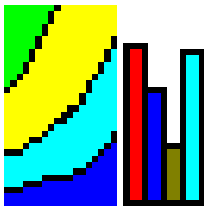Measured data management and oriented evaluation and visualisation as contour lines, bar, pie and circle charts, and tables

GGU-GEO-GRAPH

VERSION 6

Contents:

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1   Preface

The **GGU-GEO-GRAPH** program allows graphical representation of any kind of measured parameter determined for data points of known x/y coordinates. A classical application of such oriented parameter representations is the graphical processing of groundwater levels in an observation well network. The information on location and values for various data points can be implemented in the following position-oriented graphics:

- Contour lines

- Colour-filled contour lines

- Colour-filled 3D graphics

- Bar charts (linear, logarithmic, root scale)

- Bar charts (stacked)

- Pie charts

- Circle charts

- Symbol charts

- Tables.

In **GGU-GEO-GRAPH**, a total of 18 different parameters can be assigned per data point. However, you are in no way restricted to groundwater level data; you can manage and represent any kind of data, e.g. contaminant concentration for a large number of contaminants, layer and horizon boundaries and thicknesses. The program also provides link functions to facilitate determination of new values, e.g. by establishing the difference between two existing values (determination of a groundwater level in [m AD] as the difference between ground level in [m AD] minus the measured groundwater level in [m below GL (ground level)]).

Data input is in accordance with conventional WINDOWS operations and can therefore be learned almost entirely without the use of a manual. Graphic output supports the true-type fonts supplied with WINDOWS, so that excellent layout is guaranteed. Colour output and any graphics (e.g. files in formats BMP, JPG, PSP, TIF, etc.) are supported. DXF files can also be imported by means of the integrated Mini-CAD module (see the **Mini-CAD** manual).

The program has been successfully used in a large number of projects by renowned consultancies and institutes, and has been thoroughly tested. No faults have been found. Nevertheless, liability for completeness and correctness of the program and the manual, and for any damage resulting from incompleteness or incorrectness, cannot be accepted.

2 Licence protection and installation

In order to guarantee a high degree of quality, a hardware-based copy protection system is used for the **GGU-GEO-GRAPH** program.

The GGU software protected by the *CodeMeter* copy protection system is only available in conjunction with the *CodeMeter stick* copy protection component (hardware for connection to the PC, "*CM stick*"). Because of the way the system is configured, the protected software can only be operated with the corresponding CM stick. This creates a fixed link between the software licence and the CM stick copy protection hardware; the licence as such is thus represented by the CM stick. The correct Runtime Kit for the CodeMeter stick must be installed on your PC.

Upon start-up and during running, the **GGU-GEO-GRAPH** program checks that a CM stick is connected. If it has been removed, the program can no longer be executed.

For installation of GGU software and the CodeMeter software please refer to the information in the *Installation notes for GGU Software International*, which are supplied with the program.

3 Language selection

GGU-GEO-GRAPH is a bilingual program. The program always starts with the language setting applicable when it was last ended.

The language preferences can be changed at any time in the "**?**" menu, using the menu item "**Spracheinstellung**" (for German) or "**Language preferences**" (for English).

4   Starting the program

After starting the program, you will see two menus at the top of the window:

- File

- ?

After clicking the "**File**" menu, either an existing file can be loaded by means of the "**Load**" menu item, or a new system created using "**New**". Eight menus then appear at the top of the window:

- File

- Edit

- Page size + margins

- Graphic preferences

- Graphics

- Chart evaluation

- Section

- ?

After clicking one of these menus, the so-called menu items roll down, allowing you access to all program functions.

The program works on the principle of *What you see is what you get*. This means that the screen presentation represents, overall, what you will see on your printer. In the last consequence, this would mean that the screen presentation would have to be refreshed after every alteration you make. For reasons of efficiency and as this can take several seconds for complex screen contents, the **GGU-GEO-GRAPH** screen is not refreshed after every alteration.

If you would like to refresh the screen contents, press either [**F2**] or [**Esc**]. The [**Esc**] key additionally sets the screen presentation back to your current zoom, which has the default value 1.0, corresponding to an A3 format sheet.

5 Worked example

5.1 The problem

The following example is designed to allow you to quickly learn to use the **GGU-GEO-GRAPH** program by demonstrating the possibilities for data presentation and data evaluation. For the example we have the following situation:

In an industrial estate, the subsurface consists of a cinder fill with groundwater contaminated by arsenic. Five gauges were sunk through the fill for investigation purposes and developed as groundwater monitoring wells. The water levels in the gauges were surveyed at two different times. During one of the measurements water samples were taken and analysed for arsenic. You now want to present and evaluate the following data:

- Representation of groundwater contour diagrams for both sets of measurements

- Representation of a groundwater difference diagram for both sets of measurements

- Calculation of the total fill in the investigated area

- Representation of the arsenic content in the groundwater

- Profile section through the area with representation of the fill

- Transfer of data to a different program (e.g. 'WORD')

5.2 Initial input

You must first enter the existing basic data. First you assign the parameter names in order to avoid confusion later when entering the values. For the example, use the following designations in the dialogue box of the menu item "**Edit/Value names**":

Now you must specify the point locations and enter the data available. To do this, select the "**New**" button after clicking on the "**Edit/Define points (editor)**" menu item. In the following dialogue box, enter the name, the coordinates and the values. In this example, we assume that you know the AD heights of the bores, the water levels at the time of the two measurements and the depth (thickness) of the fill. The arsenic concentration is not yet known.

Fill in the first dialogue box as shown:

Press the "**Duplicate**" button to enter the next measured data point. This *saves* the steps "**Done**" and "**New**". The input box for the second point opens, the data of the duplicated point are used. Enter the data for the remaining data points as given in the following table:

	Bo 2	Bo 3	Bo 4	Bo 5
x ordinate	10	67	100	121
y ordinate	10	110	43	5
Ground level [m AD]	72,75	71,92	72,03	72,12
GW [m gauge] 3/07	2,73	2,24	2,33	2,53
GW [m gauge] 9/07	3,45	2,91	3,11	3,29
Fill [m]	0,4	1,2	2,2	1,9

After entering the final data point click "**Done**" and "**To menu bar**". The missing values for **GW [m AD] 3/07**, **GW [m AD] 9/07**, **delta GW** and **Fill [m AD]** can be calculated by the program and entered into the correct fields.

Press the [**F9**] function key or go to the menu item "**Page size + margins/Auto-resize**". The program calculates the coordinates for an optimum screen visualisation from the coordinates entered for the points. The names of the points are now visible on the screen.

To determine **GW [m AD] 3/07** go to the menu item "**Edit/Link values**" and select the following values and the link from the pull-down menus:
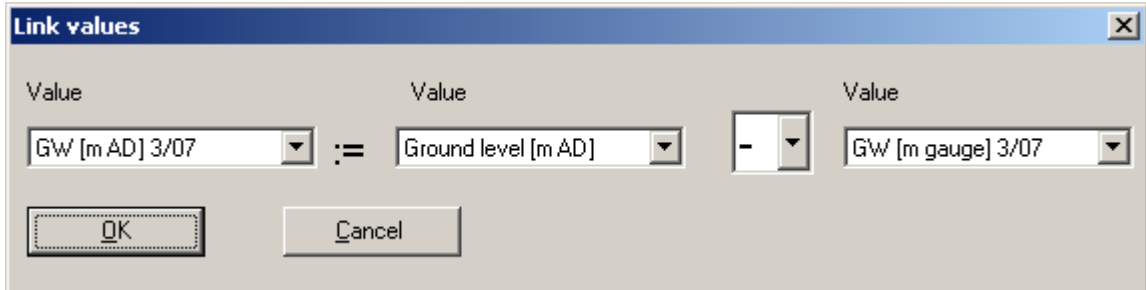
Proceed correspondingly for **GW [m AD] 9/07** (value 5 = value 1 - value 3), **delta GW** (value 6 = value 4 - value 5) and **Fill [m AD]** (value 8 = value 1 - value 7).

In the meantime, you have received the results of the arsenic analysis, which you now want to integrate in the data. To do this, go to the menu item "**Edit/Individual values**" and click the "**Arsenic [µg/l]**" button in the selection box. Fill in the dialogue box as shown:
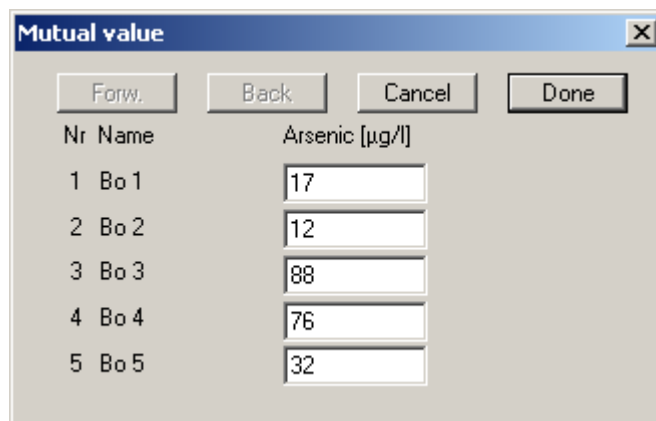
Once input is complete exit the dialogue box via "**Done**". The program checks the input and, if faulty (e.g. letters instead of numbers), issues a message such as "**Input error in input box x**". In this case, the number of the input field is **not** identical to the number in front of the faulty data, but instead designates - counted from top to bottom - the input box number. For example, if, in the case shown above, incorrect data is entered in the Bo 4 gauge box, the program will issue an "**Error in Box 5**" message.

5.3   Representing groundwater contours and groundwater differences

Once all values have been entered, a triangle mesh must be constructed between the data points (measurement points). To do this, go to the "**Graphics/Automatic mesh**" menu item.

The program then computes the triangle mesh and displays it on the screen. As you can see, the triangle formed by data points Bo 3, Bo 4 and Bo 5 is extremely acute. To remove it, you can make use of the automatic *rounding off* function in the menu item "**Graphics/Round off**". You will first see some information on the triangle radius ratios and then a dialogue box.
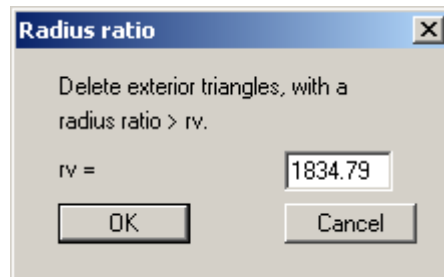
By clicking "**OK**" you delete the triangle and the modified triangle mesh is displayed.

You now want to display a groundwater contour diagram for the 3/07 measurement. To do this, go to menu item "**Graphics/Contours (normal)**". In the subsequent selection box, click the parameter to be displayed ("**GW [m AD] 3/07**" button) and then the "**Contours**" button as the type of presentation in the next box.
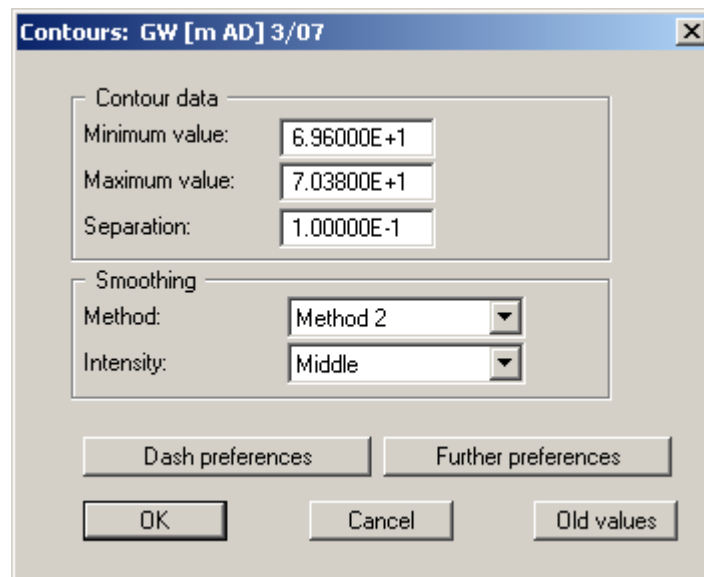
The above dialogue box then opens in which you can specify the start and end values, the contour spacing and the smoothing out method. Accept the values suggested by the program.
After confirmation using "**OK**" the groundwater contours will be drawn.

If the contour line visualisation needs changing, simply select "**Graphics/Contours (normal)**" once more, "**GW [m AD] 3/07**" button and then the "**Contours**" button. Enter "**69.60**" for the minimum value, "**70.05**" as the maximum value and "**0.05**" as separation. Click the "**Dash preferences**" button and enter the following preferences into the dialogue box:
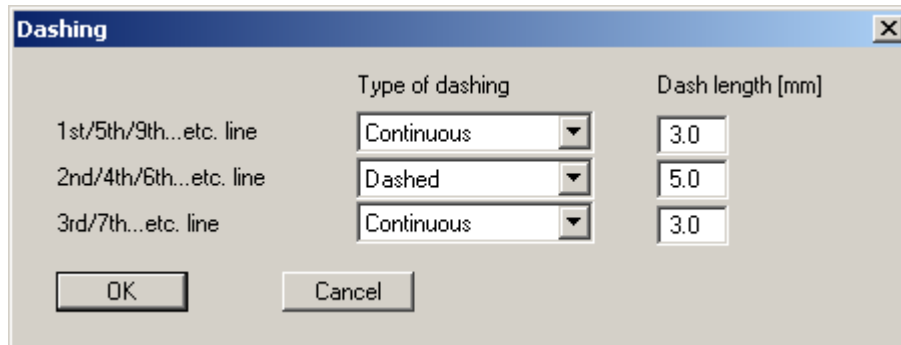
After confirming the input and closing the contour line dialogue using "**OK**" the visualisation is shown with alternating dashing for the "**5 cm**" and the "**10 cm**" contours.

Explanatory tests can be added using the "**Mini-CAD**" module or a project header loaded via "**Graphics preferences/Header toolbar**". Once the result is satisfactory go to the menu item '**File/Print**', '**Printer**' button. First select '**Landscape**' as the output format; if the '**Fit to page**' button is then clicked the program will determine the correct zoom factor for output to an A4 format printer. The groundwater contour diagram will now be sent to the default printer.

Proceed in analogy for the contour diagrams displaying "**GW [m AD] 9/07**" and "**delta GW**". Try out other presentation formats, for example "**Contours and gradients**" or "**Contours (3D)**".

5.4   Determination of fill quantity

Go to the "**Graphics/Contours (normal)**" menu item and then click "**Fill [m]**". Click "**Area and volume**" in the subsequent dialogue box. You will see the following results:
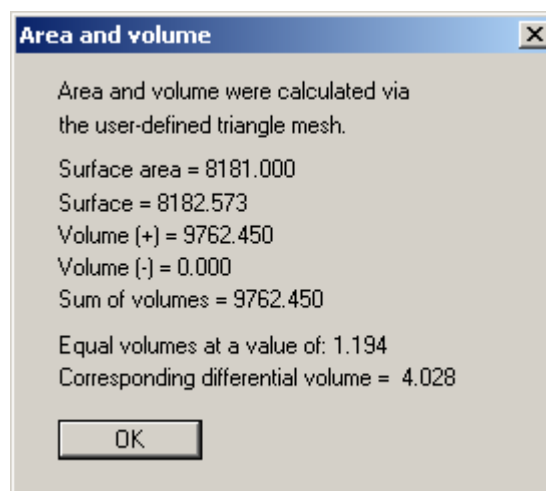
Assuming that the coordinates of the data points and the thickness of the fill were both given in metres, **GGU-GEO-GRAPH** will present the volume in m³.

5.5   Representation of the arsenic content in the groundwater

You would like to use a coloured, location-oriented bar chart to represent the arsenic contamination. Here, the colouring should correspond to the violation of the limit values and the bar height be value-dependent. The bars should be annotated with the measured data.

Go to the "**Chart evaluation/Bars**" menu item and select the "**Value-dependent colour fill**" button. Mark the value (or values) to be represented, in this case "**Arsenic [µg/l]**". You will see the following dialogue box, in which you can edit preferences such as the colour of the limit value classes, the labelling of the bars or the bar heights and widths. You achieve this by activating the various switches and by input in the dialogue boxes which open when you click buttons such as "**Presentation format**" or "**Edit limit values**".
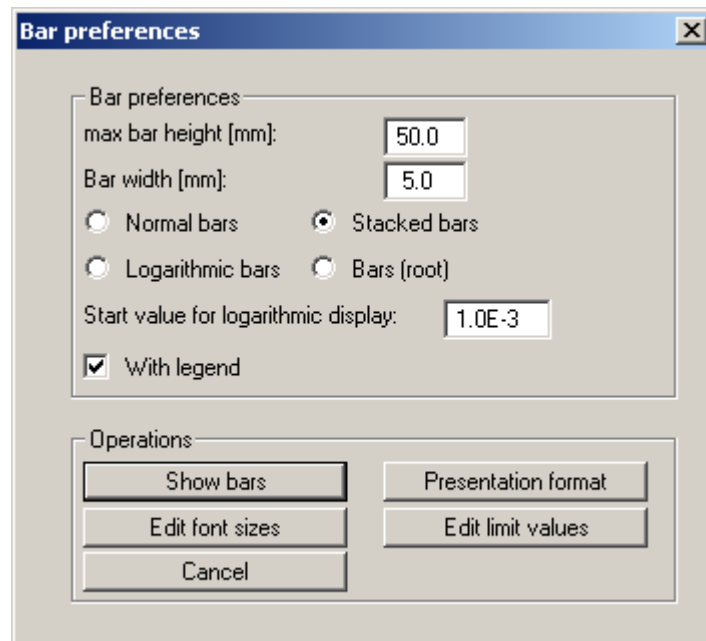
After clicking "**Edit limit values**" you see a dialogue box in which the selected values are represented as buttons (in this case only one).
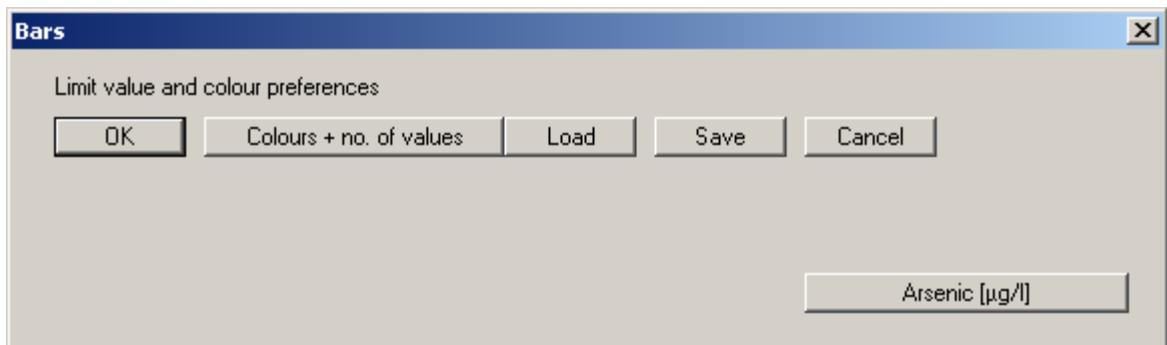
After clicking the "**Colours + no. of values**" button a dialogue box opens allowing the number of differentiations to be defined via the button "**Edit no. of values**" for the value-dependent bar fill.
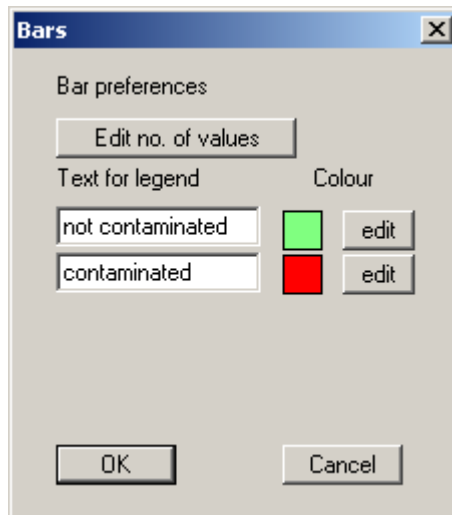
The labelling of the text boxes for the specified data can be defined; this will subsequently be displayed in the bar legend. The bar fill colours can be adapted to requirements via the "**edit**" buttons. Confirm your preferences by pressing "**OK**".

If the "**Arsenic [µg/l]**" button in the above dialogue box is now clicked the limit values can be entered. The smallest value must always be entered in the uppermost box, because the program automatically sorts the data from top to bottom starting with the smallest value when the box is closed by pressing "**OK**".

In order to annotate the bars with the measured data, click the "**Presentation format**" button in the above "**Bar preferences**" dialogue box. Activate the "**Show values**" check box in the dialogue box. After confirming the input and preferences, click "**Show bars**" and the result will be visualised on the screen. If the height of the bars means that the visualisation is incomplete at the boundaries, go to "**Page size + margins/Auto-resize**" or press [**F9**].

5.6 Profile section

Now you want to represent the fill in profile. To do this go to the "**Section/User-defined section**" menu item and select the parameters to be displayed. In this case these are "**Ground level [mAD]**" and "**Fill [mAD]**". Ensure that the "**Arsenic [µg/l]**" marker, which was activated in the previous section, is deactivated.

Because no section course has yet been defined, just click "**OK**" in the subsequent dialogue box. The triangular mesh can now be seen. Mark the starting point with a mouse click and draw the section to the end point holding the left mouse button pressed and complete it with a second mouse click (e.g. from Bo 1 to Bo 5).

> If one of the **Mini-CAD** modules was activated with the setting "**CAD without shift key**" a section cannot be defined. The **Mini-CAD** functions are always executed when the mouse button is clicked. In this case, first close the **Mini-CAD** menu.

Once the section is defined the subdivisions can be specified in the following query. Use a small number, e.g. 15, due to the very simple point raster. Then fill in the dialogue box as shown:
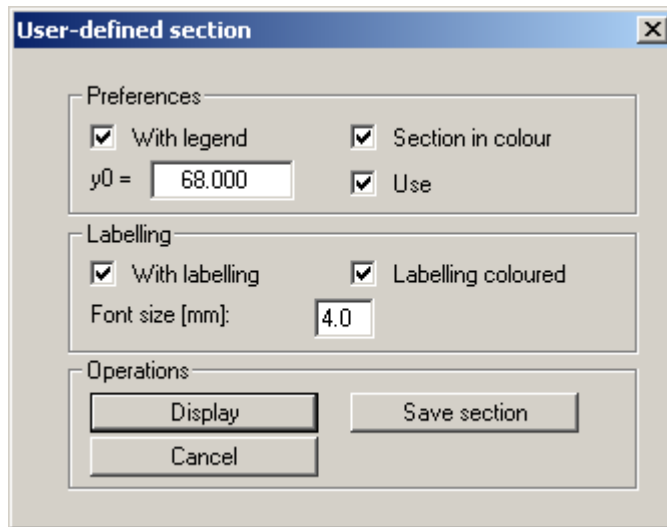
After clicking the "**Display**" button the section will be drawn. Changes can be made by going to the menu item "**Section/User-defined section**" for a second time. If the same section needs to be edited, click on the new "**Prev. section**" button in the section definition dialogue box. This opens the above dialogue box again.

5.7 Using data in other programs

You want to export the borehole height data, the determined water levels and the resulting AD heights to a word processor.

Go to "**Chart evaluation/Tables**" and mark the parameter to be exported to the word processor. In the following box, select the "**Export to ASCII file**" button and fill in the next box as follows:
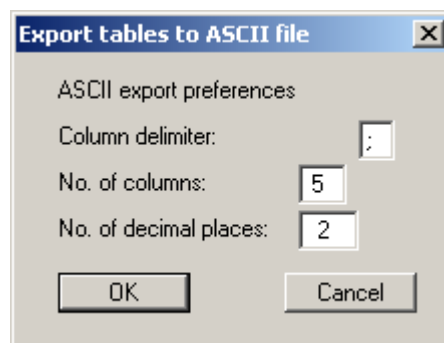
Select a character that does not otherwise occur in the data as delimiter. Using a space can lead to problems, for example if the data point designations also contain spaces.

After the data have been saved, they can be opened in ASCII format in your word processor or spreadsheet and be formatted as desired (e.g. in WORD using "**Convert text to table**").

6 Description of menu items

6.1 File menu

6.1.1 "New" menu item

All current data will be deleted after a security request. You can create a completely new system.

6.1.2 "Load" menu item

Using this menu item, you load a file previously created with **GGU-GEO-GRAPH**. The information on data points and values contained in the file can now be edited.

6.1.3 "Append" menu item

Using this menu item, you can append an existing file to the file already open. The data points and corresponding values contained in the added file will be appended to the current file. In this way, it is possible to merge files.

> However, note that the settings for the page format and image coordinates are taken from the last loaded file. This also applies to the names of the values (see menu item "**Edit/Value names**" in Section 6.2.1). The parameters themselves, e.g. groundwater levels, are retained on loading and allocated their original measured point.

6.1.4 "Save" menu item

You can save data entered or edited during program use to a file, in order to have them available at a later date, or to archive them. The data is saved <u>without prompting</u> with the name of the current file.

6.1.5 "Save as" menu item

You can save data entered during program use to an existing file or to a new file, i.e. using a new file name. For reasons of clarity, it makes sense to use "**.iso**" as file suffix, as this is the suffix used in the file requester box for the "**File/Load**" or "**File/Append**" menu items. If you choose not to enter an extension when saving, "**.iso**" will be used automatically.

6.1.6 "Import ASCII data" menu item

If the coordinates of the data points and the corresponding data are available as an ASCII file, this data can be read into the program. You can either read the data as "**new**" values (the current data will be deleted) or append it to the current data. Decimal fractions must have a point and not a comma.

After selecting the ASCII file, you will see a dialogue box. The current row of the ASCII file is shown at the top. You can move through the file using the arrow buttons on the right. In "**Column name:**", "**Column x:**", "**Column y:**" and "**1st column value**" you denote the column number containing the corresponding information. In "**No. of values:**" you enter the number of values associated with a respective data point. If all the information is correct, the result for the row is shown at the bottom right of the dialogue box after clicking the "**Import first valid row**". Otherwise, "**Error**" appears.

You may need to change the column delimiter.

If the file contains invalid as well as valid rows, these will simply be skipped during reading. After the "**Import data**" button has been pressed and the data successfully read, you will see a message box with the number of values and character strings imported. The data can now be processed further.

6.1.7 "Export ASCII data" menu item

This menu item allows you to save the current data in ASCII format. The data exported in this way can be read and further processed in other applications, e.g. in spreadsheets. A "**space**" is used as delimiter.

6.1.8 "Printer preferences" menu item

You can edit printer preferences (e.g. swap between portrait and landscape) or change the printer in accordance with WINDOWS conventions.

6.1.9 "Print and export" menu item

You can select your output format in a dialogue box. You have the following possibilities:

- "**Printer**"
  allows graphic output of the current screen to the WINDOWS standard printer or to any other printer selected using the menu item "**File/Printer preferences**". But you may also select a different printer in the following dialogue box by pressing the "**Printer prefs./change printer**" button.
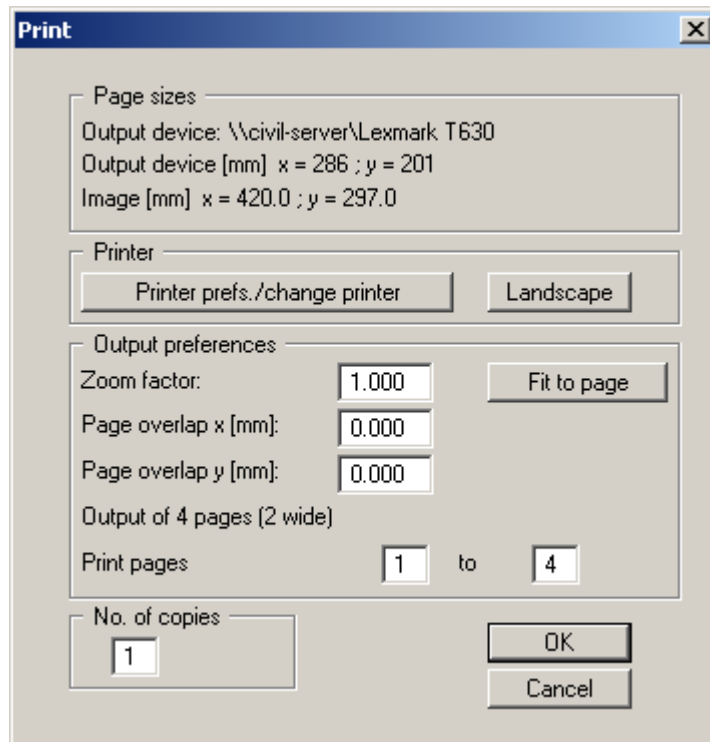
In the upper group box, the maximum dimensions which the printer can accept are given. Below this, the dimensions of the image to be printed are given. If the image is larger than the output format of the printer, the image will be printed to several pages (in the above example, 4). In order to facilitate better re-connection of the images, the possibility of entering an overlap for each page, in x and y direction, is given. Alternatively, you also have the possibility of selecting a smaller zoom factor, ensuring output to one page ("**Fit to page**" button). Following this, you can enlarge to the original format on a copying machine, to ensure true scaling. Furthermore, you may enter the number of copies to be printed..

- "**DXF file**"
  allows output of the graphics to a DXF file. DXF is a common file format for transferring graphics between a variety of applications.

- "**GGUCAD file**"
  allows output of the graphics to a file, in order to enable further processing with the GGUCAD program. Compared to output as a DXF file this has the advantage that no loss of colour quality occurs during export.

- "**Clipboard**"
  The graphics are copied to the WINDOWS clipboard. From there, they can be imported into other WINDOWS programs for further processing, e.g. into a word processor. In order to import into any other WINDOWS program you must generally use the "*Edit/Paste*" function of the respective application.

- "**Metafile**"
  allows output of the graphics to a file in order to be further processed with third party software. Output is in the standardised EMF format (Enhanced Metafile format). Use of the Metafile format guarantees the best possible quality when transferring graphics.

If you select the "**Copy/print area**" tool from the toolbar, you can copy parts of the graphics to the clipboard or save them to an EMF file. Alternatively you can send the marked area directly to your printer.

Using the "**Mini-CAD**" program module you can also import EMF files generated using other GGU applications into your graphics.

- "**MiniCAD**"
  allows export of the graphics to a file in order to enable importing to different GGU applications with the MiniCAD module.

- "**GGUMiniCAD**"
  allows export of the graphics to a file in order to enable processing in the GGUMiniCAD program.

- "**Cancel**"
  Printing is cancelled.

6.1.10 "Batch print" menu item

If you would like to print several appendices at once, select this menu item. You will see the following dialogue box:
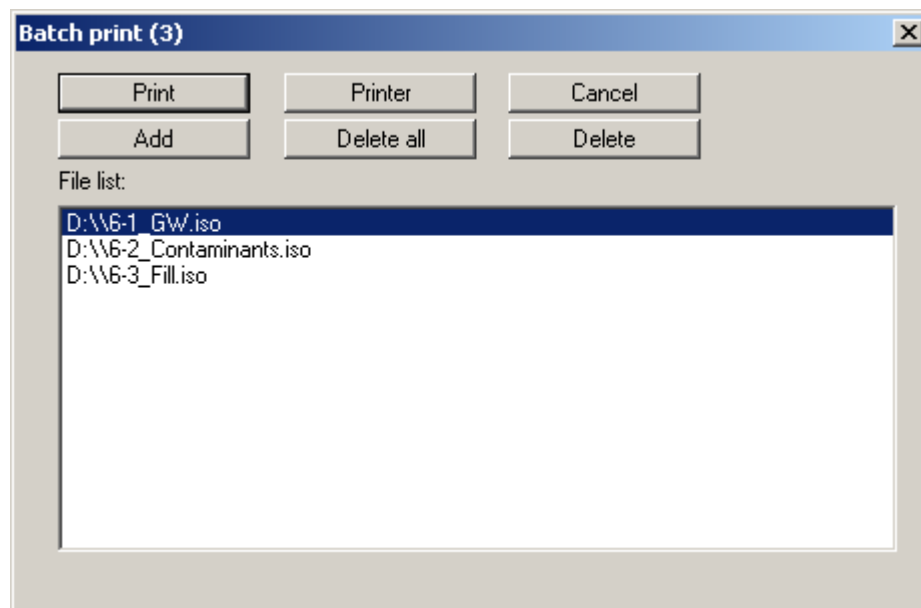
Create a list of files for printing using "**Add**" and selecting the desired files. The number of files is displayed in the dialogue box header. Using "**Delete**" you can mark and delete selected individual files from the list. After selecting the "**Delete all**" button, you can compile a new list. Selection of the desired printer and printer preferences is achieved by pressing the "**Printer**" button.

You then start printing by using the "**Print**" button. In the dialogue box which then appears you can select further preferences for printer output such as, e.g., the number of copies. These preferences will be applied to all files in the list.

6.1.11 "Exit" menu item

After a confirmation prompt, you can quit the program.

6.1.12 "1, 2, 3, 4" menu items

The "**1, 2, 3, 4**" menu items show the last four files worked on. By selecting one of these menu items the listed file will be loaded. If you have saved files in any other folder than the program folder, you can save yourself the occasionally onerous *rummaging* through various sub-folders.

6.2 Edit menu

6.2.1 "Value names" menu item

Up to 18 parameters can be managed for each data point given. You can assign these values different names. Value 1, Value 2, Value 3, etc. are the default names. The value names can be edited in the following dialogue box:

6.2.2 "Value colours" menu item

The charts (bar, pie, etc.) can be represented with a colour fill. Here, the individual parameters can be assigned certain colours.
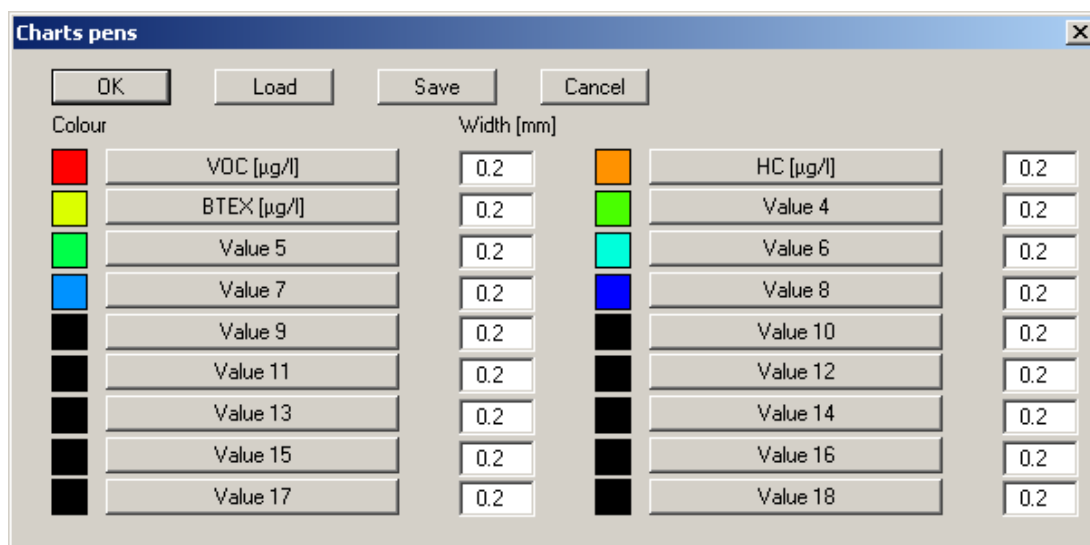
The pen colour can be edited by clicking the corresponding button and the pen width in the adjacent box. Your preferences can be saved in a file with the "**.frb**" extension. If you save the file in the program folder (default), your preferences will be automatically loaded the next time you start the program.

6.2.3 "Define points (editor)" menu item

Using this menu item all information associated with an individual data point can be entered. First, the following dialogue box opens:
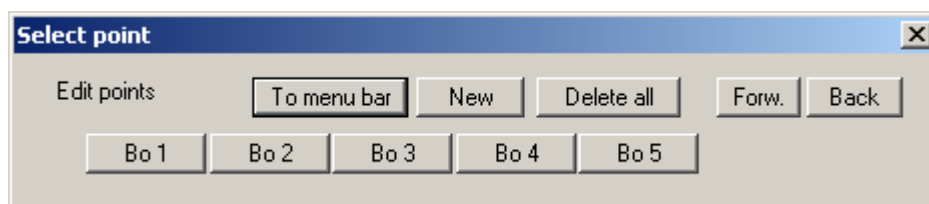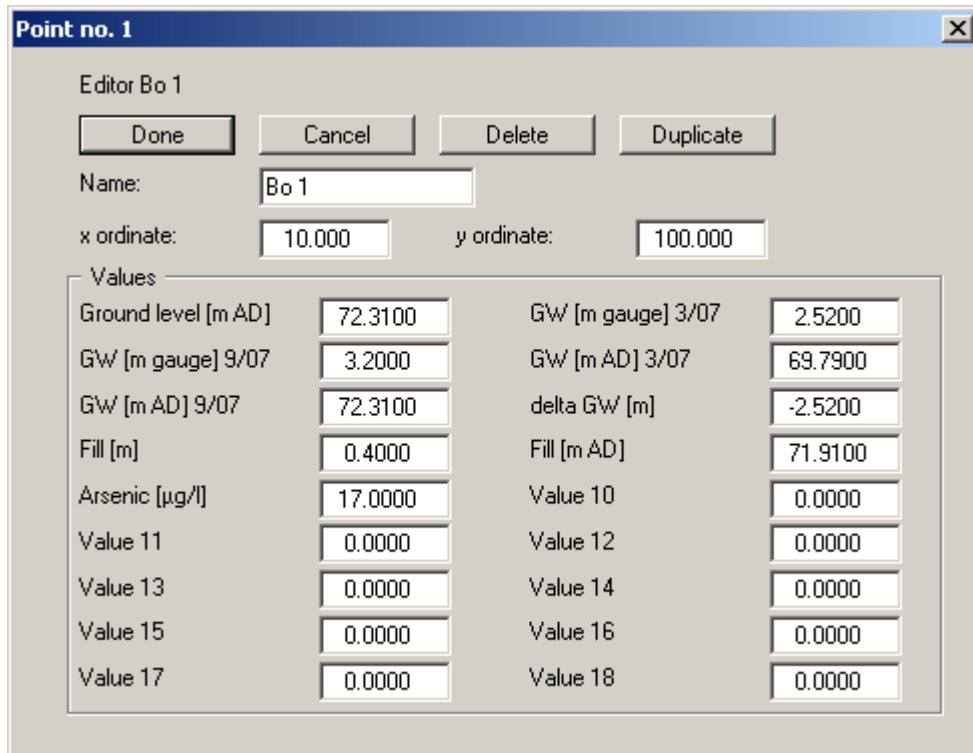
In this case 5 data points are already defined. The following operations are now possible:

- "**To menu bar**"
  You return to the previous screen and menus.

- "**New**"
  A new point is created and the dialogbox for entering the new data opens.

- "**Delete all**"
  After a confirmation prompt, all current data points are deleted.

- "**Forw.**"/"**Back**"
  If more than 105 data points are available you can reach the points beyond 105 by using the buttons.

- "**Bo 1**", "**Bo 2**", **...**
  By clicking the buttons labelled with the data point name you can open and edit the data for the corresponding point.

The following dialogue box opens after clicking the "**New**" button or the button of an existing data point.

You can now edit the data point name, the x and y coordinates and the associated 18 values. The following operations can be carried out:

- "**Done**"/"**Cancel**"
  You return to the previous dialogue box. All entered data will be accepted with "**Done**" and rejected by clicking "**Cancel**".

- "**Delete**"
  The currently displayed data point will be deleted. Any previously created triangular mesh is also deleted by this operation.

- "**Duplicate**"
  The currently displayed data point will be duplicated. You will automatically find yourself in the dialogue box of the new data point. All input made for the data point to be duplicated will be transferred to the new one. The default name for a new data point is always "**NEW**".

6.2.4 "Define points (mouse)" menu item

With this menu item you can define the position of points using the mouse. Click with the left mouse button at the location on the screen where you want the new point to be. You will see an input box in which you can enter the point name and, if required, correct the point coordinates.

New				✕
Name:	NEU			
x ordinate:	1.78	y ordinate:	59.55	
OK		Cancel		
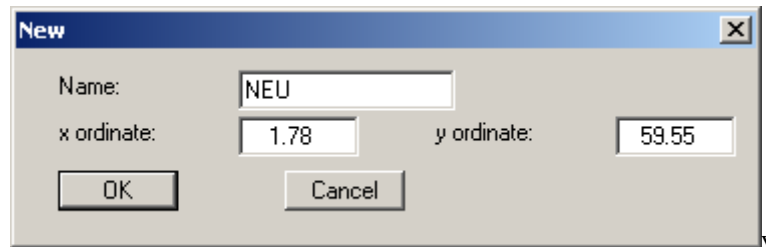
If you click an existing point with the right mouse button the editor for this point opens; you can then enter or edit measured values for this point.

Load a scanned plan or DXF file with the locations of the data points via the **Mini-CAD** module. Using this menu item "**Edit/Define points (mouse)**" you can quickly define the data points with mouse click.
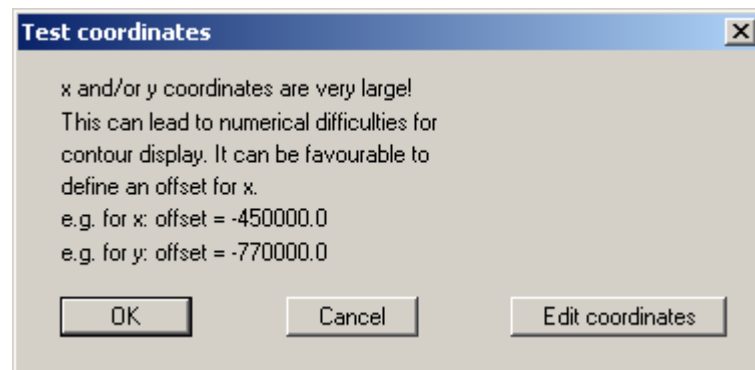
6.2.5 "Test point coordinates" menu item

If you work with eastings and northings a lot of digits are *lost* numerically, because the coordinate values only differ in the final four digits before the point.

Test coordinates	✕
x and/or y coordinates are very large! This can lead to numerical difficulties for contour display. It can be favourable to define an offset for x. e.g. for x: offset = -450000.0 e.g. for y: offset = -770000.0	
OK Cancel Edit coordinates	

It may then be expedient, and in extreme cases unavoidable, to work with a so-called offset. For example, you can subtract 3,550,000 m from all eastings between 3,555,000 m and 3,556,000 m and then work in the range from 5,000 m to 6000 m. You can make this offset visible in the graphics by correspondingly labelling the x and the y axis (see menu item "**Page size + margins/Labelling x and y axes**", see Section 6.3.2).

If the coordinates are too large, the above dialogue box opens, for example. The "**Edit coordinates**" button opens the same box as used in the menu item "**Edit/Edit point coordinates**" (see Section 6.2.6). However, the program enters the recommended offset values directly into the appropriate input boxes.

6.2.6 "Edit point coordinates" menu item

Using this menu item you can edit the coordinates of all data points. For example, if you used an incorrect scale during input, it can be corrected here by applying an appropriate factor. You can apply the factor to one direction only if necessary, i.e. to the x or to the y coordinate.
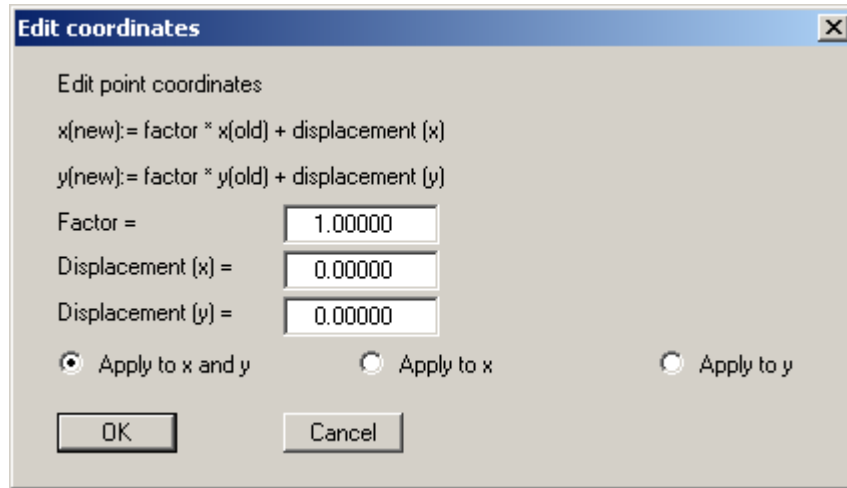
The coordinates can be displaced in x or y direction in order to achieve correct positioning.

> If your point coordinates are given in eastings and northings you can displace them by the required hundred thousand and ten thousand value. The resulting coordinate values are in the thousand range.

6.2.7 "Individual values" menu item

It is often a chore to enter or edit values using the previously described data editor in "**Edit/Define points (editor)**" because each data point must be opened individually. This menu item simplifies input, editing and checking of measured values. First, a dialogue box opens in which you must select the parameter to be edited (e.g. "**GW [m gauge] 3/07**" button):
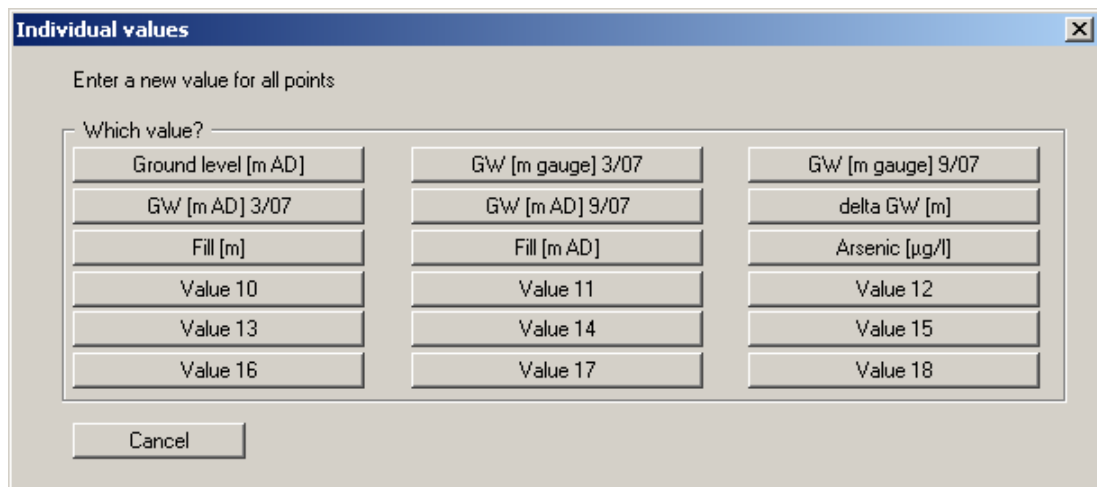
After clicking this button you will see the following dialogue box:

All existing data points for the respective parameter are displayed in this dialogue box. If there are more than 10 data points you can move through the list using "**Forw.**" and "**Back**" and make alterations or new entries.

6.2.8 "Link values" menu item

New values can be generated from existing ones using this menu item. After selecting this menu item the following dialogue box appears:

For example, if you want to graphically represent the following values:

- ground level in m AD,
- groundwater-surface distance in m,
- groundwater surface in m AD,

you generally have the values for "**Ground level [mAD]**" and "**GW [m b GL]**" available as measured data. The third value results from the difference between measured values 1 and 2. In principle, you could calculate the third value "by hand" and enter it using "**Edit/Define points (editor)**" or "**Edit/Individual values**". But with this menu item the program can do this work for you. If you fill in the dialogue box as shown above and then click "**OK**", the value"**GW [m AD]**" will be assigned the difference between values 1 and 2. This is calculated from the values previously entered by the user. The four basic mathematical operations can be used to link data.

> If, after linking data, you change a value, e.g. "**Ground level [mAD]**", the link operation must be performed once again in order to adjust the calculated result of the link operation.

6.2.9 "Modify values" menu item

In analogy to the previous section, operations can be performed by applying a constant. This can be useful, for example, if you entered an incorrect AD height for ground level during the first data evaluation phase. You can then correct this value for all data points by entering the appropriate correction value as the constant.
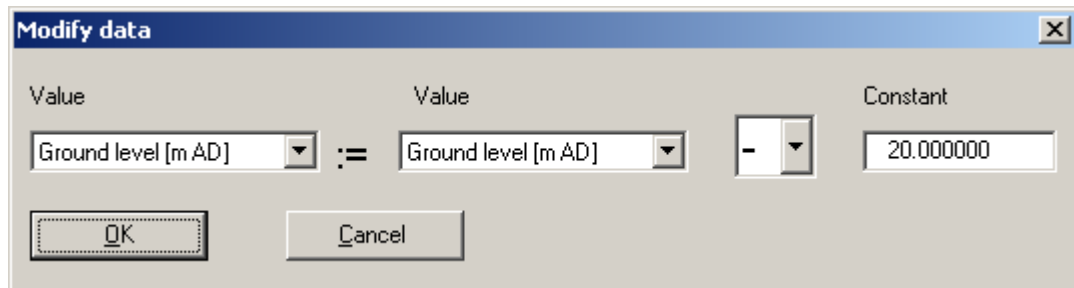
If you need to display the measured data in colour in a subsequent evaluation, a measured value may need to be visualised at a different position in the sequence. Otherwise it would be covered in section by one of the other values (see Section **Fehler! Verweisquelle konnte nicht gefunden werden.**). Copy the required value to the last unallocated value (new value = old value * 1) using this menu item.

6.2.10 "Edit values in section" menu item

If you only need to correct the values for a portion of the data points, select the parameter to which the modification is to be applied in the dialogue box as shown below and then mark the points as described.
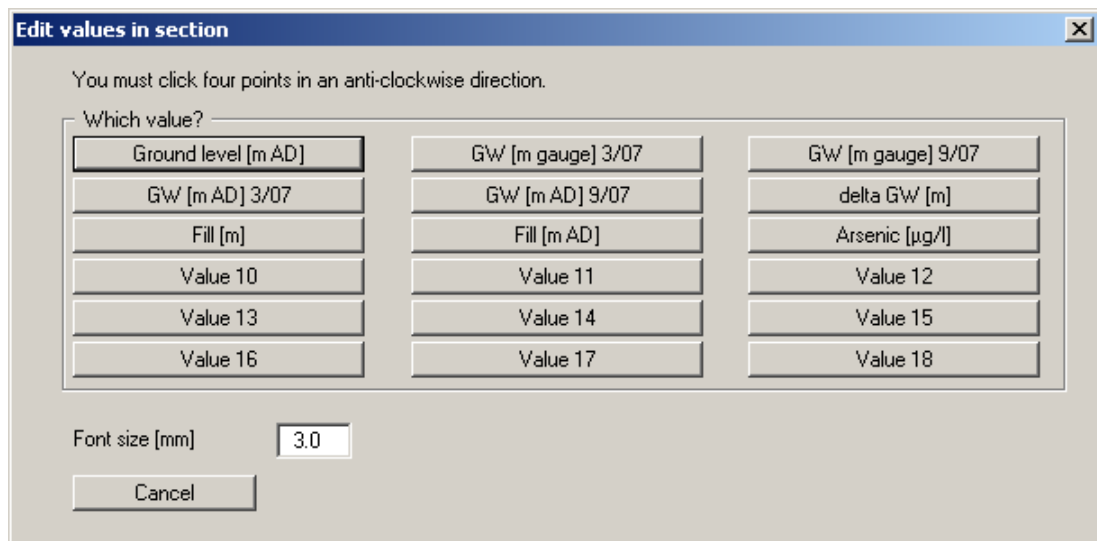
In the subsequent dialogue box you can decide whether the marked values are added to the constant or the constant is used directly as the new value for these points.
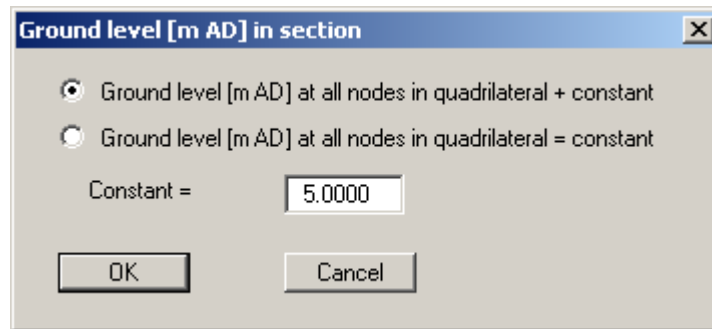
If you need to subtract a constant from a value, enter the constant as negative value and activate the upper switch.

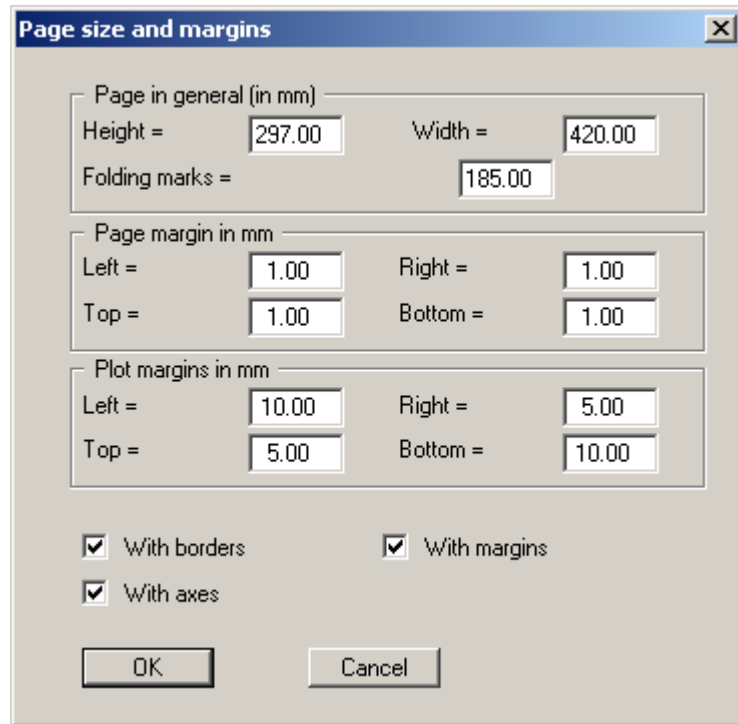### 6.3.1 "Page size and margins" menu item

The default page set-up is A3 when the program is started. You can edit the page format in the following dialogue box.

- "**Page in general**" defines the size of the output sheet. The A3 format is set as default. The program automatically draws thin cutting borders around the page, which are required when using a plotter on paper rolls. The borders can be switched off using the "**With borders**" switch.

- "**Page margin**" defines the position of a frame as a distance to the margins. This frame encloses the subsequent diagram. You can switch off the frame deactivating the "**With margins**" switch.

- The "**Plot margin**" define a set distance between the page margin and the actual *drawing area* in which the graphical evaluation of your input is presented.

- If the "**With axes**" check box is deactivated the x- and y-axis labelling is switched off in the subsequent evaluation graphics.

6.3.2 "Labelling x and y axes" menu item

You can label the x and y axes.

6.3.3 "Auto-resize" menu item

This menu item provides a to-scale visualisation, in both x and y coordinates, of the data points, contour lines, bar charts, etc.. The program computes the image coordinates so that all data points (including bar charts, etc.) are represented on the screen. This can be useful,

- if, for example, after graphical visualisation of contour lines, new data points are added, which lie outside of the original image coordinates,

- if you move from a representation of contour lines to one with bar charts, circle charts, etc. It is then possible that the bars, circles, etc, project outside of the plot margins. The height of the bar charts, circle charts, etc. is taken into consideration by using this menu item.

- If, despite all your efforts, graphics cannot be correctly represented on the screen. In a previous step, you probably altered the image coordinates to such an extent that visible graphic elements are no longer within the area seen on the screen.

This function can also be accessed using the [**F9**] function key.**"Manual resize (editor)" menu item**

You can alter the image coordinates by direct numerical input in a dialogue box. This allows precise scale input. The coordinates refer to the *drawing area*. This can be defined in the "**Page size + margins/Page size and margins**" menu item by means of the plot margins (see Section 6.3.1).
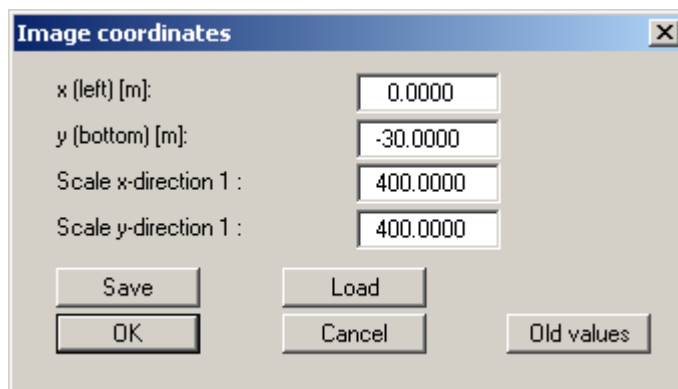
The image coordinates entered here can be saved in a file with the extension "**.BXY**" and be reloaded later for the same file or for different files.

If you want to recover the previous values during input or use the menu item again after editing the coordinates, you can do this by pressing the "**Old values**" button.

6.3.5 "Manual resize (mouse)" menu item

You can alter the image coordinates graphically with the mouse. In the dialogue box you are offered two choices.

- You can use the coordinates of a section of the visualisation as the new image coordinates by marking the desired area with the mouse, pressing the left mouse button and holding the [**Ctrl**] and [**Shift**] keys. The scales of the x- and y-axes are adjusted accordingly. If the previous proportions (scale x-direction/scale y-direction) need to be retained, the "**Proportional section**" check box must be activated.

- By activating the "**Redefine origin**" button you can change the image coordinates without altering the scale. In this way, you can quickly achieve the desired presentation with a suitably defined scale without annoying trial and error with the x/y coordinates.

6.4.1 "Refresh and zoom" menu item

The program works on the principle of *What you see is what you get*. This means that the screen presentation represents, overall, what you will see on your printer. In the last consequence, this would mean that the screen presentation would have to be refreshed after every alteration you make. For reasons of efficiency and as this can take several seconds for complex screen contents, the screen is not refreshed after every alteration.

If, e.g., after using the zoom function (see below), only part of the image is visible, you can achieve a complete view using this menu item.
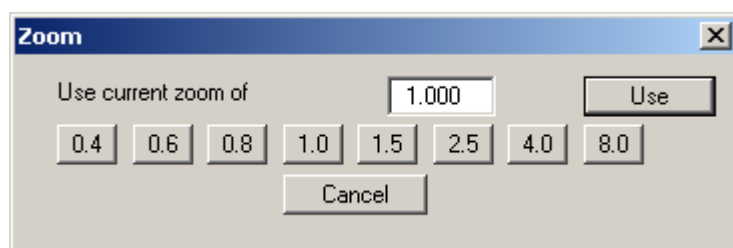
A zoom factor between 0.4 and 8.0 can be entered in the input box. By then clicking on "**Use**" to exit the box the current factor is accepted. By clicking on the "**0.4**", "**0.6**", etc. buttons, the selected factor is used directly and the dialogue box closed.

It is much simpler, however, to get a complete overview using [**Esc**]. Pressing [**Esc**] allows a complete screen presentation using the zoom factor specified in this menu item. The [**F2**] key allows screen refreshing without altering the coordinates and zoom factor.

6.4.2 "Zoom info" menu item

By clicking two diametrically opposed points you can enlarge a section of the screen in order to view details better. An information box provides information on activating the zoom function and on available options.

6.4.3 "Pen colour and width" menu item

For reasons of clarity different colours are used as default for the graphical representation of contour lines, gradients, etc. You can edit the pen widths for the elements shown in the dialogue box; by clicking on the button with the element designation you can also edit the pen or fill colours.

Your preferences can be saved in a file with the "*** .frb**" extension. If you save the file in the program folder (default), your preferences will be automatically loaded the next time you start the program.

On *monochrome printers* (e.g. laser printers), colours are shown in a corresponding grey scale. Graphic elements employing very light colours may be difficult to see. In such cases it makes sense to edit the colour preferences.

6.4.4 "Legend font selection" menu item

With this menu item you can switch to a different true-type font. All available true-type fonts are displayed in the dialogue box.

6.4.5 "Mini-CAD toolbar" and "Header toolbar" menu items

Using these two menu items you can add free text to the graphics and add lines, circles, polygons and images (e.g. files in formats BMP, JPG, PSP, TIF, etc.). The same pop-up menu opens for both menu items, the icons and functions used are described in more detail in the **Mini-CAD** manual provided. The differences between the Mini-CAD and Header CAD are as follows:

- Objects created with **Mini-CAD** are based on the coordinate system (generally in metres), in which the drawing is produced, and are shown accordingly. You should use the "**Mini-CAD toolbar**" when you wish to add information to the system (for example, labelling of slope inclinations or the location of any foundations).

- Objects created with the **Header CAD** are based on the page format (in mm). This makes you independent of the coordinate system and keeps you in the same position on the page. You should select the "**Header toolbar**" if you wish to place general information on the drawing (company logo, report numbers., plan numbers, stamp etc.). Once you have saved the header information to disk (see **Mini-CAD** user manual), you can load it into completely different systems (with different system coordinates). The saved header information will appear in exactly the same position on the page, which greatly simplifies the creation of general page information.

-

6.4.6 "Toolbar preferences" menu item

After starting the program a horizontal toolbar appears below the program menu bar. If you would rather work with a popup window with several columns, you can specify your preferences using this menu item. The smarticons can also be switched off.

At the bottom of the program window you find a statusbar with further information. You can also activate or switch off the status bar here. The preferences will be saved in the "**GGU-GEO-GRAPH.alg**" file (see menu item "**Graphics preferences/Save graphics preferences**") and will be active at the next time the program is started.

By clicking on the tools (smarticons) you can directly reach most of the program functions. The meaning of the smarticons appears as a text box if you hover with the mouse pointer over the tools. Some of the tool functions can be activated from the normal menu items.

"**Zoom out**"
If you have previously *zoomed in*, this tool returns to a full screen display.

"**Zoom (-)**"/"**Zoom (+)**"
With the zoom functions you can zoom in or out of parts of the image, by clicking the left mouse button.

⧉ "**Copy/print area**"

Use this tool to copy only parts of the graphics in order to paste them, e.g. to a report. You will see information on this function and can then mark an area, which is copied to the clipboard or can be saved in a file. Alternatively you can send the marked area directly to your printer.

6.4.7 "3D toolbar" menu item

This menu item allows you to choose a pop-up window with tools for advanced editing of the three-dimensional graphics. If you hover with the mouse pointer over the tools, the meaning of the Smarticons appears in a text box.

The "**Rotation by …**" tool allows you to rotate the graphics around one of the three axes. The plus and minus signs designate the direction of rotation. The angle of rotation can be adjusted as wished using the ◢ tool.

6.4.8 "Mini-CAD preferences" menu item

Objects added using **Mini-CAD** are normally drawn via the system representation. If the **Mini-CAD** objects are to be positioned behind the graphics this can be specified in the pop-up menu of the **Mini-CAD** module (layer dialogue in **Mini-CAD**/"**Presentation**" button).

6.4.9 "General legend" menu item

A general legend can be displayed by activating this menu item. The legend will be represented according to the information entered in the dialogue box.
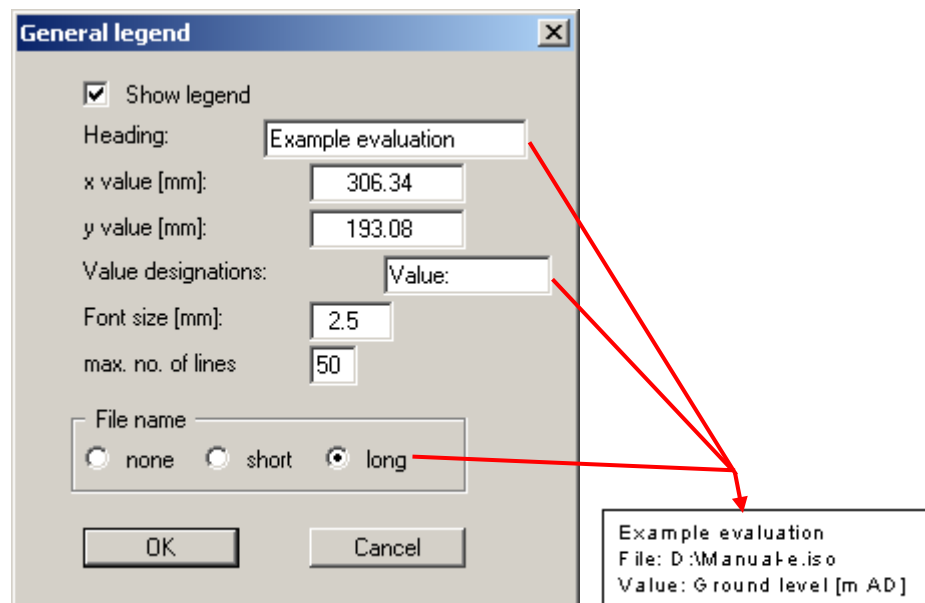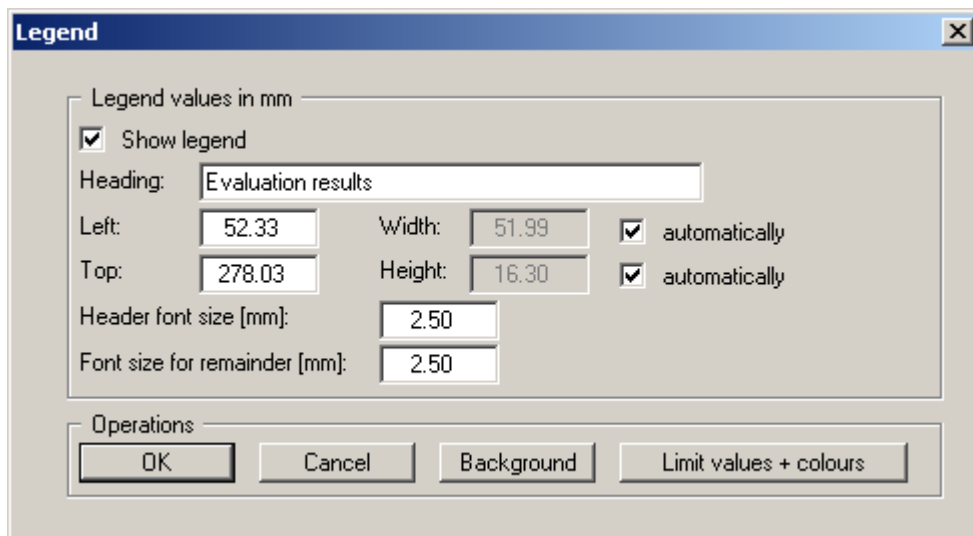

If the evaluations are performed via the "**Graphics**" or "**Chart evaluation**" menus, where a header is entered in the corresponding dialogue boxes (e.g. in the menu item "**Graphics/Contours (normal)**", "**Gradients**" button, see Section 6.5.2.5), the '**Heading**' box must be left empty. Otherwise the heading appears double.

You can define and edit the position of the legend using the values "**x**" and "**y**". You control the size of the legend using "**Font size**" and "**max. no. of lines**"; where necessary, several columns are used.

The file name can be excluded ("**none**" switch) or, by activating the appropriate switch, displayed as "**short**" or "**long**" and automatically with or without the file path.

6.4.10   "Bars legend" menu item

Once the bar visualisation is selected for evaluation a corresponding legend appears on the output sheet. If the "**Show legend**" check box is activated the presentation format can be edited in the dialogue box for this menu item. The dialogue box can also be accessed by double-clicking in the legend box.
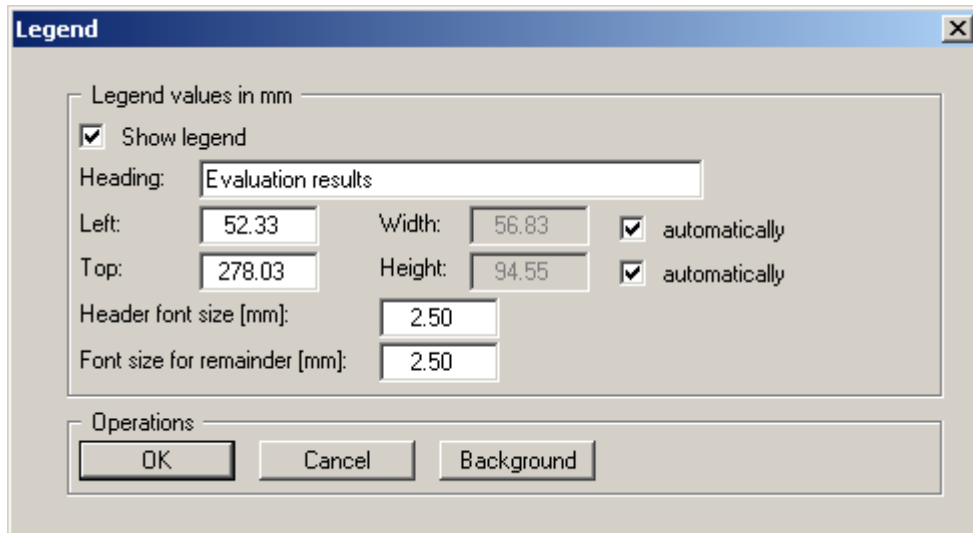

Input here defines the upper left corner of the legend box. The "**automatically**" check boxes should always be activated for specifying the width and height, because the size of the legend is then adapted to the number of measured data points and the length of the measured data designations. The font sizes for the heading and the measured data names can also be specified, as well as selecting a background colour for the legend.

The "**Limit values + colours**" button is only relevant for evaluation using value-dependent, colour-filled bars. The button can be used to alter the settings for value-dependent colour fill. The same dialogue box opens as for the menu item "**Chart evaluation/Bars**", "**Value-dependent colour fill**" button (see Section 6.6.2.3).

For a normal, coloured bar chart the measured data represented as bars are shown in the legend together with the corresponding value colours. The colours can be changed by going to the menu item "**Edit/Value colours**" (see Section 6.2.2).
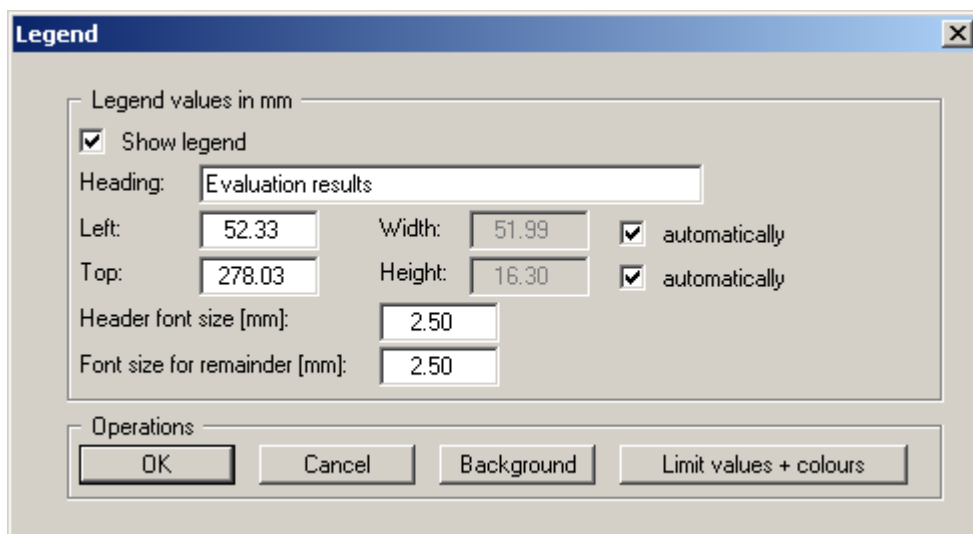
6.4.11 "Pie charts legend" menu item

If a pie chart is used a legend containing the displayed measured data and the corresponding value colours is shown on the output sheet. The colours can be changed by going to the menu item "**Edit/Value colours**" (see Section 6.2.2). If the "**Show legend**" check box is activated the legend presentation format can be altered in the dialogue box for this menu item. The dialogue box can also be accessed by double-clicking in the legend box.
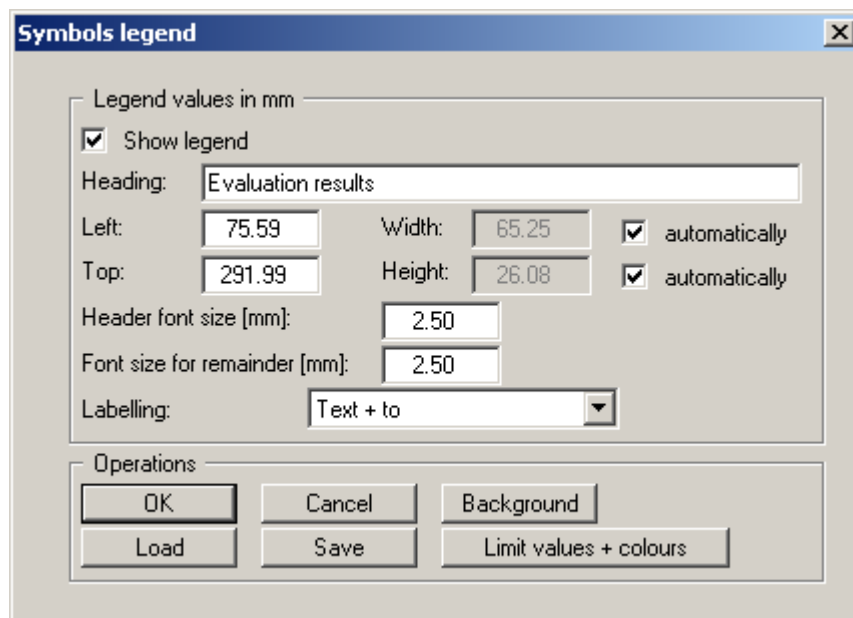

Input here defines the upper left corner of the legend box. The "**automatically**" check boxes should always be activated for specifying the width and height, because the size of the legend is then adapted to the number of measured data points and the length of the measured data designations. The font sizes for the heading and the measured data names can also be specified, as well as selecting a background colour for the legend.

6.4.12 "Tables legend" menu item

If you have selected a value-dependent colour visualisation for the table graphics a corresponding evaluation legend is displayed on the output sheet. If the "**Show legend**" check box is activated the legend presentation format can be altered in the dialogue box for this menu item. The dialogue box can also be accessed by double-clicking in the legend box.

Input here defines the upper left corner of the legend box. The "**automatically**" check boxes should always be activated for specifying the width and height, because the size of the legend is then adapted to the number of measured data points and the length of the measured data designations. The font sizes for the heading and the measured data names can also be specified, as well as selecting a background colour for the legend.

It is possible to alter the settings for value-dependent colour fill by pressing the "**Limit values + colours**" button. The same dialogue box opens as for the menu item "**Chart evaluation/Tables**", "**Edit limit values**" button (see Section 0).

6.4.13 "Symbols legend" menu item

If you have selected a discrete colour gradient visualisation for the symbol graphics a corresponding evaluation legend is displayed on the output sheet. If the "**Show legend**" check box is activated the legend presentation format can be altered in the dialogue box for this menu item. The dialogue box can also be accessed by double-clicking in the legend box.

Input here defines the upper left corner of the legend box. The "**automatically**" check boxes should always be activated for specifying the width and height, because the size of the legend is then adapted to the number of measured data points and the length of the measured data designations. The font sizes for the heading and the measured data names can also be specified, as well as selecting a background colour for the legend.
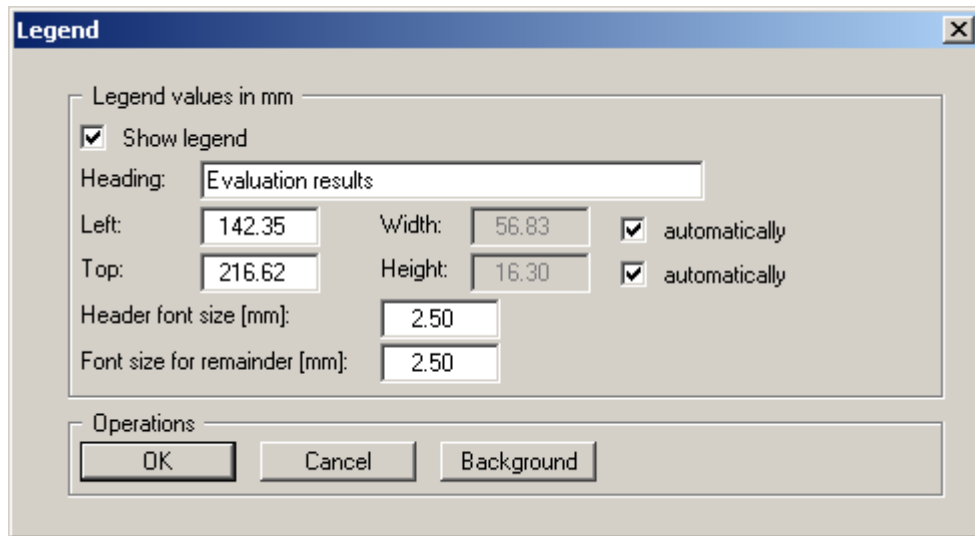
In the pull-down menu select between "**Text only**", "**Text + to**" and "**Text + from/to**" for legend limit value labelling. The limit values entered are shown in brackets according to the selected format.

It is possible to alter the settings for value-dependent colour fill by pressing the "**Limit values + colours**" button. The same dialogue box opens as for the menu item "**Chart evaluation/Symbols**", "**Discrete colour gradient**" group box, "**Colour + legend preferences**" button (see Section 6.6.6.3).

The preferences can be saved in a file with the "**.leg**" extension. If the file is saved in the program folder (default) the preferences will be automatically loaded the next time the program is started.

6.4.14 "Section legend" menu item

If a sectional visualisation is used a legend containing the displayed measured data and the corresponding value colours is shown on the output sheet. The colours can be changed by going to the menu item "**Edit/Value colours**" (see Section 6.2.2). If the "**Show legend**" check box is activated the legend presentation format can be altered in the dialogue box for this menu item. The dialogue box can also be accessed by double-clicking in the legend box.

Input here defines the upper left corner of the legend box. The "**automatically**" check boxes should always be activated for specifying the width and height, because the size of the legend is then adapted to the number of measured data points and the length of the measured data designations. The font sizes for the heading and the measured data names can also be specified, as well as selecting a background colour for the legend.

6.4.15 "Section course legend" menu item

If a section is visualised a legend is shown which includes a section location sketch. If the "**Show section course**" check box is activated the presentation format can be edited in the dialogue box for this menu item. The dialogue box can also be accessed by double-clicking in the legend box.
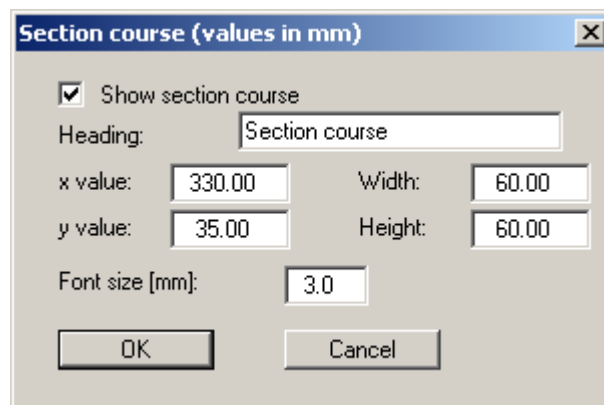
The position of the legend can be defined and edited using the values "**x**" and "**y**", "**Width**" and "**Height**". You can edit the font size of the entered heading.

6.4.16 "Move objects" menu item

Select this menu item in order to position a legend at the desired position on the output sheet. You can also move the legend by pressing [**F11**] and then positioning the legend box with the left mouse button pressed. In that case an info-box appears no more.

6.4.17 "Save graphics preferences" menu item

Some of the preferences you made with the menu items of the "**Graphics preferences**" menu can be saved to a file. If you select "**GGU-GEO-GRAPH.alg**" as file name, and save the file on the same level as the program, the data will be automatically loaded the next time the program is started and need not be entered again.

6.4.18 "Load graphics preferences" menu item

You can reload a graphics preferences file into the program, which was saved using the "**Graphics preferences/Save graphics preferences**" menu item. Only the corresponding data will be refreshed.
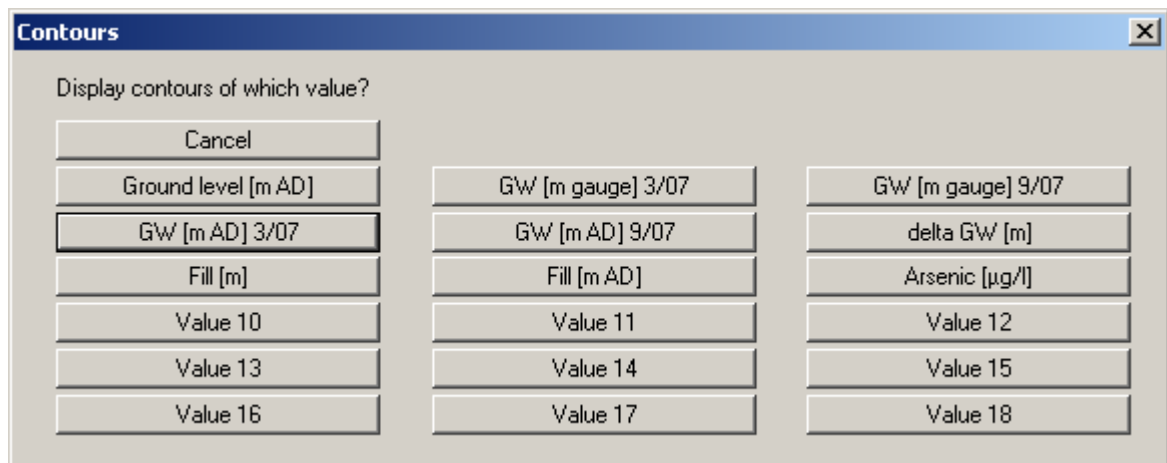
6.5.1   General note

After completing new input of data points and before using this menu item, a triangle mesh (interpolation mesh) must be defined (see following Sections 6.5.4 pp). The program utilises this triangle mesh as the basis for interpolation between the individual data points.

Slow screen output generated using the following menu items can be cancelled with a click of the right mouse button.
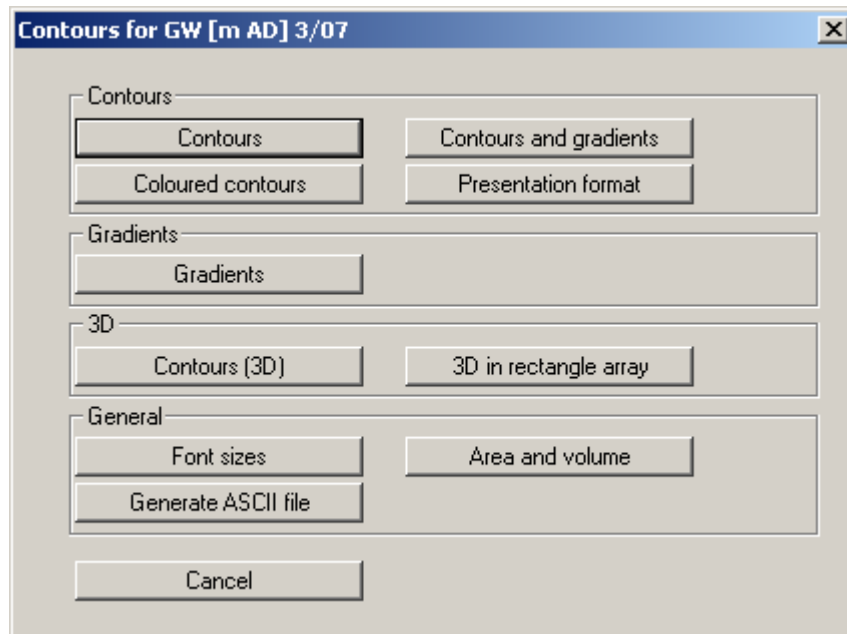
6.5.2   "Contours (normal)" menu item

6.5.2.1   Selection of measured data and type of contours

The data you have entered can be represented as contour lines using this menu item. After selecting the menu item you then select the data to be represented as contour lines.

Contours		×
Display contours of which value?		
Cancel		
Ground level [m AD]	GW [m gauge] 3/07	GW [m gauge] 9/07
GW [m AD] 3/07	GW [m AD] 9/07	delta GW [m]
Fill [m]	Fill [m AD]	Arsenic [µg/l]
Value 10	Value 11	Value 12
Value 13	Value 14	Value 15
Value 16	Value 17	Value 18

After selecting a parameter you will see the following dialogue box:

In addition to the buttons described in more detail in sections 6.5.2.2 - 6.5.2.7, the following operations can be carried out here:

- "**Contours and gradients**"
  Allows combined presentation of contours and gradients. The settings for contour line representation are described in Section   . The description of gradient representation can be found in Section 6.5.2.5.

- "**Font sizes**"
  You define the font sizes for axes labelling, etc.

- "**Area and volume**"
  The program computes the area and volume resulting from the values measured within the defined triangle mesh. If data smaller than zero is present, negative volume will also be computed. If the appropriate values are entered (e.g. ground level, thickness of topsoil, location of the excavation level) excavation volumes can also be computed.

- "**Generate ASCII file**"
  You can generate an ASCII file with the current data, which can subsequently be processed further, for example in a spreadsheet.

6.5.2.2 *"Contours" button*

The data can be displayed as lines of equal value, e.g. groundwater isohypses. A dialogue box opens in which you can define preferences for contour line representation.
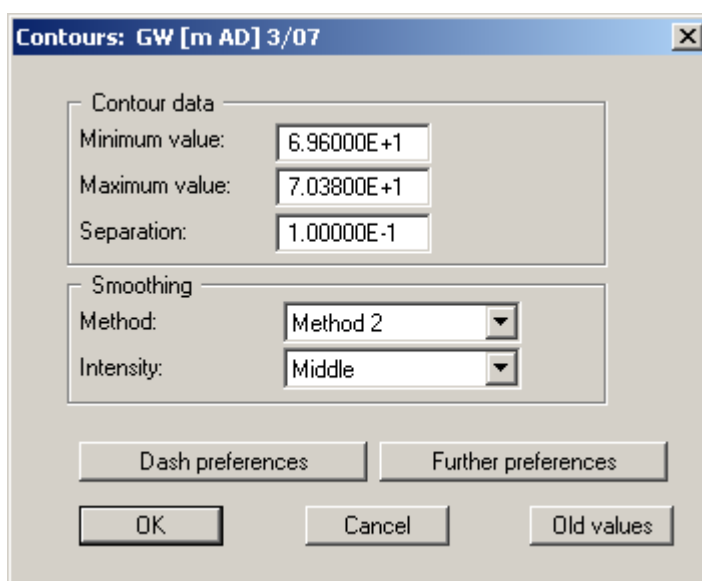
The program shows the existing smallest and largest values and the separation of the contour lines. If you want the representation to begin with a different value, the initial value can be entered here. You can also vary the spacing, in order to reduce the number of contour lines drawn for example.

If you select the "**Contours**" button in the previous dialogue box, the settings displayed here are always those automatically selected by the program. Using the "**Old values**" button, the preferences used for the previous contour line diagram are adopted. This information is saved with the record.

You can also select from three smoothing out procedures:

- "**Do not smooth**"
  As a linear method is implemented within the triangle elements, this will provide analysis results without smoothing performed by the program.

- "**Method 1**" and "**Method 2**"
  these smoothing out procedures employ two different Bezier splines. Smoothing out intensities can be given for both in order to acquire smooth contour lines. **Method 2** creates very "**round**" contours, with the danger that the true results may be falsified.

> There is no optimum method. Method suitability depends on the type of data.

You can specify the type of visualisation for the contour lines by means of the "**Dash preferences**" and "**Further preferences**" buttons. These settings can also be adjusted in advance by means of the "**Presentation format**" button (see Section 6.5.2.4).

If your preferences are confirmed by pressing "**OK**" the contours are displayed on the screen. The colour defined in "**Graphics preferences/Pen colour and width**" is used. If you need to display the contours in a different colour the colour can be adapted to suit your requirements here (see Section 6.4.3).

6.5.2.3 "Coloured contours" button

Using this button contour lines can be drawn with a colour fill.
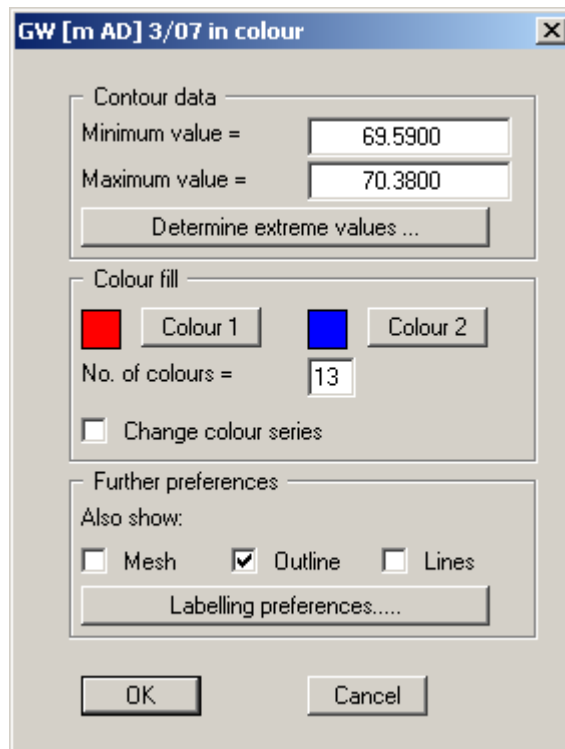
- "**Contour data**" group box
  The "**Determine extreme values…**" button computes the minimum and maximum values and enters them into the appropriate input boxes. However, you need not retain these values, but can also define your own. In the example shown in the dialogue box above it would make sense to define the minimum value as 69.50 and the maximum as 70.50. If you then enter **11** for the '**No. of colours**', the colour of the contour fill will change every 10 cm. If **21** colours are entered the colour changes for every 5 cm potential differential.

  > No smoothing of the contour lines can be performed here.

- "**Colour fill**" group box
  You can control the colour subdivisions of the contour diagram using "**No. of colours**". In the example above, 16 colours will be displayed between "**Colour 1**" and "**Colour 2**". The default setting is a colour course from red to blue. These colours can be edited as required after selecting the "**Colour 1**" and "**Colour 2**" buttons, or simply reverse the choice by selecting the "**Change colour series**" check box.

- "**Further preferences**" group box
  In addition to the colour presentation you can also have the triangle mesh and/or the outline displayed. Additional contour lines can also be drawn. Line labelling preferences can be defined by means of the "**Labelling preferences**" button.

- "**OK**"
  The colours will be drawn after confirmation.

A colour bar at the right edge of the sheet allows correlation between the colour and the corre-
sponding value. If this colour bar is drawn in the right page margin, specify a larger value for the
right plotting margin (e.g. 25 mm) in the "**Page size + margins/Page size and margins**" menu
item (see Section 6.3.1).

6.5.2.4   "Presentation format" button

In the dialogue box you can specify preferences for the type of presentation and for contour line
labelling.
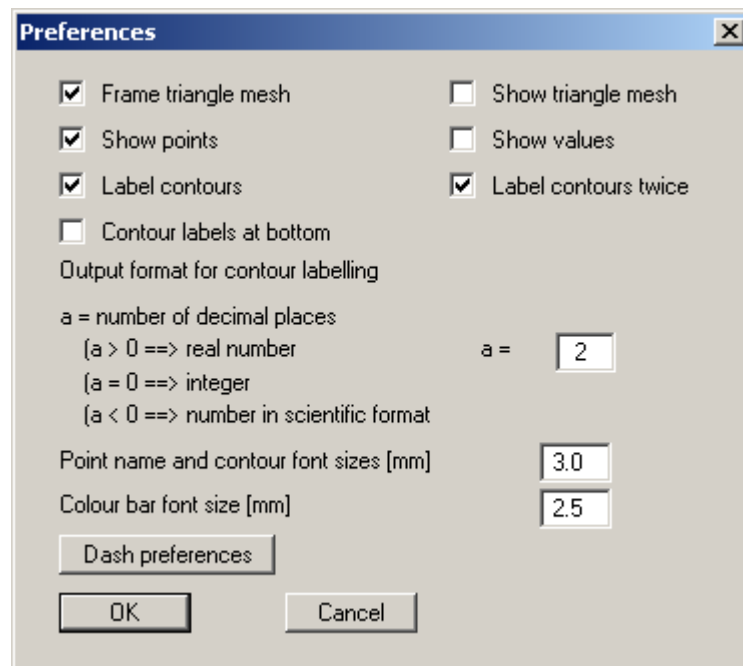
- "**Frame triangle mesh**"
  A thin line is drawn around the outer edge of the mesh.

- "**Show triangle mesh**"
  All triangles in the mesh are drawn.

- "**Show points**"
  The points and corresponding point names are displayed.

- "**Show values**"
  The measured data at the corresponding points are displayed.

- "**Label contours**"
  The contours are labelled, the text is positioned approximately in the centre of the contour
  lines.

- "**Label contours twice**"
  The contours are labelled at both ends.

- "**Contour labels at bottom**"
  Normally, contour lines are labelled towards the increasing side of the lines. This can lead
  to labelling *on its head*. Activate this check box if you always want the labelling aligned
  for reading.

In addition, the number of decimal places and the font size can be defined for contour labelling, as
well as the font sizes for the point and colour bar labelling.

The "**Dash preferences**" button opens the following dialogue box:
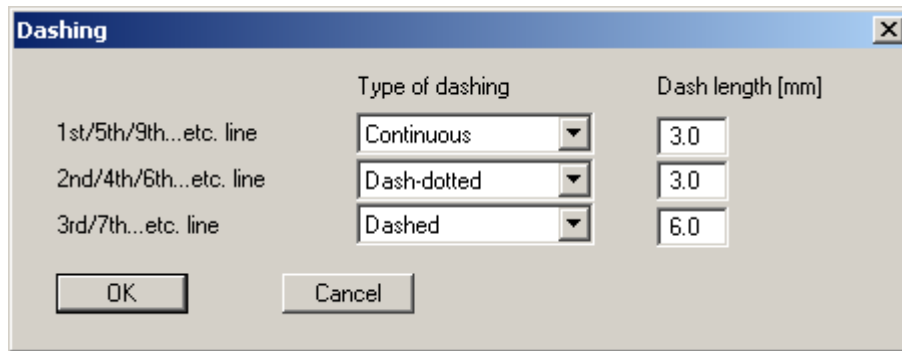
For example, if you want to display groundwater diagrams depicting wide areas, the contour labelling may be very widely spaced. The settings in the above dialogue box would lead to the following contour lines for a selected contour spacing of 0.25 m.
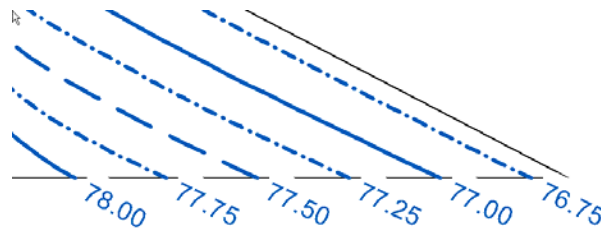
6.5.2.5   "Gradients" button

Using this button you can generate a gradient field. The gradients are computed from the three values, one at each corner, for each triangle respectively. The length of the gradients can be controlled in the dialogue box.
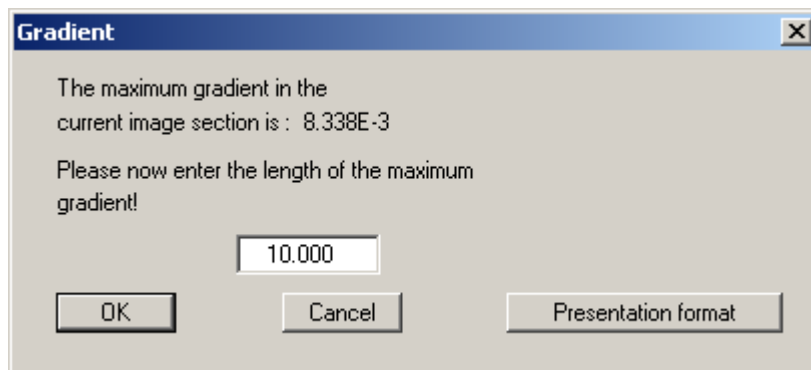
Further gradient presentation format and labelling preferences can be specified in the dialogue box that opens when you press the "**Presentation format**" button. The "**Frame triangle mesh**", "**Show triangle mesh**", "**Show points**" and "**Show values**" switches correspond to the settings for contour lines described in Section 6.5.2.4 "**Presentation format**".
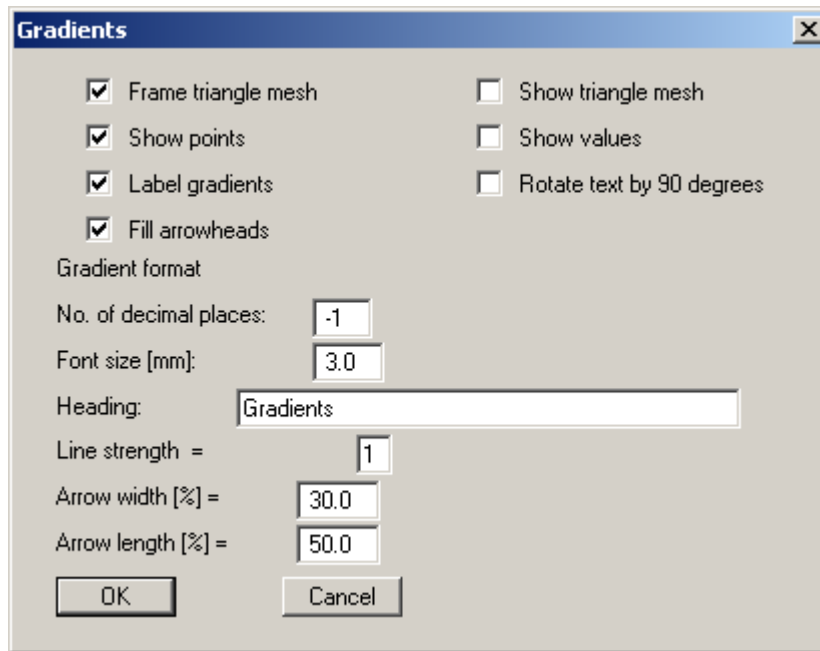
- "**Label gradients**"
  The gradients are labelled with the gradient value.

- "**Rotate text by 90 degrees**"
  Depending on the orientation of the gradient arrows, the labelling may be above the arrows. It may be useful for a clear presentation to rotate the labelling by 90°.

- "**Fill arrowheads**"
  The gradient arrowheads are colour-filled with the colour given for gradients in the "**Graphics preferences/Pen colour and width**" menu item. If a different colour is required it must be altered here (see Section 6.4.3).

- "**Gradient format**"
  Further settings for gradient visualisation can be made in the following input fields. Negative numbers in the "**No. of decimal places**" field generate exponential labelling, whereby the negative number represents the number of decimal places. Positive numbers generate normal labelling with x decimal places. A "**0**" generates labelling in integer format. The text entered in "**Heading**" is used as the heading in the general legend and need not be re-entered in the dialogue box described in Section 6.4.9. The "**Heading**" input box there remains empty.

6.5.2.6 "Contours (3D)" button

This button allows a three-dimensional contour line visualisation
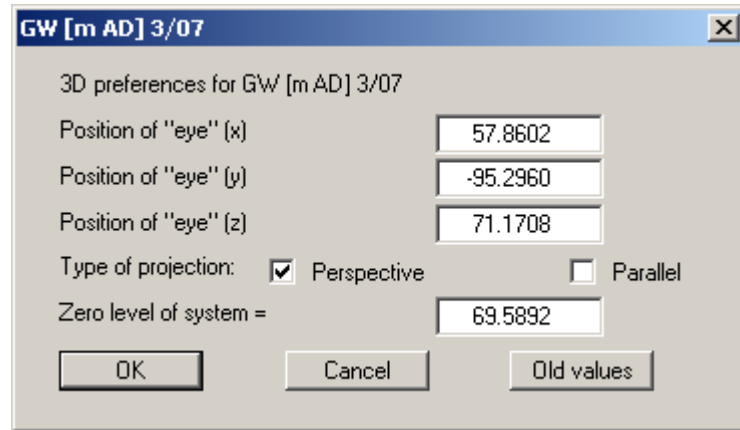
First, select the point of observation (position of the *eye* in x, y and z coordinates), the type of projection and the zero level of the 3D presentation. The values are displayed above and below the zero level (z ordinate) in three dimensions. The program will generally make sensible suggestions for the input values in the dialogue box, so you will not normally need to make alterations.

After leaving the dialogue box by pressing "**OK**" you will see the following dialogue box. It greatly resembles the box shown in the "**Graphics/Contours (normal)**" menu item "**Coloured contours**" button (see Section 6.5.2.3).
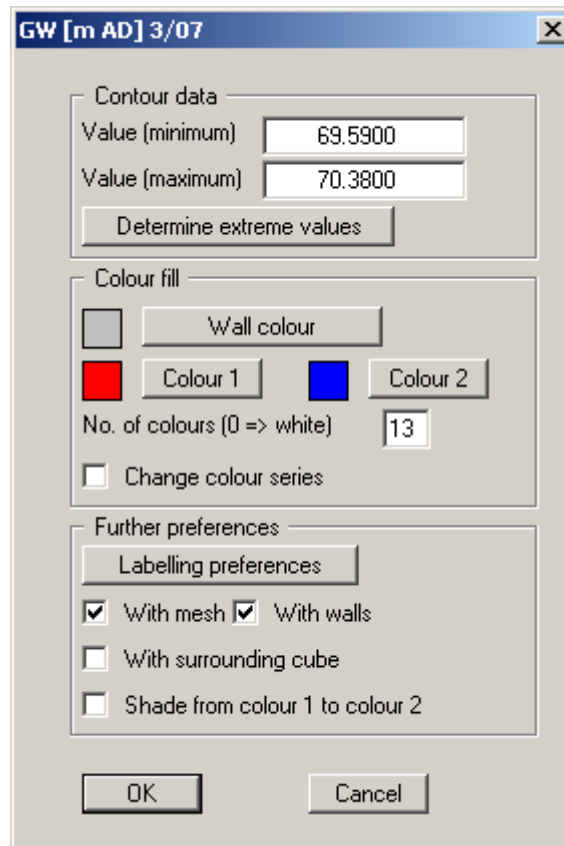
You can also specify whether an enclosing cube should be displayed; in some cases this improves the 3D effect. The "**Shade from colour 1 to colour 2**" check box represents a bit of a special effect. If this check box is activated a light source is simulated in the region of the eye. The angle between the light beam and the respective 3D surface represents a measure of the reflection. The area is shaded in accordance with colours 1 and 2. A good choice of colours, for example, would be dark grey for colour 1 and pale grey for colour 2.

If the triangle mesh is very irregular in plan, the 3D impression will probably not be optimum. You should then use the "**3D in rectangle array**" button.

6.5.2.7   *"3D in rectangle array" button*

The 3D effect is usually lost in an irregular triangle mesh. The contours are then presented as a three dimensional image in a rectangular array. The following dialogue box opens where you can define the array by selecting the number of x and y subdivisions (plates):
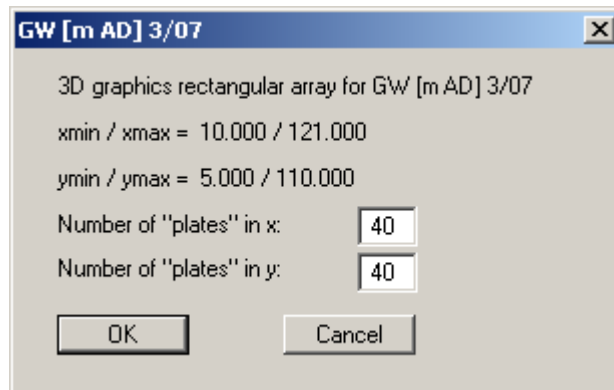
The program interpolates the values to be represented at the array points from the underlying triangle mesh. After leaving the dialogue box by pressing "**OK**" you will at first see the same boxes for defining the eye etc. and the coloured contours preferences as that described in the "**Graphics/Contours (normal)**" menu item "**Contours (3D)**" button (see Section 6.5.2.6).

6.5.3 "Contours (in mesh)" menu item

This menu item is almost completely the same as the previous one. With the difference that a triangle mesh with rectangular structure is computed from the data points of the underlying triangle mesh. Define the fineness of the rectangular mesh by entering the number of subdivisions (plates) in x and y directions:

```
Contours                                        [x]

Contours with mesh for GW [m AD] 3/07

xmin / xmax =  10.000 / 121.000

ymin / ymax =  5.000 / 110.000

Number of "plates" in x:        [ 40 ]
Number of "plates" in y:        [ 40 ]
Number of sample points:        [ 5 ]

[✓] Use floating mean

[ ] Complete rectangular area

[   OK   ]            [  Cancel  ]
```
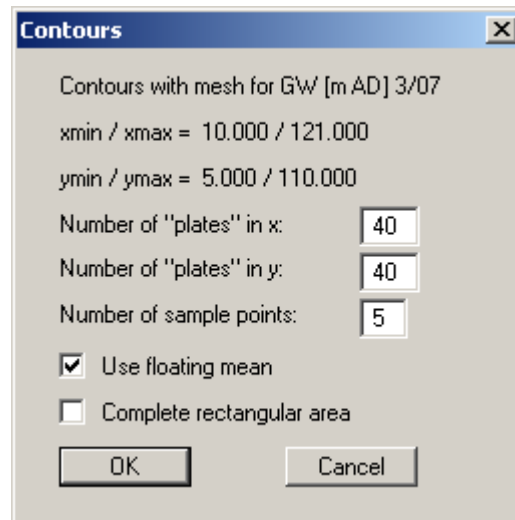
In addition, you must also give the number of control points (n) used to compute the data values at the mesh points. For each mesh point, the program uses the nearest n data points to obtain the new value for the mesh point.

If you activate the "**Use floating mean**" switch, the new values are calculated from a plane equation for n data points. Otherwise, the squares of the distances are used. In the above dialogue box the minimum x and y coordinates of the triangle system are given.

If the "**Complete rectangular area**" switch is activated, the program computes new array points within this rectangular area. Otherwise, only array points with x and y coordinates within the underlying triangle mesh are calculated. In particular for a triangle mesh with an exterior shape which deviates substantially from a rectangle, nonsensical extrapolation of new values can thus be avoided.

6.5.4 "Automatic triangle mesh" menu item

In order to represent contour lines the program first requires a triangle mesh (interpolation mesh), which serves as the basis for contour line smoothing. This mesh need only be defined once because it is then saved with the dataset. This menu items allows you to have the mesh generated automatically by the program.

6.5.5 "Manually" menu item

Generally, the automatically generated triangle mesh is very high quality. However, there are cases in which you might want to generate a different interpolation between individual points. Using this menu item, you can create a triangle mesh completely by hand or rework an existing mesh. A message box provides information on the procedure:
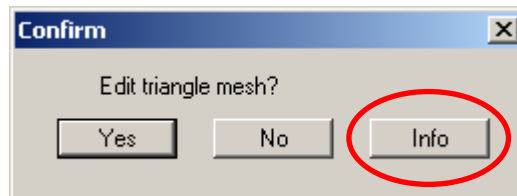
To define a triangle mesh (interpolation mesh) the data points (measurement points) are first displayed in their correct locations.

> If no points are visible, got to the "**Page size + margins/Auto-resize**" menu item or use the [**F9**] function key.

Then click three data points with the left mouse button; these then represent an interpolation triangle. Repeat this process until all the required data points are integrated into the triangle mesh.

The triangles may not overlap as this will almost always lead to nonsensical contours. You can have this condition tested by the program by going to the "**Graphics/Test**" menu item.

If you want to delete an existing triangle, click the points of the triangle once more. By pressing the right mouse button you can reset a triangle.

6.5.6 "Round off" menu item

During automatic generation a triangle mesh is generated that envelops all points. This can lead to acute-angled triangle elements in the boundary regions. These triangles can be removed from the triangle mesh using this menu item.

The program first computes the maximum and average radius ratios of the most unfavourable triangle. The radius ratio describes the relationship between external radius and internal radius of a triangle. For an isosceles triangle, this ratio equals 2.0 (optimum).
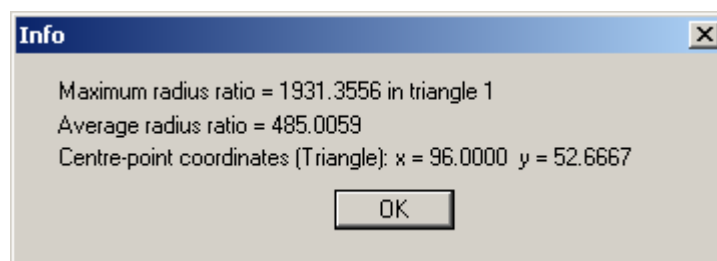
A dialogue box then opens, allowing you to define a radius ratio, above which all triangles are deleted.
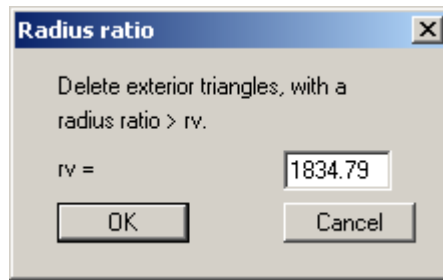
In the example above, all external triangles with a radius ratio greater than 1834.79 will be removed.

> In order to avoid *interpolation holes* in the triangle system only triangles at the boundaries are deleted.

6.5.7 "Test" menu item

The program examines the existing triangle mesh for overlapping triangles, which would normally lead to undesirable results.

6.5.8 "Display" menu item

You can have the triangle mesh (interpolation mesh) presented by means of the following dialogue box.
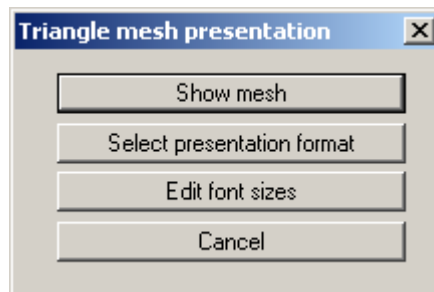
Using the "**Select presentation format**" button you have the option of specifying a number of preferences for the presentation, e.g. labelling with point names or triangle numbers.

6.5.9 "Delete" menu item

Using this menu item you can delete the triangle mesh, in part or completely. You must first click four points in anti-clockwise direction. All triangles with their centroid within this quadrilateral will be deleted.

6.5.10 "Save" menu item

You can save the triangle mesh separate from the dataset, in order to use varying interpolation meshes for the same system, for example.

6.5.11 "Load" menu item

You can load a previously saved triangle mesh (interpolation mesh).

6.5.12 "Interpolate" menu item

This menu item allows you to combine values of points not having identical x/y coordinates to one mesh. For example, this may be necessary for surveys carried out before and after land has been filled, as the following sketch shows.
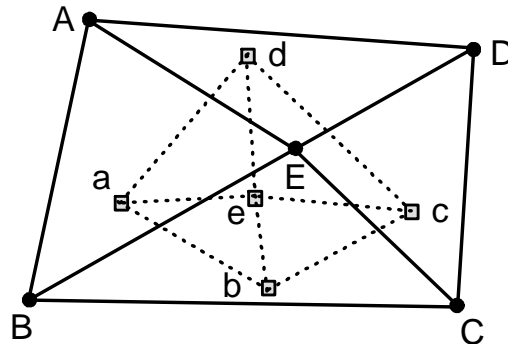
You must first create two files (the locations of the data points are not identical in the two files):

- File 1 ("**Before**") with data points A - E and the corresponding ground heights <u>before</u> filling (value "**Lower ground level [m AD]**"),

- File 2 ("**After**") with data points a - e and the corresponding ground heights <u>after</u> filling (value "**Upper ground level [m AD]**"),

No values are available for the lower ground level for data points a - e because no measurements were taken at these points before filling commenced.

First, load the dataset with the larger mesh for export; in the example above this is File 1, containing the points A - E. The points of the second file, which will later be imported, should all lie within the mesh of the file to be exported. Go to the "**Graphics/Interpolate**" menu item and click the "**Export**" button.

You can then load the file into which the previously exported data are to be imported, i.e. File 2 from the example above. Go to the "**Graphics/Interpolate**" menu item and click the "**Import**" button. You see a box with the value names. You must now specify the parameter to which the interpolated data should be transferred from the exported dataset. In the example above, the first unused parameter in File 2 with the name "**Lower ground level [m AD]**" is assigned and this parameter clicked on import.

The corresponding values are interpolated for the existing data points a - e in File 2 from the interpolation mesh of the exported File 1 for the selected parameter "**Lower ground level [m AD]**". Using these interpolated values, any graphics can now be referenced to the x/y coordinates of the data points a - e.

6.6.1   General notes on chart evaluation

Here you can select bar charts, circles, pie charts, tables or symbols to represent the measured values.

If a bar chart, a table evaluation or a symbol chart is used, two or three new menu items appear for each entry in the "**Chart evaluation**" menu. These allow the bars and tables to be repositioned using the mouse or the limit values and colours of value-dependent colour visualisations to be altered directly.

These diagram-related menu items are described in summary in sections 6.6.7 and 0.

6.6.2   "Bars" menu item

6.6.2.1   Type of bar charts

You can generate oriented bar charts with this menu item.
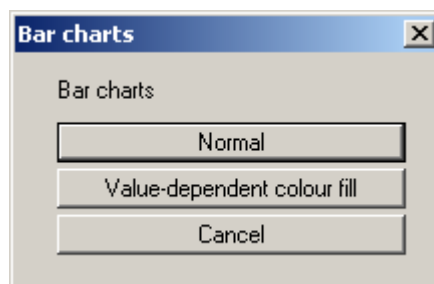
You can choose between simple bar charts and bar charts with a value-dependent colour fill. A value-dependent colour fill allows coloured representation of the bars with reference to a given value, for example violation of limit values for classification of contaminant concentrations.

6.6.2.2   Normal bars

After selecting the "**Normal**" button, mark the parameters to be represented as bar charts in the dialogue box. If several parameters are marked they will be displayed side by side or stacked.
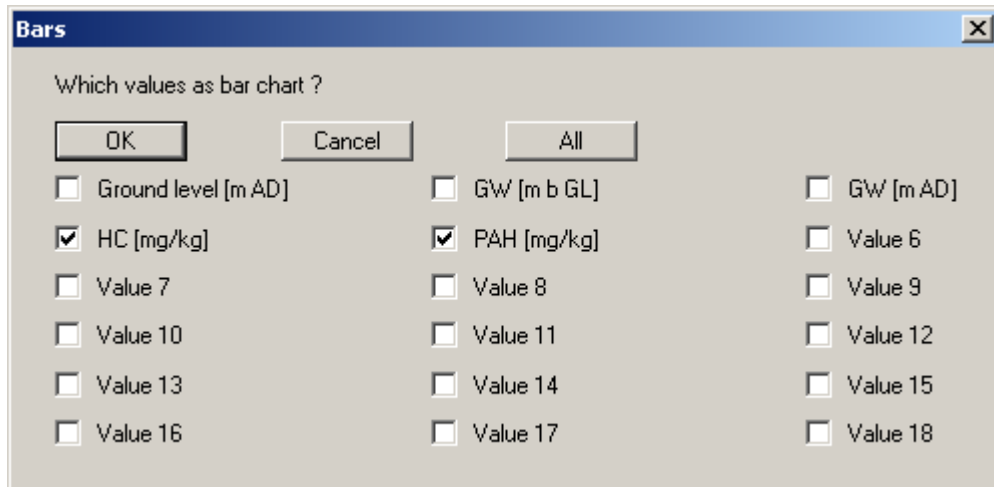
With the "**All**" button, all parameters can be activated or deactivated. Once you have confirmed your selection with "**OK**" the following dialogue box opens:
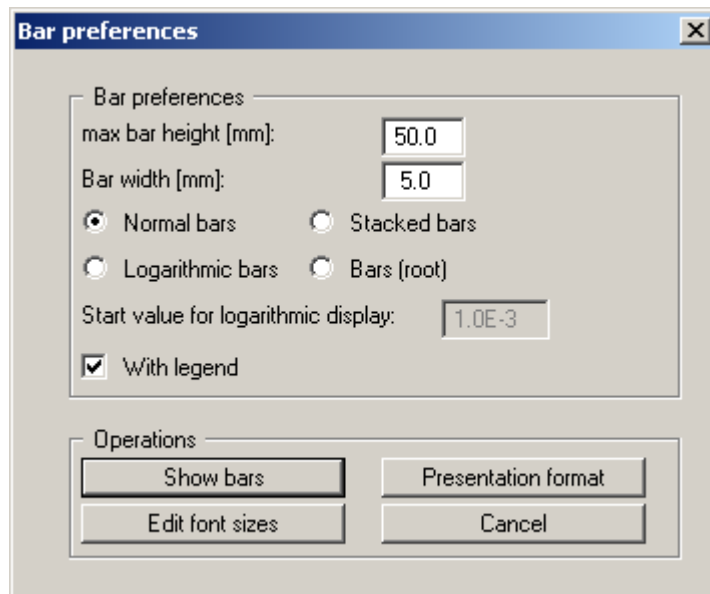
Besides height and width of the bars, you must specify the format of the bar charts. An additional starting value must be provided for a logarithmic bar representation. The difference between the measured value and the starting value is then represented on a logarithmic scale.

Using the "**Presentation format**" button it is possible to alter the settings for bar presentation in analogy to the description given in the menu item "**Graphics/Contours (normal)**" (see Section 6.5.2.4, "**Presentation format**" button). A heading can be entered in the preferences dialogue box; this is used as the heading for the general legend (see Section 6.4.9). If the "**Bars coloured**" check box is activated in the settings box the bars are visualised using the value colour of the selected data. Changes can be made by going to the menu item "**Edit/Value colours**" (see Section 6.2.2).

6.6.2.3 Value-dependent colour filled bars

If you click the "**Value-dependent colour-fill**" button in the option box for the bar graphics the measured to be displayed can be selected. The following dialogue box opens:
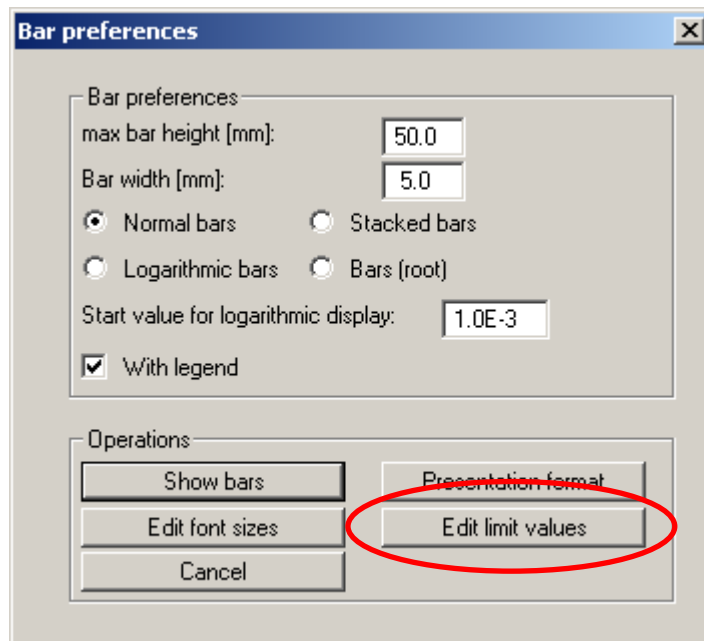
The input boxes and buttons in this dialogue box are identical to those in the box described in Section 6.6.2.2, "**Normal bars**". However, an additional button, "**Edit limit values**" is shown for the value-dependent bar chart, opening the following dialogue box
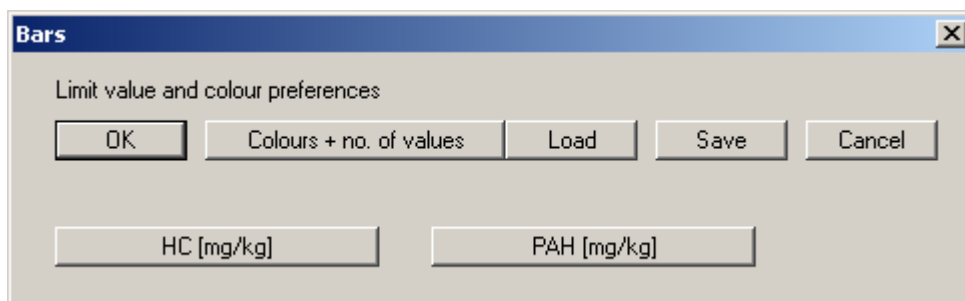
- The "**Colours + no. of values**" button allows you to define the number of limit values (maximum 5) and the corresponding text and colour. The following dialogue box opens, for example, containing 4 defined limit values.
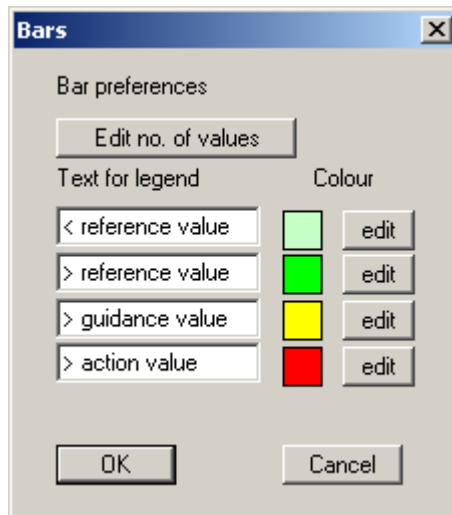
An additional limit value can be defined or the number reduced using the "**Edit no. of values**" button. The texts can be adapted to your requirements and the colours assigned to the respective values via the "**edit**" button. The changes are accepted via "**OK**" and you return to the above dialogue box.

- The settings can be saved to a file with the "**.blk**" extension via the "**Save**" button . If the file is saved in the program folder (default) the preferences will be automatically loaded the next time the program is started. Different settings files can be opened for the current session via the "**Load**" button.

In the lower region of the above dialogue box the measured data selected for display are shown as buttons, 2 values in the example:"**HC [mg/kg]**" and "**PAH [mg/kg]**".

- The limit value for each quantity can be specified by selecting it (e.g. HC).
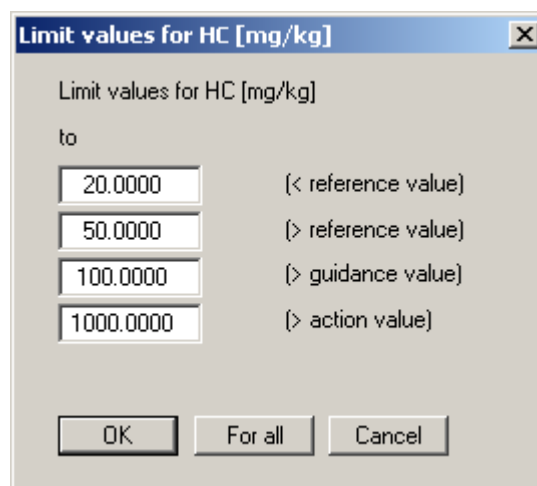
Four limit values are shown here, corresponding to the settings specified by pressing "**Colours + no. of values**". The "**For all**" button adopts the limit values given here for all other values, which will only rarely be useful.

Once you have finished defining preferences, click "**Show bars**", the bar charts will then be generated. The bars are coloured according to value of the parameter and the corresponding limit values. If the measured value exceeds the maximum value defined in the classification, the bar remains uncoloured. It therefore makes sense for many applications to define a further limit value above the actual maximum.

6.6.3 "Circles" menu item

You can generate oriented circle charts with this menu item. The sizes of the circles are represented as a function of the values of the parameters. Mark the parameter to be represented as a circle chart in the first dialogue box. The following dialogue box then appears:
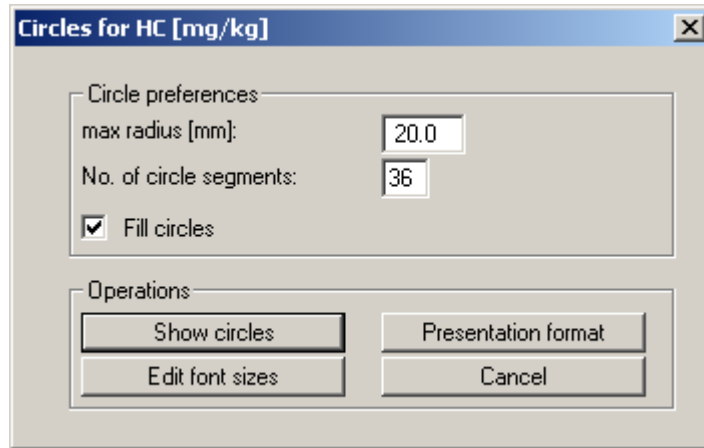
You must specify the number of segments in the circle, in addition to the maximum circle radius. If you enter a "**3**" for the number of segments, triangles will be displayed instead of circles.
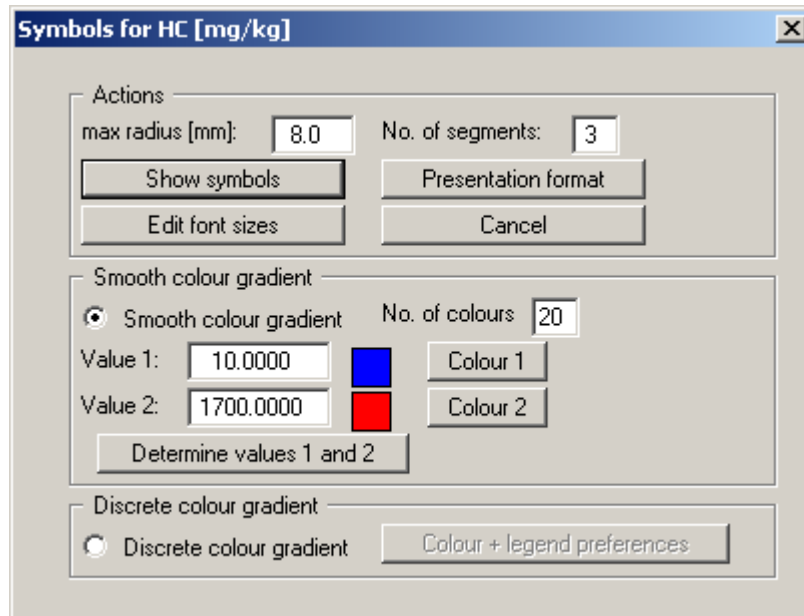
Using the "**Presentation format**" button it is possible to alter the settings for circle presentation in analogy to the description given in the menu item "**Graphics/Contours (normal)**" (see Section 6.5.2.4, "**Presentation format**" button). A heading can be entered in the preferences dialogue box; this is used as the heading for the general legend (see Section 6.4.9).

After closing the dialogue box via the "**Show circles**" button the circle charts are displayed on the screen. The colour fill of the circles is defined via the value colour of the selected data; changes can be made via the "**Edit/Value colours**" menu item (see Section 6.2.2).

6.6.4 "Pies" menu item

You can generate oriented pie charts using this menu item. In the first dialogue box you mark the parameters to be represented as percentages in the pie charts, analogous to the "**Chart evaluation/Bars**" menu item. A dialogue box then appears, in which you must specify the radius of the pie charts.
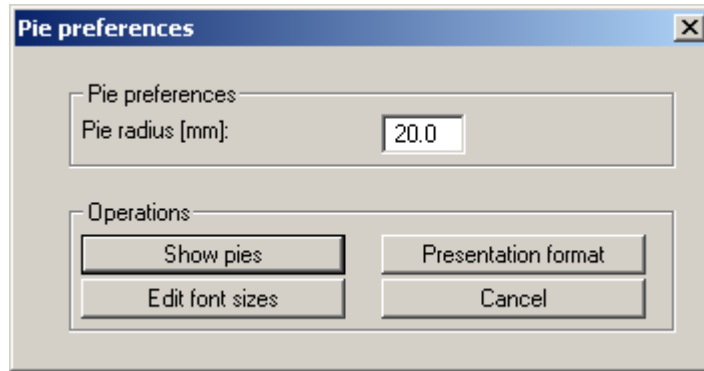
Using the "**Presentation format**" button it is possible to alter the settings for pie presentation in analogy to the description given in the menu item "**Graphics/Contours (normal)**" (see Section 6.5.2.4, "**Presentation format**" button). A heading can be entered in the preferences dialogue box; this is used as the heading for the general legend (see Section 6.4.9). It is additionally possible to select a colour fill or hatching for the pie chart. The fill and hatching line colours used are defined via the value colour of the selected data. Changes can be made by going to the menu item "**Edit/Value colours**" (see Section 6.2.2).

After closing the dialogue box via the "**Show pies**" button the pie charts are displayed on the screen.

6.6.5 "Tables" menu item

You can represent your data in oriented tables with this menu item. Mark the parameters to be represented in a table in the first dialogue box. If you mark a number of parameters they will be represented in different rows in the table. The following dialogue box then appears:
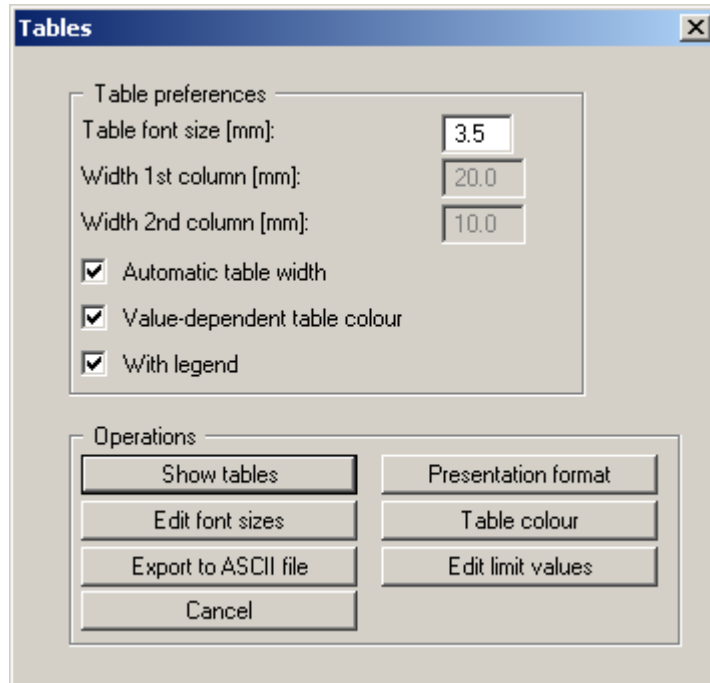
If the "**Automatic table width**" check box is activated the size of the table is controlled by the given "**Table font size**". The program optimises the column heights and widths automatically to suit the selected font size. The column widths can be user-defined if the check box is deactivated; however, this generally only leads to optimum results by trial and error.

If the "**Value-dependent table colour**" check box is activated, the table cells containing the measured data are coloured according to the settings specified via the "**Edit limit values**" button. The settings are described in detail in the menu item "**Chart evaluation/Bars**", "**Value-dependent colour-fill**" button (see Section 6.6.2.3).

Using the "**Presentation format**" button it is possible to alter the settings for table presentation in analogy to the description given in the menu item "**Graphics/Contours (normal)**" (see Section 6.5.2.4, "**Presentation format**" button). A heading can be entered in the preferences dialogue box; this is used as the heading for the general legend (see Section 6.4.9). Additionally, the "**Table coloured**" check box can be activated in the table presentation settings box. The column containing the measured data designation is then colour-filled using the colour defined via the "**Table colour**" button in the above dialogue box.

It is possible to save the current data to a file using the "**Export to ASCII file**" button and process it further in third-party applications, e.g. in a spreadsheet. Specify the number of columns according to the number of data points. If the number given is smaller than the actual number of data points two or more tables are written below each other in the file. The number of decimal places to apply for the measured data can also be specified. For example, if the measured data is to be output in m AD, a "**2**" should be specified here.

6.6.6 "Symbols" menu item

6.6.6.1 *General symbol charts preferences*

This menu item is a graphics format consisting of elements taken from bar charts (value-dependent colour fill) and circle charts. However, the size of the symbols remains constant. In analogy to circle charts you first select a parameter to be represented by symbol charts. You will then see the following dialogue box:

The symbol size can be defined by means of the radius. The symbol shape can be altered by means of the number of segments. Using the "**Presentation format**" button it is possible to alter the settings for symbol presentation in analogy to the description given in the menu item "**Graphics/Contours (normal)**" (see Section 6.5.2.4, "**Presentation format**" button). A heading can be entered in the preferences dialogue box; this is used as the heading for the general legend (see Section 6.4.9).

You can choose between two types of colour fill:

6.6.6.2 *"Smooth colour gradient" group box*

If the "**Smooth colour gradient**" check box is activated the symbols are continuously and smoothly coloured according to the parameter value and the colours assigned to Value 1 and Value 2.
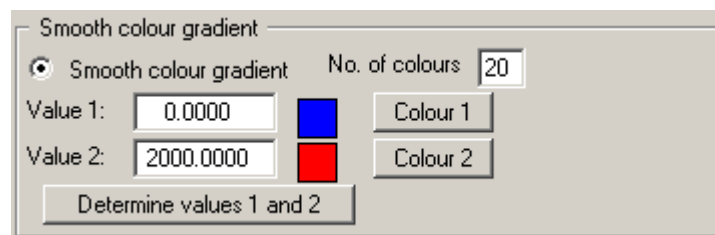
Determine the minimum and maximum measured data values using the "**Determine values 1 and 2**" button; they are automatically entered into the input boxes. If the values are *crooked* user-defined values can be used. The limit colours are defined using the "**Colour 1**" and "**Colour 2**" buttons. Define the number of colours for the colour gradient and thus the subdivisions of the colour scale. Using the example shown, for example, a colour scale is achieved with a colour change after every 100 mg/kg of the measured data.

Once the preferences for the gradual colour gradient are defined, the visualisation is shown after closing the dialogue box via "**Show symbols**". A colour bar at the right edge of the sheet allows correlation between the colour and the corresponding parameter value. If this colour bar is drawn in the right page margin, specify a larger value for the right plotting margin (e.g. 25 mm) in the "**Page size + margins/Page size and margins**" menu item (see Section 6.3.1).

6.6.6.3 "Discrete colour gradient" group box

If you activate the "**Discrete colour gradient**" check box in the lower section of the above dialogue box, the symbols will be colour-filled to allow a classification corresponding to that used for the bar charts with value-dependent colour fill.
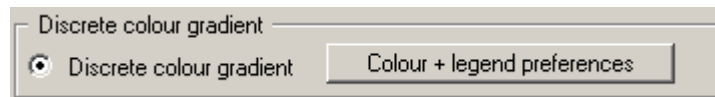
After clicking the "**Colour + legend preferences**" the following dialogue box opens for specifying legend preferences; these were previously explained in the menu item "**Graphics preferences/Symbols legend**" (see Section 6.4.13).
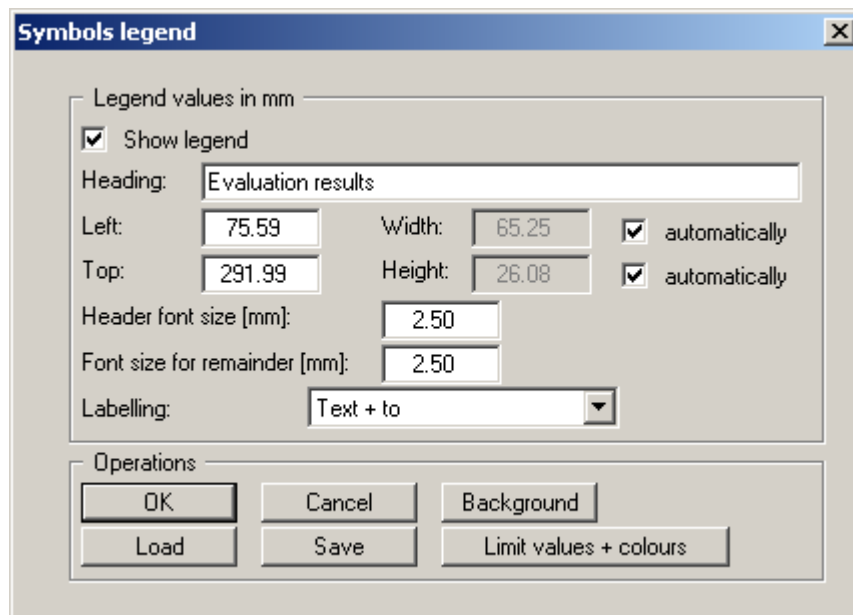
The "**Limit values + colours**" button is crucial to subsequent colour visualisation. It opens the following dialogue box:
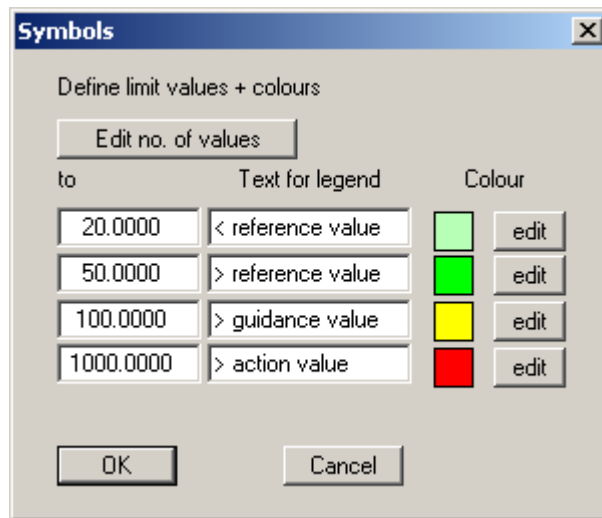
An additional limit value can be defined or the number reduced using the "**Edit no. of values**" button. The texts can be adapted to your requirements and the colours assigned to the respective values via the "**edit**" button. Because only one value can be selected for the symbol chart, the limit values are entered directly, in contrast to the value-dependent bar chart. The changes are accepted via "**OK**" and you return to the above dialogue box. The preferences can be saved in a file with the "**.leg**" extension. If the file is saved in the program folder (default) the preferences will be automatically loaded the next time the program is started.

Once the settings are completed and the legend box is closed by pressing "**OK**" the evaluation and symbol visualisation is started by pressing the "**Show symbols**" button in the start box (see Section 6.6.6.1).

6.6.7 "Move bars"/"Move tables" menu items

When data points are closely spaced bars or tables may overlap. Using this menu item or after pressing [**F12**] individual bars or tables may therefore be moved to a different position on the page using the mouse.

A dialogue box opens displaying information on moving the objects. Confirm with '**OK**' and click in the region at the top right of the starting point of the table or bar. Move the element to the new position holding the left mouse button pressed. The displayed bar or table is then connected to the corresponding data point by a line.

An individual movement can be undone using the [**Backspace**] key. If all movements are to be reset, click the "**All displacements to 0**" button in the dialogue box.

6.6.8 "Edit limit values + colours" menu item

This menu item is visible if value-dependent, colour-filled graphics were previously displayed. The limit values and colours for the visualised measured data can be edited. The dialogue boxes correspond to the boxes that open for the appropriate menu items dealing with chart evaluations. They are therefore described in the menu item "**Chart evaluation/Bars**", "**Value-dependent colour-fill**" button (see Section 6.6.2.3), menu item "**Chart evaluation/Tables**", "**Edit limit values**" button (see Section 0) and menu item "**Chart evaluation/Symbols**", "**Discrete colour gradient**" group box, "**Colour + legend preferences**" button (see Section 6.6.6.3).

6.7 Section menu

6.7.1 General notes on sections

You can have any of the data represented in true-to-scale sections. A differentiation is made between sections with control points at fixed, defined values ("**Along system nodes**") and "**Any section**" for which the control point values are interpolated.

6.7.2 "Along system nodes" menu item

6.7.2.1 Define section course

After selecting this menu item a dialogue box opens allowing the measured data to be shown in section to be selected. The following dialogue box containing a description of the procedure for defining the section then opens:
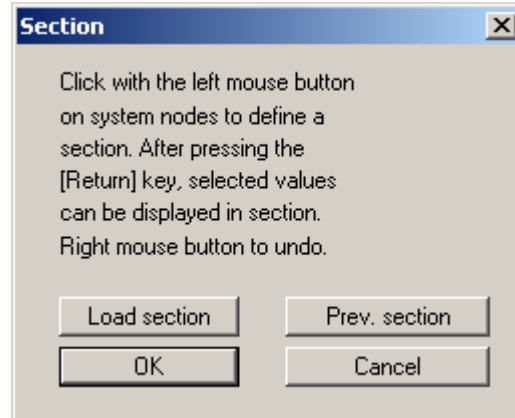
By clicking on "**Load section**" it is possible to load a section course saved during a previous session. If you have already defined a section during the current session, you can reload this section using the "**Prev. section**" button. In both cases the section course is first displayed on the screen and must be confirmed by pressing the [**Return**] or [**Enter**] key.

If you click "**OK**", you can define a new section course. The interpolation mesh is displayed on the screen to assist you. You have the option of selecting each data point for representation in section individually. However, you can also select the starting point and the end point. In this case, the system nodes lying along the shortest route from the starting point to the end point will be automatically included in the section course. Here, too, the section course is completed by pressing [**Return**] or [**Enter**].

6.7.2.2 Section visualisation preferences

After confirming the section course the following dialogue box opens in all cases:
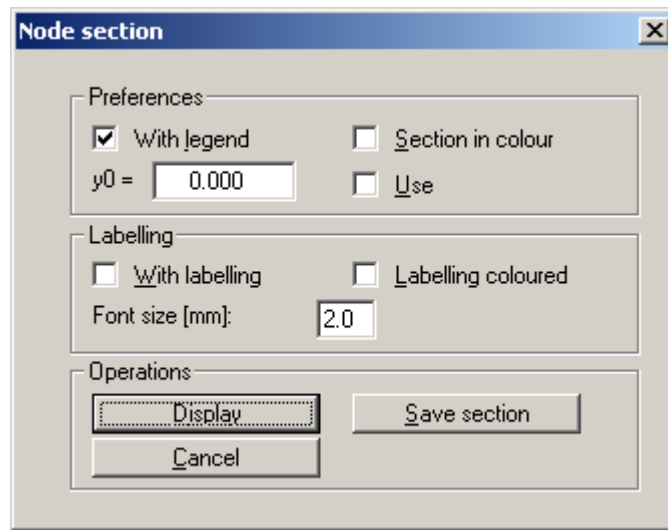
- "**Preferences**" group box
  Specify whether a legend containing the selected data is to be subsequently displayed. This legend allows assignment of the measured data to the line colours used (see Section 6.4.14). If the "**Section in colour**" check box is activated the whole area of the data is filled. The colours defined for the measured data in the menu item "**Edit/Value colours**" are used (see Section 6.2.2).

  The sequence of the selected data is important if complete colour fill is employed. Visualisation follows in the sequence specified during input using "**Edit/Value names**". In order to move a value, which would otherwise be hidden behind other data, *forwards* in the section visualisation, copy the value using the menu item "**Edit/Modify values**" (see Section 6.2.9) to the end of the data.

  It is also possible to specify a zero value for the y-axis ("**y0**"), defining the intersection of the x-axis with the y-axis. In this case the "**Use**" check box must be activated. If this option is not used, the x-axis will intercept the y-axis at the smallest value of y. For example, the use of a fixed "**y0**" value is useful if a number of sections with individual parameter values need to be visualised. The *zero line* will then remain uniform throughout.

- "**Labelling**" group box
  Automatic section labelling can also be used instead of the legend described above. When activated the program inserts a table below the section, containing the selected values at the points defined. If the section is visualised together with the labelling table the size and position of the section graphics must be adapted by hand in the menu item "**Page size + margins/Manual resize (editor)**" (see Section 6.3.4).

  The labelling font size can be altered to suit requirements. If the "**Labelling coloured**" check box is activated the measured data is visualised in the defined value colours.

- "**Operations**" group box
  The current section can be saved to a file using "**Save section**". The section will be drawn on the screen after clicking the "**Display**" button. Beside the legend containing the measured data, which can be activated in the upper group box of the dialogue box, a location sketch is automatically displayed on the screen showing the system outline and the defined section. This section course legend is activated by default, but can be deactivated in the "**Graphics preferences/Section course legend**" menu item (see Section 6.4.15).

6.7.3 "User-defined section" menu item

After defining the parameters to be displayed the following dialogue box appears:
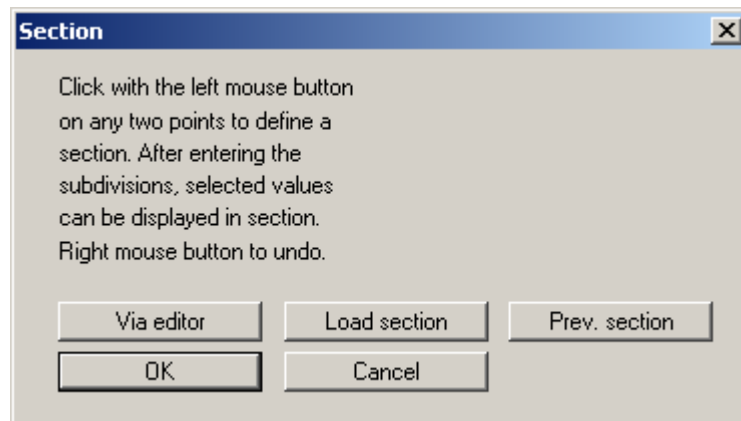
For this type of evaluation the section course is no longer bound to the data points, but consists of a start and an end point. Using the "**Via editor**" button you can specify the start and end points using numerical values instead of the mouse. If you have previously saved a section it can be loaded again using "**Load section**". The "**Prev. section**" button is only visible if a section has already been defined and loads the section defined immediately prior.

If you click "**OK**" you define a new section by clicking the start and end points using the mouse. Once the end point is defined a dialogue box opens for input of the number of subdivisions. The number of subdivisions defines the number of modelling points for interpolation. The greater the number of modelling points, the more complex is the section computation; however, at the same time the *resolution* is increased, assuming sufficient points have been defined.

Following the section definition the same dialogue opens for section presentation preferences as shown in the menu item "**Section/Along system nodes**". The further procedure corresponds to the description in the previous Section 6.7.2.

6.7.4 "Show section course" menu item

This allows the location of the section to be displayed once more in plan once the section definition is complete.

6.8.1   "Copyright" menu item

You will see a copyright message and information on the program version number.

The "**System**" button shows information on your computer configuration and the folders used by **GGU-GEO-GRAPH**.

6.8.2   "Maxima" menu item

You will see information on the maximum values allowed by the program.

6.8.3   "Help" menu item

The **GGU-GEO-GRAPH** online-help is opened using an installed browser (e.g. MS Internet Explorer). The help function can also be accessed using the [**F1**] function key.

6.8.4   "GGU on the web" menu item

Using this menu item you can access the GGU Software website: www.ggu-software.com.
Keep in touch with new program versions and the regular *download* offers.

If you would like to be automatically notified about program innovations, please register for the Newsletter in our Knowledge Base. Go to the following website: http://kbase.civilserve.com.

6.8.5   "GGU support" menu item

This menu item takes to the GGU-Software Support area at www.ggu-software.com.

6.8.6   "What's new?" menu item

You will see information on program improvements in comparison to older versions.

6.8.7   "Language preferences" menu item

This menu item allows you to switch the menus and the graphics from German to English and vice versa. To work in German, deactivate the two switches "**Dialoge + Menüs übersetzen (translate dialogues, menus)**" und "**Graphiktexte übersetzen (translate graphics)**".

Alternatively, you can work bilingually, e.g. with German dialogue boxes but with graphic output in English. The program always starts with the language setting applicable when it was last ended.

7 Tips

Slow screen output generated using the contour line menu items can be cancelled by clicking the right mouse button.

You can scroll the screen with the keyboard using the cursor keys and the [**Page up**] and [**Page down**] keys. By clicking and pulling with the mouse, with [**Ctrl**] pressed, you activate the zoom function, i.e. the selected section will fill the screen. Use the mouse wheel to zoom in or out of the screen view or to pan.

In addition, the system graphics image coordinates (drawing area within the plotting margins) can be altered directly using the mouse wheel. The following mouse wheel functions are available

Change system graphics (new values can be checked in "Page size + margins/Manual resize (editor)"):

- [**Ctrl**] + mouse wheel up = enlarge system graphics (change of scale)

- [**Ctrl**] + mouse wheel down = shrink system graphics (change of scale)

- [**Shift**] + mouse wheel up = move system graphics up (change in image coordinates)

- [**Shift**] + mouse wheel down = move system graphics down (change in image coordinates)

- [**Shift**] + [**Ctrl**] + mouse wheel up = move system graphics right (change in image coordinates)

- [**Shift**] + [**Ctrl**] + mouse wheel down = move system graphics left (change in image coordinates)

Change screen coordinates:

- Mouse wheel up = move screen image up

- Mouse wheel down = move screen image down

- [**Alt**] + [**Ctrl**] + mouse wheel up = enlarge screen image (zoom in)

- [**Alt**] + [**Ctrl**] + mouse wheel down = shrink screen image (zoom out)

- [**Alt**] + [**Shift**] + mouse wheel up = move screen image right

- [**Alt**] + [**Shift**] + mouse wheel down = move screen image left

If you click the right mouse button anywhere on the screen a context menu containing the principal menu items opens.

Define points (editor)
Define points (mouse)

Contours
Bars
Circles
Pies
Tables
Symbols

Print and export
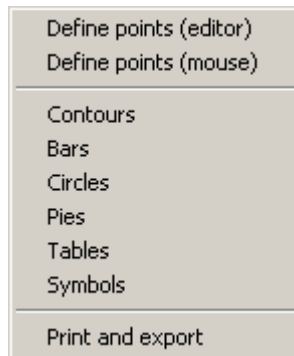
By double-clicking the left mouse button on legends or Mini-CAD objects, the editor for the selected element immediately opens, allowing it to be edited.

Some of the function keys are assigned program functions. The allocations are noted after the corresponding menu items. The individual function key allocations are:

- [**Esc**] refreshes the screen contents and sets the screen back to the given format. This is useful if, for example, you have used the zoom function to display parts of the screen and would like to quickly return to a complete overview.

- [**F1**] opens the online-help.

- [**F2**] refreshes the screen without altering the current magnification.

- [**F3**] opens the menu item "**Graphics preferences/Zoom info**".

- [**F9**] activates the menu item "**Page size** + **margins/Auto-resize**".

- [**F11**] activates the menu item "**Graphics preferences/Move objects**".

- [**F12**] activates the menu item "**Chart evaluation/Move bars**" or
  "**Chart evaluation/Move tables**", depending on the selected visualisation.

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