= 0,1 µm/s**

Graphical Presentation after execution looks accordingly:



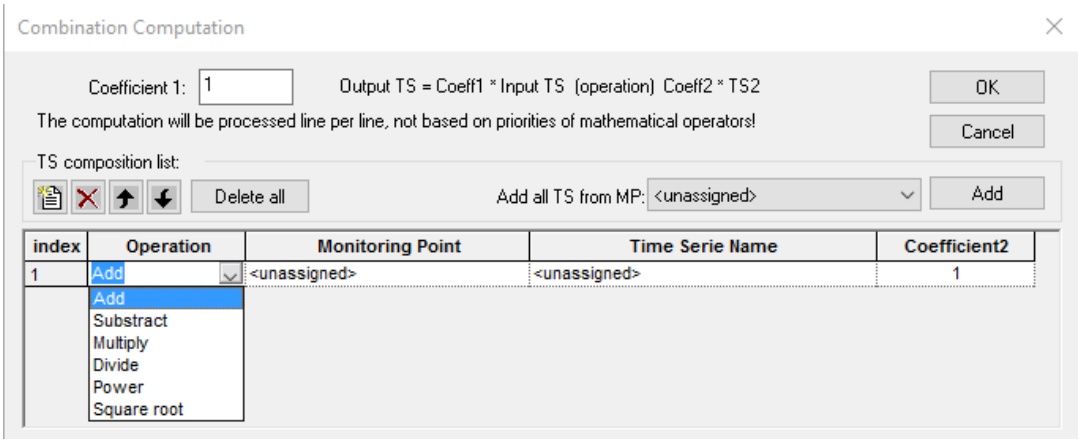
Picture 134 : Rain intensity example

Note: Standard graphical presentation for rain intensity is backstep type of graph. Go to Graph type (in Graphical Presentations) to set it up.

11.11 Combination

This function is using equation Z=x*coef1 (operation) y*coef2 where x is value from Input TS, y value of the second input TS assigned in Detail, Z is the value of output TS and coef1 and coef2 are parameters defined in *Details*.

Coefficient1 is multiplied by Input TS and Coefficient2 is multiplied by Output TS

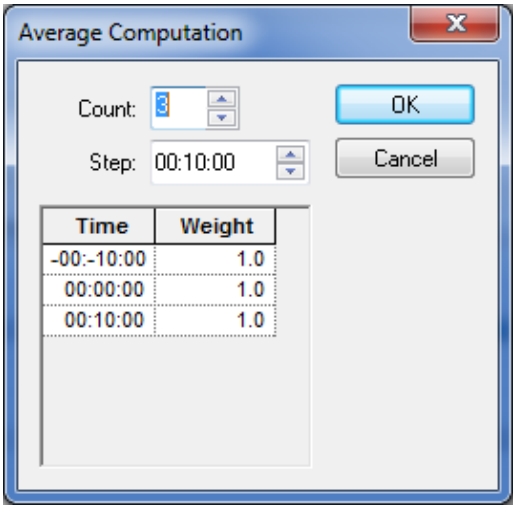


Picture 135 : Computations – Combination

- **Add** (Coeff1*Input TS) + (Coeff2* Output TS)
- **Subtract** (Coeff1*Input TS) **-** (Coeff2* Output TS)
- **Multiply** (Coeff1*Input TS) x (Coeff2* Output TS)
- **Divide** (Coeff1*Input TS) **/** (Coeff2* Output TS)
- **Power** (Coeff1*Input TS)$^{(Coeff2*Output\ TS)}$
- **Square root** (Coeff1*Input TS)$^{(1/\ Coeff2*Output\ TS)}$

11.12 Average

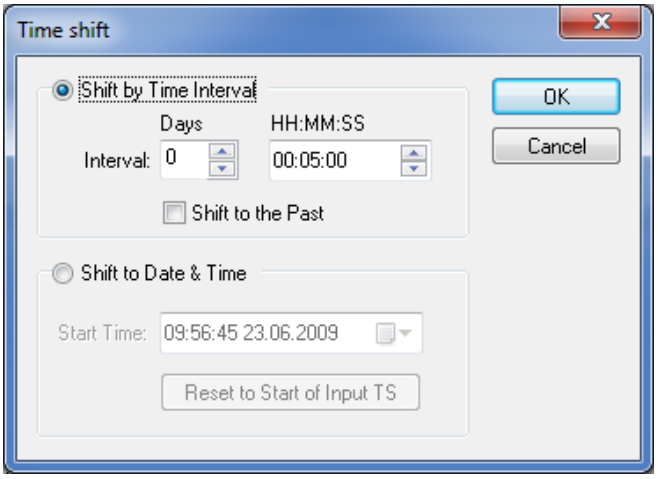
This function is averaging (smoothing) the TS. The number of time steps which are being averaged is given by Counts and time step is assigned to define an interval for computing an average value of this interval. The weight could be assigned to the given time step to compute weighed average.



Picture 136 : Computations - Average

11.13 Time shift

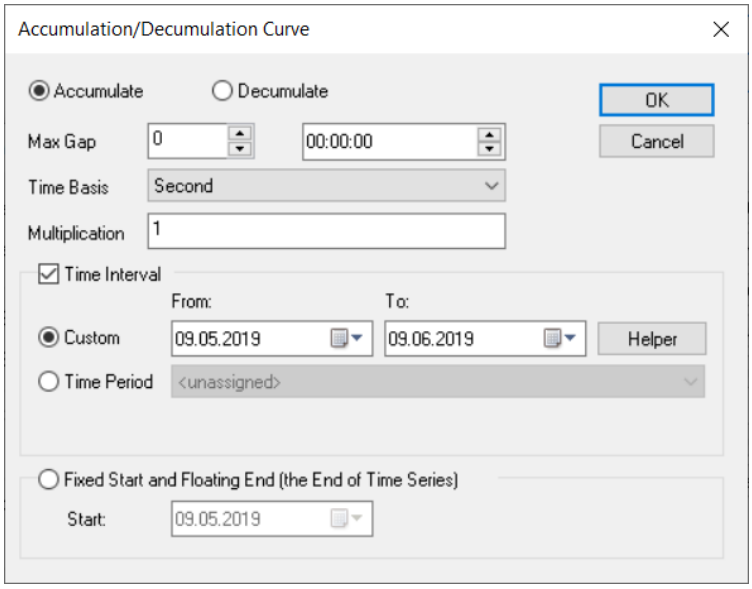
This function is shifting the whole TS over given time. If the is box Shift to the Past checked the shift is done over the clock.



Picture 137 : Time Shift

11.14 Accumulation and Decumulation Curve

This function defines cumulative or de-cumulative curve from the source data.



Picture 138 : Computations - Accumulation/Decumulation Curve

11.15 Mask/Flag Transfer Computation

Mask Transfer and Flag Transfer are two different (but similar) processes, which set flags in TS, usually according to flags in another TS.

11.15.1 Mask Transfer

Let's have some TS with flags (let's call it "first" TS). User choose a flag mask. GANDALF finds time intervals out, in which flags in first TS match the mask. These intervals are described by the Mask Transfer TS (see below). User then choose second TS and flags, which should be set (or add) in this TS according to time intervals generated from first TS.

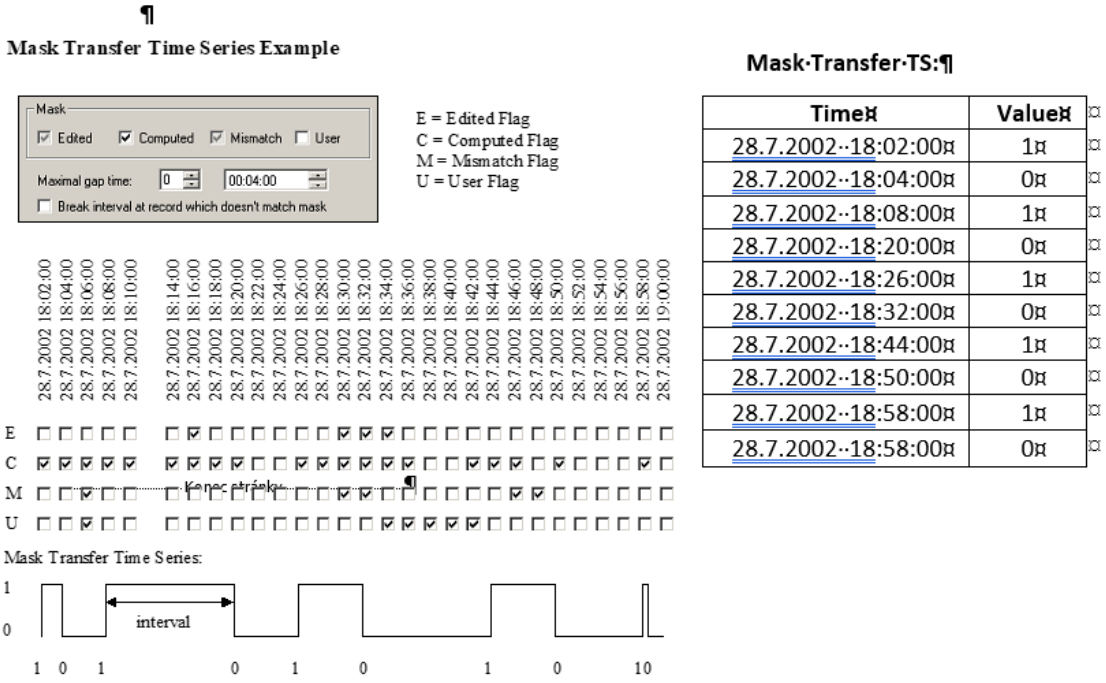
Actually, the procedure is done in this way:

1. The Mask Transfer TS is acquired, either by generating from flags of input TS, or by loading from TS/file/clipboard.
2. The Mask Transfer TS is modified – time shift, interval expansion.
3. The Mask Transfer TS is either applied on flags of output TS or saved to TS/file/clipboard.

11.15.2 Mask Transfer Time Series

The Mask Transfer TS describes intervals. Its values consist of alternating 1 (start of interval) and 0 (end of interval). Intervals are treated as closed from the left and open from the right.

Remark: The Mask Transfer TS is always only internal TS of GANDALF; it cannot be seen among ordinary TS in a project tree. Though the Mask Transfer TS can be loaded from ordinary TS (or saved to ordinary TS).



Picture 139 : Mask Transfer

11.15.3 Flag Transfer

Let's have some TS with flags (let's call it "first" TS). User choose flags, which should be transferred to the second TS. Transfer is performed via the Flag Transfer TS (see below).

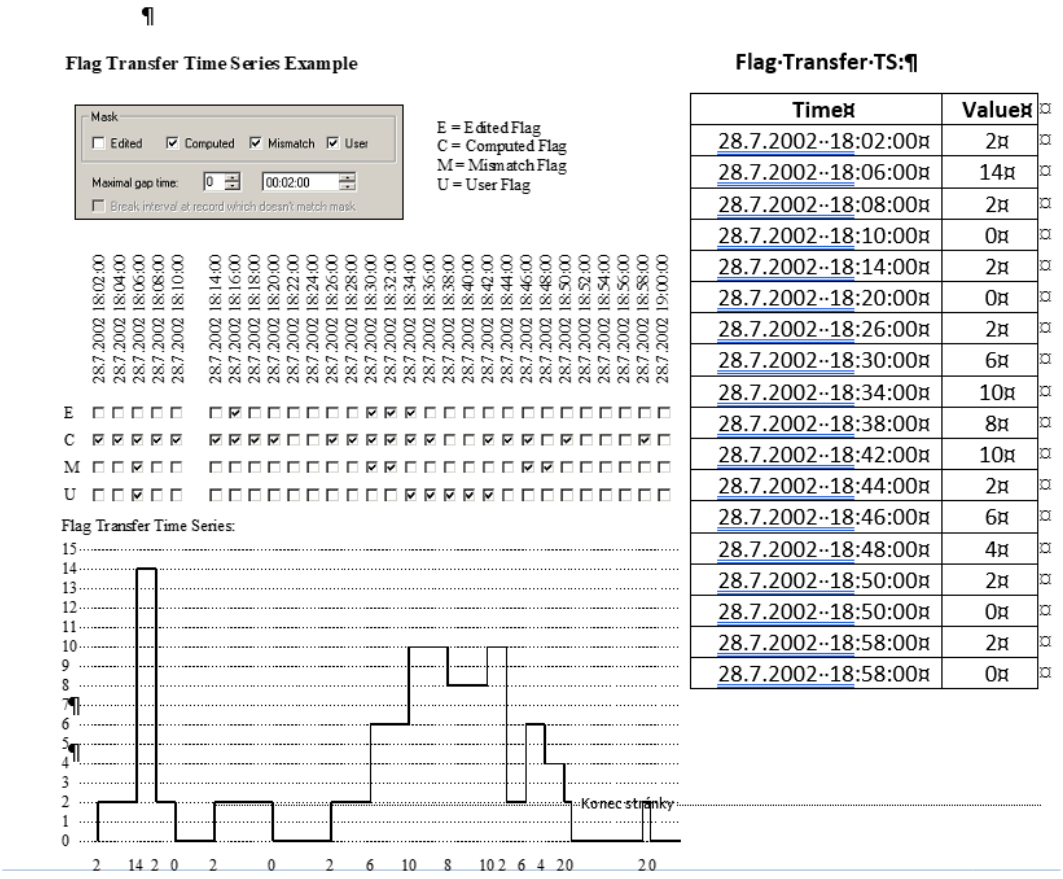
The procedure is done in this way:

1. The Flag Transfer TS is acquired, either by generating from flags of "input" TS, or by loading from TS/file/clipboard.
2. The Flag Transfer TS is modified – time shift.
3. The Flag Transfer TS is either applied on flags of "output" TS or saved to TS/file/clipboard.

11.15.4 Flag Transfer Time Series

The Flag Transfer TS is step "function" which describes time intervals (closed from the left and open from the right side), when concrete flags are set. More precisely it consists of points in time, when the flags change. Its values are integers between 0 and 15. "Edited" flags contributes by 1, "Computed" flag by 2, "Mismatch" flag by 4 and "User" flag by 8. The result value is the sum of the numbers of active flags. E.g. 0 means that no flag is active, 5 that "Edited" and "Mismatch" flag are active.

Remark: The Flag Transfer TS is always only internal TS of GANDALF; it cannot be seen among ordinary TS in project tree. Though the Flag Transfer TS can be loaded from ordinary TS (or saved to ordinary TS).



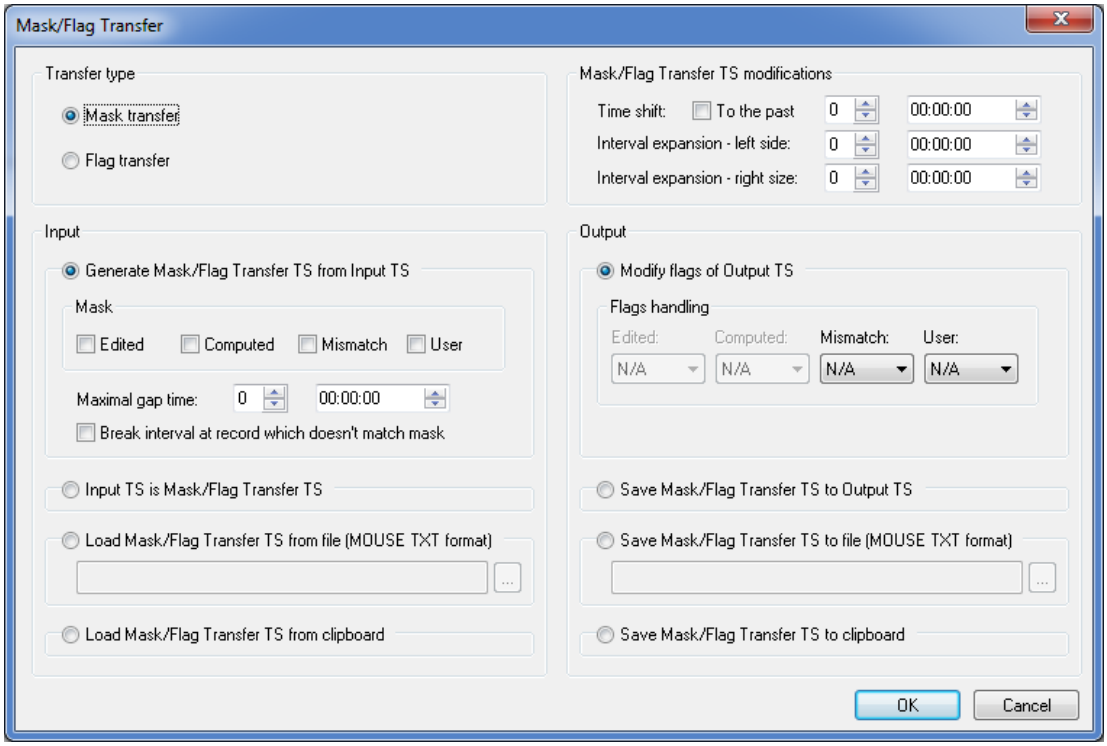
Picture 140 : Mark Transfer

11.15.5 Mask/Flag Transfer Dialog

Both Mask Transfer and Flag Transfer have similar parameters, so they are operated from common dialog. The dialog consists of 4 parts:

- **Transfer type** Choice between Mask Transfer and Flag Transfer.
- **Input** How should be the Mask/Flag Transfer TS acquired? By:
  generation from flags of Input TS; described in standalone chapters
  loading from Input TS
  loading from file (MOUSE TXT format)
  loading from clipboard
- **Modifications** The Mask/Flag Transfer TS can be shifted in time (either to the future or to the past). For Mask Transfer, intervals described by the Mask Transfer TS can be expanded (enlarged) to the left (expanded to the past) or to the right (expanded to the future).
- **Output** What should be done with resulting the Mask/Flag Transfer TS?
  - applied on flags of Output TS (modification of flags of Output TS) described in standalone chapters
  - saved to Output TS
  - saved to file (MOUSE TXT) format
  - saved to clipboard

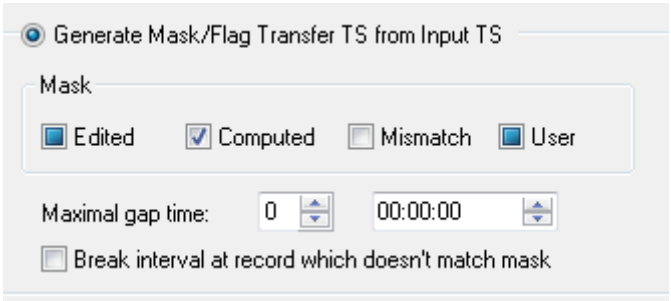
Remark: *Input TS* and *Output TS* are time series chosen in Computation dialog. Flag-masks 'Input Condition' and 'Output Condition' in Computation dialog are ignored in Mask/Flag Transfer.



Picture 141: Mask/Flag Transfer

11.15.6 Generation of the Mask Transfer TS from flags of Input TS

The Mask Transfer TS represents time intervals in which flags of Input TS match the *Mask*. For definition of the *Mask*, user can choose from three states of every flag – set, clear and ignore.



Picture 142 : Generation of the Mask transfer TS from Input TS

Interval is started (1 is put to the Mask Transfer TS) at time, when the record (flags of record) of Input TS match the *Mask*. Interval is finished (0 is put to the Mask Transfer TS) on the matching record, which is followed by a Gap. The Gap is time segment, which is longer than *Maximal gap time* and doesn't contain any records with matching flags. When *Break interval at record which doesn't match mask* is checked, interval is finished also on matching record, which is followed by record with nonmatching flags (in another words, interval must not contain records which doesn't match the *Mask*). Next interval is started at nearest following record with matching flags.

11.15.7 Application of Mask Transfer TS on flags of Output TS

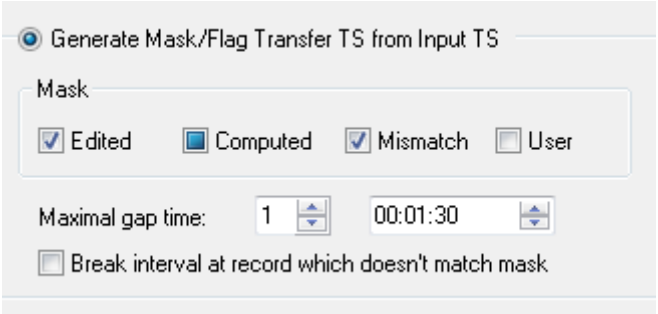
In the Mask/Flag Transfer dialog, this procedure is called “Modify flags of Output TS”. Only two flags could be modified – the “Mismatch” and “User” flag. There are three possibilities how to modify flags of Output TS (they are be chosen separately for every flag):

- **N/A** The flag is ignored; it is not modified anywhere.
- **Add** When the record (of Output TS) is in some interval described by Mask Transfer TS, the flag is set. When the record in not in any interval, the flag is not modified.
- **Set** When the record (of Output TS) is in some interval described by Mask Transfer TS, the flag is set. When the record in not in any interval, the flag is cleared.

Remark: Intervals are closed from left side and open from right side.

11.15.8 Generation of the Flag Transfer TS from flags of Input TS

User choose, which flags should be used for generation of the Flag Transfer TS. This choice is only yes/no for every flag. The flags that are not chosen are forgotten now (following description speaks only about the chosen flags though it is not always stated).



Picture 143 : Generation of the Flag transfer TS from Input TS

Input TS is passed by from the start to the end, and at every change of flags, the sum of active flags is put to the Flag Transfer TS. If the time gap between following records in Input TS is longer than “*Maximal Time Gap*”, 0 is put to the Flag Transfer TS (this interval is considered to be without flags, all flags are cleared) – the result is the same as if the first record was immediately followed (at the same time) by record with no flags set.

11.15.9 Application of Flag Transfer TS on flags of Output TS

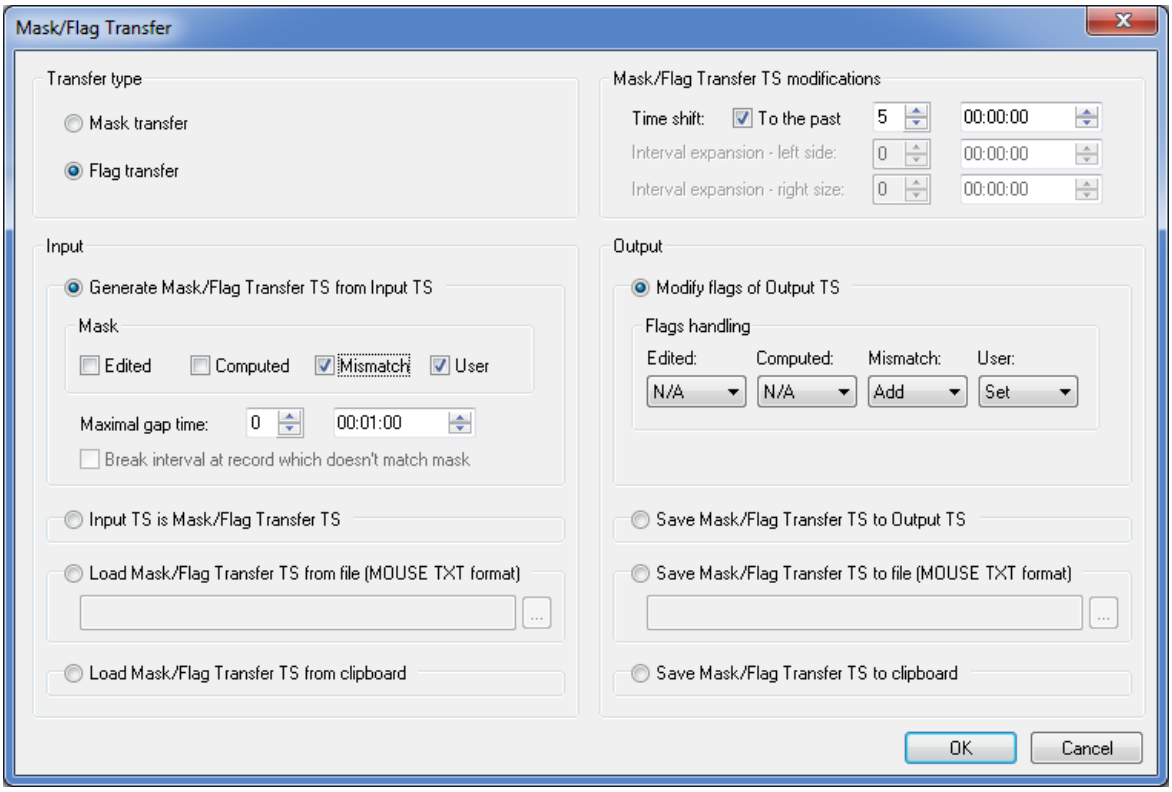
In the Mask/Flag Transfer dialog, this procedure is called “Modify flags of Output TS”. There are three possibilities how to modify flags of Output TS (they are be chosen separately for every flag). We will describe it only for the “Mismatch” flag. The other flags are analogical (all flags can be modified, not only the “Mismatch” and “User” flag).

- **N/A** The “Mismatch” flag is ignored, it is not modified anywhere.
- **Add** When the record (of Output TS) is in some interval described by Flag Transfer TS, where the “Mismatch” flag is active (the interval is started by number that contains number 4 – see description of Flag Transfer TS), the flag is set.
  When the record in not in any interval, where the “Mismatch” flag is active, the flag is not modified.
- **Set**: When the record (of Output TS) is in some interval described by Flag Transfer TS, where the “Mismatch” flag is active (the interval is started by number that contains number 4 – see description of Flag Transfer TS), the flag is set.

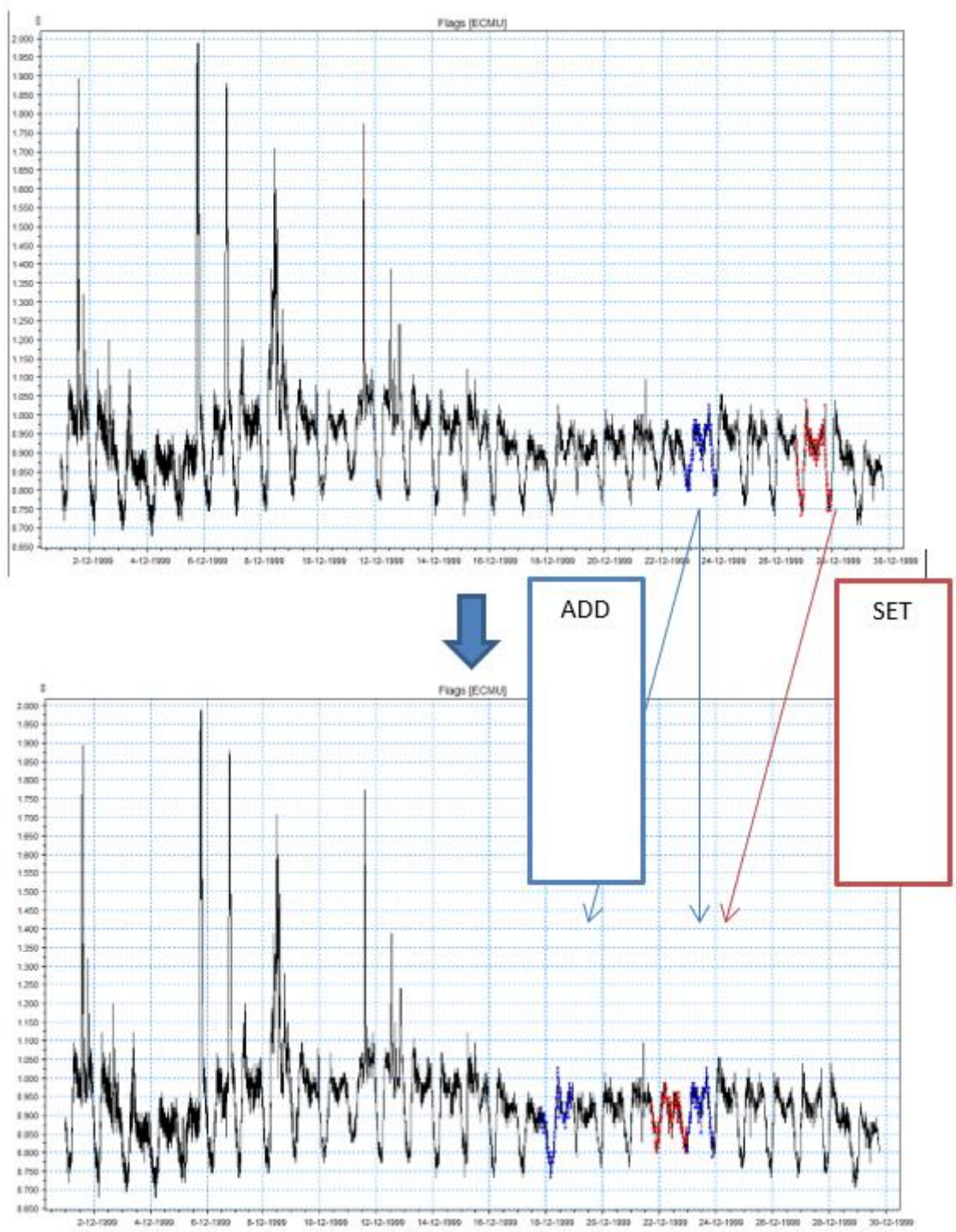
When the record in not in any interval, where the “Mismatch” flag is active, the flag is cleared.

Remark: Intervals are closed from left side and open from right side.

Example:



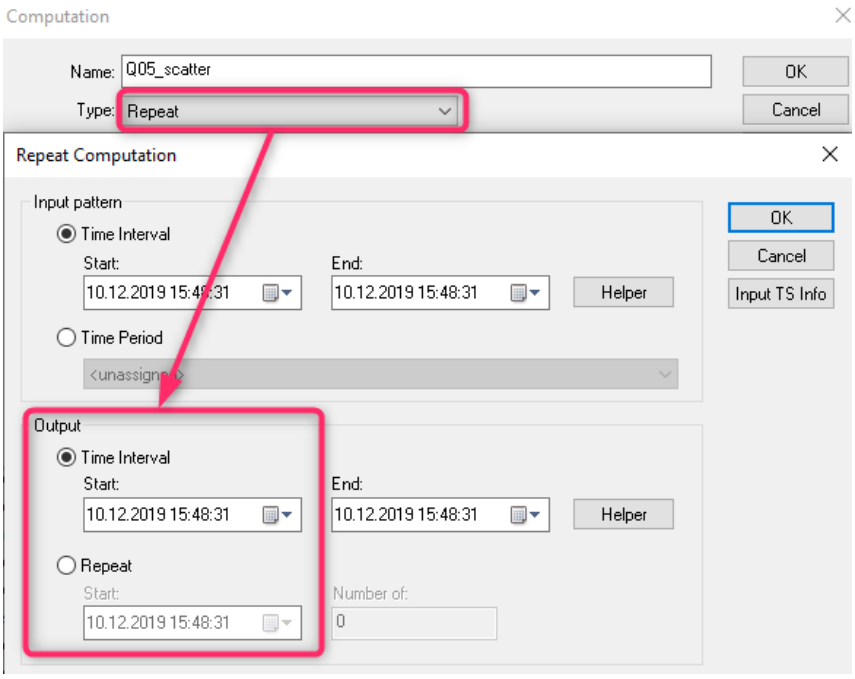
Picture 144 : Mask/Flag Transfer Example



Picture 145 : Flag Transfer - The Results

11.16 Repeat Computation

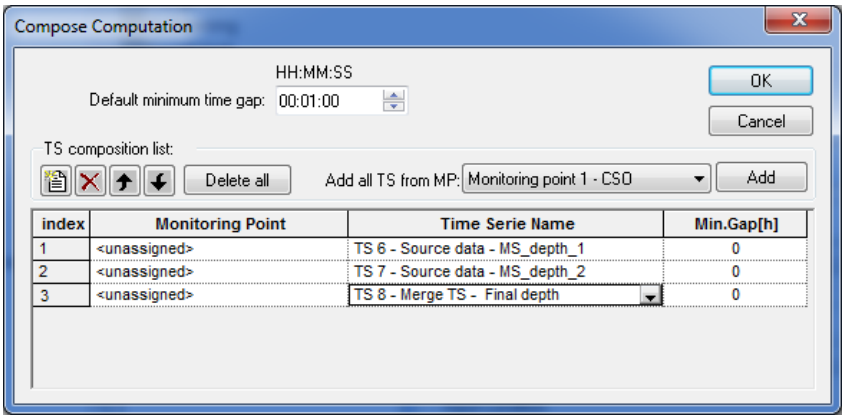
Enables the user to create a Time Series based on the master profile.



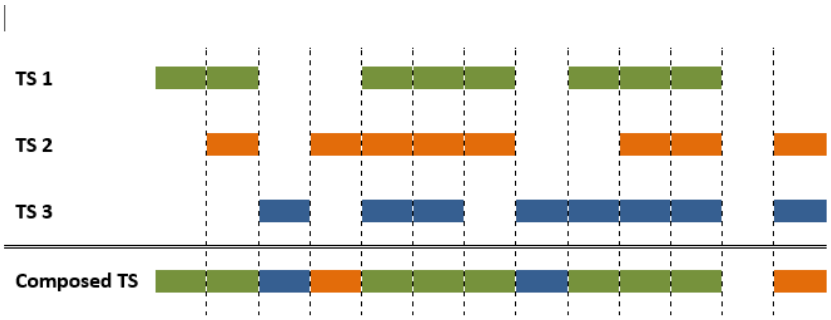
Picture 146 : Repeat Computation

11.17 Compose TS

This function merge TS from different time series (various data sources) in purpose to create the best available Time series based on existing data and covering maximum period available. You compose your TS composition list in that way that you insert the time series by priority. It means the most important (highest quality data) TS on the top and rest gradually in lower positions. Output TS is composed in each time step based on data available in the list following the priorities. For each time step are taken values from the most important TS in that interval.



Picture 147 : Compose TS

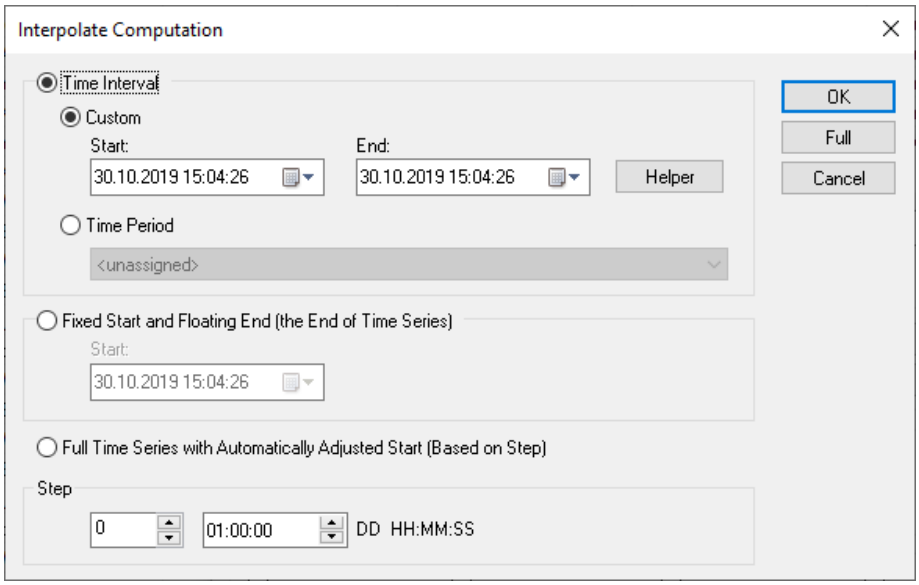


Picture 148 :Example of composing TS

Minimal Time Gap can be set for each TS or by default for all TS. Min. Time Gap is minimal time interval of missing data, when other TS with lower priority is taken for composed TS. Example: Time series have time step 1 minute. We want to omit small gaps in data, because the TS with higher priority is for our purpose better than others even with these small gaps. We can set Min. Time Gap to 2 minutes and gaps smaller than 2 minutes will be overlooked as if there was no gap (see below).

11.18 Interpolation

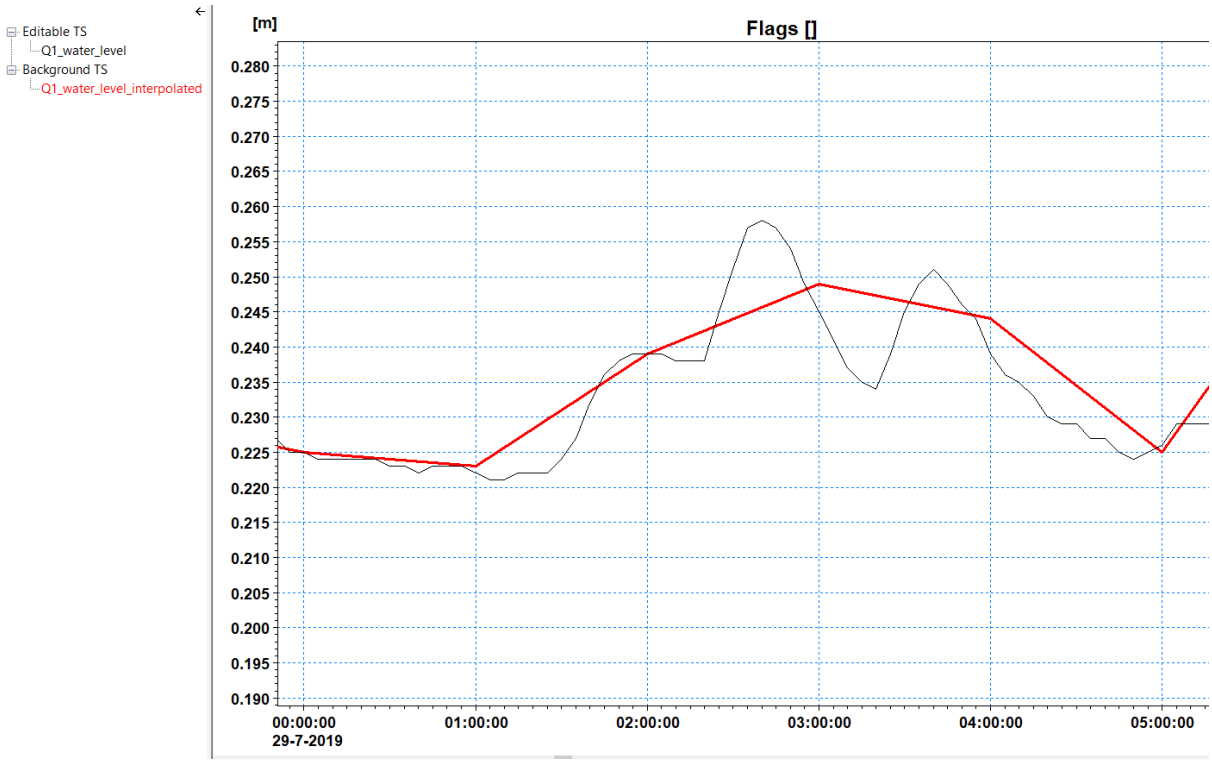
This function allows to linearly interpolate between 2 values in time series according to a selected time step.



Picture 149 : Interpolation

- **Custom** enables to set the user time interval, if clicked on *Full,* complete Time interval will show
- **Time Period** based on any Time Period created in time Periods
- **Fixed start and Floating End (the End of Time Series)** Based on time step
- **Full Time Series with Automatically Adjusted Start (Based on Step)**
- **Step** Time step of interpolation (from left Days, Hours, Minutes, Seconds)

Example of 1 hour time step interpolation of water level data is shown at following picture:

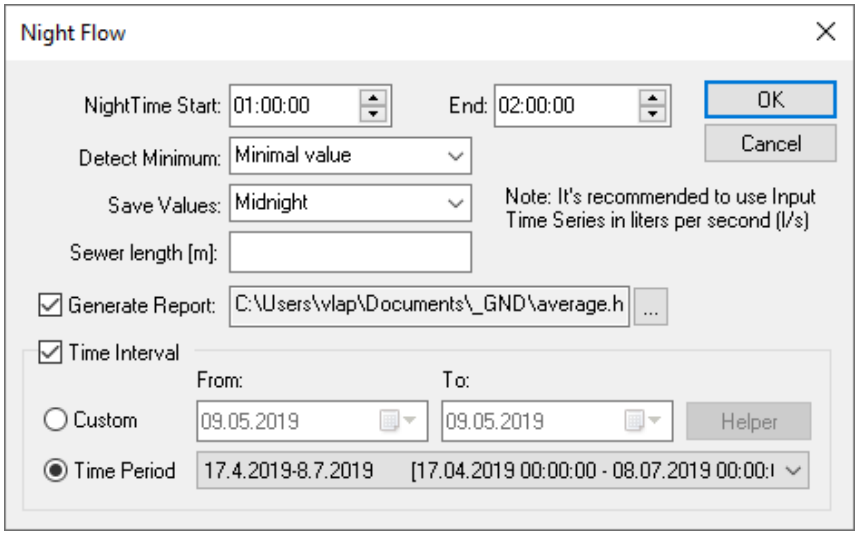


Picture 150 : Interpolation example

11.19 Night Flow

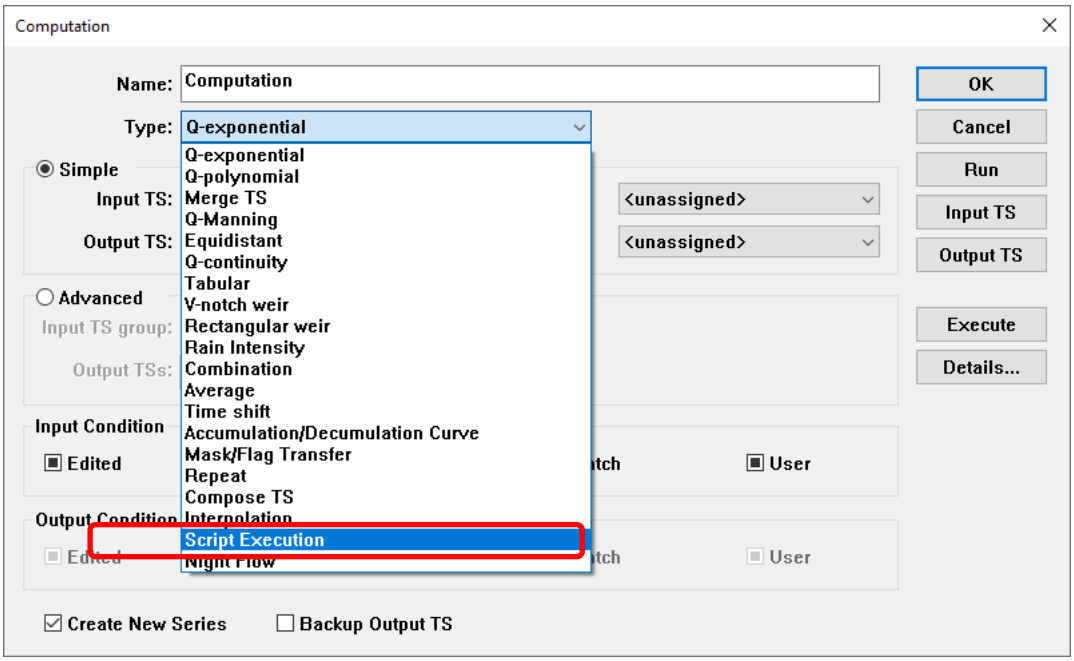
This function allows to detect minimum or average values during the night period.

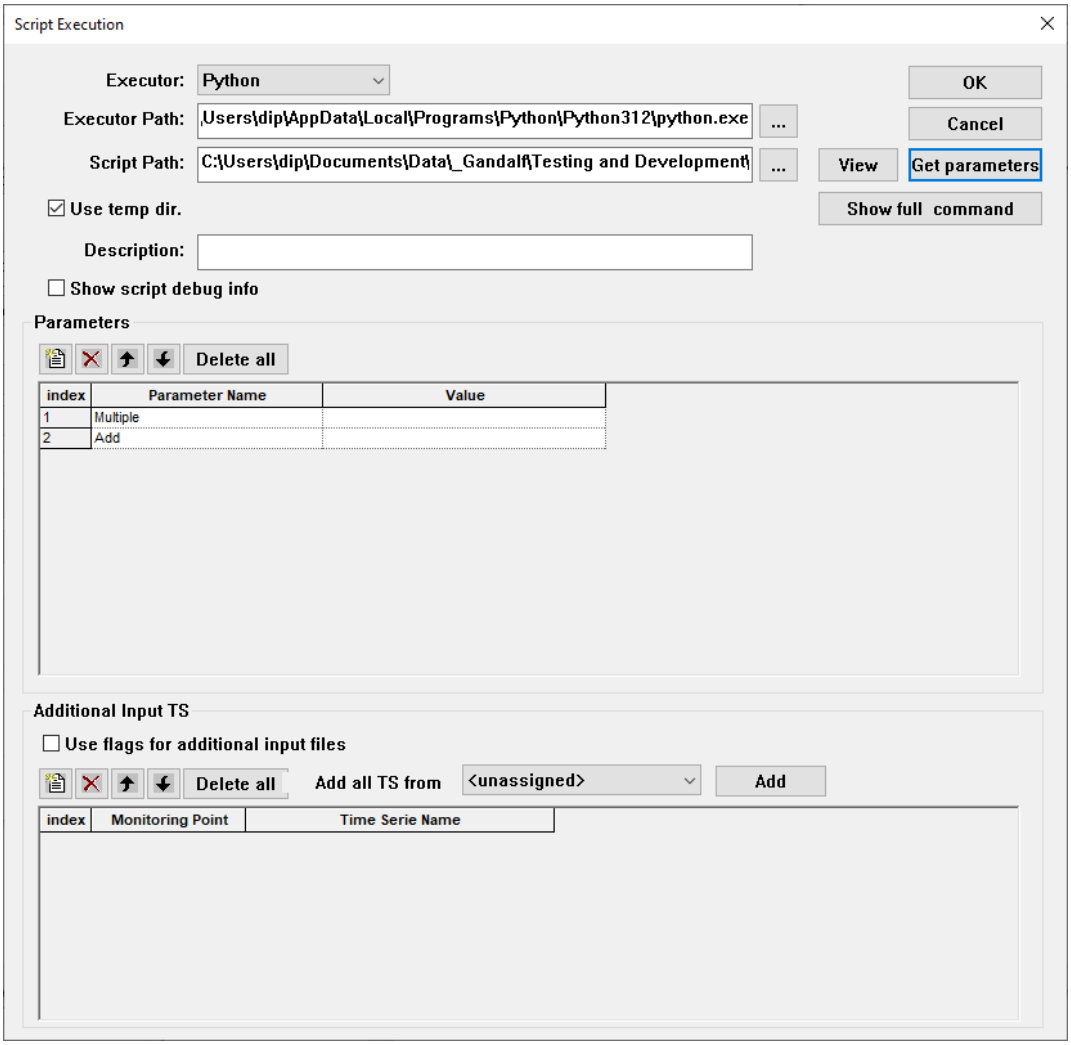
It is possible to add optionally the sewer length to obtain values of liter/day/meters that is found in generated report together with other results.



Picture 151 : Night Flow

11.20 Script Execution





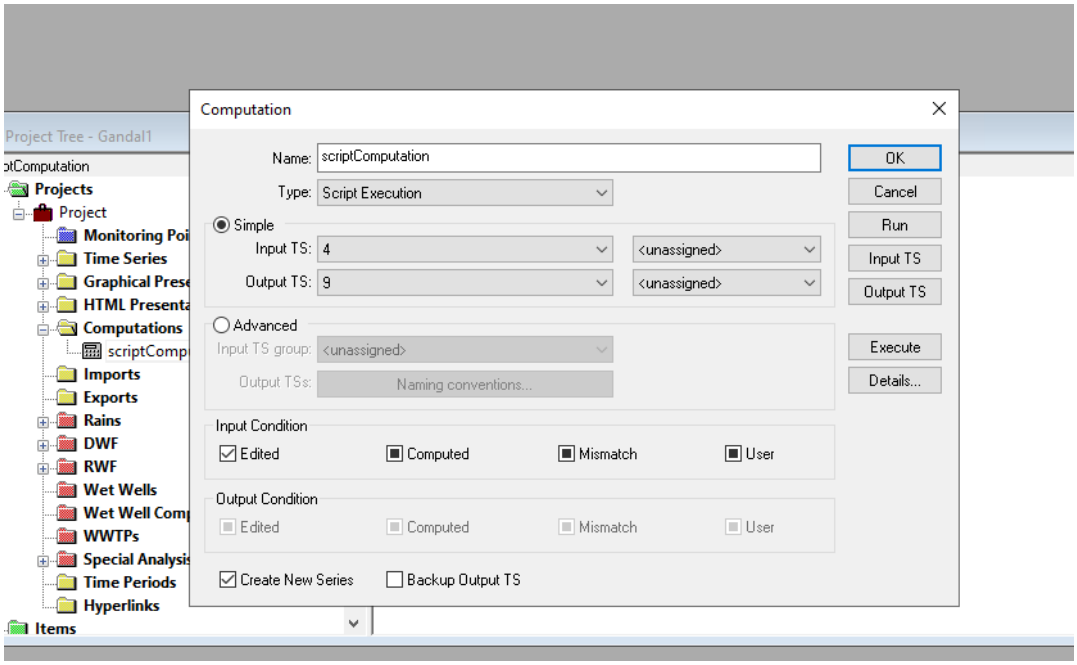
Script execution is a new type of the computation. Allow run executable file and provide analysis.

When computation is executed, Gandalf exports input time and additional input series filtered by given condition to the dfs0 file, executor provided with the script (in case of python), name of the input time series, name of the output time series and list of the parameter values is run. Output file in dfs0 format is created. Finally, Gandalf imports data from the file to the output time series.

For the script, MIKEIO python lib is needed. [GitHub - DHI/mikeio: Read, write and manipulate dfs0, dfs1, dfs2, dfs3, dfsu and mesh files.]

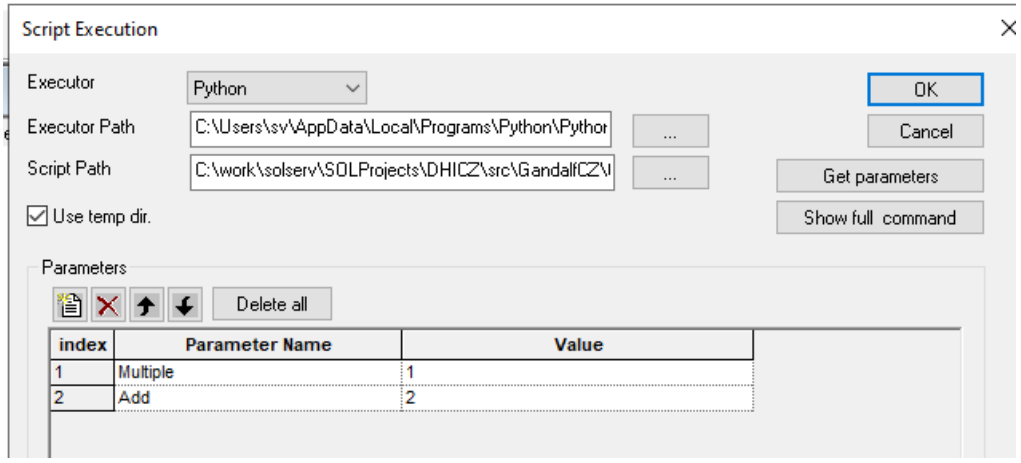
Data inputs

Input time series, Input condition and Output time series (only create new is supported) are filled in the standard Computation dialog.



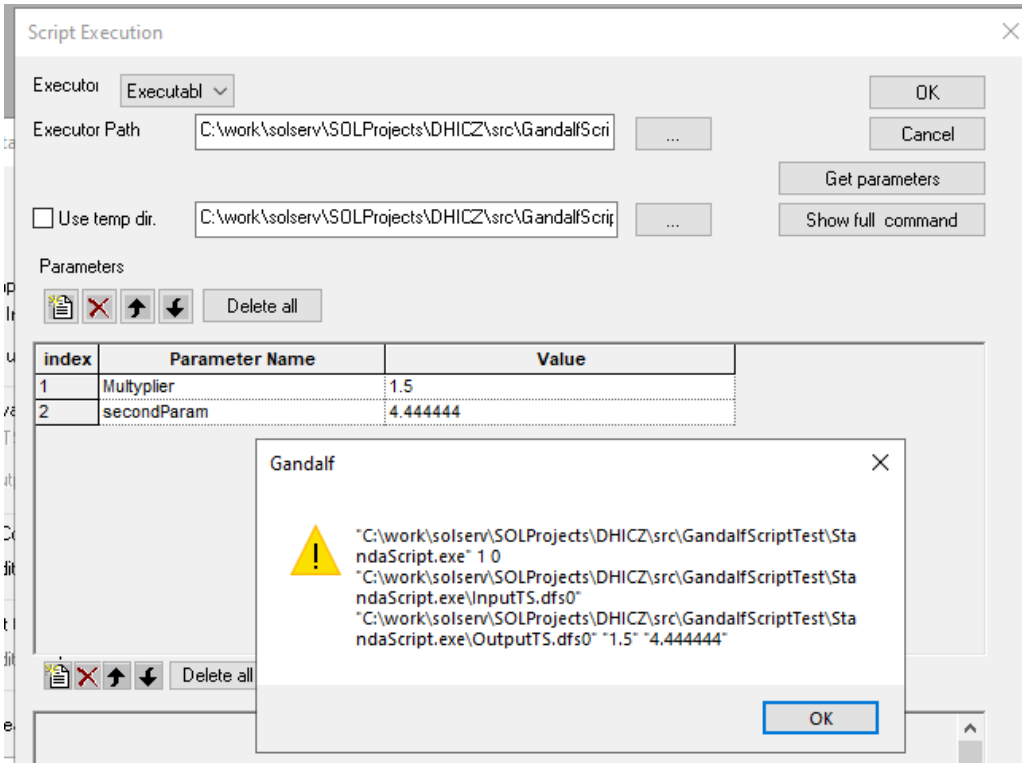
In detail dialog type of the executor is selected. Currently Python and Executable.

Path to the executor is selected – in the case of Python it is py.exe in python dir. In case of Executable -> .exe file is selected. In the case of Python – path to the python script is provided.



Get parameters -> if script or executable are written properly, grid is pre-filled by parameter names. It is possible to add, remove and change order of the parameters.

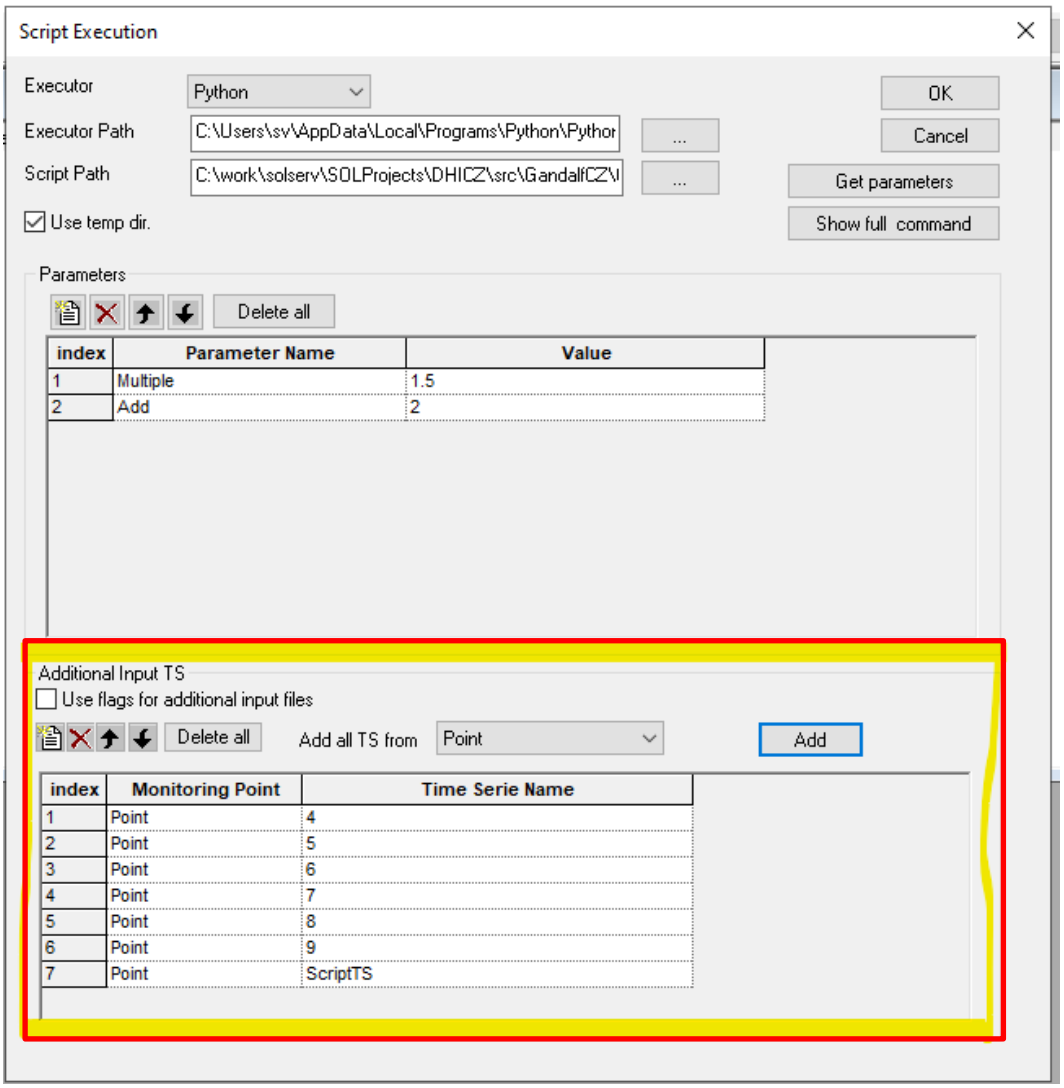
Show full command present command line to be executed.



Use temp dir. - selection of the directory, where dfs0 file will be exported / imported. When option Use temp dir. is ticked ***c:\Users\userName\AppData\Local\Temp\DHI_GandalfScript\computationName*** directory is created. Export/import files are saved/load from there.

Additional Input TS

Additional Input TS are possible to be add and used in script.

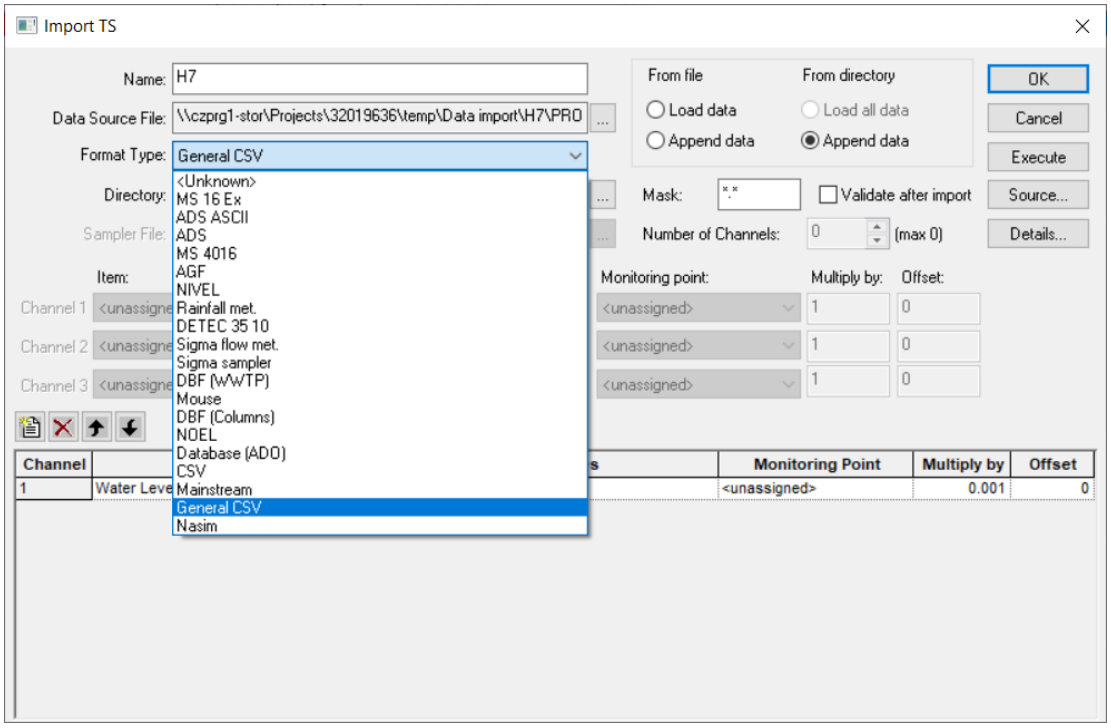


Grid can be prefilled using selection of Measuring point in *Add all TS from MP* using **Add** button. Individual TS can be added, reorganized, and deleted in the Grid.

Option **Use flags** for addition input files provide possibility to filter additional input files using the same flags as used for primary TS.

12 Imports

Measured data are imported into the internal data format from the different range of the file formats provided by measuring devices (ADS devices, AGF, Fiedler, NOEL, mouse, etc., including General CSV). You can do the offset and multiplication during the import. Import definition (including offset and multiplication constant) are stored for the future use. You will see the starting part of the imported file as the help for format selection by using button Source. Time series are fully rewritten by the imported data. You can import new data into temporally time series and after that connect it to the existing time series.



Picture 152 : Import TS

Properties of Import TS contain name, source file, format type given by type of measurement equipment (vendor), number of channels (1 data source file can fill several time series) and specific time series and its type for each channel. *Import Properties* are saved in GANDALF so imports can be executed any time, when it is necessary.

The following items are open to use in Import Properties:

- **Name** Name of specific import.
- **Data Source File** Path to source file.
- **Format Type** Type of source data.
- **Number of Channels** Number of used channels (number of time series in one imported file).
- **Units** Selection of units used during measurement.
- **Time Series** Selection of defined time series.
- **Multiply by** Multiplier value - how many times will be source data in time series multiplied.
- **Offset** Value of offset.
- **Execute** This button will execute the import.
- **Source** View of source data.
- **Details** setting up of import details (format settings must respond to format of data source file)

12.1 How to load data

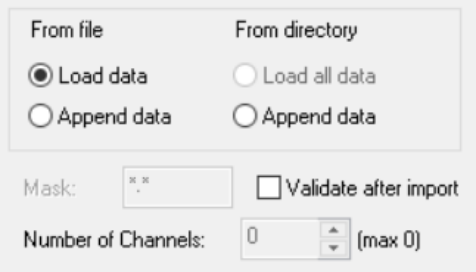
There are 2 general approaches how to set up the way to successfully import data:

From file

- **Load data** loads single file
- **Append data** joins data if it is consisting of separate following -up time intervals

From directory

- **Load all data**
- **Append data** joins data based on defined *Mask* (for example same prefix of monitoring point)



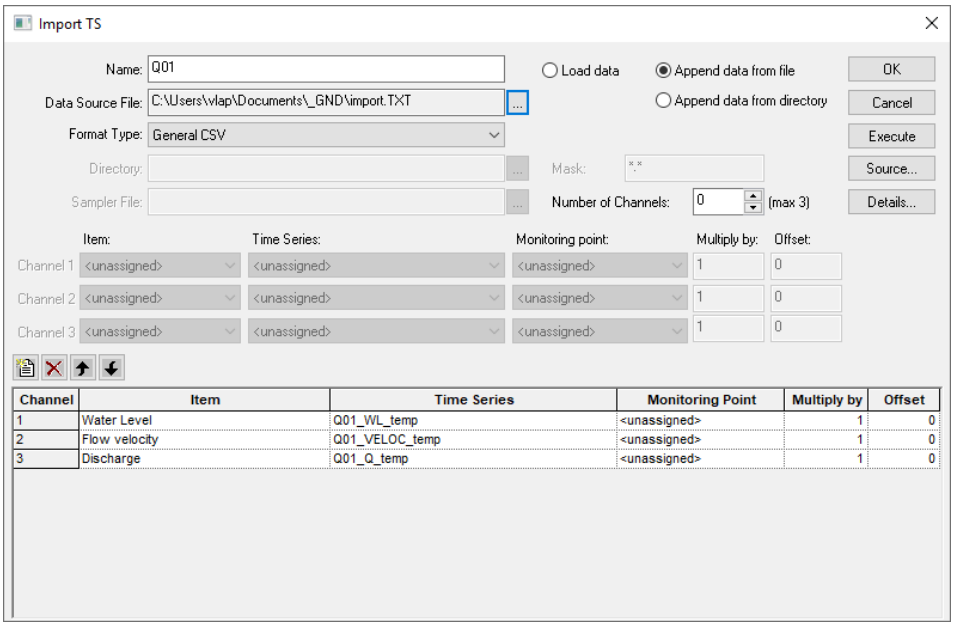
Picture 153 : Loading and appending data

If *Validate after import* is checked it will verify whether TS does not contain any time overlaps.

12.2 General CSV Import

General CSV file can be used for any type of import. Data format of CSV is set in *Details*. There has to be set type of CSV data separator, date and time format, decimal separator, number of header lines or text to detect header line, footer detection and additional settings such as date and time properties, non-valid values replace, Time order, months names, columns skip and data selection.

For frequently used data formats is possible to save your settings as a template. Templates can be imported or exported.

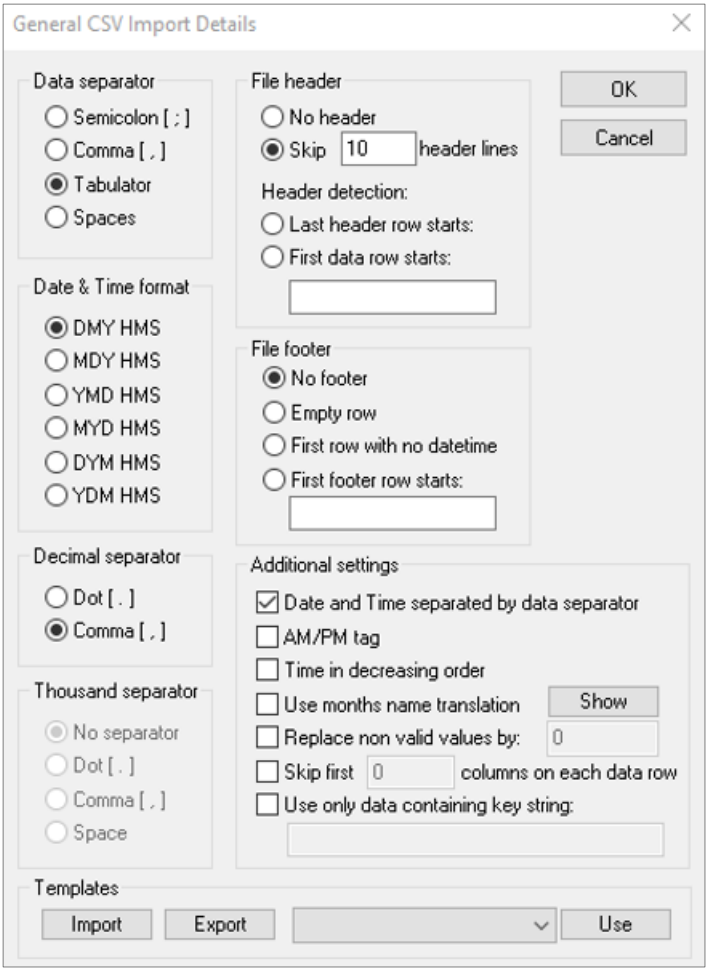


Picture 154 : General CSV Import

General CSV Import Details must comply with source data format, otherwise any data will not be imported. See picture below to understand a correspondence between source csv file and import Details.

```
NIVUS   KAD-Q01

CPU32:  V1.12   25/09/07        FLASH : 9000A   KDA   : (1)V2.10 07/12/11 (4)
datum   07.05.2019      c:\KADxQ01x.txt

                brana min[m]:    0,055
                brana max[m]:    2,790

datum   cas     hladina [m]     rychlost [m/s]  prutok [l/s]    T [°C]  ADC_1 [m]

07.05.2019      10:50:00        0,221   0,527   119,055 14,1
07.05.2019      10:52:00        0,219   0,533   119,350 14,1
07.05.2019      10:54:00        0,218   0,532   118,044 13,9
07.05.2019      10:56:00        0,217   0,516   113,135 13,8
07.05.2019      10:58:00        0,217   0,544   119,778 13,6
07.05.2019      11:00:00        0,217   0,540   118,545 13,5
07.05.2019      11:02:00        0,216   0,520   113,791 13,6
07.05.2019      11:04:00        0,216   0,523   114,426 13,5
07.05.2019      11:06:00        0,217   0,525   115,347 13,5
07.05.2019      11:08:00        0,217   0,525   115,668 13,4
07.05.2019      11:10:00        0,218   0,522   115,787 13,4
07.05.2019      11:12:00        0,220   0,528   118,315 13,4
07.05.2019      11:14:00        0,222   0,551   125,061 13,5
07.05.2019      11:16:00        0,222   0,531   121,027 13,5
07.05.2019      11:18:00        0,220   0,521   117,261 13,4
07.05.2019      11:20:00        0,220   0,535   120,037 13,4
```

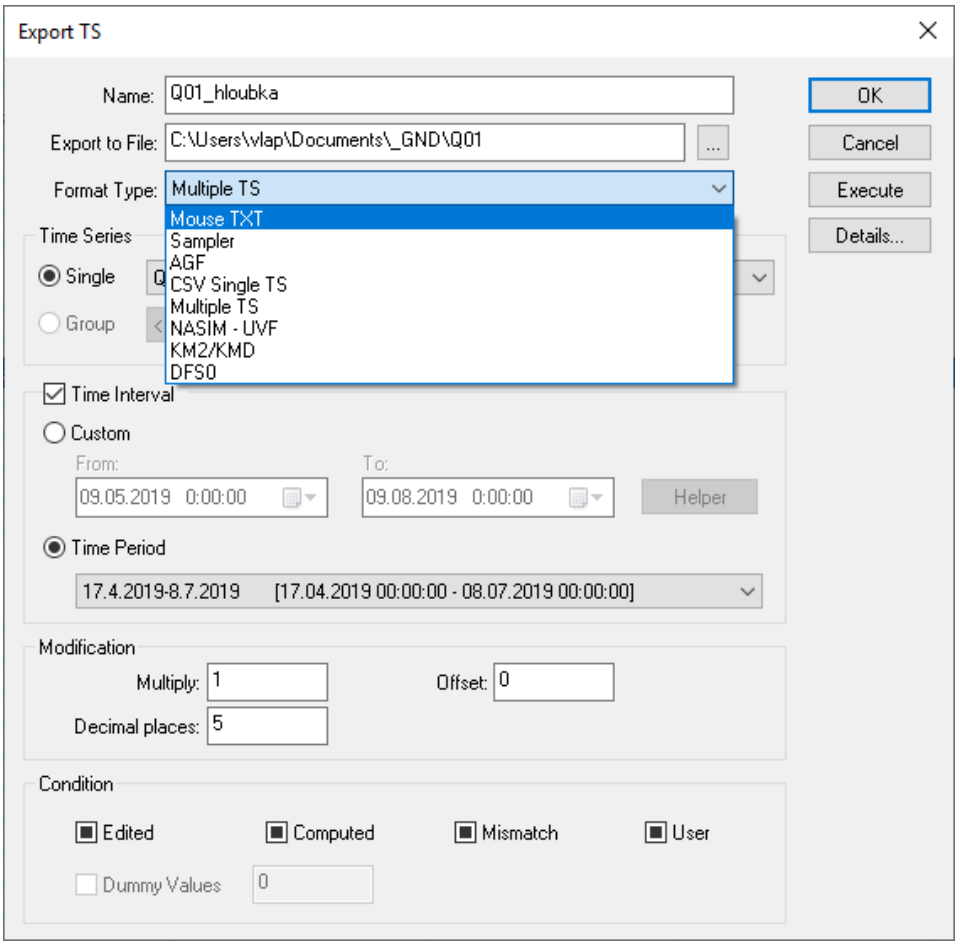
Picture 155 : General CSV Import – Source cvs



Picture 156: General CSV Import Details

13 Exports

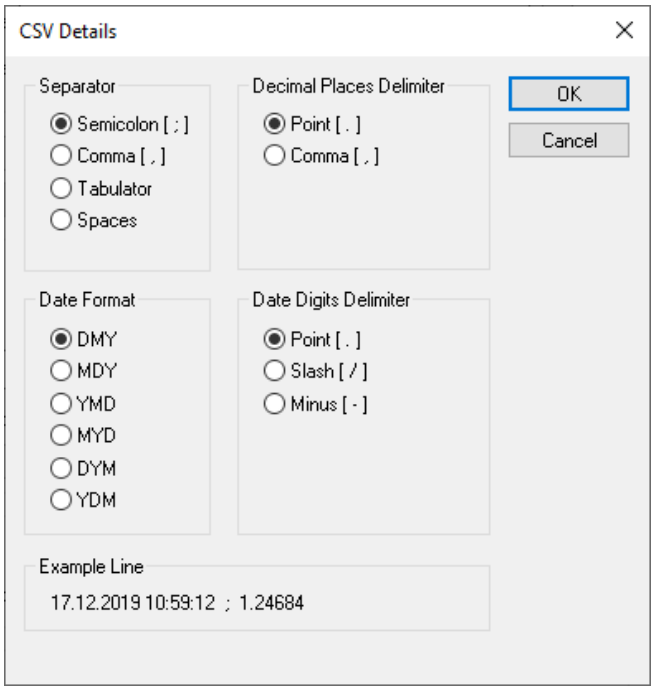
Export contains name, export file, format type (Mouse, Sampler and AGF), exported time series (either whole time series or just specific time interval), multiplier and offset. User can also restrict exported data by choosing specific flag (edited, computed, mismatch and user) and choose if also dummy values (i.e. data without measured values) should be exported.



Picture 157 : Export TS

13.1 Export CSV Single TS

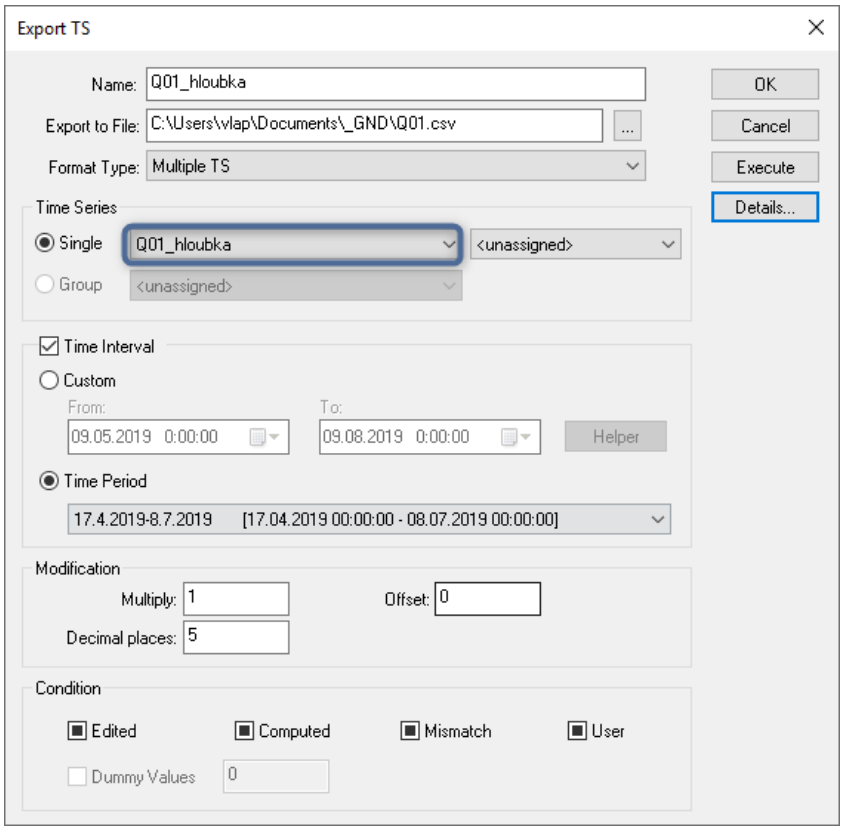
CSV Single TS export enables to export Time Series as a table in CSV format. In *Details* the data format specifications are determined as shown below.

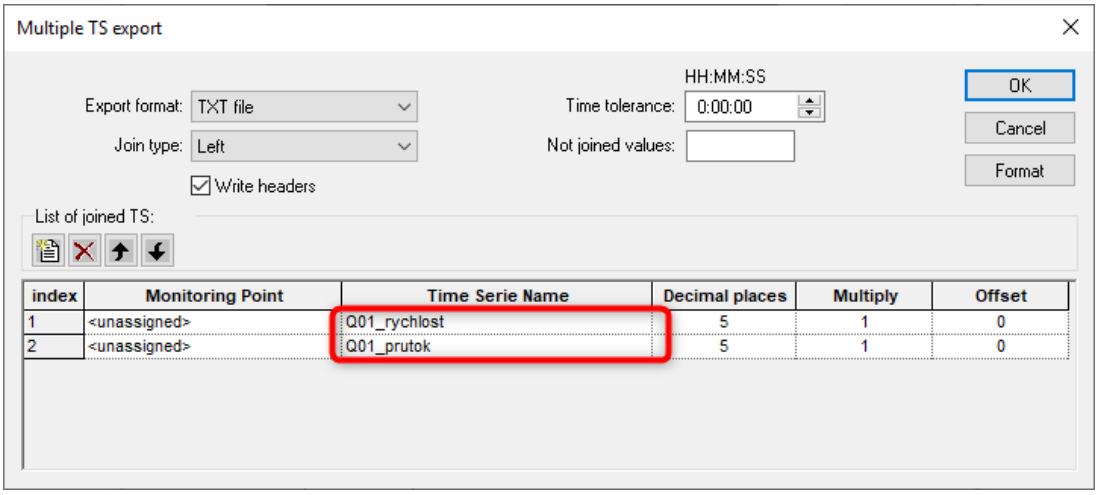


Picture 158 : CSV Details (Single)

13.2 Export Multiple TS

Multiple TS export enables to export multiple Time Series in one CSV table. There is always one main TS that determines the time step. This TS has in CSV file exactly one value for one-time step. In Details there is possibility to join arbitrary number of another TS. Export will assign every value of other TS available for time step defined by the main TS. Time tolerance can be also set in Details. That tool enables to assign values that are not defined for accurate date and time, but that are defined within adjusted time interval.





Picture 159 : Multiple TS Export Details

Number	Time Serie	Item	Units
1	Q01_hloubka	Water Level	m
2	Q01_rychlost	Flow velocity	m/s
3	Q01_prutok	Discharge	m^3/s
17.04.2019 0:02	0.1717	0.31987	0.03177
17.04.2019 0:04	0.1717	0.26023	0.02585
17.04.2019 0:06	0.1717	0.28517	0.02833
17.04.2019 0:08	0.1707	0.25047	0.02467
17.04.2019 0:10	0.1707	0.26132	0.02574
17.04.2019 0:12	0.1707	0.25698	0.02531
17.04.2019 0:14	0.1707	0.29385	0.02894
17.04.2019 0:16	0.1707	0.25156	0.02478
17.04.2019 0:18	0.1707	0.29276	0.02884
17.04.2019 0:20	0.1697	0.28734	0.02806
17.04.2019 0:22	0.1697	0.26891	0.02626
17.04.2019 0:24	0.1707	0.26132	0.02574
17.04.2019 0:26	0.1707	0.30035	0.02958
17.04.2019 0:28	0.1707	0.27433	0.02702

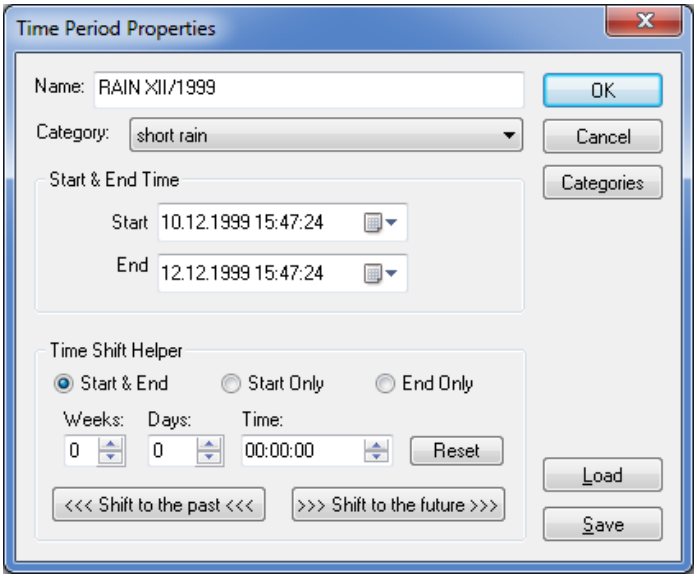
Picture 160 : Multiple TS Export

First column of the export in the export file time and date, the second column is the main TS defined in Properties menu (blue) and other columns are reserved for joined TS (red) from *Details* menu.

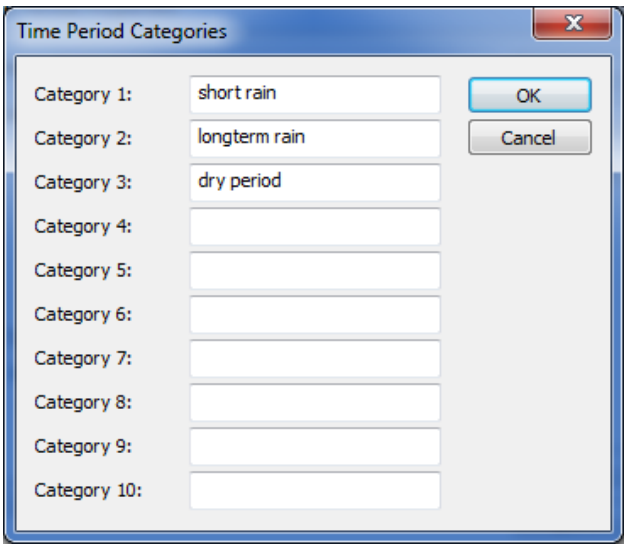
Same way it is possible to export multichannel DFS0 files.

14 Time Periods

Time periods defines a set of individual periods which can be used during data processing e.g. for Zooming in Time series presentation or Scatter Graphs and in Export of the data. Each period can be assigned to Category. Categories are set in *Categories* menu.

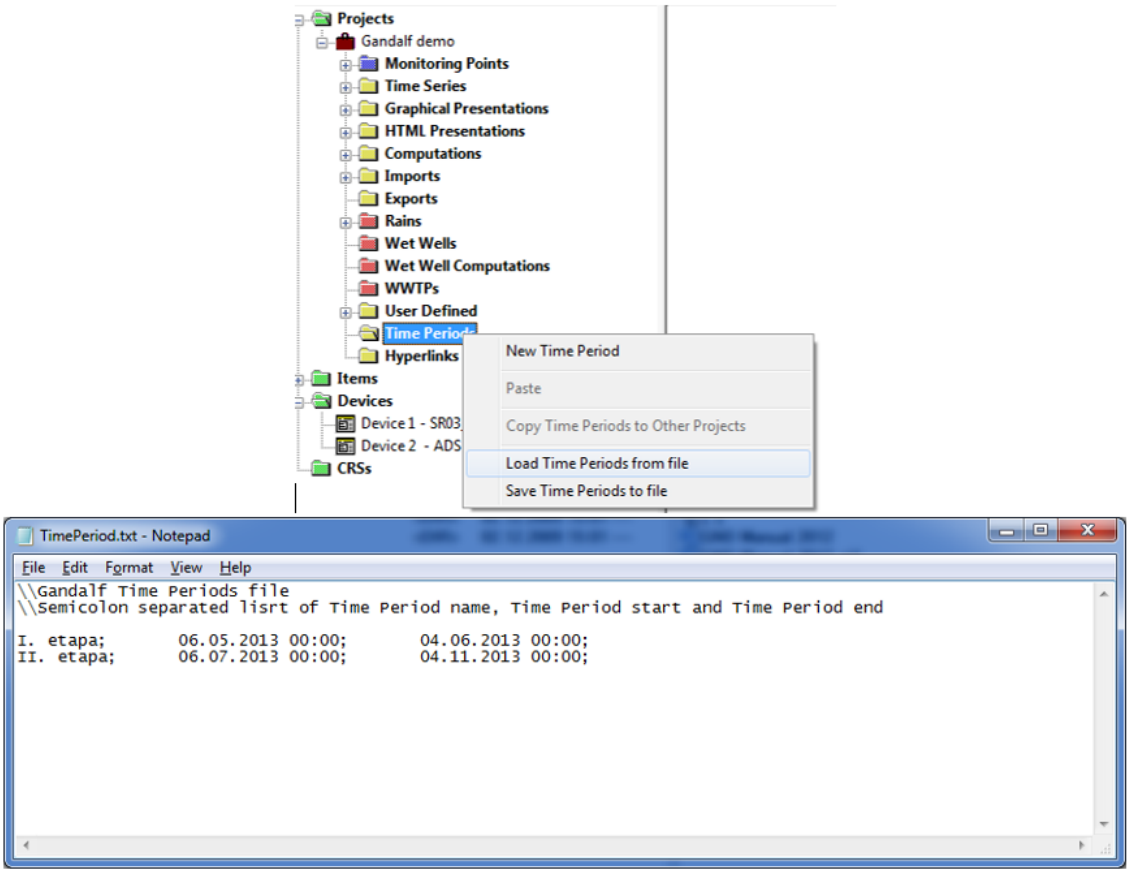


Picture 161 : Time Period Properties



Picture 162 : Time Periods Categories

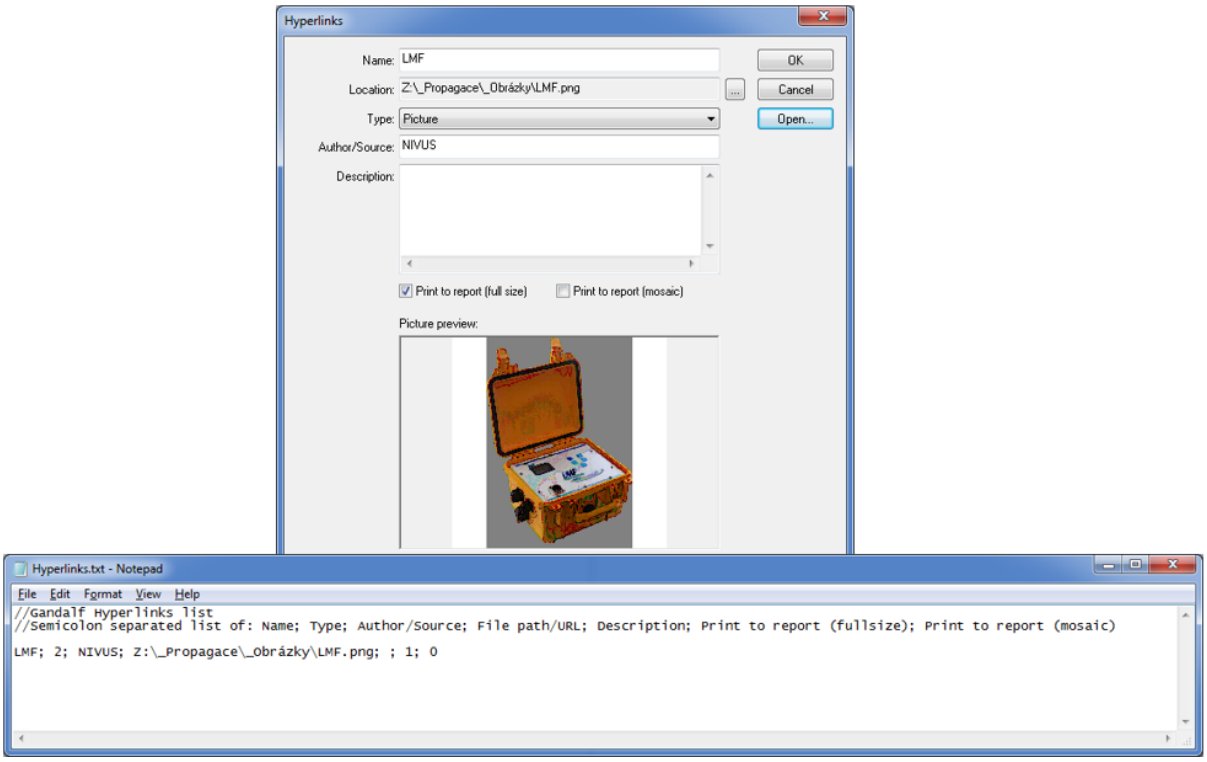
Newly it is possible to save/load Time Period from the pre-prepared TXT file or e.g. the result of the Rains analyses.



Picture 163 : Load Time Period from File

15 Hyperlinks

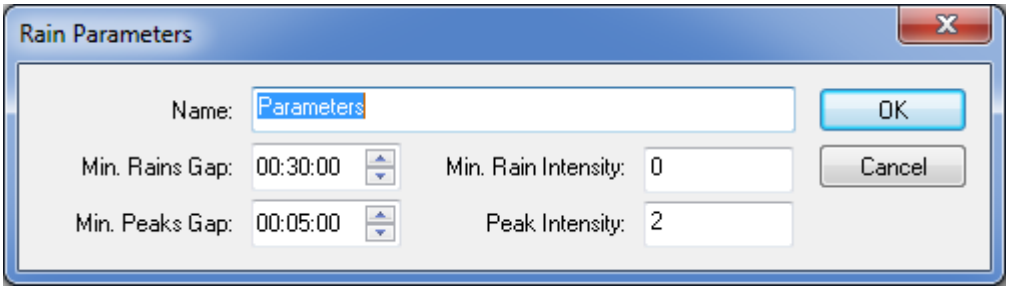
It is possible to link pictures, videos and related document and files to project. These documents can be thereafter printed in report. Hyperlinks can be saved or load in local menu.



Picture 164 : Hyperlinks

16 Rains

The menu **Rains** is designed for rainfall data analysis and especially for selection of sub-series of rainfall data and/or individual rainfall events for MOUSE HD applications.



Picture 165 : Rain Parameters

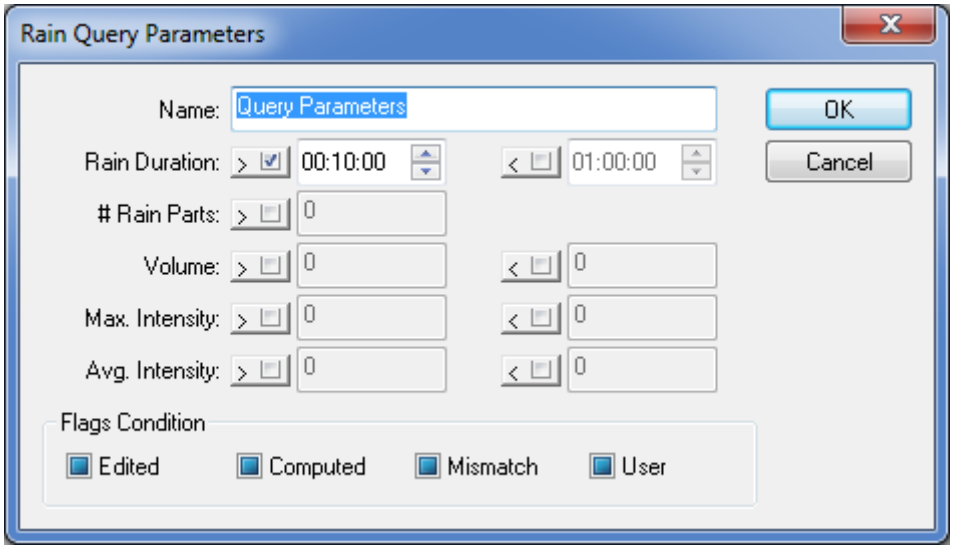
There are three main parameters defining the conditions for selection of sub-series of rainfall, as follows:

- Minimum Rain Gap
- Minimum Peaks Gap
- Peak Intensity
- Minimum Rain Intensity (when 0 is filled all rainfalls are taken into process)

The following items are open to use in Rain Parameters:

- **Name** Name of Rain Parameter Set.
- **Min. Rains Gap** Interval of dry weather period. If the dry weather period (interval containing only zero values) is longer than the given gap the first non-zero value in considered as new rainfall event.
- **Min. Peaks Gap** Interval separated two rain according peak intensity If the intensity of the rain is below to value of Peak Intensity longer than the given gap the first non-zero value in considered as new rainfall part.
- **Peak Intensity** Value of peak intensity of rain.
- **Min. Rain Intensity** Defines the minimal rain intensity from which the rainfall is taken into the rain statistic process.

Rain Query Parameters menu allow user to choose rains with selected characteristics: Rain Duration, Rain Parts, Volume, Maximum and Average Intensity.

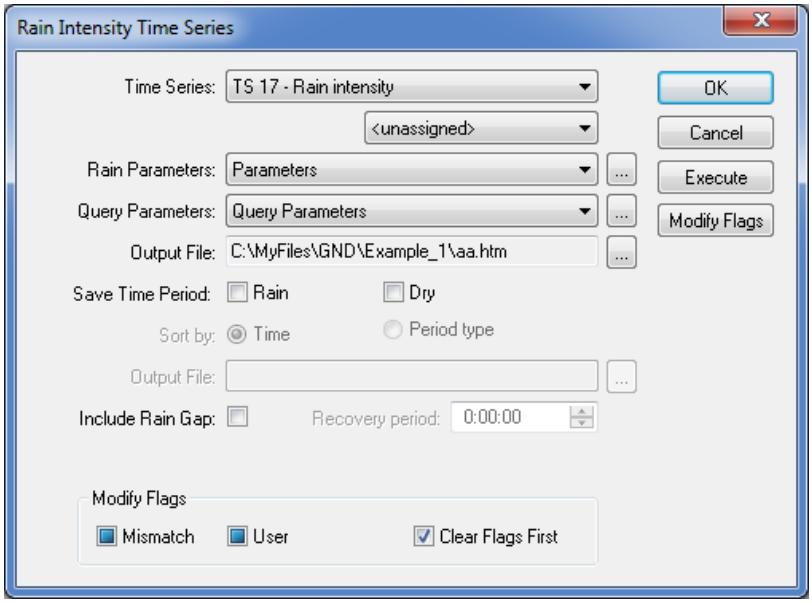


Picture 166 : Rain Query Parameters

The following items are open to use in Rain Query Parameters:

- **Name** Name of Rain Query Parameters.
- **Rain Duration** Definition of Rain Duration. It selects rains either longer or shorter than given value. Also, the interval for rainfall time of duration can be set-up.
- **Rain Parts** Definition of Rain Parts. It selects rains according to how many rainfall parts (see peak gap) are within the rain.
- **Volume** Definition of Total volume of the rainfall event. It selects rainfalls according to their total volume (precipitation).
- **Max. Intensity** Definition of Maximum Rain Intensity. It selects rainfalls according to their maximum intensity during the rainfall.
- **Avg. Intensity** Definition of Average Rain Intensity. It selects rainfalls according to their average intensity during the rainfall.

Rain Intensity Time Series menu allows user to choose Time Series, Rain and Query Parameters. Selecting the button execute the program computes the new rainfall data series according to given parameters in Rain Parameter menu and Rain Query Parameters Menu The result can be stored either as new TS or being exported (saved) as HTML file.



Picture 167 : Rain Intensity Time Series

The following items are open to use in Rain Intensity Time Series:

- **Time Series** Selection of existing time series (defined or imported). These TS can be assigned to specific Monitoring Point.
- **Rain Parameters** Selection of already defined Rain Parameters.
- **Query Parameters** Selection of already defined Query Parameters.
- **Output File** Path to export file.
- **Execute** This button will execute the computation (selection) of time series of rainfall.
- **Modify flags** This button will restrict of shown data by Selection of specific flags.
- **Save Time Period** Saves result of Rains statistics (start and end time of the rain) as Time periods in regular (Rain days) or inverted (Dry days) form.

HTML report (output file) from the Rains statistics

Table 8 : HTML Report Rain Table

Gandalf - Rains (TS 17 - Rain intensity)

Parameters	
Time Series	TS 17 - Rain intensity (C:\MyFiles\GND\Example_1\TS 17 - Rain intensity.dfs)

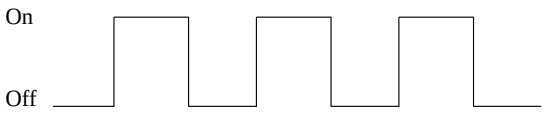
Rains							
Start	**End**	**Duration**	**Volume [-]**	**Max. Intensity [-]**	**Max. Intensity Time**	**Avg. Intensity [-]**	**# Parts**
04.12.1999 15:09	04.12.1999 16:56	1:46	13.6	0.0333333	04.12.1999 15:16	0.00212833	1
04.12.1999 18:35	04.12.1999 18:59	0:24	1.2	0.00111111	04.12.1999 18:38	0.000816327	1
06.12.1999 11:06	06.12.1999 11:31	0:25	0.6	0.00047619	06.12.1999 11:13	0.000392157	1
06.12.1999 23:39	07.12.1999 00:43	1:4	3.8	0.00333333	06.12.1999 23:59	0.000989583	1
09.12.1999 20:13	09.12.1999 20:52	0:38	1	0.00166667	09.12.1999 20:52	0.0004329	1
13.12.1999 03:06	13.12.1999 04:34	1:28	1.8	0.000666667	13.12.1999 03:32	0.000340909	1
13.12.1999 05:24	13.12.1999 05:50	0:26	0.4	0.00025641	13.12.1999 05:37	0.00025641	1
13.12.1999 14:12	13.12.1999 15:34	1:22	3.4	0.00666667	13.12.1999 14:37	0.000686869	1
13.12.1999 16:20	13.12.1999 17:05	0:44	1	0.00051282	13.12.1999 16:42	0.000374532	1
30.12.1999 06:12	30.12.1999 07:13	1:1	0.8	0.00037037	30.12.1999 06:48	0.000218579	1

17 Wet Wells

The flow measured in a pump station is calculated by using one of two methods or a combination of these methods:

- Flow calculated from run time and pump capacities.
- Flow calculated from time to fill wet well.

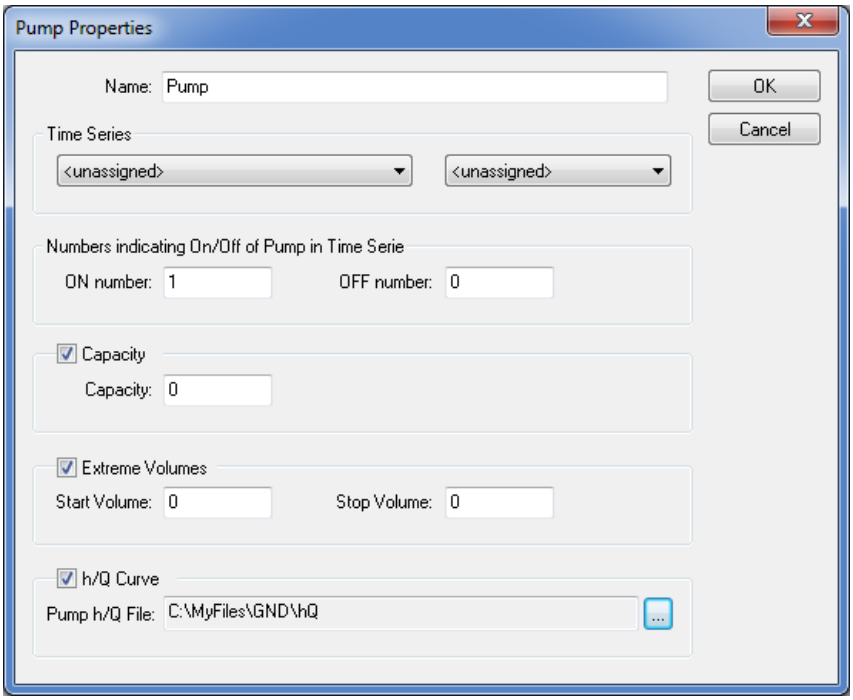
A schematic picture of on and off signals of a pump are showed.



17.1 Definition of Wet Wells

The basic characteristics of the pumping station wet well as well as the pumps is specified in menu *Wet Well/Pump*. Every pump in pumping station has following parameters

- Name of TS, obtaining ON/OFF flags (one TS can be used for more pumps).
- Number, indicating ON and OFF for this pump (important if more TS are in one TS).
- Pump capacity (constant value).
- Start and stop volume in well for this pump.
- Q/h curve of the pump – name of simple text file. If only one line is used – constant capacity is taken.



Picture 168 : Pump Properties

17.2 Wet Wells Computation

Flow calculated from runtime and capacity

If the capacity of a pump or the capacity of a combination of pumps are known the flow can be quantified from the logged runtime and the capacity. If the capacity is unknown or not reliable the capacity can be calculated from the measured incoming flow (see part *Flow calculated from time to fill wet well*).

The outgoing flow is equal to the capacity of the pump. This method to calculate the flow is often used when only one on-signal is logged.

$$Q_{OUT} = Q_{Pest} \text{ (or } Q_{pcalc})$$

Q_{Pest} = the estimated capacity of the pump

Q_{Pcalc} = the calculated capacity of the pump

To quantify the incoming flow from runtime and capacity of pump, use the following equation:

$$Q_{IN} = (Q_{Pest} * t_{on}) / (t_{on} + t_{off\ total}), \text{ where}$$

$t_{off\ total}$ = the total time when the pump is not running (during one pump cycle)

t_{on} = the runtime of the pump

The calculated flow, Q_{IN}, is the average incoming flow during one pump cycle. The total time the pump is running and the total time the pump is off ($t_{off\ total}$), as in figure, defined as one pump cycle.

Flow calculated from time to fill wet well

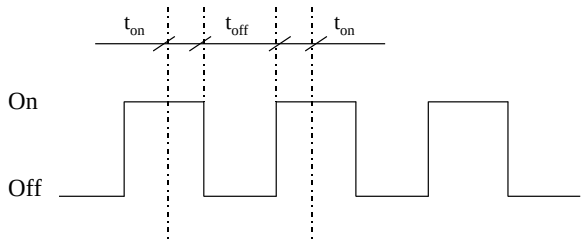
The incoming flow is quantified from the time it takes to fill the wet well with water. To quantify the flow, use the following equation

$$Q_{IN} = V_w / t_{off}$$

V_w = volume of wet well

The calculated flow is an average incoming flow during one pump cycle. The total time the pump is off and the total time the pump is running (tontotal), is defined as one pump cycle. If extrapolated the capacity QPcalc can be calculated.

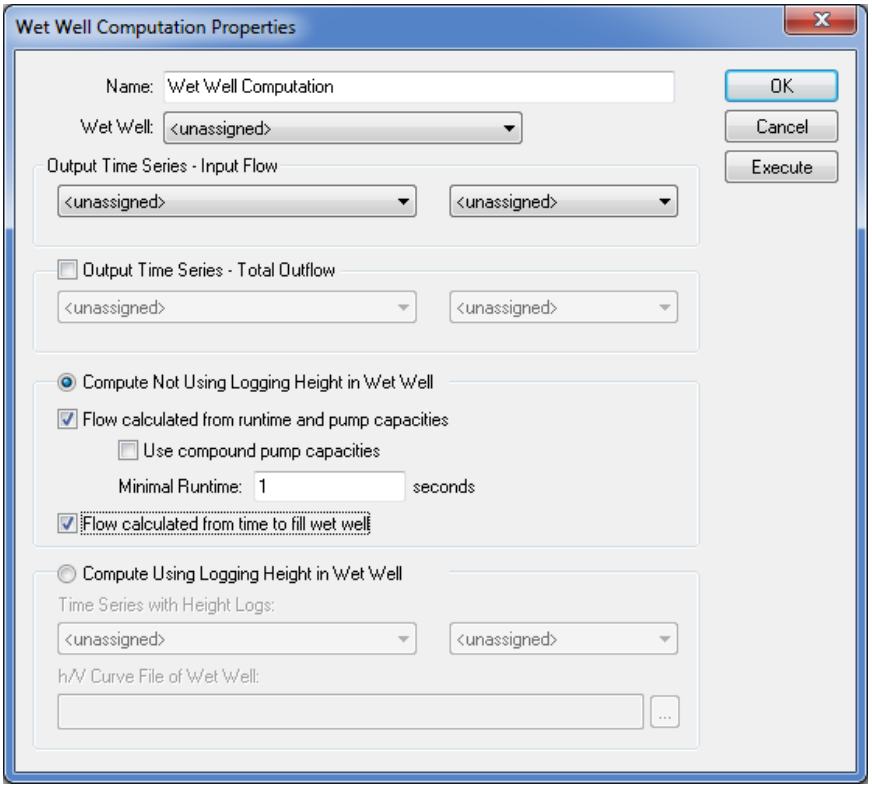
$$Q_{Pcalc} = V_w * (t_{off} + t_{on\ total}) / (t_{off} * t_{on\ total})$$



Combination of methods

When calculating flow, from the time it takes to fill the wet well (Q_{IN}), the following runtime of the pump cannot be too long, or the flow will not be correctly quantified. If the length of the runtime is long, the flow has to be quantified by using the capacity and the runtime of the pump. The user should be able to define when, after the pump starts, to use the runtime and capacity method.

Either one or the other method can be chosen in menu *Wet Well Computation Properties*. The combination of methods can be chosen as well.



Picture 169 : Wet Well Computation

Flow calculated by logging depth in wet well

By logging the depth of water in the wet well the incoming flow can vary over depth.

During runtime of the pump, flow is quantified by using the method to calculate flow from runtime and capacity:

$$Q^{t}_{IN} = (Q_{Pest} * dt - dV) / dt$$

When the pump is not running, flow is quantified by using the method to calculate flow from the time to fill the wet well:

$$Q^{t}_{IN} = dV / dt$$

The method can be chosen in menu Wet Well Computation Properties selecting *Compute Using Logging Height in Wet Well*. Volume/depth curve must to be provided for computation as the file name of text file.

18 Special Analysis

18.1 Mass Balance Analysis

Ballast water Inflow/infiltration into sewage can be assumed from night minimum flow into the sewage only in case, that the night flow is not substantially influenced by the industrial waste water (which does not correspond to a typical diurnal type of wastewater outflow) or by the night life in the bigger cities. In case, where abovementioned approach is not applicable, use the more advanced Mass Balance Analysis.

Mass balance Analysis solve identification and/or quantification of Sewer infiltration/inflow using simple mass balance (mass flux method), as described for example in V. Bares et al.[1];

18.1.1 The background

Mixing model presumes following: Resulting wastewater flowing in the WWTP is composed of two different water qualities, the raw sewage and the infiltrating ground water, where for example COD, conductivity or TS parameter can be used as differentiating qualitative constituent between these two types.

$$Q_w = Q_{foul} + Q_{par} \qquad (1)$$

Where:

Q_w represents total inflow to a WWTP;

Q_{foul} represents (variable) volume of foul sewage from households;

Qpar represents infiltrating volume of ground and surface (parasitic) waters.

Using concentrations, the equation is expressed as:

$$C_w = \frac{C_{foul}(Q_w - Q_{par}) + C_{par}Q_{par}}{Q_w} \qquad (2)$$

Where:

C represents concentration of given pollutant in related wastewater component.

18.1.2 Mass balance analysis - Data processing

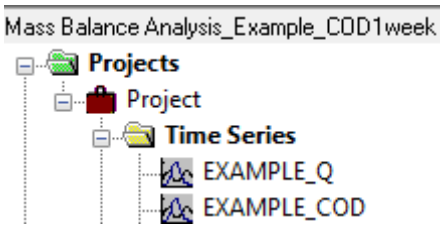
Prerequisites:

Before you start, you should have prepared Time series (at least one) of

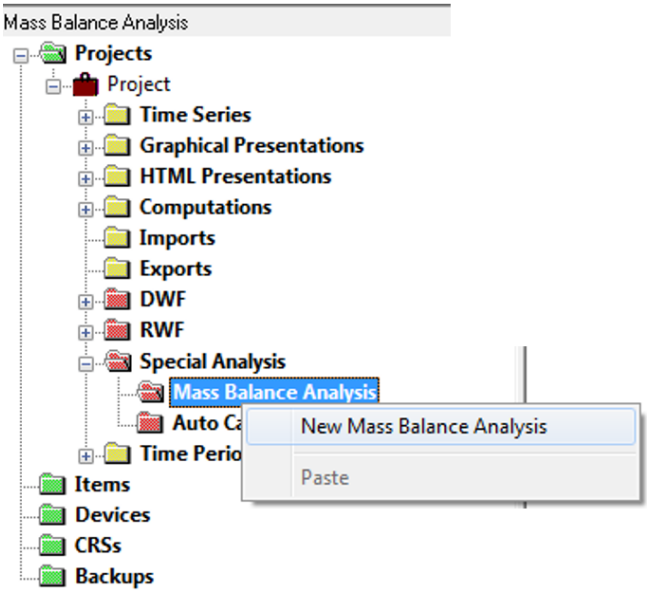
1. Analysed wastewater flow;
2. Concentrations of measured analyte (COD for example).

[1] V. Bareš, et al., Evaluation of sewer infiltration/inflow using COD mass flux method: case study Prague, Water Science & Technology, IWA Publishing 2012.

(Both of these series should be from the same time interval)



- In a project Tree, go to **Special analysis**
- Create **New Mass Balance Analysis** (right click on Mass Balance Analysis)



Picture 170 : New Mass Balance Analysis

Fill all the appropriate fields:

- **Name** name of the actual Analysis
- **Output file** path and name of the resulting output file
- **Qw TS** select proper time series for the wastewater flow
- **Cw TS** select proper time series for the wastewater quality parameter monitored
- **Cpar TS** select proper time series for the ballast quality parameter monitored (if applicable) or define
- **Constant Cpar** constant value of ballast water quality parameter value
- **Time Interval** select (if appropriate) the time interval for analysis (where the data time series are longer that the interval taken to an analysis)
- **Custom** select custom time interval (in case that appropriate Time period is not defined in the project)
- **Time Period** select predefined Time period (if previously defined in the Project, see chapter: 2.18 Time Periods)
- **Time Period Category** select predefined Time period category (if previously defined in the Project, see chapter: 2.18 Time Periods)

Parameters select appropriate limits:

- **Qpar** flow volume limits for the ballast water expected
- **Cfoul** concentration limits of measured parameter, expected (measured) in the raw sewage water
- **Computation grid size** one axis number computation points, the higher the number is, the more precise the computation is, and in accordance with them, the computation time is increased. Choosing the value 100 means that grid 100x100 points is used, i.e. increase this number from 10 to 100 cause increase computing demand factor 100times (from 100 to a 10 000 and not 10times as one may expect).
- **Advanced Computation**
  Allow running advanced functions of numeric calculations, used to precise results.

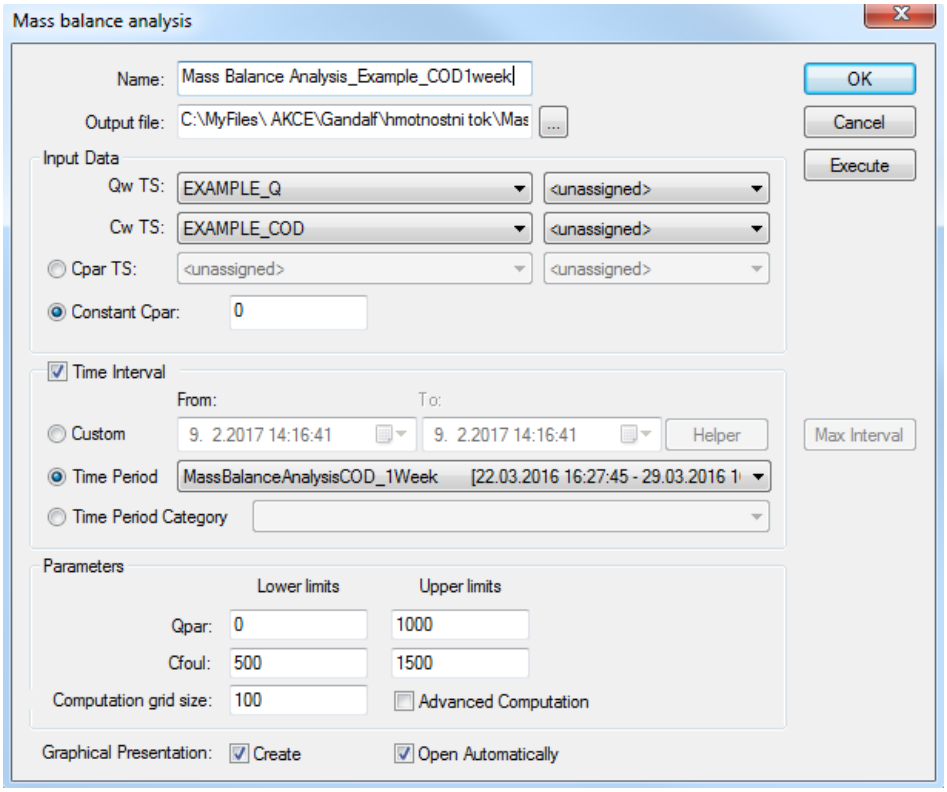
Note: Allowing this function can extend computing time.

Graphical Presentation mark if appropriate:

- **Create** the program will create predefined graphical html presentation (see later)
- **Open Automatically** program will open created graphical html presentation automatically.

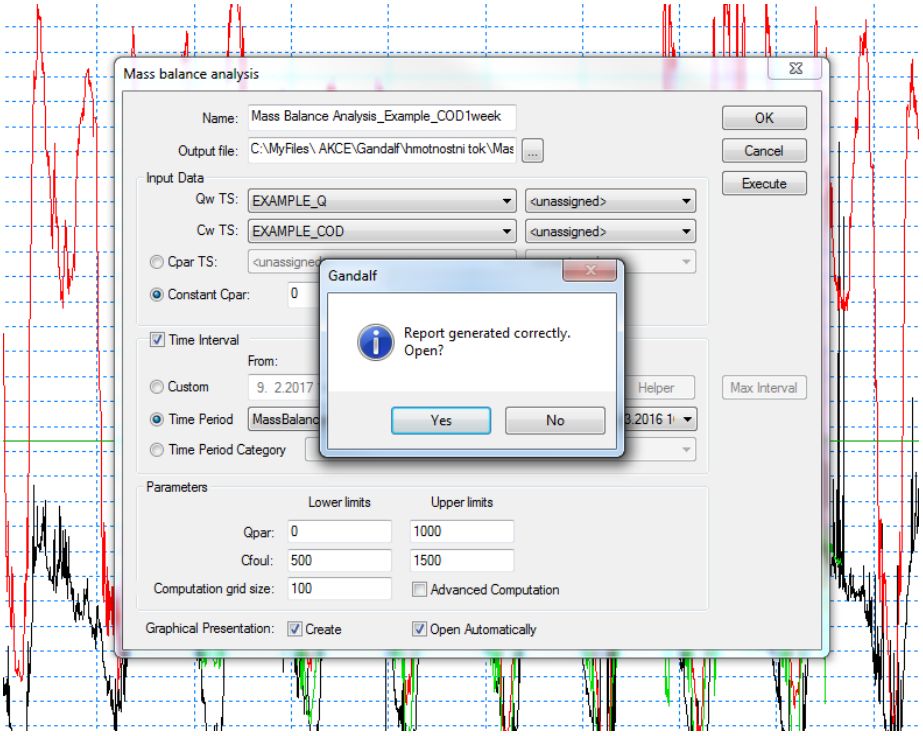
Selecting **Execute**, the program will compute ballast water flow and concentration of measured parameter for the raw sewage water (without the ballast load)

Please note: The computation time can take bit longer interval, depending on the computing power, number of computational points (see Computational grid size) etc.



Picture 171 : Mass Balance Analysis

In case you asked for the report creation and opening, the following dialog appears: **Report generated successfully, Open?** The report is opened…



Picture 172 : Mass Balance Analysis - Report

18.1.3 Mass balance analysis – Results reading

Report summarize input parameters and **analysis results**:

- **Cfoul found** Average Concentration of parameter used to differentiate between ballast and raw wastewater (here COD) in the raw wastewater.
- **Qpar found** Average ballast water inflow
- **QwMin** minimal flow volume of combined foul and ballast water (WWTP inflow)
- **Qpar/QwMin** ratio between ballast water flow and total minimal flow showing contribution of Ballast water to a total minimal flow (WWTP inflow)
- **Qw24** Average flow volume of combined raw and ballast water (WWTP inflow)/24 hour
- **Qpar/Qw24** ratio between ballast water flow and average total 24 hour flow showing contribution of ballast water to a 24 hour flow (WWTP inflow)

Table 9 : Mass Balance Analysis

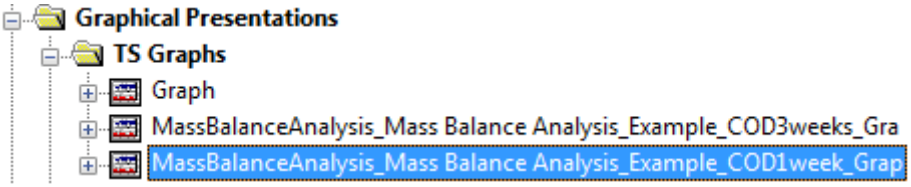
Mass Balance Analysis 'Mass Balance Analysis_Example_COD1week'

Parameters	
Cw Time Serie	EXAMPLE_COD
Qw Time Serie	EXAMPLE_Q
Constant Cpar	0.000
Interval Start	22.3.2016 16:27:45
Interval End	29.3.2016 16:27:45
Qpar Range	0.000 - 1000.000
Cfoul Range	500.000 - 1500.000
Computation Grid	100
Analysis type	Simple

Results	
Cfoul found	1020.000
Qpar found	310.000
QwMin	385.636
Qpar / QwMin	80 %
Qw24	1213.196
Qpar / Qw24	26 %

In the tree structure go to:

- Graphical Presentations/TS Graphs /Mass Balance Analysis_name-you-have-defined
- **Right click** on the selected name and **Open**



Picture 173 : Mass Balance analysis - Results reading

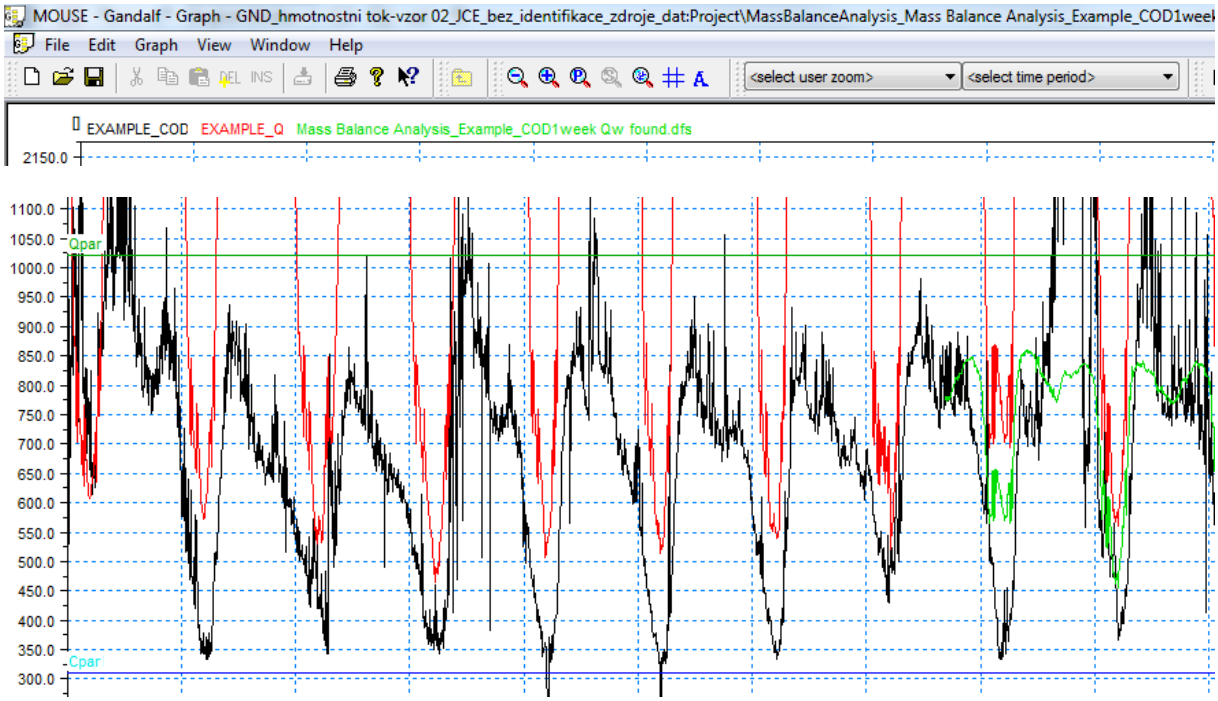
Note: the presentation is usually opened after analysis automatically

The graphic presentations show following information:

Time series **of total water flow**

Time series of **measured parameter concentration** (COD for example)

- **Qpar** line showing contribution of ballast water to the total flow
- **Cfoul** line showing computed average concentration of used parameter (COD for example)
- **Cpar** line showing concentration of used parameter in ballast water (COD for example)



Picture 174 : Mass Balance Analysis - TS Graph

18.2 Pollution Load Analysis

The function Load Pollution Analysis is a tool in Gandalf software that is used for a calculation of substance pollution. It can be applied when it comes to an assessment of pollution load in sewer systems.

Inputs of the analysis

- accumulated a volume of wastewater over time
- concentration of examined chemical substances taken at a monitoring site.

The output of the analysis

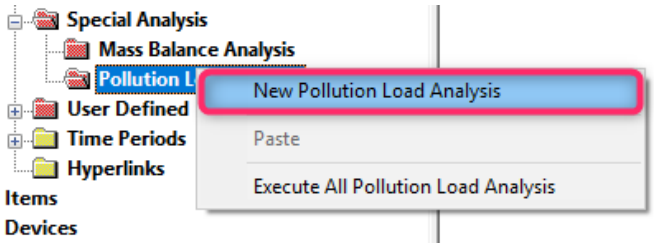
- the weight of a particular chemical substance

There are **3 calculation types** are depending on the particular event occurring

- **Default** Automatically calculated average concentration of all samples taken at a monitoring point. That is for a case when there is an event, but the sample were not taken
- **Single** Only one sample is taken during one event.
- **Detailed** Multiple samples were taken during one event.

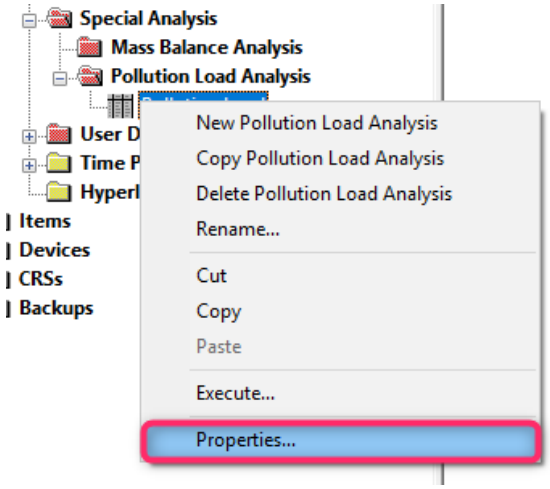
18.2.1 How to set up Pollution Load Analysis

Initially, right click at the folder *Pollution Load Analysis and select New Pollution Load Analysis.*



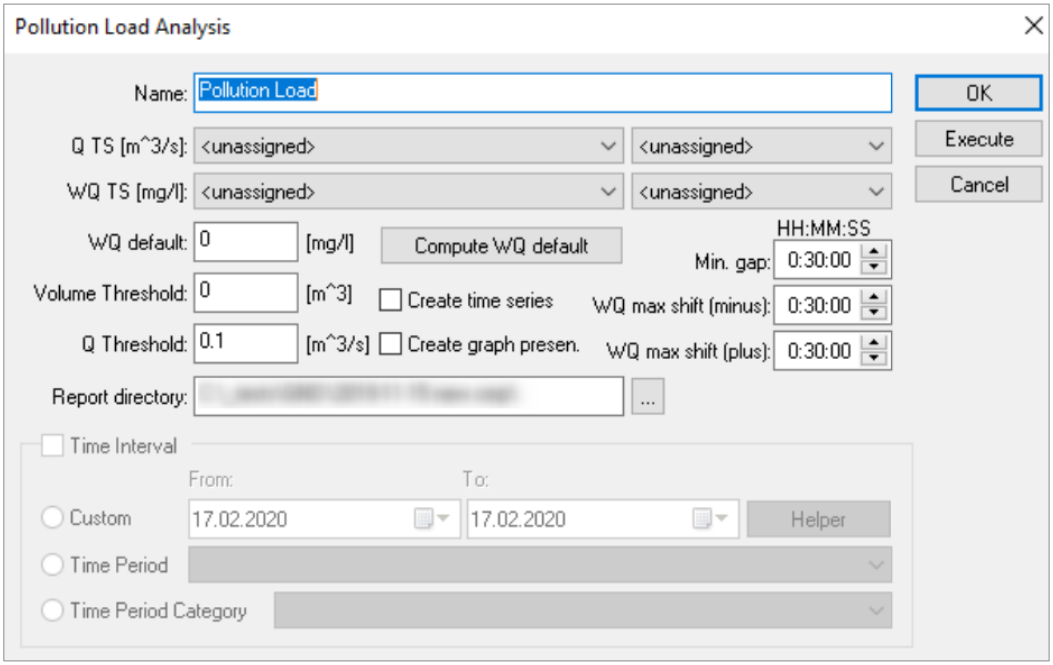
Picture 175 : New pollution Load Analysis

Next, right click at the node of your newly created Analysis and go to *Properties…*



Picture 176 : Pollution Load Analysis Context Menu

Pollution Load Analysis Properties consists of following parameters:

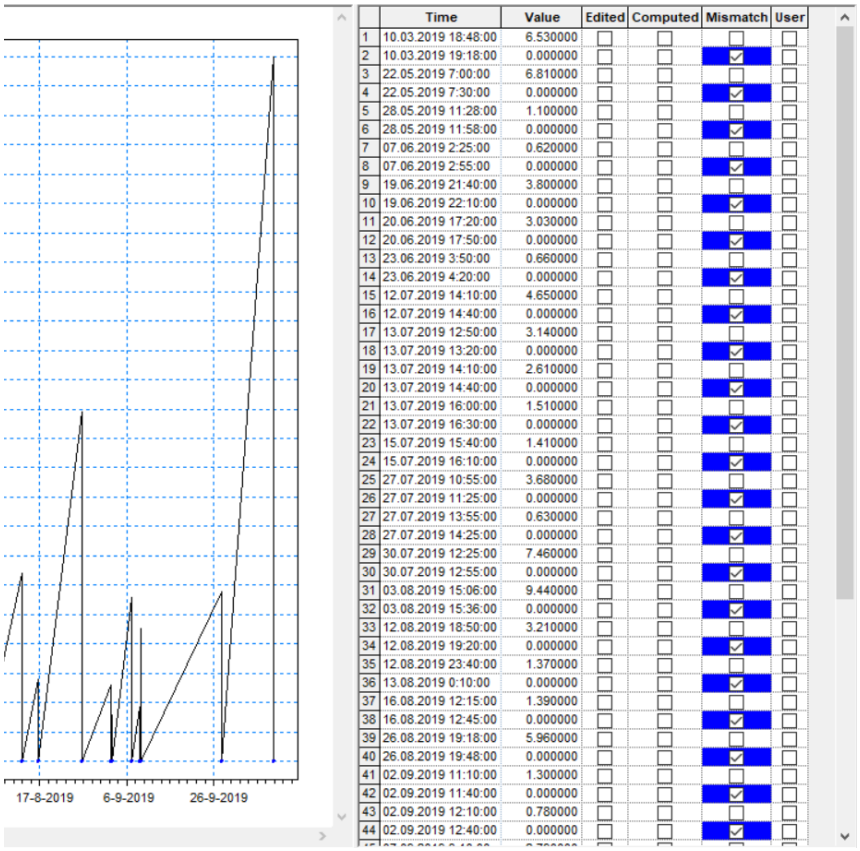


Picture 177 : Pollution Load Analysis Properties

- **Name** Name of the Analysis
- **Q TS** Input Time Series of Discharge [m^3/s]
- **WQ TS** Input Time Series of Water Quality (concentration) [mg/l]
- **WQ default** Average value of all samples taken
- **Compute WQ default** Automatically computes WQ default
- **Volume threshold** Minimum value of Volume that goes in the computation [m^3]
- **Q Threshold** Minimum value of Discharge that goes in the computation [m^3/s]
- **Min Gap** Minimal time period that evaluates if events are left separated or are merged together. If the time interval between 2 events is smaller than Min. gap it is assessed as 1 event
- **WQ max shift (minus)/(plus)** Time shift of WQ event. It is used when WQ Events do not occur exactly as the Q events.
- **Report directory** Path where HTML report is generated.

Remarks:

It is crucial to modify **WQ TS** (time series of concentration) accordingly to successfully carry out the computation. Therefore, it is needed to insert zero values **after** every sample is taken. The time series that enters the computaion should look like the picture below.
See chapter **8.4 Clear Flags, TS Validate, Mark Redundant, Insert Values** how to insert values.



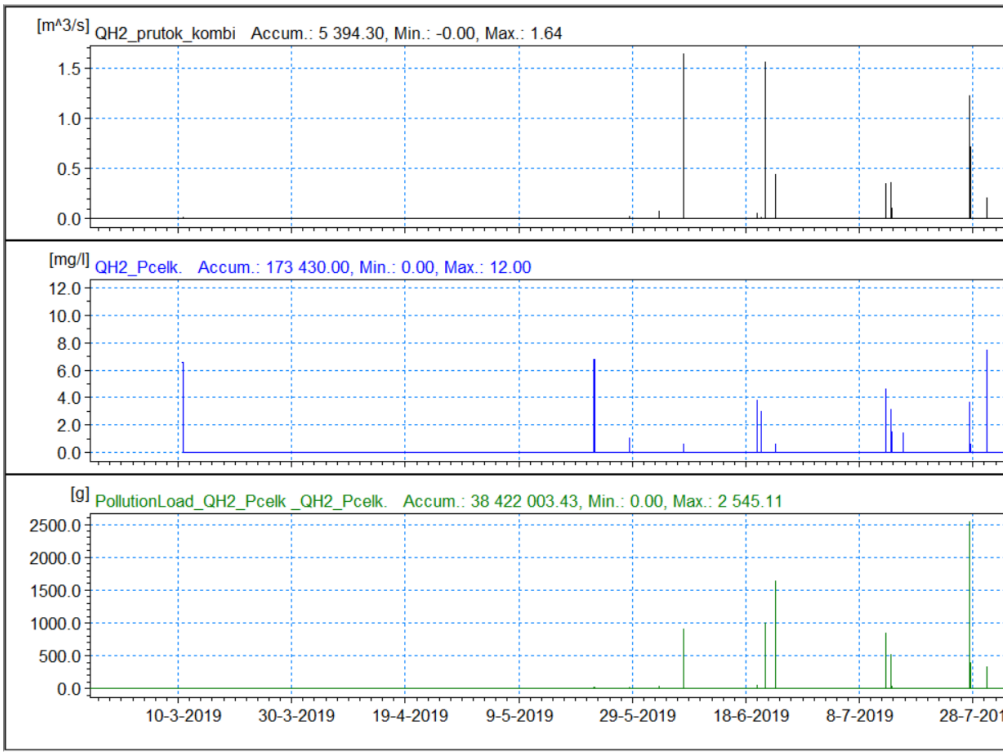
	Time	Value	Edited	Computed	Mismatch	User
1	10.03.2019 18:48:00	6.530000	☐	☐	☐	☐
2	10.03.2019 19:18:00	0.000000	☐	☐	☑	☐
3	22.05.2019 7:00:00	6.810000	☐	☐	☐	☐
4	22.05.2019 7:30:00	0.000000	☐	☐	☑	☐
5	28.05.2019 11:28:00	1.100000	☐	☐	☐	☐
6	28.05.2019 11:58:00	0.000000	☐	☐	☑	☐
7	07.06.2019 2:25:00	0.620000	☐	☐	☐	☐
8	07.06.2019 2:55:00	0.000000	☐	☐	☑	☐
9	19.06.2019 21:40:00	3.800000	☐	☐	☐	☐
10	19.06.2019 22:10:00	0.000000	☐	☐	☑	☐
11	20.06.2019 17:20:00	3.030000	☐	☐	☐	☐
12	20.06.2019 17:50:00	0.000000	☐	☐	☑	☐
13	23.06.2019 3:50:00	0.660000	☐	☐	☐	☐
14	23.06.2019 4:20:00	0.000000	☐	☐	☑	☐
15	12.07.2019 14:10:00	4.650000	☐	☐	☐	☐
16	12.07.2019 14:40:00	0.000000	☐	☐	☑	☐
17	13.07.2019 12:50:00	3.140000	☐	☐	☐	☐
18	13.07.2019 13:20:00	0.000000	☐	☐	☑	☐
19	13.07.2019 14:10:00	2.610000	☐	☐	☐	☐
20	13.07.2019 14:40:00	0.000000	☐	☐	☑	☐
21	13.07.2019 16:00:00	1.510000	☐	☐	☐	☐
22	13.07.2019 16:30:00	0.000000	☐	☐	☑	☐
23	15.07.2019 15:40:00	1.410000	☐	☐	☐	☐
24	15.07.2019 16:10:00	0.000000	☐	☐	☑	☐
25	27.07.2019 10:55:00	3.680000	☐	☐	☐	☐
26	27.07.2019 11:25:00	0.000000	☐	☐	☑	☐
27	27.07.2019 13:55:00	0.630000	☐	☐	☐	☐
28	27.07.2019 14:25:00	0.000000	☐	☐	☑	☐
29	30.07.2019 12:25:00	7.460000	☐	☐	☐	☐
30	30.07.2019 12:55:00	0.000000	☐	☐	☑	☐
31	03.08.2019 15:06:00	9.440000	☐	☐	☐	☐
32	03.08.2019 15:36:00	0.000000	☐	☐	☑	☐
33	12.08.2019 18:50:00	3.210000	☐	☐	☐	☐
34	12.08.2019 19:20:00	0.000000	☐	☐	☑	☐
35	12.08.2019 23:40:00	1.370000	☐	☐	☐	☐
36	13.08.2019 0:10:00	0.000000	☐	☐	☑	☐
37	16.08.2019 12:15:00	1.390000	☐	☐	☐	☐
38	16.08.2019 12:45:00	0.000000	☐	☐	☑	☐
39	26.08.2019 19:18:00	5.960000	☐	☐	☐	☐
40	26.08.2019 19:48:00	0.000000	☐	☐	☑	☐
41	02.09.2019 11:10:00	1.300000	☐	☐	☐	☐
42	02.09.2019 11:40:00	0.000000	☐	☐	☑	☐
43	02.09.2019 12:10:00	0.780000	☐	☐	☐	☐
44	02.09.2019 12:40:00	0.000000	☐	☐	☑	☐

Picture 178 : Inserting Values in Pollution Load Analysis

18.2.2 Viewing the Results

After the execution is carried out, Pollution Load Graph is created. It contains 3 views:

- **Discharge TS** (input)
- **Concentration TS** (input)
- **Pollution Load TS** (output)



Picture 179 : Pollution Load Graphical Presentation example

To get the summarised results in the table see HTML report that is generated with execution of the analysis.

Event #	Start	End	Duration	Volume	Max Q	Avg conc. load	Pollution load	Calc. type
1	22.02.2019 10:45:00	22.02.2019 10:55:00	00:10:00	0.1055	0.0004	3.2100	0.3387	Default
2	10.03.2019 19:40:00	10.03.2019 19:50:00	00:10:00	3.0960	0.0155	3.2100	9.9383	Default
3	22.05.2019 6:50:00	22.05.2019 7:40:00	00:50:00	3.3861	0.0056	6.8100	23.0592	Single
4	28.05.2019 11:20:00	28.05.2019 12:00:00	00:40:00	16.7776	0.0271	1.1000	18.4554	Single
5	02.06.2019 16:10:00	02.06.2019 16:17:00	00:07:00	13.3345	0.0713	3.2100	42.8037	Default
6	07.06.2019 2:24:00	07.06.2019 2:52:00	00:28:00	1455.2278	1.6444	0.6200	902.2412	Single
7	19.06.2019 21:34:00	19.06.2019 22:00:00	00:26:00	15.4188	0.0560	3.8000	58.5916	Single
8	20.06.2019 17:14:00	20.06.2019 17:18:00	00:04:00	1.4812	0.0140	3.0300	4.4880	Single After
9	21.06.2019 10:17:00	21.06.2019 10:45:00	00:28:00	310.7977	1.5556	3.2100	997.6607	Default
10	23.06.2019 3:29:00	23.06.2019 4:05:00	00:36:00	3.6678	0.0065	0.6600	2.4207	Single
11	23.06.2019 4:55:00	23.06.2019 7:00:00	02:05:00	511.6730	0.4368	3.2100	1642.4702	Default
12	12.07.2019 14:00:00	12.07.2019 14:50:00	00:50:00	180.6519	0.3533	4.6500	840.0314	Single

Picture 180 : Pollution Load Report example

Note: Special Analysis *User Defined* is no longer support in Gandalf version 2020. It used to function for user defined Imports and Exports. It has been replaced with standard Imports and Exports in Project Tree (such as Multiple Imports and Exports)

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