TRAINING COURSE

ON

SOFTWARE FOR GROUNDWATER DATA MANAGEMENT

UNDER

WORLD BANK FUNDED HYDROLOGY PROJECT

LECTURE NOTES
ON

GENERAL PURPOSE SOFTWARE
(UNIT-1)

BY

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GRAPHER

1.0 INTRODUCTION

GRAPHER is a computer software to represent the data or results in pictorial form. It has been developed by Golden Software, Inc., Golden, Colorado, U.S.A. It is the mostly used graphic package by scientists, engineers, academicians and researchers. Using this package, one can show the behaviour of the dependence of some physical quantities/variables on other quantities/variables in two dimensional plot. Typical examples include rating curve, representation of time series data, variation of discharge with time, groundwater level fluctuation with time, etc.

It is a menu driven package. Its use is very simple and straightforward. The GRAPHER can be loaded in MS-DOS environment. It may be started using DOS level arguments. When GRAPHER is started, DOS prompt is suppressed and GRAPHER environment is then displayed on the screen. The hard copy of the generated graphs can be obtained using dot-matrix printers, plotters or laser printers. Almost all commercially available printers and plotters are compatible with this software. For example, most of the printers and plotters of the Epson, Hewlett-Packard, IBM, Okidata, etc. are supported by the GRAPHER.

The basic structure of the features of the software is shown in Fig. 1. Four components namely; GRAPHER Main Menu, Format a graph, Print or plot a graph and Configure GRAPHER are shown in details in Fig. 1. The abilities of this package can be broadly summarized as:

- Generating a two dimensional plot
- Establishing a best fit line
- Inserting error bars on the plot
- Data clipping
- Data sorting
- Other applications such as Triangular plots, Data clipping with multiple data runs

A maximum of 10 graphs can be plotted in one plot. It means, a vector having ten physical quantities/dependent variables can be plotted on y-coordinate keeping the independent variable (one in number) on x-coordinate. The different variables can be distinguished by putting different symbols, colours or different styles of lines. Since the points are joined by straight lines if it is permitted, large data will yield a smooth curve. The step by step procedure to use the GRAPHER package is described in the following sections.

2.0 HOW TO START?

Switch on the computer. If the GRAPHER package is already loaded on the hard disk, go into the directory in which files of this package are existing. It can be operated from A or B drive also if the floppy diskette contains the GRAPHER software. Then type "grapher" in DOS prompt, and press <Enter>. Let us assume that files of the GRAPHER
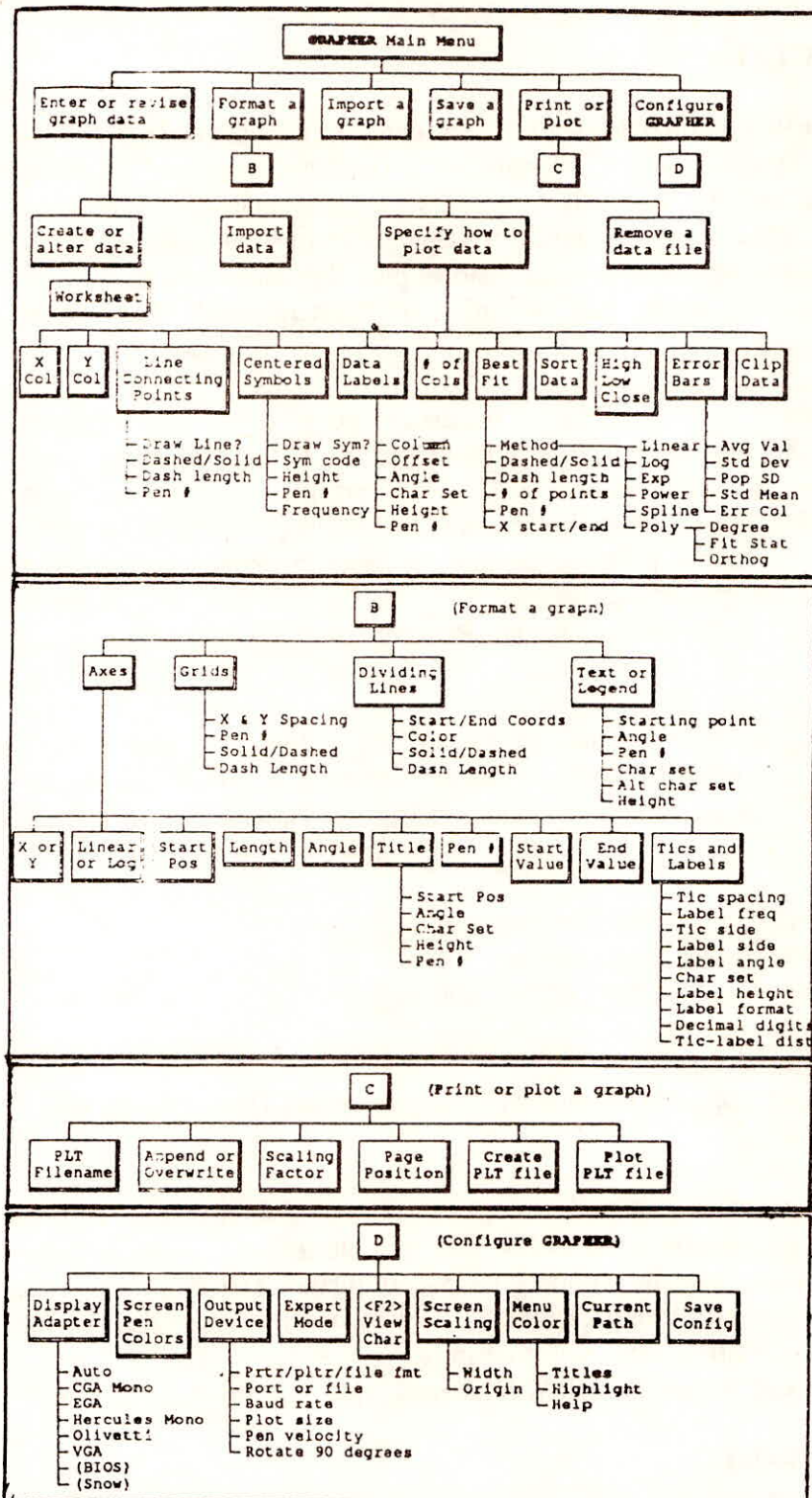
Fig. 1 Basic structure of the GRAPHER package

package are loaded in a directory called GRAPH, the commands will be given as follows:

C:\)cd graph < Enter >

C:\GRAPH)grapher < Enter >

It will enter into GRAPHER environment, and the Main Menu will be displayed on the screen as shown in Fig. 2. Six options are available in this menu. The numerical order of the options on the GRAPHER Main Menu begins at the top of the left-hand column and ends at the bottom of the right-hand column. Menu options followed by a colon prompt for a specific item or value. Menu options that are not followed by colons will call up submenus. By observing Fig. 2 carefully, one can realise that all the six options are submenus. The function of the highlighted option is displayed in the middle of the menu chart. At the bottom of the Main Menu, some command listings appear which guide to perform some operations to go ahead with the assignments. By pressing "Esc" key, back 1 level is obtained, i.e. from submenu to menu. Arrow keys are used to select the option, and "Enter" key is pressed to execute the selected option. The menu under which the particular option is found will be listed at the top of the page. This numbering system enables to see the location of the option within GRAPHER.

3.0 HOW TO PROCEED?

To develop a graph, first action is to load the data file from which graphs are to be generated. A data file can be either imported if already existing or created if it does not exist. The first option of the Main Menu will serve this purpose, and this option will also facilitate to specify how to plot data. Performing this option, a graph will be generated. To view the graph, press "F1" key. Although graph is ready, but many things remain to do to finalise the developed graph. For example, writing axis titles, text, legend, etc. remain to do. After this, most important part is to save the graph and to obtain a hard copy print. These things will be accomplished by the other options available in the Main Menu. The operations of each menu are briefly, however sufficient to use this package, described in following sections:

3.1 Enter or Revise Graph Data (Option 1, Main Menu)

This option can be used to create, import, or modify up to ten data files for use with the current graph. Also included on the menu are options to specify how to plot data from those files and to remove data files from the current graph. Menu 1.0 (Fig. 3) and its submenus provide access to all of the data related charting functions within GRAPHER.

3.1.1 Create or alter data file (Option 1, Menu 1.0)

This option can be used to use the GRAPHER's worksheet (Fig. 4) to enter data or modify an existing data set. It enables to create, view, or alter a data file. When "Create or alter a data file" option is selected, a second menu pointer will appear at line number one (or the last filename used) in the list of data files. The arrow keys can be used to move to any
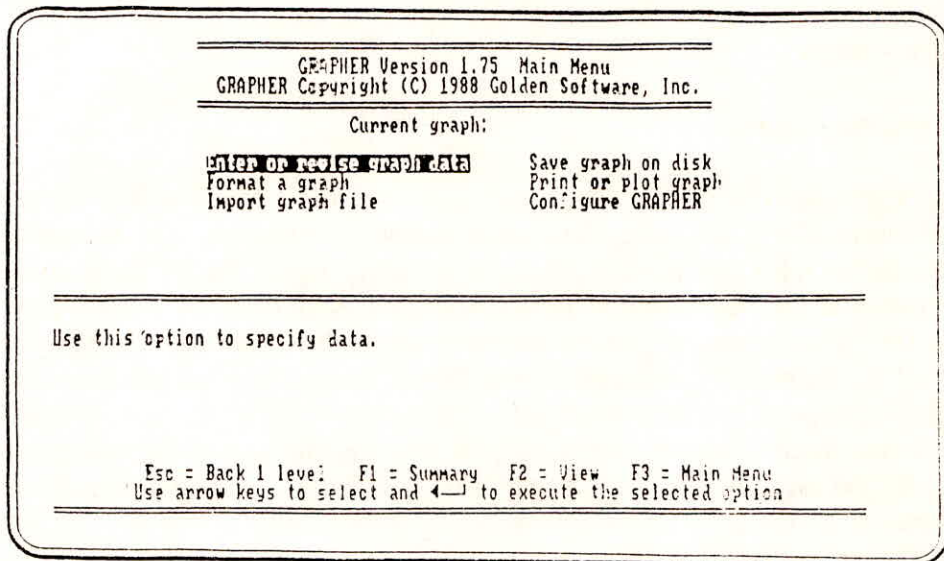
```
                    GRAPHER Version 1.75  Main Menu
            GRAPHER Copyright (C) 1988 Golden Software, Inc.
                          Current graph:

            Enter or revise graph data      Save graph on disk
            Format a graph                  Print or plot graph
            Import graph file               Configure GRAPHER



            Use this option to specify data.




                Esc = Back 1 level   F1 = Summary   F2 = View   F3 = Main Menu
                Use arrow keys to select and ◄─┘ to execute the selected option
```

Fig. 2 GRAPHER Main Menu

```
                    Menu 1.0 - Enter or Revise Graph Data
            GRAPHER Copyright (C) 1988 Golden Software, Inc.
                      Current graph file: DEMO1

            Create or alter a data file     Specify how to plot data
            Import data files               Remove data filename from menu


                    1) DEMO1              6) _____
                    2) _____           7) _____
                    3) _____           8) _____
                    4) _____           9) _____
                    5) _____          10) _____
            Use this option to create, alter, or view a data file.




                Esc = Back 1 level   F1 = Summary   F2 = View   F3 = Main Menu
                Use arrow keys to select and ◄─┘ to execute the selected option
```

Fig. 3 Menu 1.0: Enter or Revise Graph Data

```
VALUES 420.00
Rows Allocated = 256        Bottom Data Row = 10        Press / for commands
          A              B              C              D              E
 1     420.00          5.90
 2     480.00          6.20
 3     510.00          5.50
 4     540.00          8.50
 5     560.00          8.00
 6     580.00          5.60
 7     600.00          7.00
 8     650.00          7.50
 9     680.00          5.50
10     750.00          5.70
11
12
13
14
15
16
17
18
19
20
21
22
```
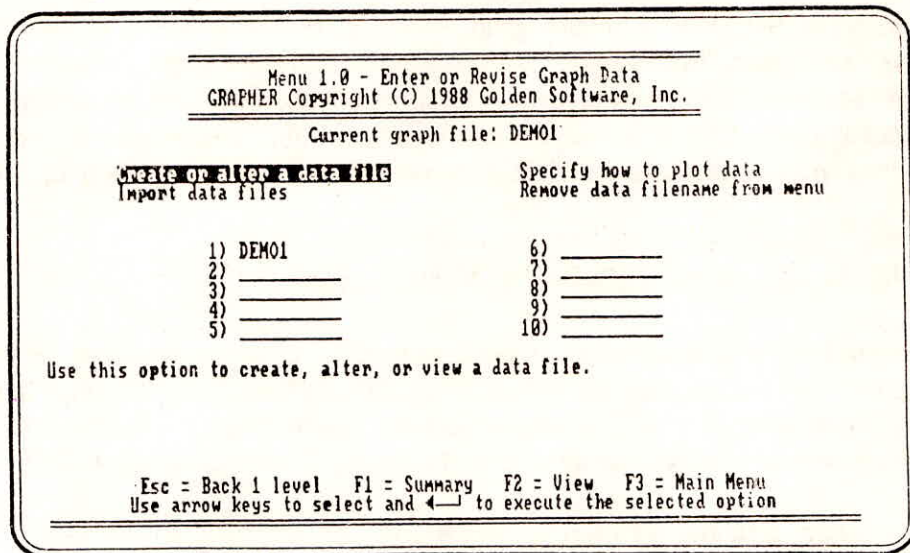
Fig. 4 GRAPHER Worksheet

```
                    Menu 1.3 - Specify How to Plot Data
           GRAPHER Copyright (C) 1988 Golden Software, Inc.

                       Current data file # 1: DEMO1

                  X column: A          Plot a best fit line    NO
                  Y column: B          Sort data column letter: NO SORT
     Line connecting points  SOLID     High-low-close data:    NO
         Centered symbols    YES              Error bars:      NONE
        Data point labels    NO LABELS    Data clipping        NO
     Number of columns to read:  5


  Specify the data file column containing the X coordinates.




          Esc = Back 1 level   F1 = Summary   F2 = View   F3 = Main Menu
          Use arrow keys to select and ◄─┘ to execute the selected option
```

Fig. 5 Menu 1.3: Specify How to Plot Data

of the ten lines. If the pointer is on a line which is blank, press < Enter > to create a new data file. GRAPHER will ask to enter a name for the file to be created. Type any valid filename and press < Enter >. GRAPHER will automatically apply a .DAT extension to the data filename when it is saved. GRAPHER will then prompt for the number of columns to allocate in the worksheet. Since there are about 60,000 cells in the worksheet on a 640 K machine, the larger the number of columns allocated, then the smaller number of rows allowed. The default of five columns fills the screen and allows up to about 12,000 rows.

If the pointer is on a line that contains a filename (the file already exists), press < Enter > to alter the contents of the data file. GRAPHER will then prompt for the number of columns to read from the file. If zero is entered, then GRAPHER will report the number of columns within the data file by reading the first 20 rows. GRAPHER will read only the number of columns specified. For example, if five columns are specified, and the data file contains ten columns then only the first five columns are read. If five columns are specified, and the data file contains only two columns, then the worksheet is set up with five columns available, but only the first two columns have data. After specifying the number of columns to allocate in the worksheet, GRAPHER enters the worksheet where data and data point labels may be entered or altered. To save the file, select the "Quit" option on the worksheet. Up to ten data files within any one graph can be used.

3.1.2 Import data files (Option 2, Menu 1.0)

This option is used to add an existing data file to the current graph. When this option is selected, GRAPHER will prompt as "Enter data file to import:" and will list all files found on configured drive that have a .DAT extension. The configure drive is selected in the "Configure GRAPHER" option in the GRAPHER Main Menu. A second menu pointer will appear on the line listing data filenames. Use the arrow keys to move the pointer until it highlights the file to be imported, or type the filename, and press < Enter >.

3.1.3 Specify how to plot data (Option 3, Menu 1.0)

This option can be used to specify the symbols, line types, colours and a best-fit method for representing the data. This option also specifies data clipping, data point labels, data sorting, high-low-close data, error bars, and the column letters for X and Y. Selecting this option will place a second menu pointer on the first data file listed on the menu. Select the name of the data file whose plotting parameters are to be changed. This will call up Menu 1.3, and Fig. 5 will be displayed on the screen. The first item on the menu, **Current data file #**, will display the name of the data file for which the user is specifying how to plot data. On this menu, there are 11 options defining the selection of data and the format in which it will be represented on the graph. Various lines/curves can be distinguished by putting different symbols, colours or line style. This will be achieved by selecting options "Line connecting points" and "Centered symbols". To get different symbols, the user can specify any different numbers between 32 and 127. Different colours for various curves/lines can be achieved by specifying different pen numbers between 1 and 15. There are two types of line styles, solid and dash in which dash length can be varied for various lines/curves in the plot.

The option "X column:" can be used to specify the worksheet data column containing the x-coordinate. Similarly, option "Y column:" can be used to specify the worksheet data column containing the y-coordinate. Option "Line connecting points" allows lines to be drawn to connect data points. It also provides options for dashed or solid lines and user-specified dash lengths as well as pen number for the colour. Menus 1.3.3 and 1.3.4 ask questions, and the user has to answer in yes or no, or by specifying some numeric numbers. Option 5 of Menu 1.3, "Data point labels", (Fig.5) enables user to place text labels next to data points on the graph. Data point label options include positioning, colour, size, type style (font), and selection of the worksheet column from which labels will be read.

Option 6 of Menu 1.3, "Number of columns to read", enables user to specify the number of columns to read from the data file into memory. The default setting is for 5 columns. It should be noted here that the number of columns to read should be large enough to include the x- and y- coordinates columns, the sort column if any, the data point labels column if any, and the columns for high-low-close graphs. The number of columns to read may be set to a larger value than the number of columns in the data file. The extra columns will be blank, and may be used for entering additional data or labels. Option 1.3.8 "Sort data column letter", enables user to organize data from the input file in ascending order. Option 1.3.9, "High-low-close data", enables the user to plot a range of values such as an error range (error bars) or the daily high, low, and closing stock prices. Option 1.3.10, "Error bars", enables user to insert error bars to display average values, two types of standard deviation, or standard error of the mean. Option 1.3.11, "Data clipping", enables to exclude data that exceeds a specified limit. It should be noted here that options 1.3.5 and 1.3.7-1.3.11 will show NO as a default setting. Unless these options are desired, the default settings are not altered.

3.1.4 Plot a best fit line (Option 7, Menu 1.3)

This option can be used to interpret data by overlaying a best fit line depicting trends within the data. Best fit methods for determining trends in data include linear, logarithmic, exponential, power, cubic spline and polynomial. Selecting this option, a menu as shown in Fig. 6 will appear on the screen. The desired option can be selected by typing the appropriate number. Examples of each fitting method along with corresponding equations are shown in Fig. 7.

The cubic spline interpolator will produce a smooth curve through data pairs even if their variation is quite complicated. After selecting the cubic spline as a best fit method, GRAPHER prompts for a tension factor. This tensor factor indicates the curviness desired for the line produced by the cubic spline. If the tension factor is very large, then the resulting curve is very nearly a polygonal (straight) line. The default setting of 2.0 will produce a smooth curve in most cases. For very erratic data, it may be necessary to tighten up the tension factor to 5 or 6 to adequately follow the data points. The polynomial option will produce a best fit from degrees 0 to 10. The desired degree can be selected.
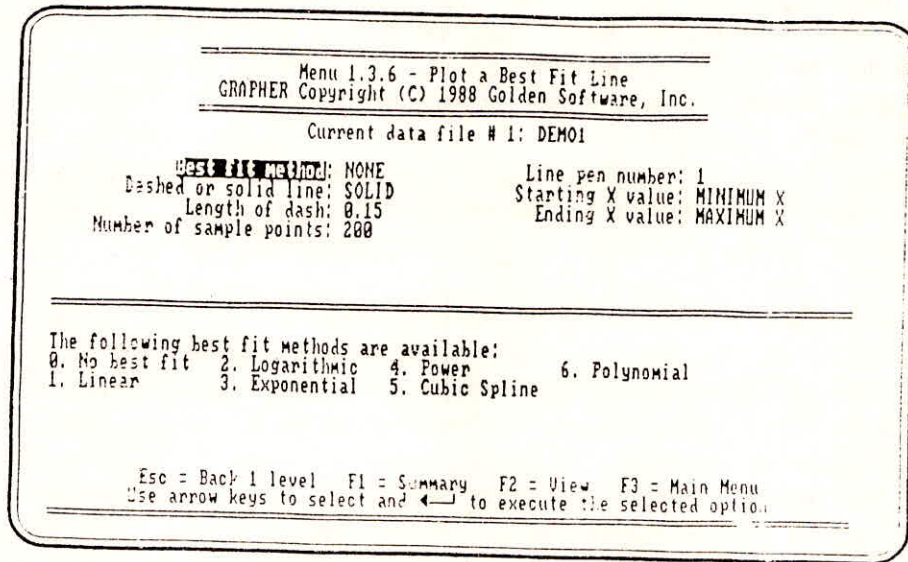
```
                    Menu 1.3.6 - Plot a Best Fit Line
              GRAPHER Copyright (C) 1988 Golden Software, Inc.

                        Current data file # 1: DEMO1

          Best Fit Method: NONE              Line pen number: 1
       Dashed or solid line: SOLID        Starting X value: MINIMUM X
             Length of dash: 0.15          Ending X value: MAXIMUM X
     Number of sample points: 200


     The following best fit methods are available:
     0. No best fit    2. Logarithmic   4. Power
     1. Linear         3. Exponential   5. Cubic Spline    6. Polynomial



          Esc = Back 1 level   F1 = Summary   F2 = View   F3 = Main Menu
          Use arrow keys to select and ◄─┘ to execute the selected option
```

Fig. 6 Menu 1.3.6: Plot a Best Fit Line

Linear Regression

$y = a + bx$

Exponential Curve Fit

$y = ae^{bx}$

Logarithmic Curve Fit

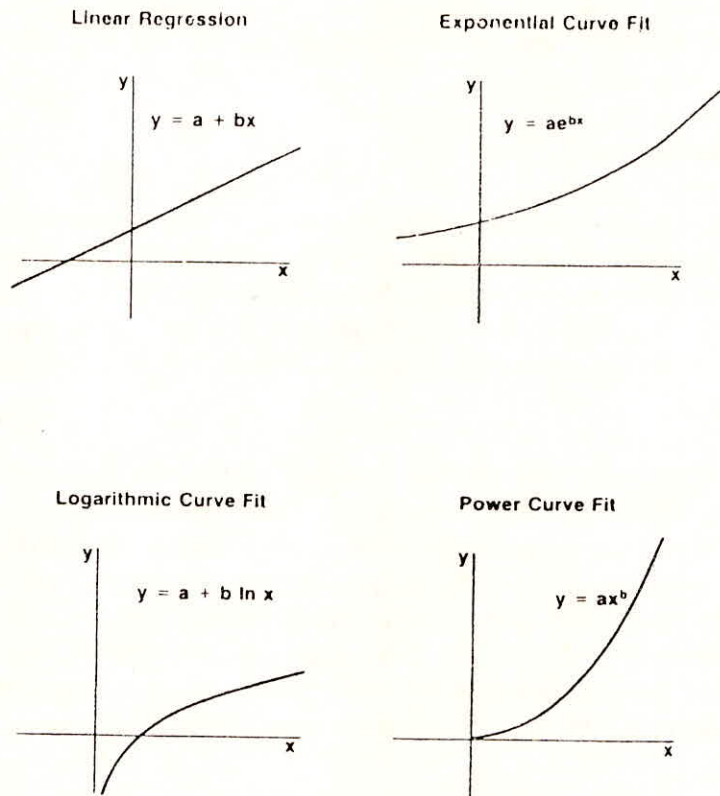$y = a + b \ln x$

Power Curve Fit

$y = ax^b$

Fig. 7 Different curve fitting techniques with corresponding equations

3.1.5 Remove data filename from menu (Option 4, Menu 1.0)

This option can be used to remove a data filename from the menu. When a data filename is removed from the menu, that file will no longer appear as part of the current graph. Removing a filename from the menu does not erase that file on disk.

3.2 Format a Graph (Option 2, Main Menu)

This option can be used to specify and alter the format of a graph. The pointer will be on "Enter or revise axes". The other format options include "Enter or revise grid lines", "Enter or revise dividing lines, and "Enter or revise text". After selecting this option, a menu will appear on the screen as shown in Fig. 8. Option 2.2, "Enter or revise grid lines", enables user to create or alter linear or logarithmic grids. Option 2.3, "Enter or revise dividing lines", enables the user to create or alter dividing lines. Unless these are desired, these options are not selected. In this case, no grid or dividing lines will appear on the graph.

3.2.1 Enter or revise axes (Option 1, Menu 2.0)

This option can be used to create, view, or alter an axis. When this option is selected, a second menu will appear at line number one of a ten line list for axis files. To create a new axis file, place the pointer on a line with no filename and press <Enter>. GRAPHER will ask to enter a name for the axis to be created. Type any valid filename and press <Enter>. GRAPHER will enter Menu 2.1.1 - "Create or alter an axis" and display default settings for the current axis. GRAPHER will append a .AXS extension to the axis filename when it is saved on disk. To alter an axis file, place the pointer on the line that contains the axis to be altered and press <Enter>. After selecting this option, a menu will appear as shown in Fig. 9. By moving arrows, axis title, type, starting position, starting and ending values for the variables on x-axis/y-axis, axis length and axis angle can be specified. Starting and ending values will be taken automatically if the user is typing "a" for these options and pressing <Enter>. To format tick marks on the axes and to alter decimal digits, select option "Tick marks & labels" of Menu 2.1.1. In the similar fashion, y-axis also can be created, altered or formatted.

3.2.2 Enter or revise text (Option 4, Menu 2.0)

This option can be used to create or alter a legend or block of text. After selecting this option, Menu 2.4 will appear with four options. When "Enter or revise text" option is selected, a second menu pointer will appear at line number one of a ten line list for legends or text blocks. Arrow keys can be used to move the pointer to any of the ten lines. To create a new legend or text block, place the pointer on a line with no name and press <Enter>. GRAPHER will ask to enter a name for the legend or text block to be created. Type any valid name and press <Enter>. GRAPHER will then ask whether the new file is for a legend or text block. The default is T for a text block. Entry of L (or l) will cause it to be a legend. GRAPHER automatically goes to the proper menu for legend or text. Both menus are very similar, these are shown in Figs. 10a-b, respectively, for legend and text. Option "Begin entering text" will enable to enter the contents of the legend or text block. After
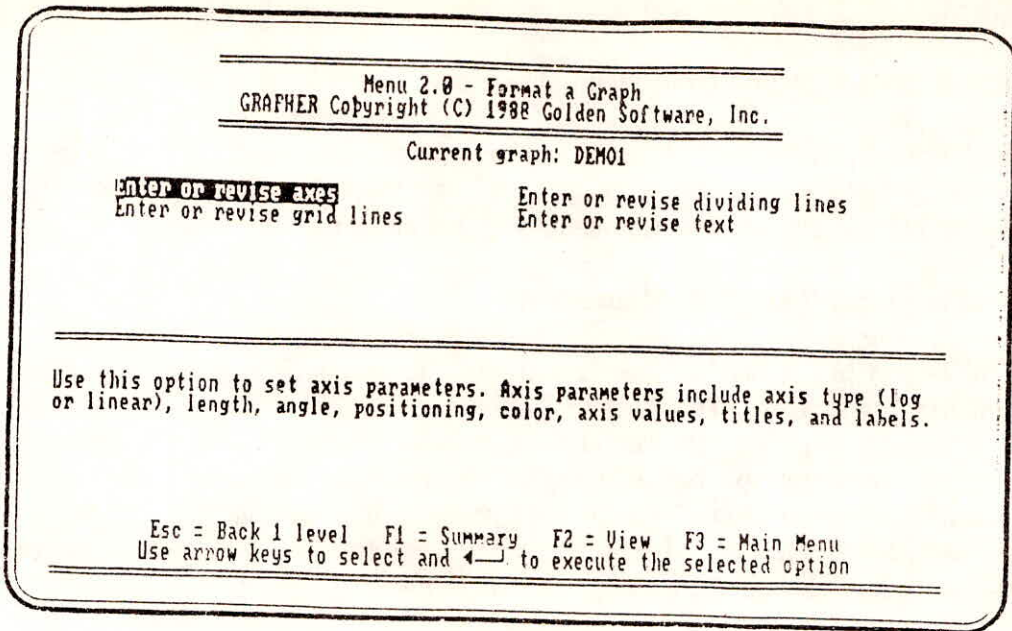
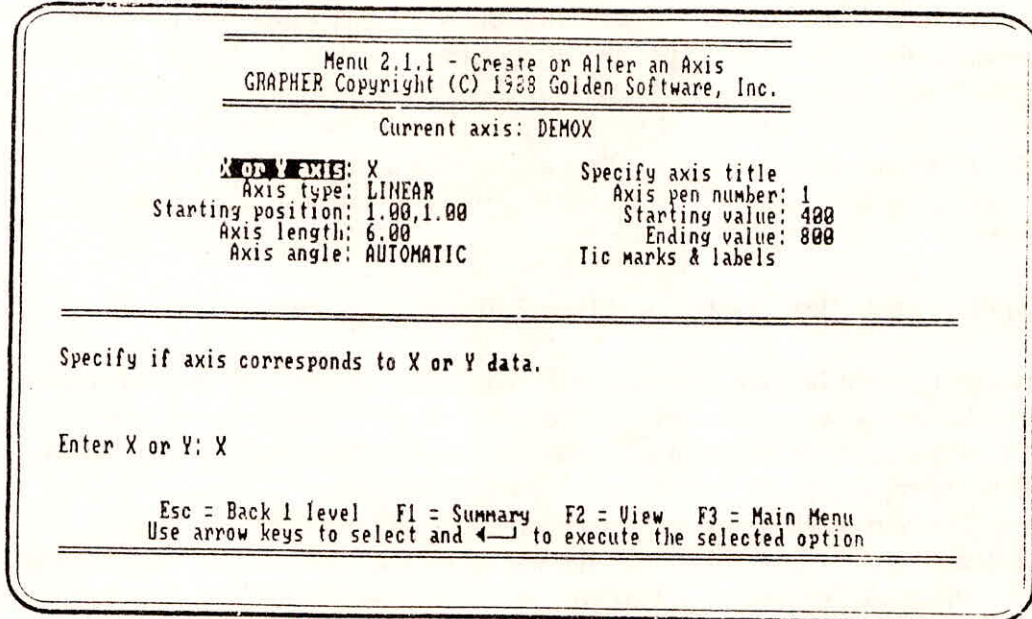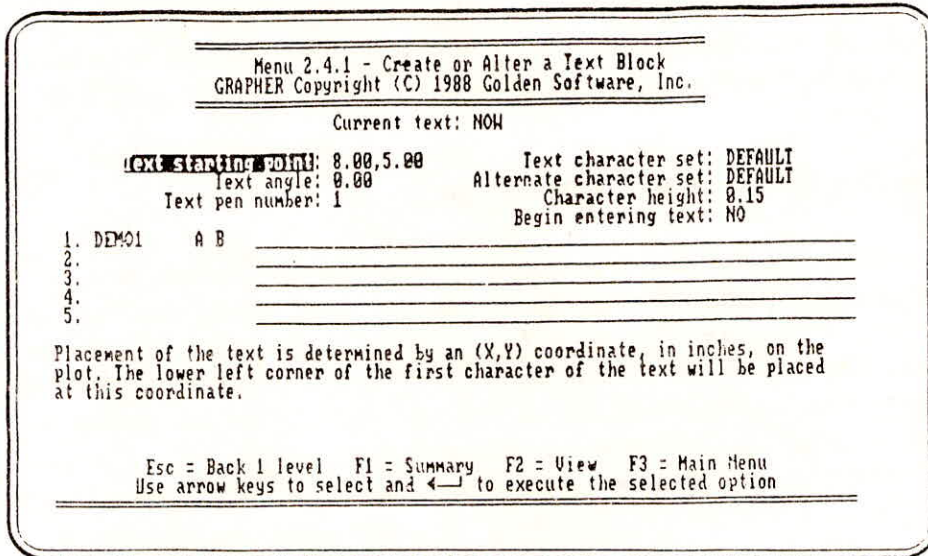Training course on "Software for Groundwater Data Management",   National Institute of Hydrology, Roorkee.

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```
                       Menu 2.0 - Format a Graph
         GRAPHER Copyright (C) 1988 Golden Software, Inc.

                        Current graph: DEMO1

    Enter or revise axes             Enter or revise dividing lines
    Enter or revise grid lines       Enter or revise text



    Use this option to set axis parameters. Axis parameters include axis type (log
    or linear), length, angle, positioning, color, axis values, titles, and labels.




        Esc = Back 1 level    F1 = Summary    F2 = View    F3 = Main Menu
        Use arrow keys to select and ◀─┘ to execute the selected option
```

Fig. 8 Menu 2.0: Format a Graph

```
                       Menu 2.1.1 - Create or Alter an Axis
         GRAPHER Copyright (C) 1988 Golden Software, Inc.

                        Current axis: DEMOX

         X or Y axis: X              Specify axis title
          Axis type: LINEAR          Axis pen number: 1
   Starting position: 1.00,1.00       Starting value: 400
        Axis length: 6.00              Ending value: 800
         Axis angle: AUTOMATIC       Tic marks & labels


    Specify if axis corresponds to X or Y data.


    Enter X or Y: X


        Esc = Back 1 level    F1 = Summary    F2 = View    F3 = Main Menu
        Use arrow keys to select and ◀─┘ to execute the selected option
```

Fig. 9 Menu 2.1.1: Create or Alter an Axis

```
        Menu 2.4.1 - Create or Alter a Text Block
     GRAPHER Copyright (C) 1988 Golden Software, Inc.

                   Current text: NOW

   Text starting point: 8.00,5.00      Text character set: DEFAULT
            Text angle: 0.00      Alternate character set: DEFAULT
       Text pen number: 1              Character height: 0.15
                                    Begin entering text: NO
  1. DEMO1     A B    _____
  2.                  _____
  3.                  _____
  4.                  _____
  5.                  _____

  Placement of the text is determined by an (X,Y) coordinate, in inches, on the
  plot. The lower left corner of the first character of the text will be placed
  at this coordinate.


        Esc = Back 1 level    F1 = Summary    F2 = View    F3 = Main Menu
        Use arrow keys to select and ◄──┘ to execute the selected option
```

(a)

```
        Menu 2.4.1 - Create or Alter a Text Block
     GRAPHER Copyright (C) 1988 Golden Software, Inc.

                   Current text: NOW

   Text starting point: 8.00,5.00      Text character set: DEFAULT
            Text angle: 0.00      Alternate character set: DEFAULT
       Text pen number: 1              Character height: 0.15
                                    Begin entering text: NO

  _____

  _____

  _____

  Placement of the text is determined by an (X,Y) coordinate, in inches, on the
  plot. The lower left corner of the first character of the text will be placed
  at this coordinate.


        Esc = Back 1 level    F1 = Summary    F2 = View    F3 = Main Menu
        Use arrow keys to select and ◄──┘ to execute the selected option
```

(b)

Fig. 10 Menu 2.4.1: Create or Alter a Text Block (a) legend option, (b) text option

11

writing or altering the contents of legend or text, press <Ctrl E> to finish the job for this option. By choosing "Text starting position" option, the legend or text can be placed anywhere in the graph. Either in formatting axes or text, different characters by choosing different font options can be set, if it is required, otherwise default option will write the contents in the normal alphabetical styles of Roman script. Different characters sets enable to use Greek, mathematical/scientific and a variety of special symbols in writing text or axes titles. While saving the text or legend blocks on the disk, it will add a .TXT extension in the filename.

3.3 Import Graph File (Option 3, Main Menu)

This option can be used to load a graph file previously created with GRAPHER for viewing, altering or plotting. When this option is selected, GRAPHER will ask to enter a graph filename. Below the information line, a list of all the graph files on the configured drive will be displayed on the screen. Name of the graph file to be imported can be typed or the pointer can be moved on the list of graph files on the configured drives until it highlights the desired file, and press the <Enter> key. A graph file will have an extension .GRF. It is important to remember that files carrying the .GRF filename extension contain all of the information necessary for creating the graph except for the data.

3.4 Save Graph on Disk (Option 4, Main Menu)

Selecting this option results in the current graph being saved under a graph filename with a .GRF extension on the configured drive. All data, axis, text, grid, and dividing line files must have been saved as they were created or altered in order for them to become incorporated as part of the graph file. All such files named under the graph file must be present on the same drive.

3.5 Print or Plot Graph (Option 5, Main Menu)

This option can be used to create a plot file from one or more graph files and to send plot files to a printer or plotter via the PLOT program. Options on this menu enable to create a plot that may be seen on the screen with the VIEW program or output as hard copy on a printer or plotter. The plot can be made from a single graph file or multiple graph files. Graphs within the plot may be placed over one another or at various locations within the page. Individual graphs can also be scaled. The print can be taken from dot-matrix printer, laser printer or plotter. At the time of printing or plotting, the user will be asked about scaling of x- and y-axes even though he does not select this option in Menu 5.0 (If installed version is like that), if desired, scale factors can be given equal or unequal for the axes. However, scaling factor for the complete graph can be given by selecting the option 5.3, "Scaling factor". For printing or plotting, select options "Begin creating plot file" and "Begin plotting plot file" in sequence. The plot can be shifted anywhere on the paper. To do this job, the option 5.4, "Page position" is selected, and the distances for x- and y-axes by which the user wants to shift the graph are specified. Fig. 11 shows a print of a typical example of a plot generated from the GRAPHER package. While printing/plotting, to stop the printing due to some reasons, press <Ctrl C>. It will stop printing job. After this, press <Enter>
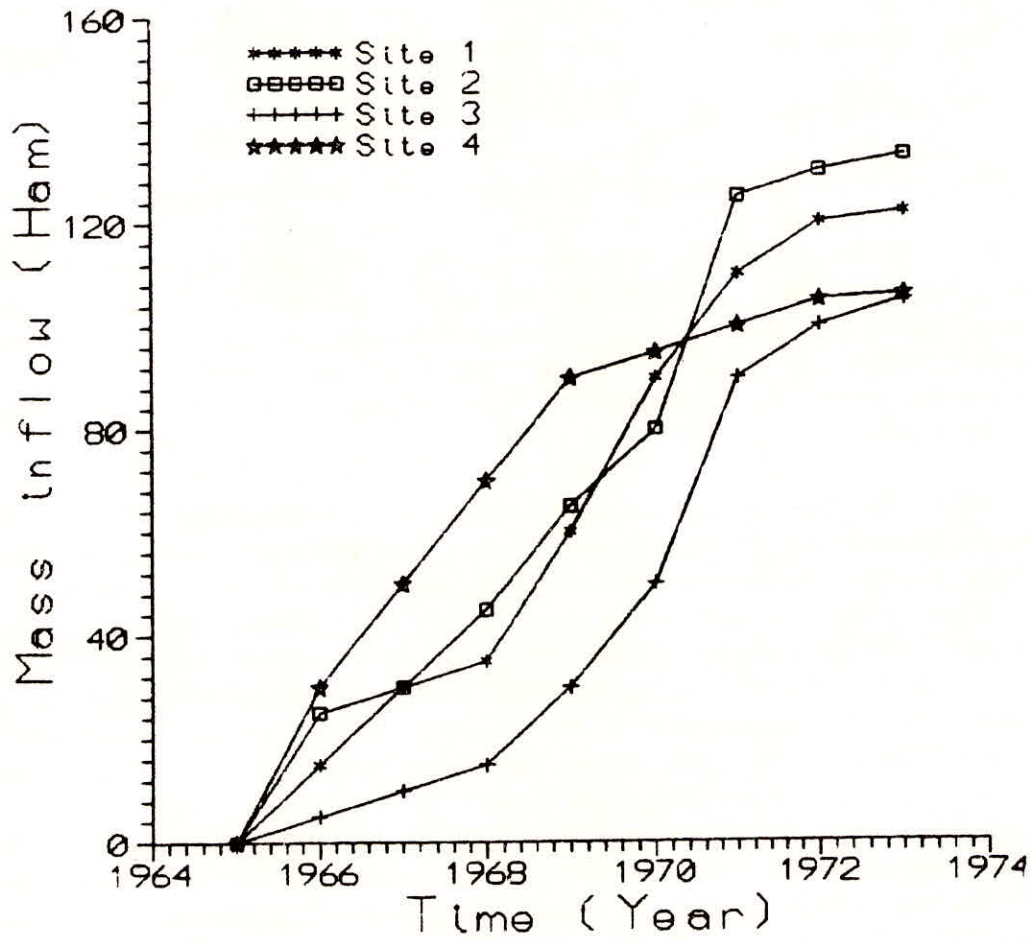
Fig. 11 Mass inflow at various sites

to go into the GRAPHER environment.

3.6 Configure GRAPHER (Option 6, Main Menu)

This option allows to install GRAPHER to fit particular computer equipment. It is important to select this option for the first time use of the GRAPHER. After setting configuration for the first time, the user may not need to go back to this option unless he changes equipment or desires to change viewing colours, the default directory, or screen scaling. All graph files generated and saved will be saved in the directory mentioned in this option. Therefore, the user should select the option 6.8, "Current path", accordingly.

4.0 GRAPHER WORKSHEET

This can be used to enter numerical data from the keyboard, or alter data from another file (including an ASCII or text file), and enter or alter data point labels. The worksheet accommodates up to 26 columns and as many rows as will fit in available memory, up to a maximum of 32,767. Rows are allocated in units of 256, with the number allocated shown at the top of the worksheet. The bottom row shown at the top of the worksheet is the number of the last row with data. When the worksheet is saved to a disk file, rows will be written till the bottom row. Allocated rows (if any) beyond the bottom row will not be written.

Columns can be used to enter numerical data, or data point labels. A column must have the same type of data (numeric or text) in every row. The program default sets columns A and B for x- and y-coordinates, respectively. However, any allocated column can be used to enter values for these two coordinates. Any allocated column also can be used to enter text for data point labels. To enter numerical data, place the cell pointer in cell A1 which is in the upper left hand corner of the worksheet. Type the first x value and then move the pointer down once. This will enter the value in the worksheet and will move the pointer down one cell. Repeat the process until all the x-coordinates have been entered. Now move the pointer to B-1 to enter values for the y-coordinates (Simply move the pointer to column B and press the up arrow key until the pointer is located in cell B-1). Repeat the process of entering values for y-coordinates in column B. Like this, all columns are filled with data. To enter digits as character labels, precede the digits with a single or double quote. To change a value, move the pointer to the existing value, type in the new value, and press any arrow key or press <Enter>.

For additional worksheet options, press the </> or <Esc> key. The worksheet commands are : insert, delete, copy, move, format, goto and quit.

4.1 Insert

Use this option to insert a blank row or a range of blank rows in the worksheet. For example, to copy a range of data to the top of the worksheet from another area in the worksheet (without overlaying the data at the top of the worksheet), use the Insert option to open a range of blank rows. Then use the Copy option. Press </> for worksheet

commands. Place the pointer on the Insert command and press < Enter > or type "I" < Enter > . This will prompt:

First row to insert:

with a default setting of the row number that the pointer is on. To change the row number at this point, enter the number of the row at which blank lines are to inserted. Now press < Enter > , which will prompt:

Last row to insert:

with a default setting of the row number that the pointer is on. To insert one blank line, type the same row number as the first and press < Enter > . To insert a range of blank lines, enter the number of the last row through which you want the range inserted, and press < Enter > .

4.2 Delete

Use this option to delete a row or a range of rows on the worksheet. Press < / > or < Esc > for worksheet commands. Place the pointer on the Delete command and press < Enter > or type "D" < Enter > . This will prompt:

First row to delete:

and will default to the row the pointer is on. To change the first row to delete, enter the number of the row to be deleted. After pressing < Enter > , GRAPHER will prompt:

Last row to delete:

This will default to the row the pointer is on. To delete just one row, type the same row number as the first and press < Enter > . To delete a range of rows, enter the number of the last row through which you want the range deleted, and press < Enter > . GRAPHER will delete all rows from the first row to the last row (including the first and last rows). All data will scroll up to close in the gap created by the deleted rows.

4.3 Copy

Use this option to copy or duplicate a line or range of lines from one point to another. The original rows will remain unaltered. Press the < / > key for the worksheet commands. Assuming at least two rows with data, place the pointer on the Copy command and press < Enter > . This will prompt:

First row to copy:

and will default to the row the pointer is on. To copy only that row to another row, press < Enter > . To start from another row, enter the row number and press < Enter > . GRAPHER will prompt:

Last row to copy:

and will default to the row the pointer is on. Type in the number of the last row you want to copy. To enter a range of rows from the existing rows, type in the last row through which you want the rows to be copied and press <Enter>. This will prompt:

Row to copy to:

and will default to the row the pointer is on. The first row in the range of lines copied will be positioned at the row to copy to. Type in the number of the row to which you want lines copied and press <Enter>. If you copy rows to occupied rows, it will replace previous data. Thus, the user should prompt this option carefully, otherwise he may loose data. Use the Insert command to open a range of rows, and then copy the data from the desired rows.

4.4 Move

Use this option to move a line or a range of lines from one point to another. This option is the same as a Copy followed by a Delete. Press the </> key for worksheet commands. Assuming you have at least two rows with data, place the pointer on the Move command and press <Enter>. This will prompt:

First row to move:

and will default to the row the pointer is on. Type the number of the first row to move and press <Enter>. GRAPHER will then prompt:

Last row to move:

and will also default to the row the pointer is on. To enter a range of lines to move, type in the number of the last line through which you want rows to be moved and press <Enter>. GRAPHER will then prompt:

Row to move to:

and will default to the row the pointer is on. The first row of the range of lines moved will be positioned at the row to move to. Type in the number of the row to which you want to move the lines and press <Enter>. If you move rows to occupied rows, they will replace the existing data. Therefore, the user should answer this question carefully, otherwise he may loose original data. Blank lines will occur in rows from which the numbers were moved. Use Move to reposition a line within the worksheet.

4.5 Format

Use this option to specify how to display numerical data in the worksheet. Fixed or exponential values with up to 9 decimal places may be selected. Press the </> or <Esc> key for worksheet commands. Place the pointer on Format and press <Enter>. GRAPHER

will prompt:

Enter F for fixed or E for exponential format:

To show the values in the exponential format, press E <Enter>. To show them in a fixed or conventional format, simply press <Enter>. After pressing the <Enter> key, GRAPHER will prompt:

Enter number of decimal places (0-9):

Enter the number of decimal places (up to 9 for fixed data and 8 for exponential data) that you want the numeric data to be printed with and press <Enter>.

4.6 Goto

Use this option to go to any row within the worksheet. Press the </> or <Esc> keys to get the worksheet commands. Select the Goto option and press <Enter>. This will prompt :

Enter row to go to:

You may enter any number from 1 to 32,767. If you have run out of memory at, say row 10,000 and go to row 20,000, the screen will show a blank worksheet and not allow data entry.

4.7 Quit

Use this option to leave the worksheet and return to Menu 1.0. Press the </> or <Esc> keys to get the worksheet commands. Select the Quit option and press <Enter>. This will prompt:

Save changes in disk file ?

and will default to YES. Press <Enter> to save the contents of the worksheet in a disk file. If the worksheet could not accommodate all of the data file (a warning message is displayed as to the number of rows read) or fewer than the total number of columns were read in, then you should avoid saving the changes in a disk file unless a different filename is used. Use GRAPHER's next prompt to change the filename:

Enter filename:

and will default to the data filename that you have been working with. Enter a new filename or press <Enter>. GRAPHER will then prompt:

Clear worksheet ?

and will default to NO. Press <Enter> so that the worksheet contents will remain in memory.

After responding the **Clear worksheet ?** prompt, you will be returned to Menu 1.0.

5.0 HOW TO VIEW THE GRAPH ?

After finishing the "Specify how to plot" assignment, the graph can be viewed. However, complete graph including the desired format for axis and text (axis title, legend, text, etc.) can be viewed only after performing the options first and second of the Main Menu if a new graph is generated, and then pressing <F2> key. An imported graph can be viewed on the screen by performing the option 3 of the Main Menu, and then pressing <F2> key. In viewing mode, you can go back to your menu mode by pressing <Esc> key.

6.0 HOW TO QUIT ?

To quit from the GRAPHER package, come to the Main Menu. After that, press <Esc>, you will get prompt:

Exit to DOS? y

Either press <Enter> or "y" key for yes, then you will get prompt:

Save changes? y

If you type "n" and press <Enter>, it will come out from the GRAPHER environment, and you will get a DOS Prompt. If you type "y" and press <Enter>, it will prompt:

Enter filename:

Enter the filename of the graph, and then press <Enter> to quit. You will come out from the GRAPHER environment, and you will get a DOS Prompt.

REFERENCE

Golden Software (1990) GRAPHER: Reference Manual. Golden Software, Inc., Golden, Colorado, U.S.A.

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