PIPES for WINDOWS

USER   MANUAL

Table of Contents

1 Overview

PIPES for WINDOWS is used to calculate the flows and pressures in pressure pipe systems. Components which can be modelled include:

- Reservoirs
- Pipes
- Pumping Stations
- Minor Head Losses
- Check Valves
- Pressure Reducing Valves
- Pressure Sustaining Valves
- Flow Control Valves
- Sprinklers
- Hydrants
- Hose reels
- Town Mains

Pipe flows may be calculated using either the Colebrook White equation or the Hazen Williams equation. You draw the network on screen using lines to represent pipes and pre defined symbols to represent pumps, valves and reservoirs. If you already have the pipes drawn in a CAD system (eg Autocad) you can create a DXF file of the pipes and nodes. PIPES can then read this DXF file. Data is entered via dialog boxes which are accessed by right clicking on the pipe or symbol, and selecting *Edit Data*.

There is no limit on the number of pipes, nodes etc which can be modelled. If your computer has sufficient RAM you can model any size network.

PIPES can be installed in its normal version or in the Building Services version. In the Building Services industry, it is common practice to use diversity factors which reduce the probable simultaneous flow per fitting as the number of fittings increases. The Building Services version includes automatic diversity calculations.

2 Equipment Required

You will need a machine with Windows 98 or later. You will also need the software lock supplied with PIPES to run the full version. The demo version does not require a lock.

3 Getting Started

A CD containing all the PIPES files and a software lock are provided with the full version of PIPES. The software lock should be attached to a parallel port on your computer. Files on the CD are compressed and you must install PIPES on your hard disk before using it. You should start Windows **Explorer**, select the drive containing the PIPES CD and double click **SETUP.EXE** in the PIPES directory**.** This will decompress the files and copy them to your hard disk. You will have the choice of installing either the Building Services version or the normal version.

PIPES incorporates an extensive online help system and we encourage you to use it. You can access the help system from the Help menu, or by pressing F1, or using the Toolbar help button. Clicking the Toolbar help button puts PIPES into help mode. You can then click on any object (eg a menu item, another symbol in the toolbar, a pipe, a node etc) to get specific help on that object.

You might like to experiment with the sample data file **SMALL.PIP** which is supplied with PIPES.

4 Using the Mouse

Clicking on a shape, such as a node or pipe, will highlight it. You can perform various operations on a highlighted shape such as deleting it or moving it around the screen. To move a highlighted shape you drag it using the mouse.

To open a dialog box relating to a shape right click on the shape and select *Edit Data* from the pop up menu. For example, in the dialog box for a pipe you can enter the pipe length, diameter, roughness etc. and view results of the analysis.

5 Menu Commands

All of the menu commands can be accessed from the menu bar shown in the figure below. In addition many of the commands can be accessed from the tool bar below the menu bar. The commands behave in the same manner regardless of how they are accessed.

File Menu
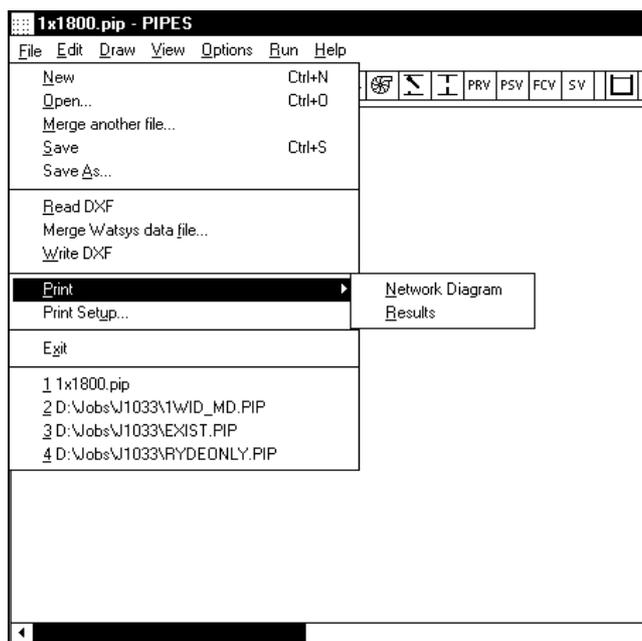
Many of the choices available from the **File** menu are common to most Windows Applications.

New allows you to clear the current drawing, ready to start a new network.

Merge Another File allows you to add the details from another PIPES file to the current diagram. The merging file must have two nodes in common with the current diagram so that PIPES can determine the correct orientation and scaling for the file to be merged.

Read DXF allows you to read information stored on a DXF file. These files can be created by most CAD packages. If you already have pipes shown on a CAD drawing this feature will save you some time in drawing a network and entering pipe data. You will be prompted to supply the Pipe layer name and the Node layer name. PIPES will interpret all straight lines and circles on these layers of the DXF file as pipes and nodes respectively. This means that no other straight lines or circles can be drawn on these layers. It is not necessary to draw all pipes and nodes on the DXF file. You can add pipes and nodes later from within PIPES. You will be asked if the DXF drawing is drawn to scale. If you answer yes, PIPES will assign a length to all pipes based on the length you enter for one pipe.

Merge Watsys data file is useful if you have data files prepared for Watsys. Conversion of these data files is described in Appendix A.

Write DXF allows you to create a new DXF file of the pipes and nodes or to update an existing file. You might wish to update an existing drawing if you have changed the number or location of pipes while working in PIPES. If you update an existing DXF file, the information on other layers will be retained unchanged.

Print allows you to print the current network diagram, the results of an analysis and HGL graphs for a series of pipes. Before printing, you will have the opportunity to change printer settings (eg Landscape or Portrait mode, etc). The information shown on a network diagram plot depends on values set under *View/Pipe Text and Colors* and *View/Node Text and Colors*. These menu items are described on page 19.

Print Setup allows you to change printer settings, add a new printer, remove an old printer etc.

Exit will close PIPES. If you have made changes to the current network you will be asked whether you wish to save them.

Below Exit is a list of up to 4 of the most recently opened files. Clicking on one of these files is the easiest way to open a file you were recently using.

Edit Menu
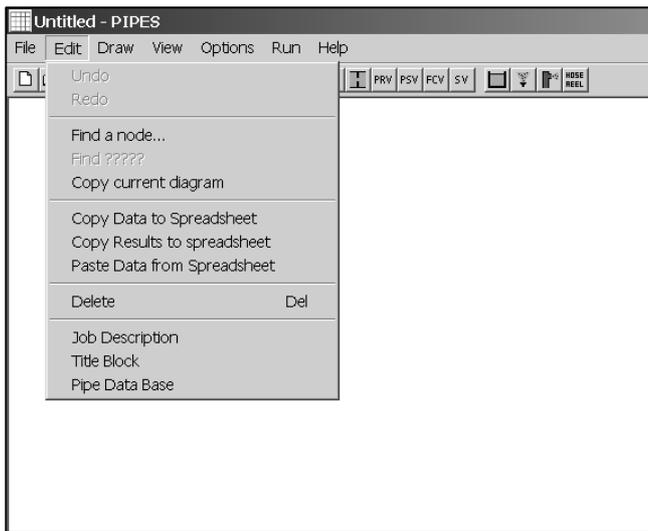
Undo and **Redo** can be used to change recent actions such as drawing new shapes, moving shapes, deleting shapes and editing data for a shape. When these menu items become active the text will change to indicate the type of action to be affected (eg *Undo* might change to *Undo Edit Data*).

Find a Node allows you to easily locate a node in the network. This is useful on large drawings, especially if you are not very familiar with the network.

Find ????? allows you to find a shape for which data is incomplete. This is useful on large drawings if PIPES++ cannot calculate results because there is some shape for which data is incomplete, but you don't know which shape it is.

Copy Current Diagram will copy the network diagram to the Clipboard. You can then paste it into your Windows Word Processor or Windows Drawing Program for inclusion in a report.

Copy Data to Spreadsheet will copy the current pipe and node data to the clipboard. You can then paste this data into a spreadsheet by placing the cursor in cell A1 of the

spreadsheet and selecting *Edit / Paste*. You can then format the data to make it more readable. You might make the headings bold, center the text in cells containing numbers etc.

Copy Results to Spreadsheet will copy the current pipe and node results to the clipboard. You can then paste these results into a spreadsheet. This is useful for large networks where it can be difficult to identify nodes with low pressures, pipes with high friction losses or velocities. With the results shown in a spreadsheet you can use the spreadsheet's capabilities to quickly identify problem areas. For example, you can sort the node results based on pressure to see all the problem pressures. You can also sort the results based on pipe friction slope to identify the best candidates for augmentation to overcome low pressure problems.

Paste Data from Spreadsheet can be used to edit the data in a spreadsheet, add new pipes and nodes, or even to create a new network directly from data entered into a spreadsheet. It is recommended that you first paste data into a spreadsheet. You can then edit the data. For example you might change some pipe diameters and add levels and demands to nodes. When you are satisfied with the changes you select (highlight) all the rows from row 1 to the last row of pipe data. Then you select *Edit / Copy* to copy the data to the clipboard, then use Alt-tab to switch to PIPES and select *Edit / Paste Data from Spreadsheet*. Any changes that you have made in the spreadsheet will then be made within PIPES and any new pipes or nodes that you added in the spreadsheet will be created in PIPES.

If you add a new node in the spreadsheet you will need to provide an x,y coordinate for it. If you change a pipe type the text must exactly match a pipe type in PIPES data base. The safest way to do this is to copy a pipe type from another cell and paste it into the cell to be changed.**Copy Current Diagram** will copy the network diagram to the Clipboard. You can then paste it into your Windows Word Processor or Windows Drawing Program for inclusion in a report.

Delete allows you to delete a pipe, pump valve etc. First you click on the item to highlight it. You can then press the *Del* key or select this menu item to delete it.

Job Description allows you to document this job in detail. You can enter notes such as new pipes included in this analysis, the fact that this analysis uses Peak Day Demands for Year 2010 etc.

Title Block allows you to edit the text which appears in the bottom right of the drawing. This text may not always be visible on the screen. If you pan to the bottom right of the drawing (using the arrows or sliders on the bottom and right of the drawing) you will see the text. If you do not want to show a title block you can simply delete all three lines of text.

Pipe Data Base allows you to edit the pipe data base. The data base contains internal diameters for a range of common pipe materials and classes. You can add or remove pipe types and pipes. The pipe data base was introduced with Versions 95.20. If you are using data files prepared with an earlier version of PIPES the data base feature will be temporarily disabled.

Draw Menu
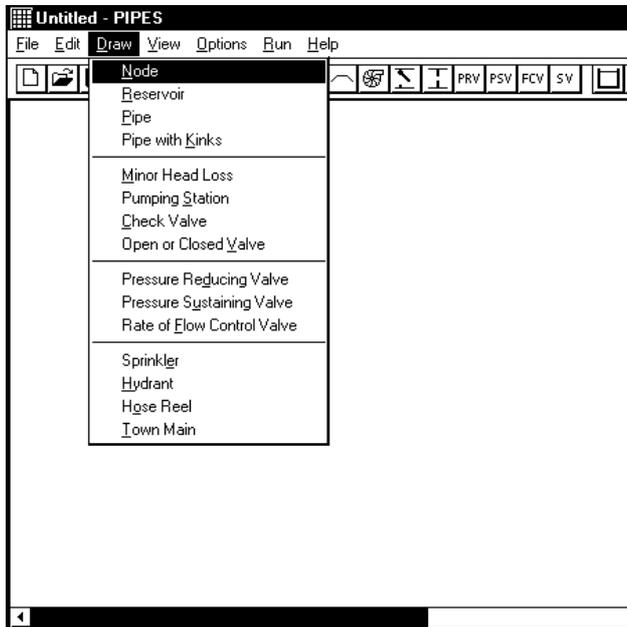
Rules for Drawing a Pipe Network

The **Draw** menu is used to enter the details of your pipe network. A glance at this menu will show that you can include nodes, reservoirs, pipes, minor head losses, pumping stations, check valves, stop valves, pressure reducing valves, pressure sustaining valves, sprinklers, hydrants, hose reels and town mains. You can also draw these items using the Toolbar.

Before discussing these components in detail, there are some rules which you must follow in drawing a pipe network. These are:

- reservoirs, sprinklers, hydrants and hose reels are located at a node. That is, the base or corner of these items should just touch one node. If there is too big a space between the item and its node, PIPES will not associate the item with that node.

- pipes are located between two nodes. That is, each end of a pipe should just touch one node. If there is too big a space between the end of a pipe and its node PIPES will not associate the pipe with that node.

- minor head losses, pumping stations and all types of valves are located between two nodes. That is, you should draw two nodes, one on each side of these items. The space between the item and its nodes is not important, but about 5 mm is recommended for appearances sake. You will be prompted to supply the name of the upstream and downstream node in a dialog box. **Note:** If you draw a pipe from N1 to N2 and a valve from N1 to N2, the pipe and the valve will be in parrallel. If you want them in series you will need another node (eg draw the valve from N1 to N2 and the pipe from N2 to N3).

- a Town Main is a special type of node which you can use if you are analysing pipework supplied from a Town Main. The local Water Authority will supply maximum and minimum HGLs at the town main. Pipes, minor head losses, pumping stations and all types of valves can be located between a Town Main and another node.
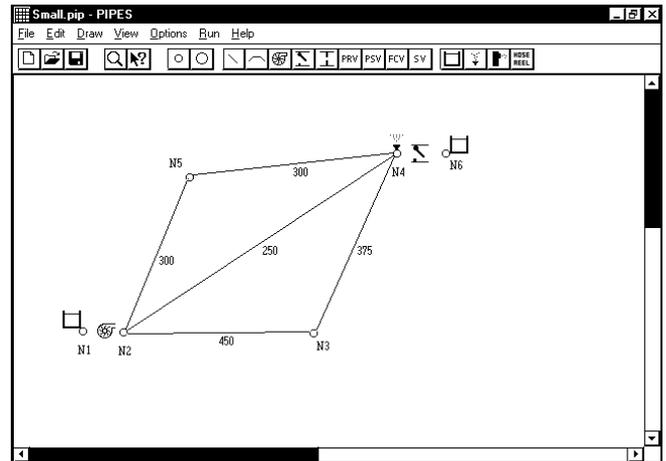
Nodes

A node is shown as a small circle on the network diagram. It is an essential part of the network diagram and is used as follows:

- pipes are drawn from one node to another node

- valves, pumping stations and minor head losses are drawn between two nodes

- reservoirs, sprinklers and hydrants are drawn touching one node

To draw a node:

- select **Node** from the *Draw* Menu, or click on the node button in the Toolbar

- place the mouse cursor where you want the node

- press and hold down the left mouse button

- you can move the mouse to place the node precisely. When the node is correctly located release the mouse button.

Hint: To draw many nodes hold down the *Shift* key as you release the mouse button. You will then be ready to draw another node immediately.

The procedures described here for drawing a node, apply to the various other network components. The use of the *Shift* key applies to nodes and pipes only.

Data for a node is optional. You can specify the elevation at the node and you can specify details about demand from the node. To enter data for the node point to it, right click and select Edit Data from the pop-up menu. A dialog box will appear and you can enter data for elevation, and demand details.

Hint: You can keep your drawing looking tidy by moving the node label (simply drag it with the mouse). When results have been calculated the label will be replaced by the HGL value which may require a little more space. If necessary you can drag the HGL value to suit.

In the normal version of PIPES, demands from a node are allocated to one of ten areas. Each area can have a different multiplying factor which is applied to all demands in that area. The dialog box shown below appears when you right click on a node, and select *Edit Data* from the pop-up menu.

In the Building Services version of PIPES the dialog box for a node is different. The dialog box comes preconfigured with the fittings shown below. You can change these fitting names and change the values of Loading Units (L.U.) per fitting if you wish.

You specify the number of each type of fitting and PIPES calculates the Probable Simultaneous Flow (PSF) for all fittings in Litres per second. For less than 70 L.U.s the program obtains the PSF from Table 3.3 in AS3500 Part 1 - 1992. It has been common practice in Australia to convert L.U.s to PSF using Table 48 in *The Selection and Sizing of Copper Tubes for Water Piping Systems* by Barrie Smith (published by The Institute of Plumbing Australia). For greater than about 70 L.U.s Table 48 gives considerably higher flows than the formula used to produce Table 3.3. For this reason, we have not used this formula for more than 70 L.U.s, but have used a number of straight line relationships which give a PSF similar to Table 48.

The dialog box also allows you to enter a constant flow (Litres per second) which is not diversified. For example you might use this for a bank of showers which are likely to all be used at the same time.

In the Building Services version of PIPES, the diversity calculations are carried back as far as a ring or loop main. In other words, flows in the branching sections of pipe system may not satisfy continuity. In the normal version of PIPES flows always satisfy continuity.

Reservoirs

Selecting **Reservoir**, or clicking the Reservoir button in the Toolbar, allows you to draw a reservoir. When you do this you will notice *?????* appears beside the reservoir. This indicates that some data is required for the reservoir.

Right click on the reservoir and choose edit data. You can now type in this data.

If you have drawn the reservoir at a node (as you should) PIPES will show the node label in the title bar of the dialog box (eg "Reservoir at Node N1"). If the reservoir is not drawn at a node, the title bar will show only "Reservoir".

When PIPES is satisfied that all essential data has been specified for the reservoir, and that the reservoir is drawn close to a node, the *?????* will disappear from the drawing. If you have specified a name for the reservoir, this name will appear in place of the *?????*.

Pipes

Selecting **Pipe**, or clicking the pipe button in the Toolbar, allows you to draw a pipe. Point to the pipe starting point and press the left button (don't release it yet). Now move the mouse and you will see the pipe follow the mouse movement. When you are satisfied with the pipe location release the left button.

Not satisfied with the location? Highlight the pipe (simply click on it). You can now drag the entire pipe or drag only one end. To drag the entire pipe, point near the centre of the pipe and drag from there. To drag one end, point to that end and drag it.

Hint: To draw many pipes hold down the *Shift* key as you release the mouse button. You will then be ready to draw another pipe immediately.

To enter data for a pipe right click on the pipe and select *Edit Data* from the pop-up menu to bring up the dialog box. When all data is specified, and both ends of the pipe are touching a node, the *?????* will be replaced by the diameter (unless you have requested some other item of data from the *View/Pipe Details* menu). If the text associated with a pipe (*?????* or diameter etc) is badly located you can simply drag it elsewhere.

Prior to Version 95.20 you were required to specify the internal diameter of each pipe. If you are working with data files prepared with an older version of PIPES this still applies. However, for new data files you will select the pipe type (eg uPVC to AS1477 Class 12) and nominal diameter from drop down list boxes in the dialog box. If the pipe you wish to use is not in the pipe data base you can add it by editing the data base under the menu item *Edit / Pipe Data Base*.

The dialog box will allow you to specify:

- Length
- Pipe Type
- Nominal Diameter

- whether to use the default roughness specified in the pipe data base, or to specify a different roughness for this pipe
- Details of minor head losses (valves, bends and fittings) to be included with the pipe.

Hint: It is simpler to lump valve and fitting losses in with a pipe rather than to model them as a separate minor head loss.

Kinked Pipes

Occasionally you may wish to draw a pipe as a series of straight lines (eg when drawing a second pipe between two nodes). Selecting **Pipe with Kinks** allows you to do this. You draw the first segment as you would a normal pipe. Then move the mouse to draw the second segment and click once to lock it in place. Repeat this process for additional segments. Click with the RIGHT mouse button to lock the last segment in place.

After you have drawn it, a kinked pipe is very similar to a normal pipe. The only difference is that you can drag the kinks as well as the ends. The kinks are symbolic only, and there is no headloss associated with these kinks.

Minor Head Loss

A minor head loss should be drawn between two nodes. Minor head losses can be used to model anything which has a head loss proportional to flow squared.

$$\text{ie Headloss} = a.Q^2$$

The data required is the nominal diameter and K where

$$\text{Headloss} = KV^2 / 2g$$

You can draw a minor head loss, enter data for it and inspect the results of an analysis as you would for any network component.

Pumping Station

A pumping station should be drawn between two nodes. A pumping station can contain several different pumps. Clicking the *Pump Details* button allows you to define three points on the pump Q - H curve for each pump in the station.

You can draw a pumping station, enter data for it and inspect the results of an analysis as you would for any network component.

Check Valve

A check valve should be drawn between two nodes. Check valves will allow flow in the forward direction only. They will close to prevent reverse flow if necessary. The data required is the nominal diameter and K where

$$\text{Headloss} = KV^2 / 2g$$

Open or Closed Valve

This valve is useful if you want to examine the effect of isolating a part of the network. The dialog box allows you to specify whether the valve is open or closed.

Pressure Reducing Valve

A pressure reducing valve should be drawn between two nodes. A pressure reducing valve will automatically throttle flow to limit the maximum downstream pressure to a preset value. The data required is the downstream HGL setting, the nominal diameter and K where Headloss $= KV^2 / 2g$.

Pressure Sustaining Valve

A pressure sustaining valve should be drawn between two nodes A pressure sustaining valve will automatically throttle flow to sustain the upstream pressure at a preset minimum value. The data required is the upstream HGL setting, the nominal diameter and K where

$$\text{Headloss} = KV^2 / 2g$$

Rate of Flow Control Valve

A rate of flow control valve should be drawn between two nodes This valve will automatically throttle flow to limit the maximum flow to a preset value. The data required is flow setting, the nominal diameter and K where

$$\text{Headloss} = KV^2 / 2g$$

Sprinkler

A sprinkler should be drawn touching one node. The data required is the elevation (RL) of the nozzle and the flow at some pressure.

Hydrant

A hydrant should be drawn touching one node. The data required is the elevation (RL) of the outlet and the required flow.

Hose Reel

A hose reel should be drawn touching one node. The data required is the elevation (RL) of the outlet and the required flow.

Town Main

A Town Main is a special type of node. If you are designing pipework supplied from a Town Main you might wish to use this. The local Water Authority can supply the maximum and minimum HGL in their main. If they supply the maximum and minimum pressure at a specified level, you can calculate the maximum and minimum HGLs by adding the pressure (expressed in metres) to the ground level (in metres). The data required is the Hydraulic Grade Level (HGL).

Borehole Drawdown Device

A borehole drawdown device should be drawn between two nodes. This device simulates the drawdown from the static water level to the pumping water level in the borehole. Flow through the soil is assumed to be laminar and the headloss equation is dH = BQ. The data required is the drawdown (in metres) for a pump out rate of 1L/s (this defines B in the equation).

A reservoir on the device's upstream node should be set with a water level equal to the static water level. Headloss through the device will then produce the pumping water level (HGL) at the device's downstream node. You should draw a pump station in series with this device (i.e. downstream of the device).

View Menu
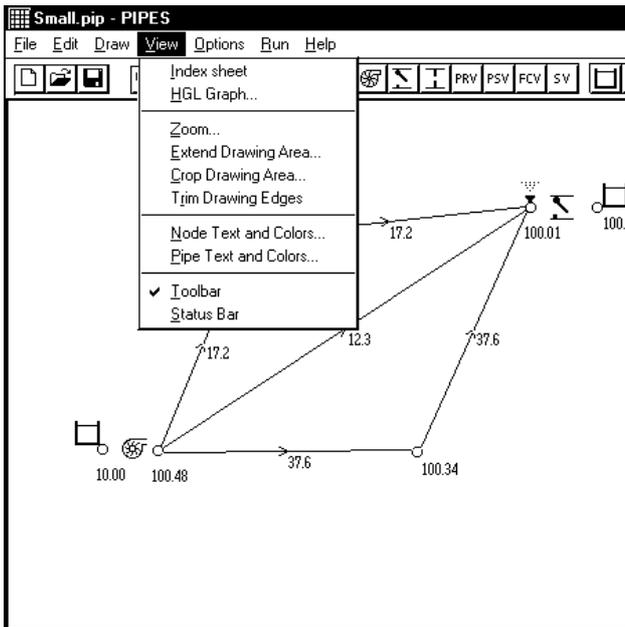
Drawing Area

You have probably realised by now that you cannot hope to fit a large pipe network on a single screen. When you start a new drawing PIPES allocates a drawing area the size of 4 screens (2 vertically by 2 horizontally). In other words, when you start PIPES you are looking at the top left hand quarter of the available drawing area.

You can think of the screen as a window through which you can see only part of the entire drawing. You can move this window around the drawing area using the scroll bars to see any part of the drawing.

Index Sheet allows you to quickly zoom out to look at the entire drawing. It also lets you quickly locate the viewing window precisely where you want it. If you find yourself getting lost looking at a small part of a larger drawing this will be helpful. When you select **Index Sheet**, you will see the entire drawing on one screen and a dashed rectangular box. This box indicates the present position of the normal view window. You can drag this box wherever you want to position the normal view window. Releasing the left mouse button will return you to the normal view window.

HGL Graphs will show a graph of HGL along one or more pipes. You can nominate the nodes along each pipe route. See page 24 for more details.

Zoom will be useful if you find your drawing is too cluttered or too spread out. This can happen when you read a DXF file or if you are inexperienced in drawing a network diagram in PIPES. You will be prompted for a magnification factor.

If you work with large networks, sooner or later you will find that the 4 screens of drawing area are insufficient (ie your network has "run off the page"). When this happens, you can choose **Extend Drawing Area**. This is like sticking more paper to your drawing. The size of your entire drawing area increases, but you can see no more on one screen (ie the size of the view window does not change).

Crop Drawing Area allows you to trim the edges of the drawing area. You can crop right down to the size of one screen full.

Extending or Cropping the drawing area adds or subtracts one half a screen width and height each time you do it. If you inadvertently lose some of your network when you Crop the drawing it will reappear if you Extend the drawing.

Toolbar can be used to show or hide the Toolbar. The check mark indicates that the Toolbar is currently visible.

Status Bar can be used to show or hide the Status Bar. The check mark indicates that the Status Bar is currently visible.

Pipe and Node Details

When you draw a network there is some text associated with each node and pipe. When you first draw a network this text shows the node labels and the pipe diameters. After you calculate results, the text shows the node HGLs and the pipe flows. Using **Node Text and Colors** and **Pipe Text and Colors** you can change this text to show other data or results.
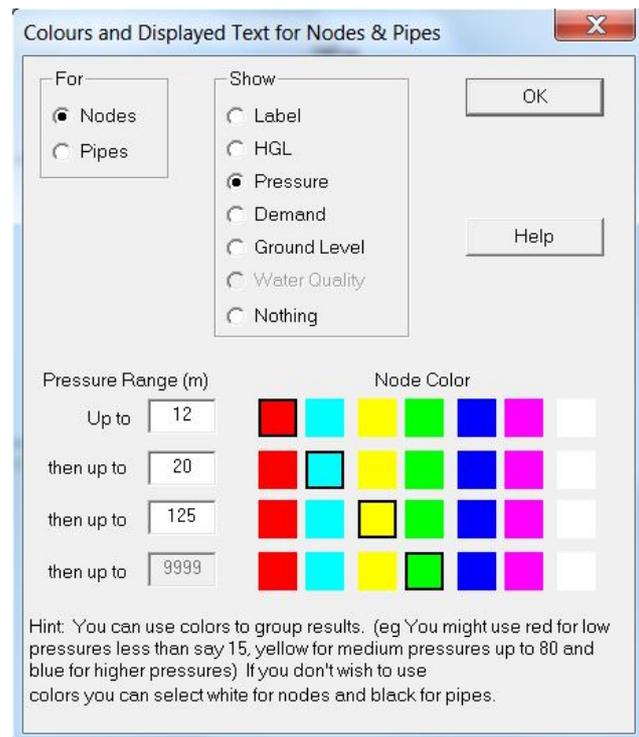
You can also use these menu items to colour code the results. For example, selecting **Node Text and Colors** shows the dialog box in the figure above. The user has then specified that the pressure should be displayed at each node and that the nodes should be colour coded based on the value of pressure. In this example, the user has specified pressures up to 12 m should be red, 12 to 20 should be cyan, 20 to 125 should be yellow, and greater than 125 should be green. The square boxes, shown black in the above figure, appear as colours when you use PIPES.

Options Menu

Flow Units allows you to choose between various units. You should select your preferred option before entering data for pumps, valves, demands etc. The Building Services of PIPES works in Litres per second only, and this option is not available.

Headloss Formula allows you to choose between the Hazen Williams and Colebrook White formulae for headloss in pipes. You should choose the formula you prefer before entering data for pipes. The Building Services version of PIPES uses the Colebrook White equation only, and this option is not available.

The Hazen Williams equation is described in most standard hydraulic texts. The Colebrook White equation is:

$$V = -2\sqrt{2gDS}\,\log\left[\frac{k}{3.7D} + \frac{2.51v}{D\sqrt{2gDS}}\right]$$

where   V = velocity of flow

g = acceleration due to gravity (m/s^2)

D = pipe internal diameter (m)

S = slope of Hydraulic Grade Line

k = pipe wall roughness (m)

v = kinematic viscosity of fluid (m^2/s)

The Colebrook White equation is considered to be more accurate than the Hazen Williams equation and has the added advantage that roughness values (k) do not vary with pipe diameter.

Fluid Properties allows you to specify the water temperature and to model fluids other than water by specifying the kinematic viscosity and specific gravity. This option is only available if you are using the Colebrook White equation.

Run Menu

Hydraulic Analysis starts an analysis. This menu item will be grey until all data is complete and only then will you be able to select it to start an analysis. If ????? appears beside any network component it indicates that the data for that component is incomplete. It could also indicate that a reservoir or sprinkler is not located at a node, or that one or both ends of a pipe are not touching a node.

In the Building Services version of PIPES, you have the option of specifying a maximum velocity in each pipe. If the calculated velocity exceeds the maximum velocity, PIPES will offer to upsize the relevant pipes for you at the completion of the analysis. If you accept this offer, the results will be recalculated using the revised pipe sizes and the affected pipes will be shown in bold. After you right click and edit data on a bold pipe, to see the new size, it will appear normally.

Help Menu

Table of Contents is like the Table of Contents of a text book. It shows topics covered by the help system.

Index is like the index of a text book. It invokes a dialog box in which you can search for key words.

Using help is an introduction to the help system.

About PIPES shows copyright information and the version number of PIPES.

6 Inspecting Results

After running a hydraulic analysis, the results will be displayed on the network diagram for every pipe and every node. By default, the flow in each pipe and the HGL at each node will be shown. You can control what results are shown by selecting **Pipe Text and Colors** or **Node Text and Colors** from the **View** menu.
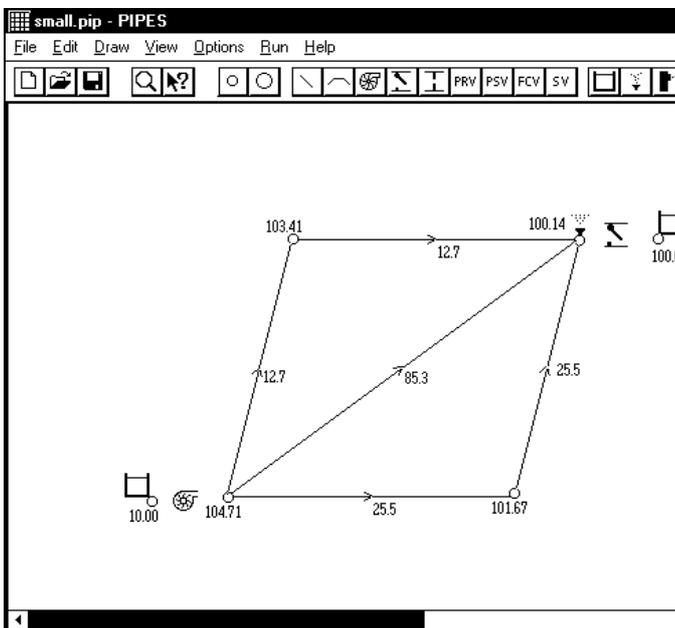
You can right click and edit the data for any network component to see the complete results for that component. The figure below shows the dialog box for a pipe.

HGL Graphs

You can plot the HGL along one or more pipes by selecting **HGL Graphs** from the **View** menu.

You can specify any pipe route for plotting an HGL graph. If you have specified a level for every node along the route the ground level will also be plotted.
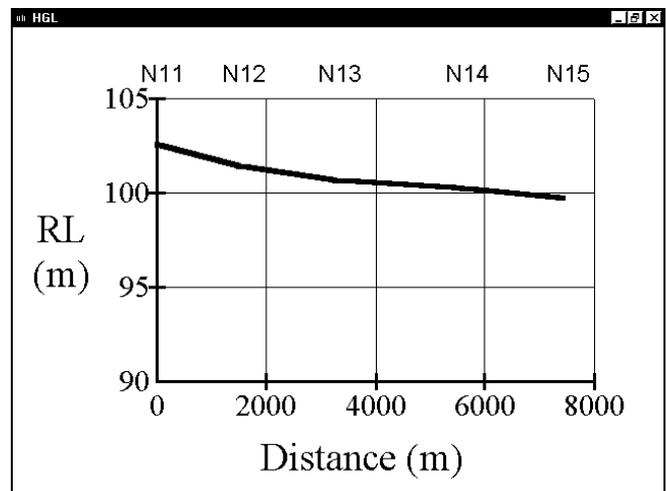
Appendix A

CONVERSION OF
WATSYS DATA FILES

If you have been using WATSYS you can convert your existing data files for use in PIPES. Most of the effort in setting up a data file is spent in collecting and specifying data for pipes and nodes. This data will be automatically converted, but data for reservoirs, pumps and valves will not. This is because WATSYS and PIPES are sufficiently different in their treatment of these devices that automatic data conversion would be too dangerous.

Before converting any data, you should check the node demand data to ensure that it complies with the following conventions used in PIPES:

- the multiplying factor for an area can be specified only once. (eg if Area 1 was assigned a multiplying factor of 0.75 for some nodes, and a factor of 0.5 for some other nodes, you might define a new Area No. 10 for those nodes having a multiplying factor of 0.5).

- If you use more than one sub system in your data file, each sub system name must start with a different letter.

These requirements apply across all sub systems used in the data file. If your data breaches any of these requirements, you must adjust it to comply. Once the files are converted, you can forget about these conventions.

You must first draw up the network and ensure that the node labels shown on the network match those in the Watsys data file. If the Watsys data file uses subsystems other than MAIN, the label on the network diagram should be prefixed by the first letter of the subsystem name. (eg for node 101 in the Western subsystem, the network diagram should show node label W101). For the MAIN subsystem (or if no subsystem names are used), the node label shown on the network diagram should be exactly the same as that in the Watsys data file.

Rather than draw up a network from scratch, you may prefer to import a DXF file which could be prepared from a Watsys map file or from Autocad etc. When the network diagram is ready, you can merge in data from a Watsys file **using** *File / Merge Watsys data file*.

It still remains to add reservoirs, valves and pumping stations to complete the network. You can do this using

the *Draw* menu. You can then right click and edit the data for each component in turn to specify the data.

Appendix B

TECHNIQUES FOR LARGE NETWORKS

While using PIPES with large networks we have developed certain methods of setting up and checking a model. There are other ways of doing the same thing, but these are the methods we prefer.

Using DXF Files

The first step in setting up a model is to prepare the network diagram. While this can be done within PIPES, for large networks we prefer to import a DXF file which is produced from a CAD package. If the DXF file is drawn to scale PIPES can determine the lengths for all pipes after you specify the length for one pipe. Often the pipes are already included in a CAD drawing. While this appears to save some time there are hidden traps in using such a file. Because every line on a certain layer will be interpreted as a pipe (or part of a kinked pipe) it is important that each line is drawn once and only once, and that there are no stray short lines accidentally drawn. These errors are easily made and difficult to detect. Unless the original draftperson was aware of these requirements we have found it safer and often faster in the long run to redraw (trace over) all the pipes on a new layer. Nodes are added on a separate layer to define the extents of kinked pipes and the interconnection details. We prefer to let PIPES number the nodes automatically.

Using a Spreadsheet for Editing Data

The next step is to set up demands at nodes. For large networks we prefer to do this in a spreadsheet such as Excel. You should copy the data to the Windows clipboard and then paste it into cell A1 of a spreadsheet. You can then add demands and ground levels in the spreadsheet. You can also change the node labels here if you wish to use a particular labelling system. When the data is finalised select all rows from row 1 to the last row of pipe data and choose Edit / Copy. Then use Alt-tab to switch back to PIPES and choose *Edit / Paste*.

Checking Results

In very large models (eg 3000 nodes, 4000 pipes) it can be a daunting task to look for substandard pressures and high headloss pipes on the screen or on a printed diagram of results. To help in checking results you can select *Edit / Copy Results to spreadsheet*, then switch to an empty spreadsheet and select *Paste*. The results for for nodes are shown on the upper part of the spreadsheet and for pipes on the lower part of spreadsheet.

You can select the node results and sort the data in ascending order of pressure. This will quickly show all those nodes with substandard pressures.

You can also select the pipe results and sort the data in descending order of friction slope (m/km). Excessive values of friction slope indicate that this pipe is a good candidate for augmentation. They can also mean that there is an error in the network diagram forcing this pipe to carry flow which should be carried by another (possibly larger) pipe.