IRRICAD Training Course

Version 14

1.1 TABLE OF CONTENTS

1.2 STARTING OUT

The intention of this training manual is to show you how IRRICAD works and to do this as simply as possible.

There is no rigidly prescribed method of carrying out IRRICAD designs; you should use these examples as a guide only and try to develop a procedure which best suits your situation.

Only those options needed to produce these designs are described.

The exercises in this manual are set up to show specific features of IRRICAD, so please complete each section even if the type of design is not in your general line of work. Work through the exercises at your own pace and please feel confident with each exercise before moving on to the next one. These exercises can be completed at an IRRICAD training course or at your own computer in your office.

The database that is necessary for the tutorials is supplied with the program.

When directed to select a command from a menu, the menu name, menu option and sub menu option (if applicable) will be listed. For example, select *Settings*|*Digitizer*|*Scale*. This refers to selecting the *Scale* option from the *Digitizer* submenu that is found in the *Settings* menu. The *Settings* menu is found on the Menu bar at the top of the IRRICAD window.

All button names will be displayed with square brackets such as [OK], all dialog field names will be displayed with double quotation marks such as “Description” and all keyboard keys will be displayed in angle brackets such as <Shift> . All entries you need to enter, select or are editable if automatically entered for you, are in bold e.g. Enter the “Width” as **32** and the “Height” as **50**.

1.2.1 HELPFUL HINTS

Before you begin any designs on your own, please note the following:

1.2.1.1 TERMINOLOGY

Because IRRICAD can be used for the design of any pressurized irrigation system, the following terminology is used:

Block:	An option for laying out an area of equally spaced spraylines (Spray Block) or tapes (Tape Block). The spraylines may be connected or unconnected (see below). Immediately after entry, each sprayline or tape becomes an independent item. Use of Block does not define an irrigation block. This means that the Block tools may be used to layout all of the spraylines for a design at one time. The Zones only become defined when these Spraylines are connected to Control Valves.
Control Valve:	Any device which can be used to control the flow of water to an outlet or group of outlets.
Irrigation Block Entity:	An option for laying out an area of equally spaced spraylines or tapes, with automatic placement of submains, flushing manifolds and control valves. The spraylines may be connected or unconnected (see below). Each block entity is defined as an irrigation zone. These are dealt with as a complete entity and can be subdivided using the *Tools*|*Sub-Divide Block* option.
Mainline Pipes:	Pipes used to connect control valves to water supplies.
Mainline Outlets:	Outlets on a mainline. Each outlet is treated as a zone and is assumed to also perform the function of a zone control valve. Valve-in-head sprinklers are mainline outlets.
Misc. Hydraulic Items (mainline):	Items such as isolating valves, back flow preventors, air release valves that are connected into or onto a mainline pipe.
Misc. Hydraulic Items (zones):	Items such as isolating valves, backflow preventors, air release valves that are connected into or onto a Zone pipe.
Outlet:	Any device that discharges water from an irrigation system.
Sprayline (connected):	A zone pipeline containing equally spaced external outlets, also known as a lateral. A connected sprayline is maintained as a single unit.
Sprayline (unconnected):	A method of spacing outlets uniformly along a Zone or Mainline pipe. As soon as the sprayline has been entered it is converted into individual pipes and outlets, i.e., it is not maintained as a single unit.
System Duty:	A situation in the mainline (resulting from the turning on or off of control valves) in which the flows are fixed for a particular time interval. Also known as stations, sets or groups.
Tapes:	A lateral with internal emitters (drippers), commonly called dripline.
Water Supply:	A point of supply for the irrigation system.
Zone:	Items downstream of control valves (including the valves themselves). A zone becomes defined when control valves are entered, and zone pipes or spraylines connected to it, regardless of how or when those spraylines, pipes and outlets were entered.
Zone Outlets:	Outlets within a zone.
Zone Pipes:	Pipes used to connect zone outlets to control valves. Also known as submains.

Designs in IRRICAD consist of:

- A water source
- Mainline Pipes (pipes connecting a water supply or water supplies to Valves)
- Zones containing Valves, Zone Pipes (pipes connecting Zone Valves to laterals or outlets, e.g. submains), and Outlets, Spraylines (equivalent to laterals) or Tapes (dripline).

A Zone becomes defined when a *Control Valve* is entered and *Zone Pipes*, *Spraylines*, *Tapes* and / or *Outlets* are connected to it.

1.2.1.2 ON-LINE HELP

The on-line Help is available through the *Help* menu. Select *Help Topics*. It contains all the topics and chapters available in the manual and is divided into six main divisions:

- The Overview contains information for new users and installation instructions.
- The User Manual describes how to approach a particular task, using IRRICAD tools and options.
- The Database Editor section describes the function of the database and how to enter hydraulic items into the database.
- The Tutorials section contains tutorials you can run through to help you become familiar with the program.
- The Tool and Command Reference goes through each menu item and describes how to mechanically use the tool. Each menu is a chapter heading.
- The Technical References contains the Appendices and provides information such as Hazen-Williams C Values for pipe friction loss, Fitting Selection Rules, Keywords for Labels and Plot Templates and Screen Messages help and explanations.

The *Help* menu will also contain an option called *Release Notes*. This will contain all features added to later versions of IRRICAD since the manual was printed. If an explanation of how to use an item is not present in the *Help Topics*, refer to the *Release Notes*.

Use Search or Find to enter a key word and find the sections the key word appears in.

1.2.1.3 TUTORIALS

It is a good idea to run through a few of the tutorials when first learning IRRICAD. The tutorials will describe a number of the new tools and options using a step by step process. Though you may know how to use IRRICAD for design purposes, the tutorials help you to navigate around the new program and help you to develop a process for the new version. There are more tutorials available in the manual and the on-line help. The tutorials may also give you a fuller picture of IRRICAD's capabilities and introduce new features and functions for you to try.

1.2.1.4 USING THE INTERNET

Upgrades are available from our website (www.IRRICAD.com). You are able to download and upgrade your current version of IRRICAD if you have Pro Version 9 or later. If you have an older version of IRRICAD please contact your distributor for the upgrade.

Email contact is available on the website. Email us any requests of what you would like to see in IRRICAD in the future.

For any support, please contact your distributor.

1.2.1.5 IRRICAD USERS FORUM

The IRRICAD Users Forum is a great tool to find answers to your questions or issues as others may have had the same question or issue in the past. The forum is fully searchable.

You can subscribe to the forum to be notified of the latest topic posts as they happen. You can ask your own questions here or reply to someone else's question or query.

The Tip of the Week will also be posted on the IRRICAD Users Forum. Subscribe to receive notifications of posts.

1.2.2 How to Use IRRICAD Tools

1.2.2.1 Mouse Operation

IRRICAD uses the mouse installed with Windows operating systems.

Clicking the left mouse button selects or places. Clicking the right mouse button will bring up additional menus of choices for aiding or finishing tasks when using tools.

In most circumstances do not hold down the left mouse button after placing the first click of a line, pipe, select window or similar. Simply left-click then move the mouse and left-click again.

- The mouse wheel can be used for zooming. You can set the mouse tasks in *Settings|Mouse*.

1.2.2.2 Drawing Pipes

When drawing pipes, click for the first point, click the end point or click when there is a change in direction. To finish a pipe, *Right-click* and select *Restart* and press the <Esc> key.

1.2.2.3 Navigational, Modification, Selection Tools & Drawing Tools

IRRICAD incorporates a number of keyboard and mouse shortcuts that help to speed up the operation of various tools. Here is a selection of these that you may find useful:-

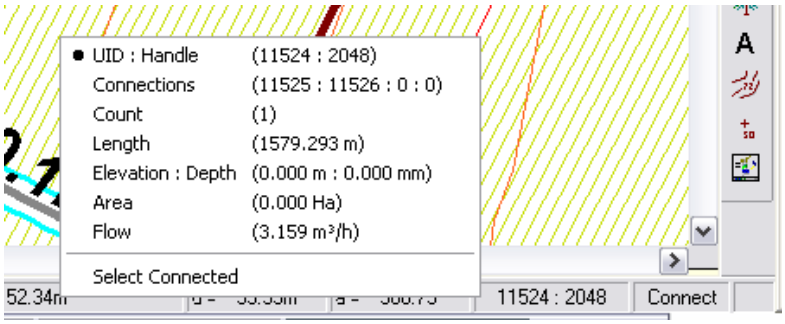
- Double-clicking on an item when in *Select Object* operates the change tool on the item.
- To bring up the change dialog, for a Block Entity, hold down the <Alt> key while clicking on any child component of the block entity.
- If you using the *Select Object* tool in "Single Select" mode, (see *Settings|Mouse*) you can hold down the <Shift> key to highlight subsequent items.
- In "Single Select" mode clicking empty space clears the current selection.
- Pressing the <Esc> key twice in quick succession clears the current selection and returns you to the default *Select Object* tool.
- Redrawing a large design may be stopped by pressing the <Esc> key.
- To place control valves and mainline outlets without having to view and "OK" the Zone Name dialog, hold the <Shift> key down when clicking to locate them. The default zone name will automatically be accepted and the dialog will not appear.
- All *Copy* tools have a "no dialog" shortcut, which repeats the last copy without showing the dialog each time. To action, hold the <Shift> key for the 2nd and subsequent copies.

1.2.2.4 Status Bar

Three panels are available on the right-hand side of the status bar. All the panel options can be selected by right-clicking the panel to access a pop-up menu, or left clicking to cycle through the available options.

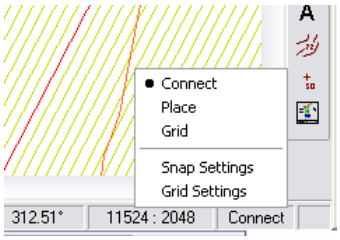
Info Panel

This panel displays a variety of information about the currently selected objects. This includes UID, connections, selected item count, cumulative length of selected items, elevation and depth, cumulative area, cumulative nominal flow and Z Coord. The menu also allows the user to select the items connected to the current item. The options may also be cycled with the shortcut key combination <Ctrl>+<Shift>+<I>, while <Ctrl>+<Shift>+<C> will select the connected items. Note that the current values of all options are displayed on the popup menu.



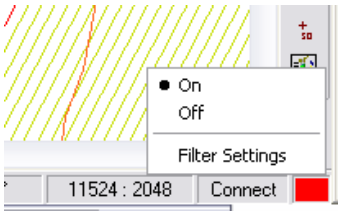
Snap Panel

This panel shows the currently selected default snap mode (Connect, Place or Grid) and, through the popup menu, allows quick access to the *Snap* and *Grid* settings. May be cycled with <Ctrl>+<Shift>+<S>.



Selection Filter Panel

This panel shows the status of the selection filter - a red panel indicates that the filter is active. The user can also access the filter settings through the popup menu and flip the filter status using <Ctrl>+<Shift>+<F>



1. Practice drawing and finishing pipes.

2. Practice some of the above tools and modes.

Notes

1.2.3 THE FIRST STEPS

Before starting a design:

- Your company information is important and can be saved for use with future designs. Select *Settings*|*Company* and enter your company details.

- Customise IRRICAD for future designs. Select *Settings*|*Irrigation - Design Specific* to customise the pipe line widths. Select *Settings*|*Irrigation Items* to customise other hydraulic symbols. If a [Save As Default] button is present, you need to click this to retain the settings for all future designs.

- Select *Settings*|*Units* to select the units to use for each dimension.

- If you know how large your design will be, you can select a "Design Size" from *Settings*|*Miscellaneous*. This option gives the symbols on the screen an appropriate symbol size relative to the area the design covers. It can be altered at any time during the design by selecting another "Design Size" or typing in a "Base Database Symbol Size". Note if the "Update Database Symbols" checkbox is checked, all symbols currently on the screen will be updated to the new size. Select a size where the symbols are recognisable in the printed plan.

- Design headings can be entered at any time. However, it is a good idea to include these at the beginning to avoid confusion if several copies of the base design are made. Select *Settings*|*Design Details*.

- You are now ready to enter your design. All Management and Design options are available from the *Design* menu. All Zooms are available from the *View* menu. Remember if you cannot find something, use Find or Search in the *Help*|*Help Topics* to locate which menu it is in.

Remember that you can enter items and information at any time and in any order. Make sure only Mainline items are used upstream from a control valve, and only Zone items are used downstream from a control valve.

- Design the zones first (*Design*|*Zone Design*|*...*) to be able to use the actual flows in the management process (see next point).

- You must tell IRRICAD how the system is to operate before you can design the mainline. Select one of the management options from the *Design* menu: *Assign Zones to System Flows* (or one of the two partly automated options) or *Other Management Options* for tabulated management, before designing the mainline (*Design*|*Mainline Design*|*...*).

Happy Designing!

1.2.4 IMPORTANT RULES TO REMEMBER

There are two main rules for IRRICAD. Neither can be broken, and if you remember them then designing with IRRICAD is made easier.

You cannot connect zone items to mainline items. Only a control valve can join zone and mainline

The order in which you draw items is flexible but Design is not. You must first design the zone tell IRRICAD how the system is to run and then design the mainline as listed below:

1.2.4.1 PROCESS LIST FOR DESIGNING WITH IRRICAD

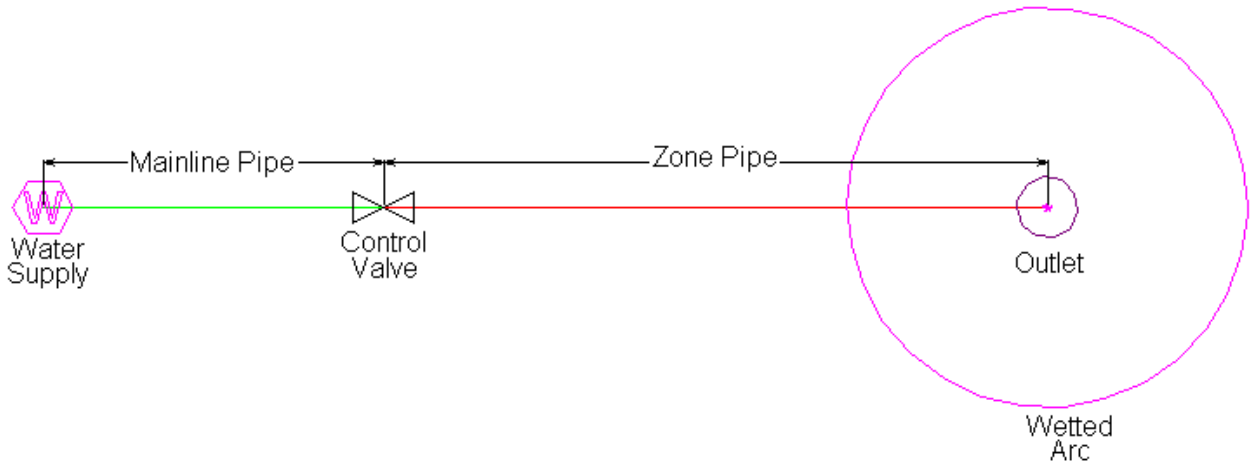
1. Enter background information
2. Layout the irrigation system
3. Design / Analyse the Zone
4. Management – tell IRRICAD how the system is to run – what zones are operating when
4. Design / Analyse the Mainline
5. Reports
6. Finalise Design
7. Computer Selection of Fittings and Bill of Materials Report
8. Place a Plot Layout and then Print.

1.3.1 VERY BASIC INITIAL DESIGN

Tasks covered in this tutorial:

- Using Zone and mainline items
- Drawing a simple system
- Turning valves on
- Sizing pipes based on required pressures
- Reading reports

This design takes you through the very basic concepts of an IRRICAD design. Understanding these concepts and principles will allow them to be applied to larger and more complex designs.



1.3.1.1 STARTING THE TUTORIAL

1. Double-click on the IRRICAD icon or select *Start|All Programs|IRRICAD Pro|IRRICAD Pro 14* to start IRRICAD. If IRRICAD is already running, select *File|New* to start a clean design.

2. Go to *Settings|Irrigation - Design Specific* and [Browse] for the **Tutorial.mdb** database. Highlight and select [Open].

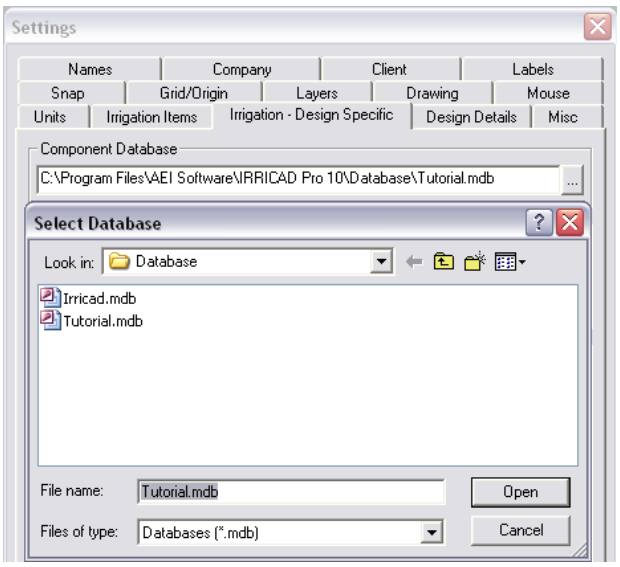


Figure BB 1

3. Go to the *Units* tab and click the [Metric] button to restore the default units for this tutorial. These settings can be retained for each design by clicking the [Save As Default] button.

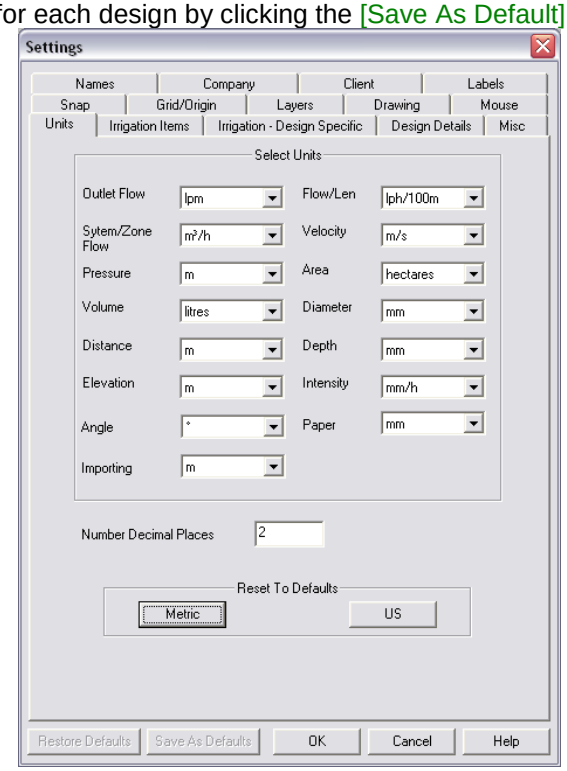


Figure BB 2

4. Select the *Misc* tab (*Settings*|*Miscellaneous*) and select the **Medium** "Design Size" (centre of dialog). Click [OK].

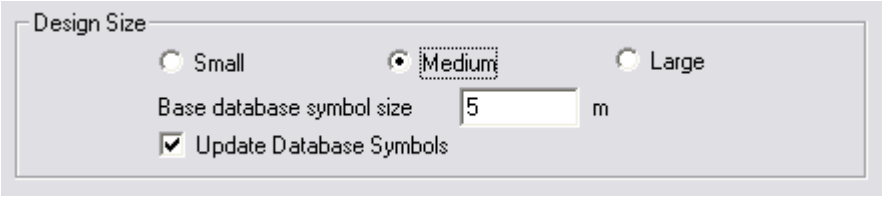


Figure BB 3

1.3.1.2 Drawing the Layout of the System

5. Select *Mainline*|*Water Supply* and place the water supply on the screen, near the left-hand side. Leave the entries as **0**, so that IRRICAD will calculate the system duty for the system you draw. Click [OK] to accept and close the dialog.

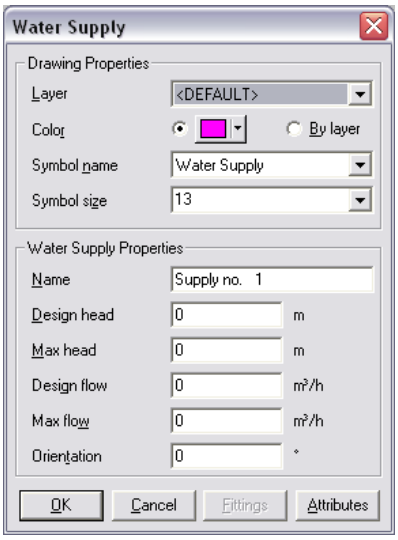


Figure BB 4

6. Select *Mainline|Pipe*. Leave the pipe as "Computer Selected" so that IRRICAD will size the pipe for you. Click [OK] and click in the centre of the water supply to place the start point of the pipe (left-click on the screen). The pipe will rubberband with the cursor until you place the end point or next point of a pipe (if the pipe is bent). The pipe tool is like a continuous line tool and will rubberband between points until you end the pipe by right-clicking and selecting *Restart* (*Right-Click|Restart*).

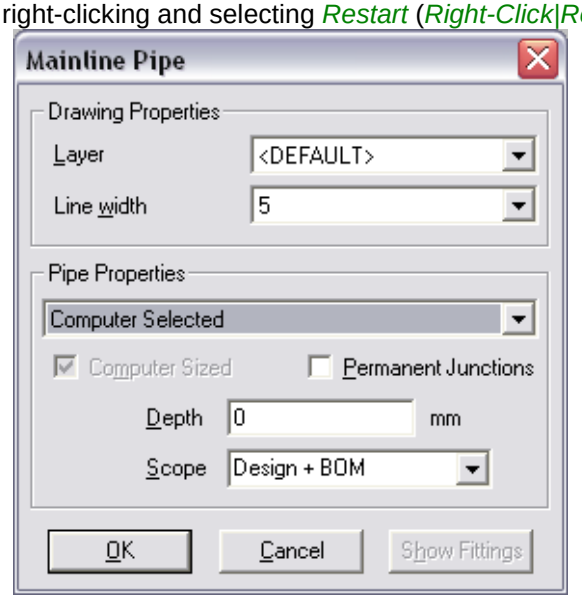


Figure BB 5

Between mainline and zone items there always needs to be a control valve – upstream from the control valves are always Mainline items and downstream from the control valve are always Zone items. You can select a control valve from either the Mainline or the Zone menu (*Mainline|Control Valve* or *Zone|Control Valve*).

7. Select the **¾" (20mm) Electric Valve**, click [OK] and place it on the black junction (square) at the end of your mainline pipe. Once placed, IRRICAD will assign a default name of **Zone no. 1** to this control valve because valves need to be identified. Click [OK]. The black junction will disappear when the control valve connects to it.

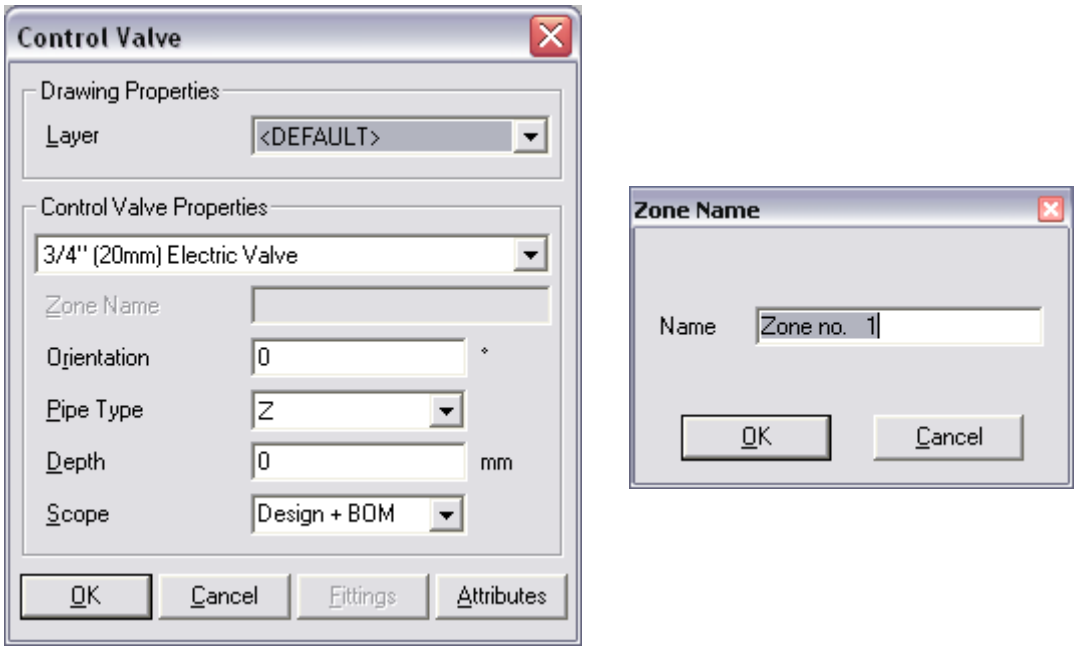


Figure BB 6

8. Now select *Zone|Pipe*. Leave the pipe as "Computer Selected", Click [OK] and place the start point on the control valve. Click to place the end point of the zone pipe. When you have completed your zone pipe, *Right-Click|Restart*.

9. Select *Zone|Outlet*. Select the **Big Impact Drive Sprinkler**. In the "Nozzle" field you can select the nozzles associated with this sprinkler. Select the **4.9mm** nozzle. Leave the "Pressure" and "Flow" as the default values. Click [OK] and place the outlet on the end of the zone pipe in the centre of the black junction. The black junction will disappear when the outlet connects to it.

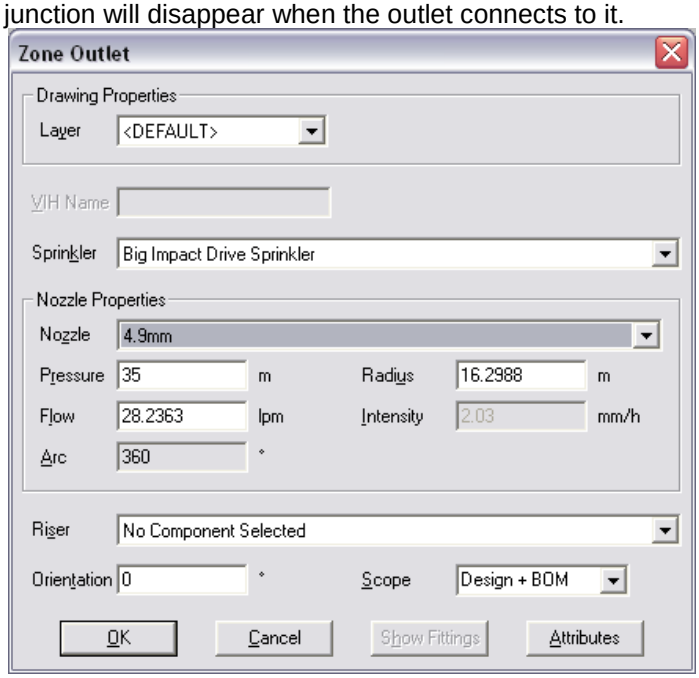


Figure BB 7

We have drawn the layout of the system, selected valves and sprinklers and allowed IRRICAD to select pipe sizes and calculate the required system duty.

1.3.1.3 CHECKING CONNECTIONS

10. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with Design (see Figure BB 8). This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design|Clear Connectivity Marks*.

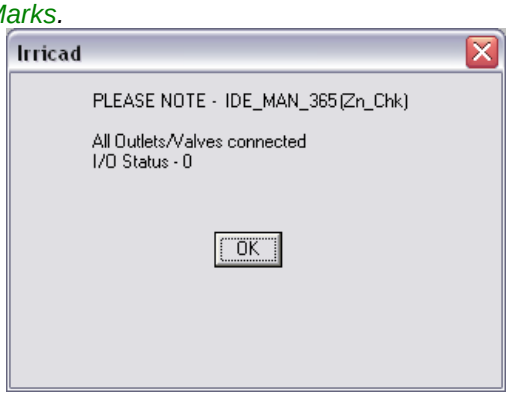


Figure BB 8

If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View|Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify|Select Object* and click on the item) and move the item to the centre of the junction (*Modify|Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check the "Default Snap Mode" in *Settings|Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

1.3.1.4 ZONE DESIGN

Now we can design the zone by sizing the pipes. You will see that the Zone Design menu has four options in it. *Analyse* is used when you have selected the pipe sizes or after you have made further changes to the design. *LP Design* is used when you wish to size zone pipes based on the pressure required at the outlets. *Velocity Design* is used when you wish to size pipes based on a maximum velocity or when the pipes are looped. *Detailed Analysis* is normally used at the completion of design and adjusts the flow at each sprinkler based on the pressure at each sprinkler giving a more accurate analysis than calculations based on nominal flows.

11. Select *Design|Zone Design|LP Design*. You should see the pipe change colour. The colour for pipes is stored in the database.

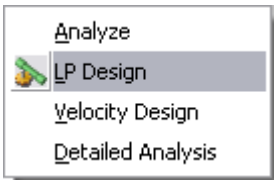


Figure BB 9

IRRICAD also checks that the flow through the valve is within the manufacturers' specification and calculates the valve headloss.

1.3.1.5 ENTERING MANAGEMENT REQUIREMENTS

IRRICAD needs to know how the system will be operated. We call this Management and there are several ways to accomplish this task. Management gives us the ability to specify when control valves are on and off.

12. In our simple example there is only one valve so the simplest option is to select *Design|Assign All Zones to One System Flow*. This option is automatic. IRRICAD assigns "Zone no. 1" to operate on **System Flow 1**. Click [OK].

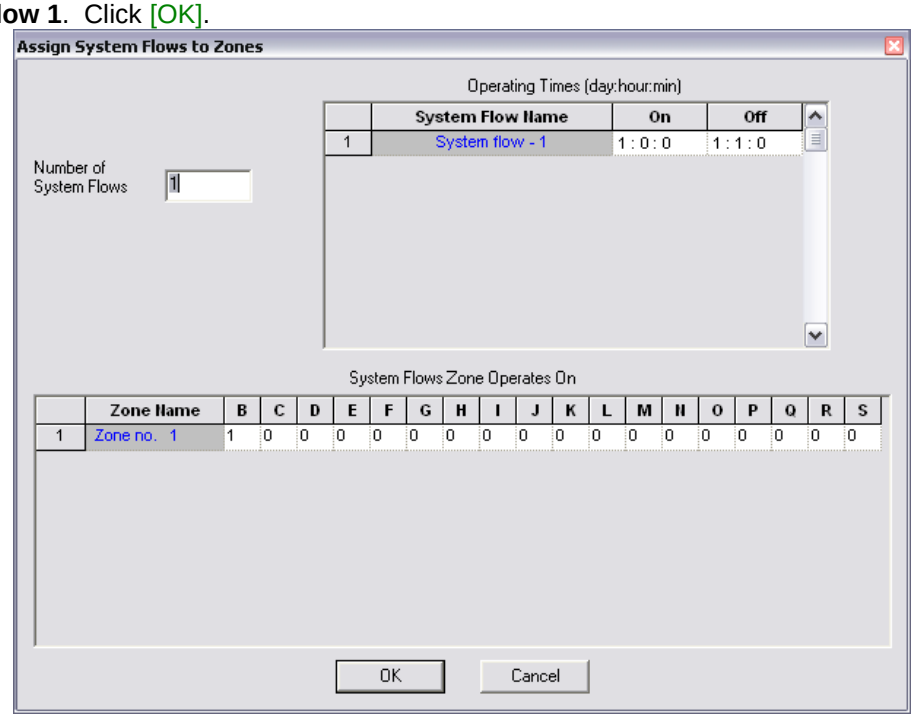


Figure BB 10

1.3.1.6 MAINLINE DESIGN

We can now size the mainline. You will notice the same four options here are the same as were available in the Zone Design submenu. The only differences are that LP Design will size pipes based on the control valve required pressure and that Velocity Design must be used if the system has more than one water supply.

13. Select *Design|Mainline Design|LP Design*. You should see the pipe change colour. Again the colour for pipes is stored in the database.

1.3.1.7 REPORTING

14. Select *Reports|Zone Design Reports|Zone Design Summary*. This report summarises what is happening in the zone – from the outlets to the control valve as seen in Figure BB11.

Zone Name :	Zone no. 1	**Valve Description :**	3/4" (20mm) Electric Valve
Zone Head (D/S) :	35.22 **(m)**	**Zone Head (U/S) :**	36.71 **(m)**
Total Zone Flow :	1.69 **(m3/h)**	**Valve Headloss :**	1.49 **(m)**

	Allowable Flow (lph)	Actual Flow (lph)	Allowable Pressure (m)	Actual Pressure (m)
Minimum Outlet	1609.47	1616.95	31.48	31.78
Maximum Outlet	1778.89	1616.95	38.72	31.78
Outlet Variation (%)	9.52	0.00	18.70	0.00
Oulet Locations (X,Y)	Minimum :	67.6 , 57.5	Maximum :	67.6 , 57.5

Figure BB 9

Possibly the most useful reports are the Full and Pipe reports. The Full report will tell you the length of a pipe, its head difference and its velocity (as seen in Figure BB12) whereas the Pipe report will tell you the pressure in the pipe and elevation of the start and end point. Both reports will tell you the size of pipe and flow in the pipe.

Zone Name :	Zone no. 1			**Valve Description :**	3/4" (20mm) Electric Valve				
Zone Flow :	1.69	(m3/h)							
Zone Head (D/S) :	35.22	**(U/S) :**	36.71	**Valve Headloss:**	1.49	(m)			

Pipes

From X (m)	From Y (m)	To X (m)	To Y (m)	Size	Code	Flow1 (m3/h)	Flow2 (m3/h)	Max. Vel (m/s)	Length (m)	Headloss (m)
16.4	57.4	67.6	57.5	20.00	PV2	1.7	1.7	1.1	51.2	3.44

Outlets and Inflows

Location (x,y,z) (m)				Out Loss (m)	Flow (lph)	Pressure (m)	Min Pressure (m)	Max Pressure (m)
67.6	57.5	0.0	Outlet	0.0	1617.0	31.8	31.5	38.7
16.4	57.4	0.0	C.valve	0.0	-1694.2	35.2	0.0	0.0

Figure BB 10

16. Now open the *Reports|Mainline Design Reports|System Duty Report*. Here we see the system duty IRRICAD calculated for running the system you have designed (Figure BB13).

Water Supply : Supply no. 1

Duty Number	On time	Off time	Pressure (m)	Flow (m3/h)
1	1: 0: 0	1 : 1 : 0	37.65	1.69

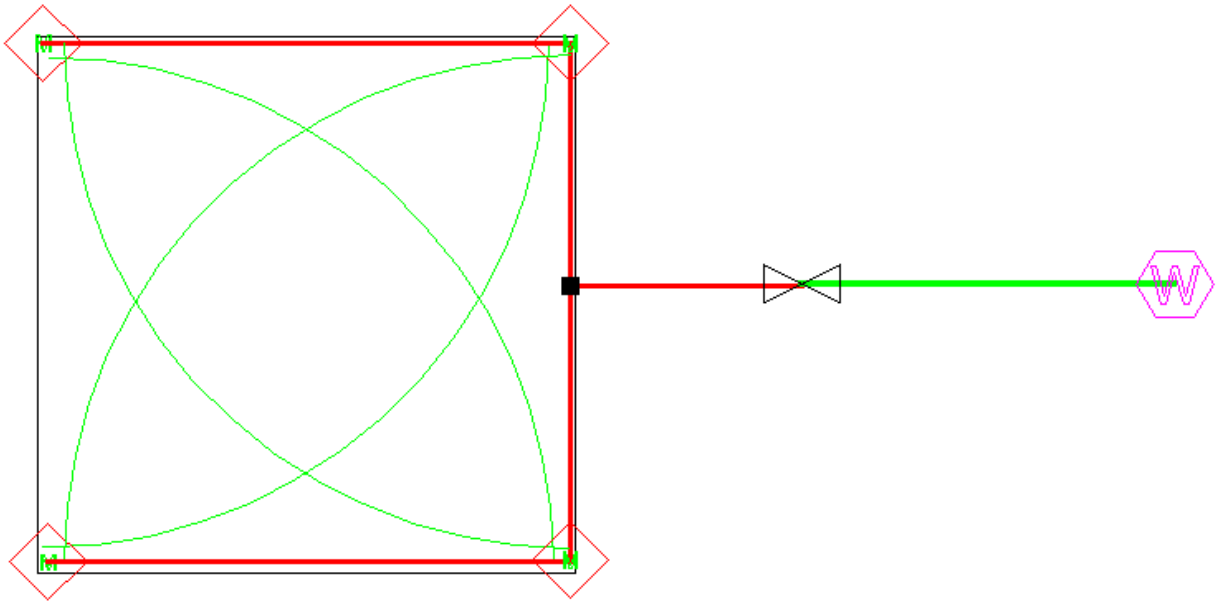
Figure BB 11

1.3.2 A SIMPLE TURF DESIGN

Tasks covered in this tutorial:

- Zone and mainline items
- Drawing simple background information
- Setting pipe line widths
- Drawing a simple turf system
- Setting required outlet pressures
- Selecting outlet connectors (risers)
- Resizing database symbols to suit design size
- Using the Change tool
- Orientating arcs manually
- Turning valves on
- Sizing pipes based on pressure
- Reading reports

This tutorial is to show a simple method for laying out several sprinklers and connecting them to the water supply. It is for demonstration purposes only and hence is of a small size.



1.3.2.1 GETTING STARTED

1. Double-click on the IRRICAD icon or select *Start|All Programs|IRRICAD Pro|IRRICAD 10* to start IRRICAD. If IRRICAD is already running select *File|New* to start a clean design.

2. Go to *Settings|Irrigation - Design Specific* and [Browse] for the **Tutorial.mdb** database. Highlight and select [Open].

3. On the same tab change the "Zone Pipes" line width to **2** and the "Mainline Pipes" line width to **3**.

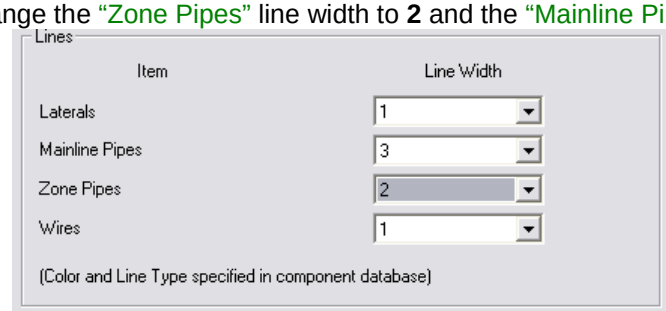


Figure ST 1

4. Go to the *Units* tab and click the [Metric] button to restore the default units for this tutorial. These settings can be retained for each design by clicking the [Save As Default] button.

In the previous tutorial we did not draw in any background information. This is not usual, since in most cases you need to have the area, fence lines etc laid out before you can draw in the hydraulic system. We will enter some basic background information in this design.

5. Select *Draw|Rectangle|2 Point* and place the first point on the screen by left-clicking. Move the cursor and click again to place the opposite corner of the rectangle (the second point).

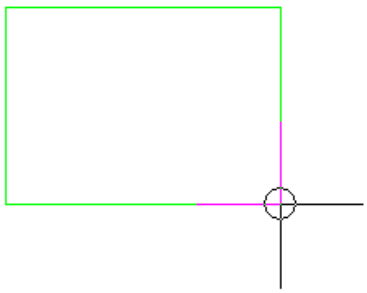


Figure ST 2

6. Select *Modify|Change* and click on the boundary of the rectangle. In the dialog change the "Width" and "Height" to **3.5m** as in Figure ST 3. Click [OK]. Select *View|Zoom All* then *View|Zoom Out.*

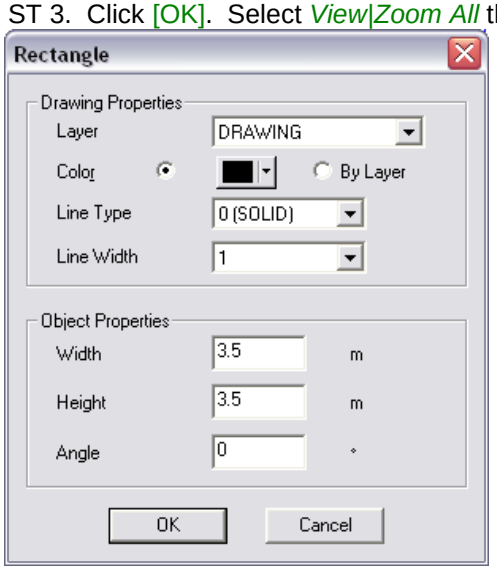


Figure ST 3

1.3.2.2 LAYING OUT THE SYSTEM

7. Select *Mainline|Water Supply* and place the water supply to the far right of the square, some distance away (left-click to place). In the dialog leave all the fields as **0**. Click [OK].

8. Select *Settings|Miscellaneous* and type in **0.5** for the "Base Database Symbol Size", make sure that "Update Database Symbols" is checked. Click [OK]. The hydraulic symbols on the screen will now appear smaller.

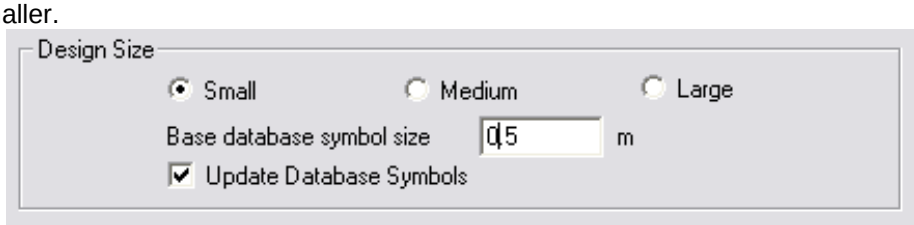


Figure ST 4

9. Select *Zone|Outlet*. In the dialog select the **Garden Spray Sprinkler** by clicking on the down arrow and highlighting the required item. The "Nozzle" field will show the **10 garden** Nozzle. Change the "Pressure" to **20m** and the arc to **90°**. In the "Riser" field select the **½" x ½" Flexible Swing Joint** (the riser determines how the sprinkler is connected to the pipe). Click [OK].

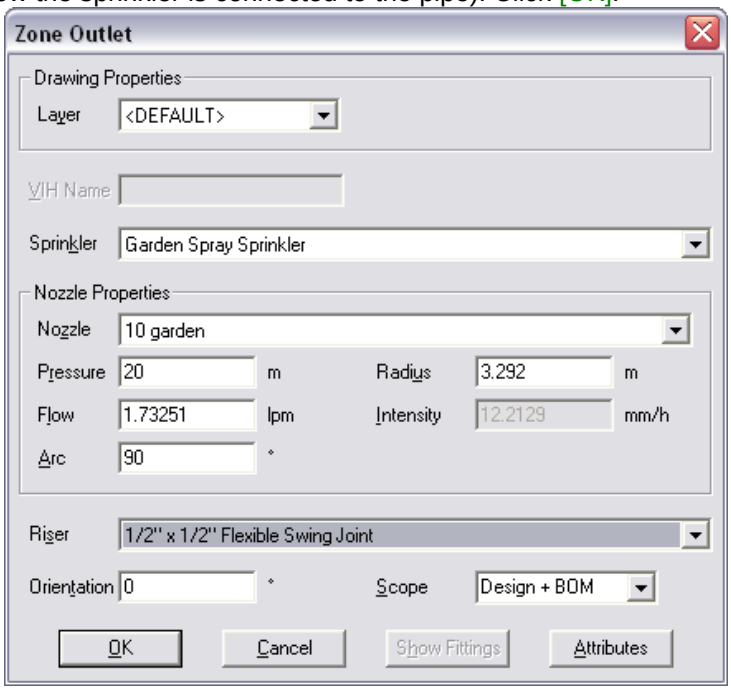


Figure ST 5

10. Place an outlet at each corner of the square by left-clicking.

11. You will notice that the arcs are not oriented to water inside the square. We will manually fix this by selecting *Modify|Change* and clicking on a wetted arc. In the dialog change the "Start Angle" to be **0**, **90**, **180** or **270** as required (bottom left = 0, top left = 270, top right = 180 and bottom right = 90) as in Figure ST 6. Click [OK]. Repeat for each arc.

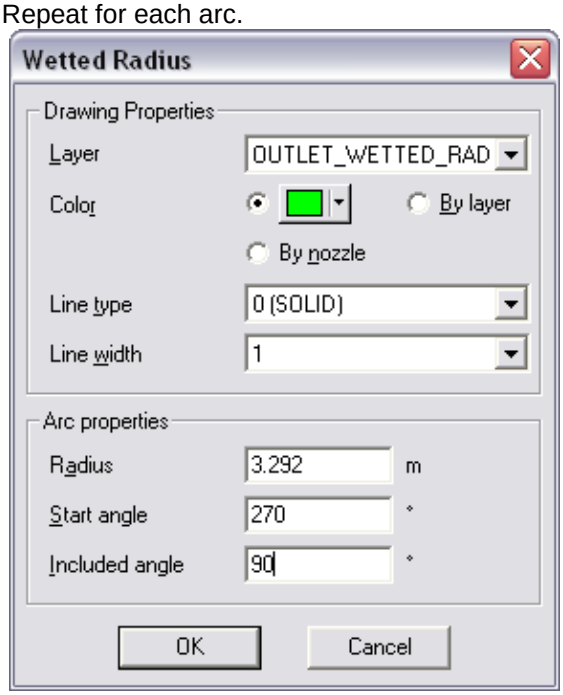


Figure ST 6

12. Connect the outlets by selecting the *Zone|Pipe* tool (**Computer Selected** pipe) and clicking on each item to connect to the pipe. Start at the top left outlet then the top right, then the bottom right and last the bottom left. *Right-Click|Restart*.

13. *Right-click|Snaps|Midpoint* and click on the pipe joining the top right sprinkler and the bottom right sprinkler. Draw this pipe out a little to the right about half way towards the water supply. Left-click to place the end point of this pipe then *Right-Click|Restart.*

14. Select *Zone|Control Valve* and select the **1" (25mm) Electric Valve**. Place the valve on the zone pipe end.

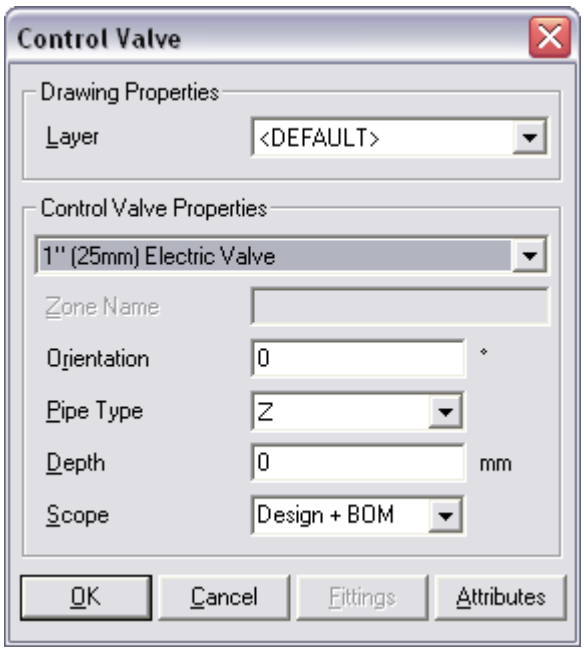


Figure ST 7

15. Select *Mainline|Pipe* and left-click on the valve, then left-click on the water supply. *Right-Click|Restart*. See Figure ST 8.

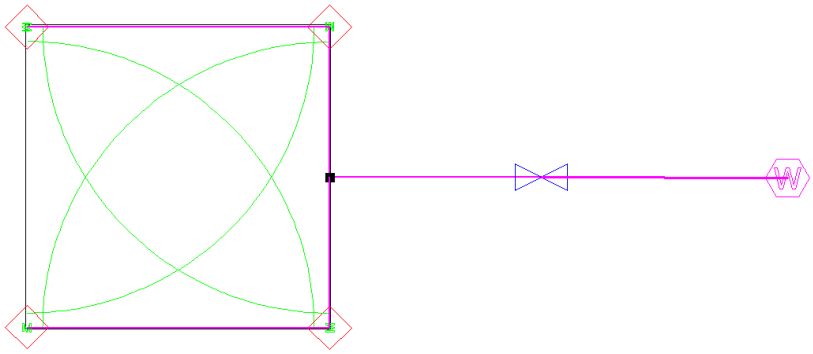


Figure ST 8

1.3.2.3 CHECKING CONNECTIONS

16. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design|Clear Connectivity Marks.*

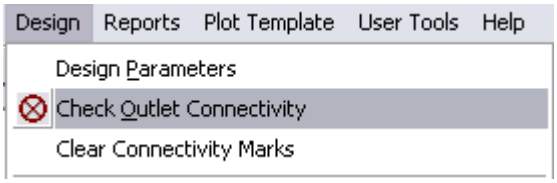


Figure ST 9

If any outlets or control valves are marked as unconnected , check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View|Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet

(*Modify|Select Object* and click on the item) and move the item to the centre of the junction (*Modify|Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check the "Default Snap Mode" in *Settings|Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

1.3.2.4 ZONE DESIGN

Now we can design the zone by sizing the pipes.

17. Select *Design|Zone Design|LP Design*. You should see the pipe change colour. The colour for pipes is stored in the database. If the pipe selected has the same colour as the "Computer Selected" pipe you will not see a colour change.

IRRICAD also checks the flow through the valve is within the manufacturers' specification for that valve.

1.3.2.5 ENTERING MANAGEMENT REQUIREMENTS

Once again IRRICAD needs to know how the system will be operated. We call this Management and there are several ways to accomplish this task. Management gives us the ability to specify when control valves are on and off.

18. In our simple example there is only one valve so the simplest option is to select *Design|Assign All Zones to One System Flow*. This option is automatic, IRRICAD assigns "Zone no. 1" to operate on **System Flow 1**. Click [OK].

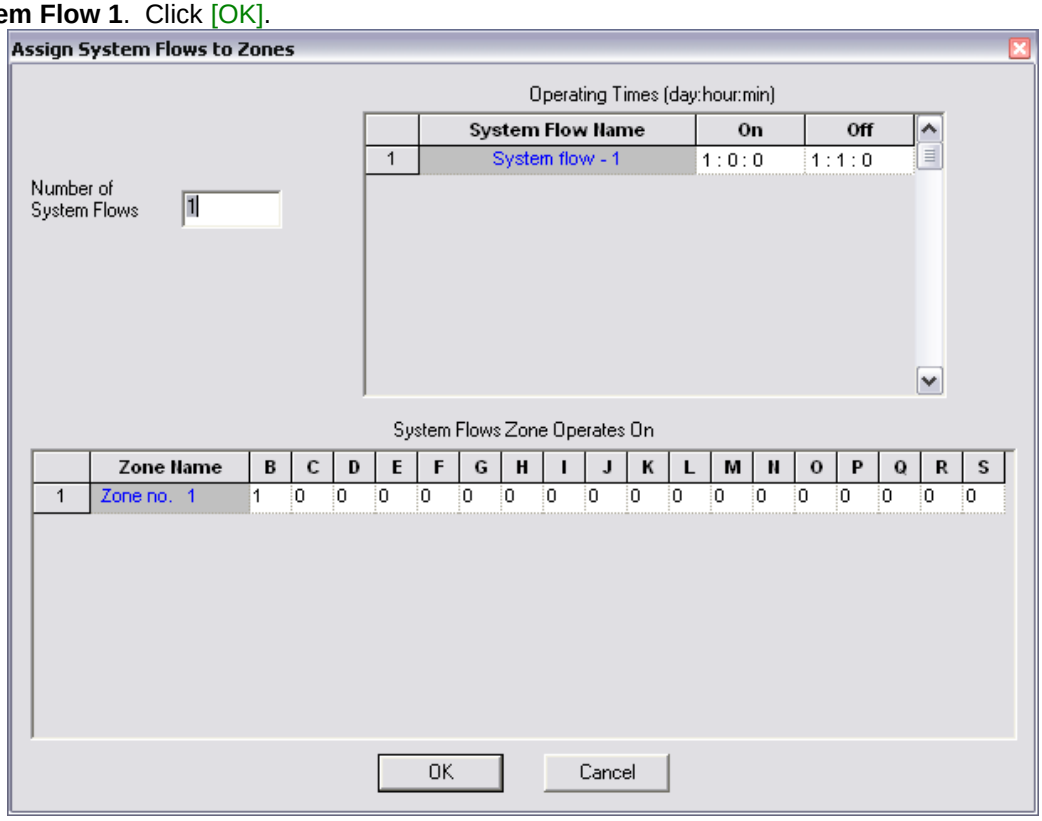


Figure ST 10

1.3.2.6 MAINLINE DESIGN

We can now design the mainline.

19. Select *Design|Mainline Design|LP Design*. You should see the pipe change colour. Again the colour for pipes is stored in the database.

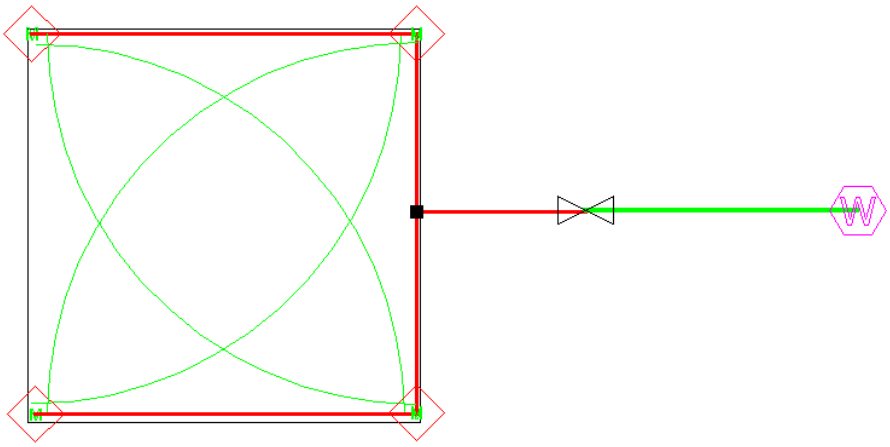


Figure ST 11

1.3.2.7 REPORTING

20. Select *Reports|Zone Design Reports|Zone Design Summary*. This report summarises what is happening in the zone – from the outlets to the control valve as seen in Figure ST 12.

Zone Name :	Zone no. 1	**Valve Description :**	1" (25mm) Electric Valve
Zone Head (D/S) :	19.53 **(m)**	**Zone Head (U/S) :**	20.04 **(m)**
Total Zone Flow :	0.42 **(m3/h)**	**Valve Headloss :**	0.51 **(m)**

	Allowable Flow (lph)	Actual Flow (lph)	Allowable Pressure (m)	Actual Pressure (m)
Minimum Outlet	98.75	99.55	18.73	18.93
Maximum Outlet	109.15	99.56	21.28	18.93
Outlet Variation (%)	9.52	0.01	11.99	0.01

Oulet Locations (X,Y)	Minimum :	8.7 , 63.7	Maximum :	12.2 , 63.7

Figure ST 12

The total zone flow is reported. The minimum and maximum allowable outlet pressures are calculated based on the pressure entered in the Outlet dialog and the flow tolerance specified for the Garden Spray Sprinkler in the database. This tolerance allows a pressure variation of 12.8%. The actual outlet pressure variation in this system is 0%. IRRICAD calculates the required valve pressure (downstream from the valve) and the resulting minimum and maximum outlet pressures in the zone.

1.3.3 PLACEMENT AIDS AND TIPS

The following placement aids are provided to simplify and speed up some tasks:

- Circular Cursor: *Settings|Drawing Items* – "Circular Cursor"
- Direct Entry: Keyboard
- Connecting Hydraulic Items: *Settings|Snap*
- Place vs Connect: *Settings|Snap*
- Grid: *Settings|Grid*
- Snap to Grid: *Settings|Snap*
- Ortho Mode: *Settings|Drawing Items* – "Ortho"
- Snaps: *Right-click|Snaps*
- Running Snaps: *Settings|Snap.*

1.3.3.1 CIRCULAR CURSOR

The circular cursor is a tool that can be used to position items a particular distance from an existing item. A radius is specified, at the required distance, and the cursor is used as a visual locator to place the next item.

This tool can be used for all geometric and hydraulic tools.

An example of the use of this tool would be drawing in a block of tapes a set distance from the fence line.

1.3.3.2 DIRECT ENTRY

Distances, angles and co-ordinates can be entered directly by using the keyboard. As the characters are typed they are displayed on the left-hand side of the status bar. Pressing the <Enter> key executes the command.

A single number is always a length; angles require a length first, and co-ordinates are two numbers divided by a comma. E.g.:

Length	34	<Enter>
Length & angle	34,<90	<Enter>
Co-ordinates	0,0	<Enter>

This feature can be used for all geometric objects.

1.3.3.3 CONNECTING HYDRAULIC ITEMS

During the management, design, analysis, and fittings selection processes IRRICAD needs to "know" how hydraulic items in the system are connected to each other and subsequently back to control valves or Water supplies. This list of connections is referred to as the "Connectivity" and gives rise to a number of rules and mechanisms that help ensure the correct arrangement of a system.

Pipes, spraylines, and tapes must always directly connect to a point hydraulic item and not another pipe, sprayline or tape. In the cases where a water supply, control valve, outlet or miscellaneous hydraulic item is not present the connection is denoted by a "Junction", which is typically displayed as a black square symbol. For example, when a pipe line changes direction a junction will exist between the two pipes. Free ends of pipes, spraylines, and tapes are also required to connect to a junction or a point hydraulic item. Junctions are normally inserted automatically by the IRRICAD tools and simply serve as internal nodes for the design process, placeholders for fittings selection, and a location to display information.

Some consequences of this system are:-

- Junctions cannot be deleted individually unless unattached. They will be removed automatically when all connected items are removed.
- Junctions will be removed when point hydraulic objects are connected to them.
- When a point hydraulic item is deleted from a pipe, sprayline, or tape it will be replaced by a junction.

Hydraulic items can only connect to items of the same class (Zone or Mainline). The exception is Control Valves which may connect to both Zone and Mainline pipes.

To assist the user and ensure the correct connectivity the hydraulic entity creation tools, by default, employ a visually based "connect mode" (snap). This method uses a user-defined (in *Settings*|*Snap*) screen distance to determine how connections are made to items near the point clicked. If the screen distance (i.e. in screen millimeters or inches) between the point clicked, and the nearest hydraulic item, is less that the setting a connection will be made. Additionally clicking on a pipe, sprayline or tape, within the setting distance from the end of the item, will result in the connection being made at the end exactly.

Using this method helps to avoid unwanted small pieces of pipe being created beyond connections and situations where pipes are not quite connected to items that they were intended to be. Note that zooming in before clicking will allow closer (in real terms) connections to be made.

1.3.3.4 Grid / Snap to Grid

A grid can be set up to be any spacing desired along the X and Y-axis. Enter a value for the spacing along the "X"-axis (horizontal) and the "Y"-axis (vertical). Check the "Display Grid Points" if you wish to see the grid points on the screen. If you have an existing item on the screen and you wish grid points to be positioned on this item (or corner of the item) enter the co-ordinates of the item (or corner) into the X and Y fields for "Grid Origin".

Snap to Grid

Once a grid has been established you have the option to use *Settings*|*Snap* "Snap to Grid". Once "Snap to Grid" is enabled, the cursor is restricted to only moving between grid points.

This is a very useful tool for drawing straight pipelines, positioning sprinklers at a specific spacing (without using the Sprayline tool) and for positioning and drawing geometric objects.

1.3.3.5 Ortho Mode

Ortho Mode aligns each new point horizontally or vertically with the previous point placed for geometric items and pipes. The angle of alignment can be changed from horizontal and vertical to any specified angle with the *Settings*|*Drawing Items* "Ortho Angle" setting.

Ortho mode works for both geometric and hydraulic items.

Holding the <Ctrl> key down when in Ortho Mode will disengage Ortho Mode. Holding the <Ctrl> key down when not in Ortho Mode will engage Ortho Mode using the angle set in the "Ortho Angle" dialog field..

1.3.3.6 Snaps and Running Snaps

Snaps give you the ability to place or constrain points in relationship to other objects in your drawing. When you use a Snap command while locating a point, the point snaps into position.

Snap tools that are used frequently can be set as running snaps so that they don't have to be selected repeatedly. Running snaps remain activated until turned off in the "Running Snaps" dialog. If the "Show Preview" option is selected, then when the cursor moves within range of a point for which a running snap is set, an icon for that snap is displayed beside the cursor. Running Snaps is now available for drawing and hydraulic items. Go to *Settings*|*Snap* and click the [Running Snaps] button. You can select any or all to be on. Remember to check the "RN Snaps On" check box.

Select the *Right-click*|*Snap* tool before placing first or subsequent points in a tool if Running Snaps are not on. The *Right-click*|*Snap* tool is only active for the next mouse click. For placing an item or point in the centre of an existing closed object, use *Right-click*|*Snap*|*Center*.

When drawing hydraulic items on the screen (including Contours and Spot Heights), the *Right-click*|*Snap*|*Place* tool is the same as setting the "Default Snap Mode" to "Place" (rather than "Connect") but is only active for the next mouse click. Very useful if placing hydraulic items close the existing hydraulic items and not wishing them to connect.

The Snap tools work in much the same way as Connect does. IRRICAD uses a tolerance range. If an item is within this range then IRRICAD assumes you wish to snap / connect to this item. The tolerance range is determined by zoom factor, distance on the screen and world distance.

Try the above tools to see how they work.

Notes

1.3.4 METHODS TO LAY OUT SPRINKLERS

These tutorials illustrate the different methods available to lay out sprinklers. There are three main methods:-

- Placing sprinklers individually (as shown in the previous tutorial)
- Placing sprinklers at a fixed or even spacing along a pipe length
- Automatically placing sprinklers in irregular areas

Before we look at these different methods it is useful to note that you do not need to orientate the arcs, of part circle sprinklers, manually. The previous tutorial detailed the manual method since there were few sprinklers and the required orientation was easy to determine. The *Area* tool (short for Irrigation Area) is used to automatically orientate arcs. This tool will be explained when we look at the different ways to layout sprinklers.

1.3.4.1 GETTING STARTED

1. Double-click on the IRRICAD icon or select *Start|All Programs|IRRICAD|IRRICAD Pro 14* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.

2. Go to *Settings|Irrigation - Design Specific* and [Browse] for the **Tutorial.mdb** database. Highlight and select [Open].

3. Change the "Zone Pipes" line width to **2** and the "Mainline Pipes" line width to **3**.

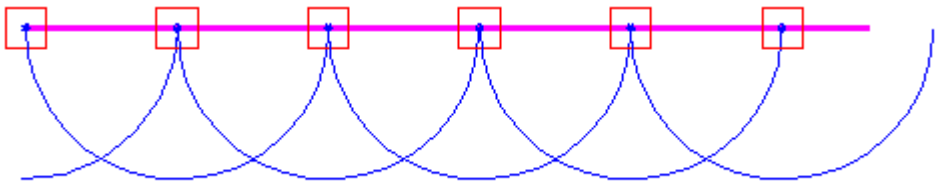
4. Go to the *Units* tab and click the [Metric] button to restore the default units for this tutorial.

These settings can be retained for each design by clicking the [Save As Default] button.

1.3.4.2 PLACING SPRINKLERS AT A FIXED SPACING

Tasks covered in this tutorial:

- Drawing simple background information
- Orientating arcs automatically
- Adding pipe and fixed spaced sprinklers in one action
- Snapping to a point



This method allows pipe and sprinklers, at a fixed spacing, to be placed in one action.

5. Draw a rectangle **25 x 15m** on the screen using *Draw|Rectangle|2 Point*. You can draw out the rectangle any size and then select *Modify|Change* and click on the border of the rectangle. Change the "Width" to be **25m** and "Height" to be **15m**.

6. Select *Mainline|Water Supply* and place the water supply to the right of the rectangle. Leave all fields set to **0**. Click [OK]. Select *View|Zoom All*.

7. Click on the rectangle edge and then select *Zone|Area* to convert the existing polygon to an irrigation Area. Click [OK] on the message to convert the selected item to an Area. In the dialog make sure the "Set Arc Orientation Using Area" check box is checked. See Figure M1.

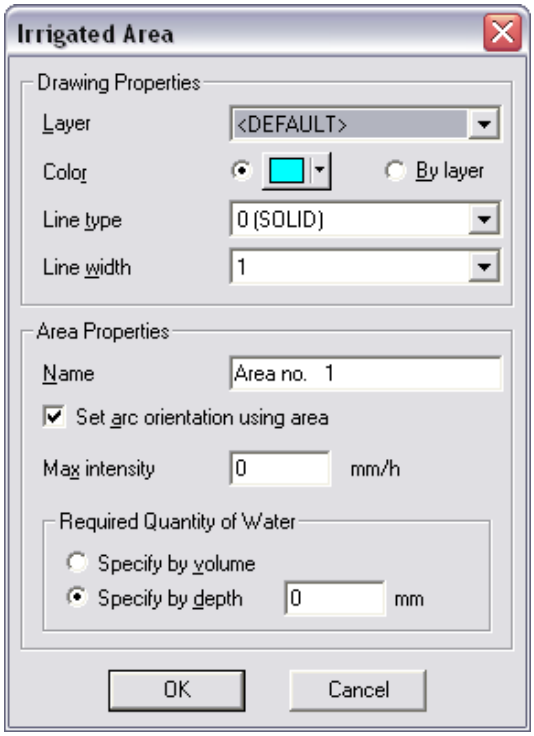


Figure M 1

8. Select *Zone*|*Sprayline* and leave the pipe as "Computer Selected".

9. Select the **Low Flow Garden Sprinkler** as the sprinkler. This sprinkler has only one nozzle (**Low Flow Nozzle**) which will automatically appear in the "Nozzle" field. Leave the "Pressure" as the default pressure of **21m**. Leave the "Riser" field as **No Component Selected** and enter **4.5m** as the "Outlet Spacing" (for head-to-head spacing).

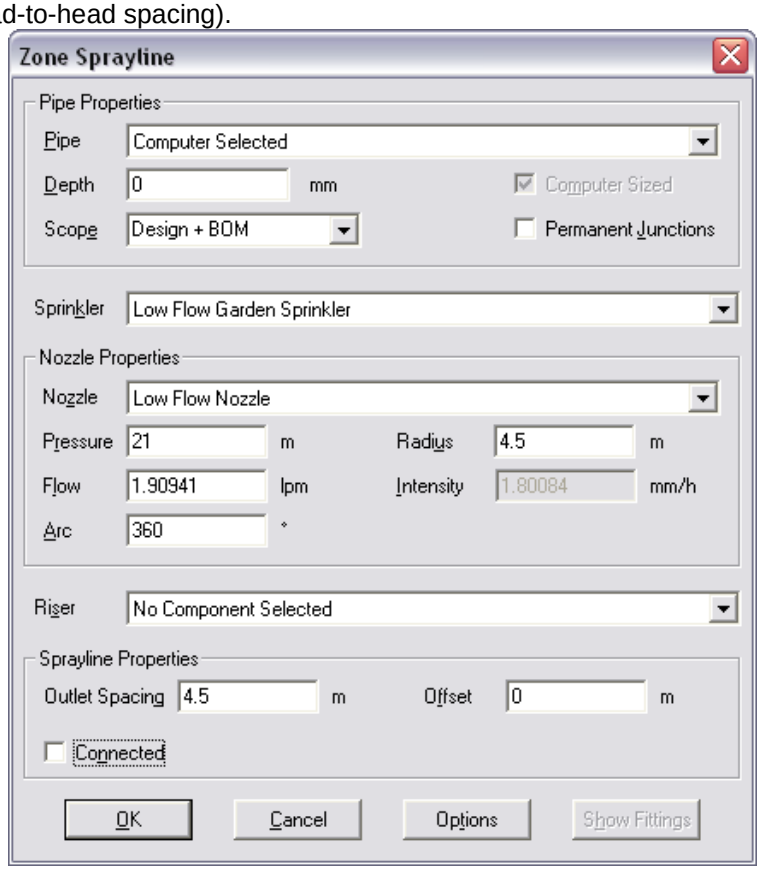


Figure M 2

10. Uncheck the "Connected" check box, as we want these items to be treated as separate outlets and pipes. Click [OK].

11. *Right-click*|*Snaps*|*Endpoint* and click on the top left corner of the rectangle. *Right-click*|*Snaps*|*Endpoint* again and click on the top right corner of the rectangle. *Right-Click*|*Restart*. A line of pipe has been drawn with the sprinklers at fixed spacing. Starting from the left-hand side, draw another line so that the pipe will touch the extents of the wetted radii from the previous line of outlets as in Figure M3.

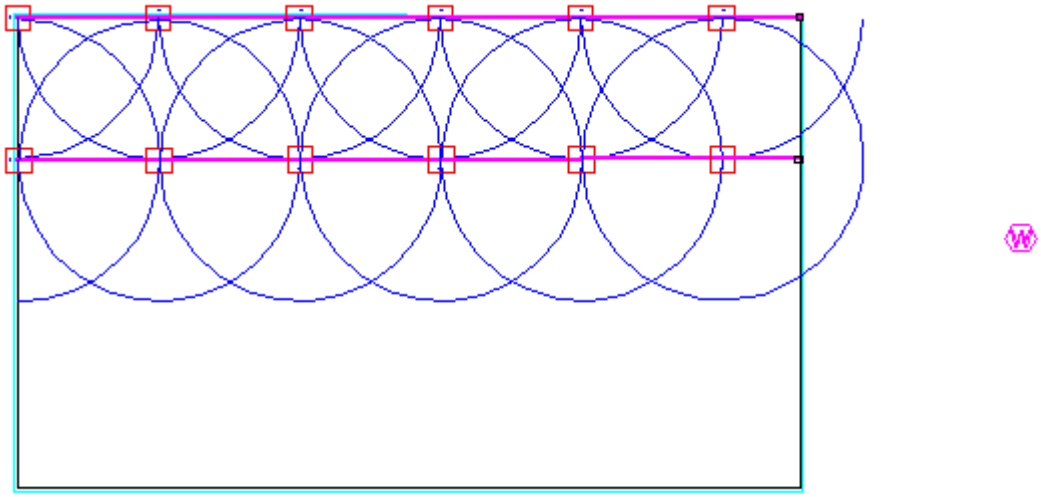
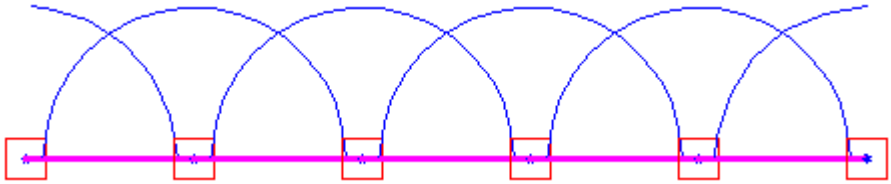


Figure M 3

1.3.4.3 Even Spacing Along a Pipe Length

Tasks covered in this tutorial:

- Drawing simple background information
- Orientating arcs automatically
- Adding pipe and evenly spaced sprinklers in one action
- Snapping to a point



This method is similar to above but uses the length of the sprayline drawn (i.e. the length of pipe) and places sprinklers at the start and end of the line. Sprinklers, at approximately the spacing you have specified, are then placed evenly between the start and the end.

12. Do the above tutorial (Placing Sprinklers at a Fixed Spacing).

13. Now select *Zone*|*Sprayline*. This tool should remember the sprinkler, nozzle, pressure and outlet spacing from before. Click the [Options] button and uncheck the "Fixed Spacing" check box. Click [OK] on both dialogs.

14. *Right-click*|*Snaps*|*Endpoint* and click on the bottom left corner of the rectangle. *Right-click*|*Snaps*|*Endpoint* again and click on the bottom right corner of the rectangle. *Right-Click*|*Restart*.

15. A line of pipe has been drawn with the sprinklers at fixed spacing. Starting from the left-hand side, draw another line so that the pipe will touch the extents of the wetted radii from the previous line of outlets as in Figure M4.

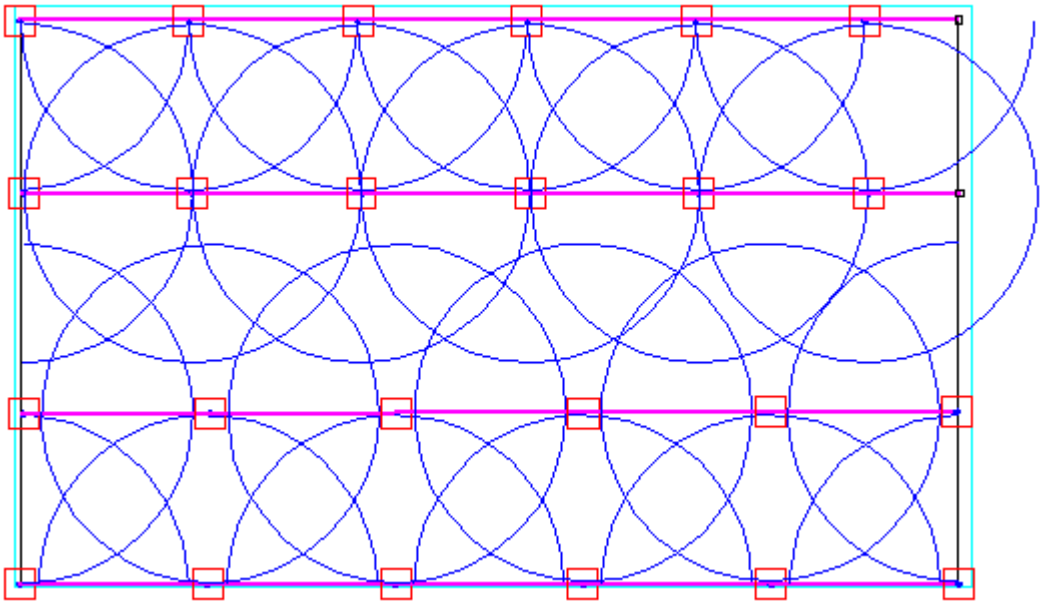


Figure M 4

IRRICAD determines that the sprinklers should only water within the *Area* lasso, which is just outside the rectangle boundary. The appropriate arc will be selected in most cases, depending on placement of the sprinkler. Any arcs outside the *Area* can be altered by using *Modify|Change*. Click on the wetted radii and adjust the "Include Angle" as described in the above tutorial (A Simple Turf Design).

16. Connect the spraylines together with zone pipe on the right-hand end of the laterals. Select a **1" (25mm) valve** and connect the valve to the zone pipe end.

17. Select *Mainline|Pipe* and connect the valve to the water supply to complete the system. See Figure M5.

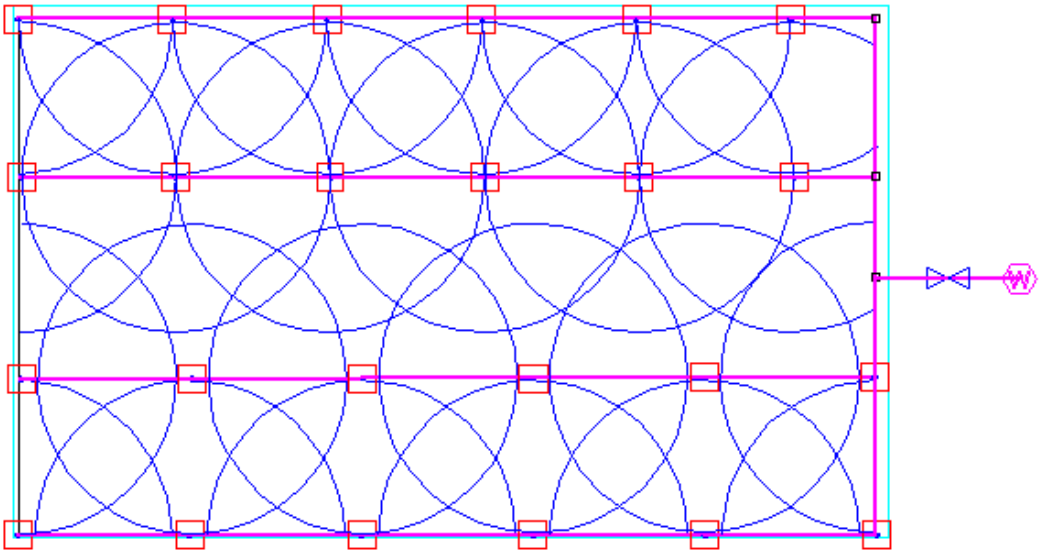


Figure M 5

18. Follow the same design procedure as in the previous tutorials.

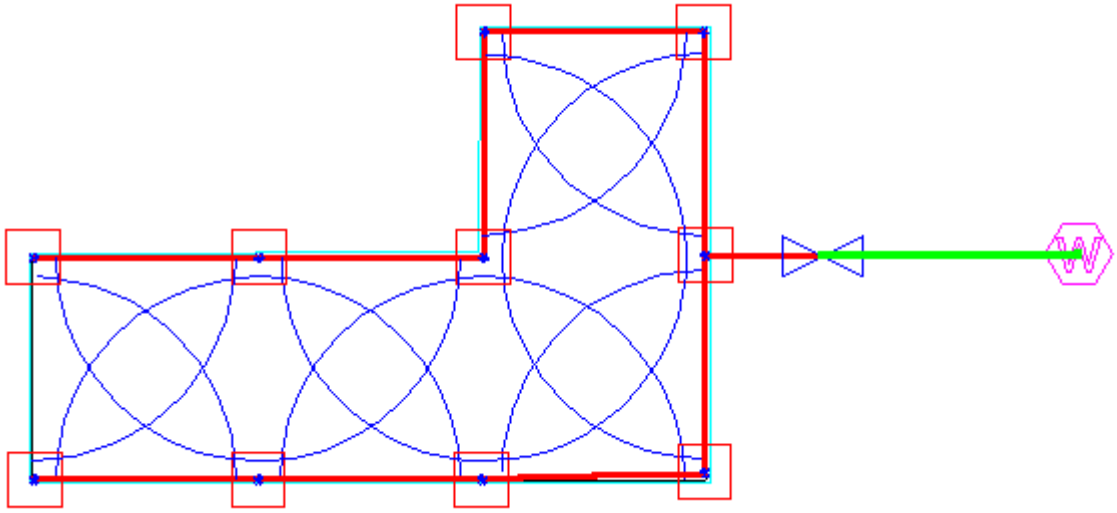
19. Select *Reports|Show Zone Pressure Limits* to label the outlet with the minimum pressure and the the outlet with the maximum pressure.

The sprayline tool can be used to place sprinklers evenly and the pipes subsequently deleted when the pipes need to be connected in a different way. This tool can also be used without the *Area* tool, without having the arcs or wetted radii showing, without using *Snaps* and can be used in any application where even spacing or fixed spacing of outlets is required. It can be used in conjunction with *Grid*, "Snap to Grid" or "Circular Cursor" as placement aids.

1.3.4.4 AUTOMATICALLY PLACING SPRINKLERS IN IRREGULAR AREAS

Tasks covered in this tutorial:

- Drawing simple background information
- Orientating arcs automatically
- Automatically determining spacing and arcs in an area
- Moving an item
- Connecting pipe to more than one item quickly



The third method used for placing sprinklers is a tool called *Autohead*. Note that *Autohead* is normally used for small irregular areas.

Autohead attempts to maintain a uniform precipitation over the area. Because of this, best results are achieved when matched precipitation sprinklers or fixed sprinklers with a combination of nozzles for the different arcs that are used. *Zone|Area* is used alongside *Autohead* to orientate the wetted arcs.

20. Set Ortho mode on by going to *Settings|Drawing Items* and enable "Ortho Mode" at **0°**.

21 Select *Draw|Polygon|Irregular*. Place the first point in the lower left of the screen. Move the cursor towards the right and type **15** on the keyboard and press <Enter>. Move the cursor upwards and type **10** and press <Enter> on the keyboard. Using this method continue to draw another line towards the left for **5m**, downwards for **5m**, towards the left for **10m**. Now select *Right-click|Done* to finish the polygon.

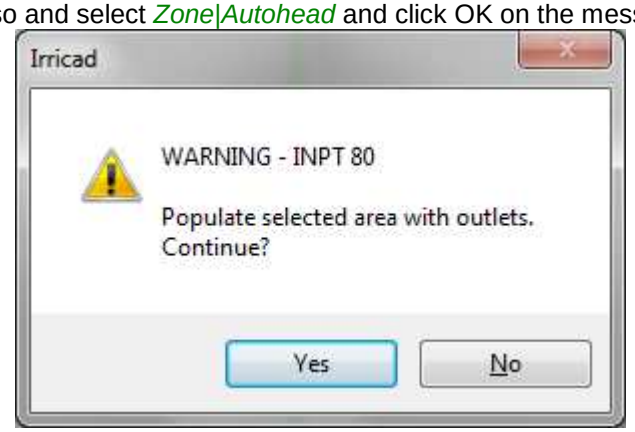
21. Select *View|Zoom All*.

22. Click on the rectangle edge and then select *Zone|Area* to convert the existing polygon to an irrigation Area. Click [OK] on the message to convert the selected item to an Area. In the dialog make sure that "Set Arc Orientation Using Area" is checked. It should look something like Figure M 6. Select *View|Zoom Out*.

Figure M 6

23. Select *Mainline|Water Supply* and place the water supply to the right of the polygon. Leave all fields in the dialog as **0**. Click [OK].

24. Highlight the Area lasso and select *Zone|Autohead* and click OK on the message:



In the dialog set the "Sprinkler" as the **Low Flow Garden Sprinkler**. This sprinkler has only one nozzle (**Low Flow Nozzle**) which will automatically appear in the "Nozzle" field. Leave the "Pressure" as the default pressure of **21m**. Leave the "Riser" field as **No Component Selected**. Click [OK]. See Figure M 7.

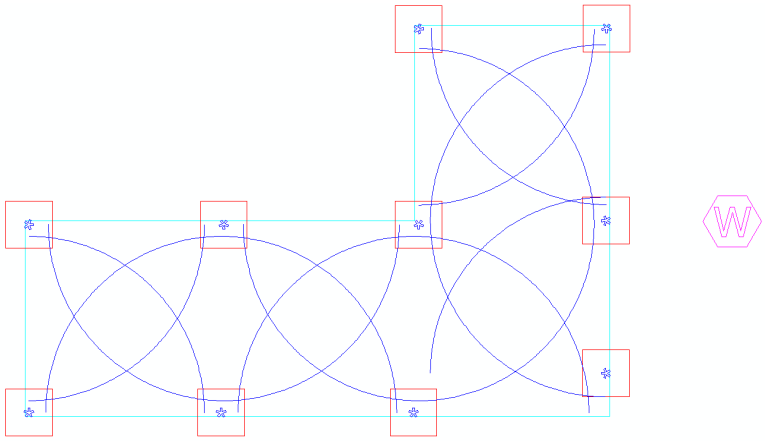


Figure M 7

25. Select *Modify|Move* and click on the bottom right sprinkler. To move the sprinkler click to place it in its new position in the bottom right corner.

26. Select *Zone|Cut Pipe*. This tool is similar to *Zone|Pipe* and is a tool to put in a straight pipe with quick connections to each zone item the pipe crosses without having to click on each item to connect to it. Click on the top far left sprinkler. Now click on the sprinkler where the area goes upward. Click on the top left sprinkler then the top right sprinkler. Now click on the bottom right sprinkler and then the far-left sprinkler. *Right-Click|Restart*. Your design should look like Figure M8.

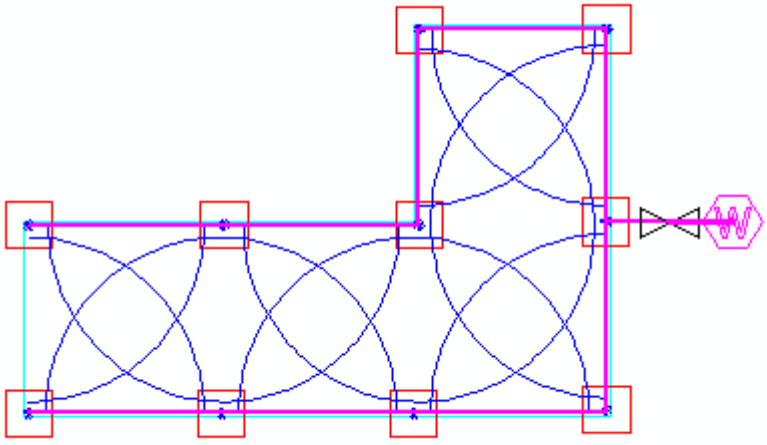


Figure M 8

27. Follow the same design procedure as in the previous tutorials.

28. Save your design as **Lawn.dez**.

1.3.5 APPLYING A SPECIFIC AMOUNT OF WATER TO AN AREA

Tasks covered in this tutorial:

- Changing an item
- Using Irrigation Areas
- Determining run times
- Determining water application

In many cases a specific amount of water is required to be applied to the crop or landscape. This may differ depending on the type of plants or soil, and whether the location is lawn, garden, shady or sunny.

Previously we have used the Irrigation Area tool (*Zone|Area*) to simply orientate wetted radii within a boundary. This same tool allows us to specify the amount of water we wish to apply and subsequently calculate the run time. The Area tool has two purposes that are unrelated. You do not need to have arcs to use the Area tool for water requirements.

An *Area* lasso can be drawn around an entire section which has the same water requirements even if there are different sprinklers or several zones (control valves) in this section.

1. If you have not completed the above tutorial (Automatically Placing Sprinklers in Irregular Areas) do so now. If you have, open the saved design.

2. Double-click on the *Area* lasso (double-clicking does the same as *Modify|Change*). The *Area* dialog will appear. See Figure A1.

1.3.5.1 THE AREA DIALOG

3. The maximum intensity can be specified in mm/hr. This is the maximum amount of water per hour that can be applied to that area or soil type. Enter **5** as the "Maximum Allowable Intensity".

4. The required quantity of water to be applied can be expressed by volume (US gallons or litres) or depth (inches or mm). Select "Depth" and enter **2mm**. See Figure A 1. Click [OK].

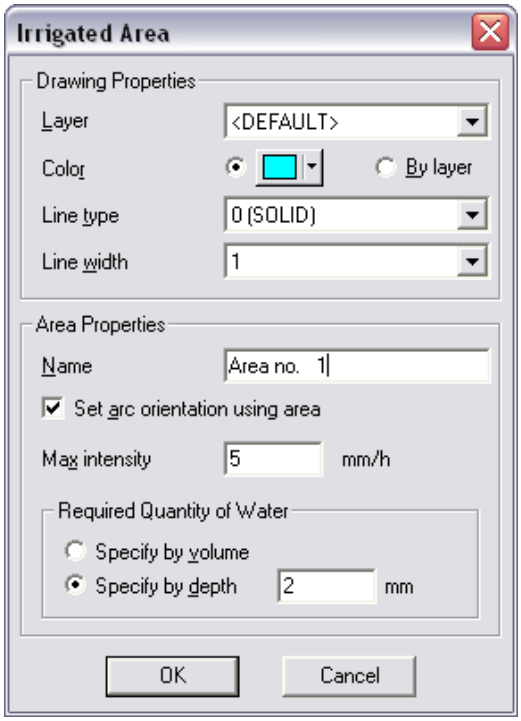


Figure A 1

1.3.5.2 CALCULATING ZONE RUN TIMES

When Areas are used you can still use the default running time of 1 hour in *Design|Assign System Flows* options (Management). After management has been completed the Zone Flows Report

(*Reports|Management Reports|Zone Flow Report*) will specify the time we need to run the zone in order to achieve the required depth or volume entered in the *Area* dialog.

5. Open *Reports|Management Reports|Zone Flow Report*. This report has 26 minutes as the required running time.

The *Zone Flow Report* will report the run time and the applied precipitation to the area per zone. The *Water Requirements* report will list the applied volumes and depths based on the current run time (which is 1 hour). See Figures A2 (*Zone Flows Report*) and A3 (*Water Requirements* report).

Cycle Time is 1 day Times are per cycle

Zone Name	Number of Outlets	Flow (m3/h)	Operating Time dd:hh:mm	Precipitation Rate (mm/h)	Max. Precipitation Rate (mm/h)
Zone no. 1	10	0.458	0: 0: 26	4.58	5.00

Figure A 2

Zone/Area Name	Flow (m3/h)	Area (Ha)	Depth Applied (mm)	Depth Required (mm)	Vol. Applied (l)	Vol. Required (l)
Zone no. 1	0.458	0.01	4.5826	2.00	458.26	200.00
Area no. 1	0.458	0.01	4.5826	2.00	458.26	200.00

Figure A 3

You can set the run time in *Design|Other Management Options|Assign System Flows to Zones* to be that which is reported in the *Zone Flows Report* (26 minutes). Open the *Water Requirements* report with the updated run time of 26 minutes.

6. Complete Mainline Design.

1.3.6 IMPORTING OTHER FILE TYPES

Files from other CAD programs can be imported into IRRICAD. File formats supported are:

- .vcd Visual CADD files – Use *File|Import*
- .dxf DXF files – Use *File|Import*
- .dwg Autocad drawing files – Use *File|Import*
- .gcd Generic CADD files – Use *File|Import*
- .shp ESRI maps – Use *File|Import*
- .mif Mapinfo maps – Use *File|Import*
- .jpg JPEG files – Use *File|Import Image*
- .bmp Bitmap files – Use *File|Import Image*
- .tif TIFF files – Use *File|Import Image*
- .wmf Windows metafile – Use *File|Import Image*
- .emf Windows metafile – Use *File|Import Image*
- .amp Windows metafile – Use *File|Import Image*
- .pcx Paintbrush – Use *File|Import Image*
- .png PNG – Use *File|Import Image*

Elevations can be imported into IRRICAD as contours and spot heights from a dxf file only. The dxf file must contain 3-D polylines or point objects that have a Z vertex. Any layer imported as an Elevation layer (*File|Import Contours*) will automatically be placed on the ELEVATIONS layer.

1.3.6.1 ELEVATIONS

TIPS FOR IMPORTING ELEVATION INFORMATION

Tip #1: Sometimes when importing elevations, it is not clear which layer(s) to select. To find the name of the layer(s) containing elevations, import the complete drawing using *File|Import*. By using *Change* or *Object Info*, on items which look like they could be contours or spot heights, view the layer name. You now know which layer(s) to import using *File|Import Contours*.

Tip #2: To avoid a double-up of points or lines beneath the spot heights or contours turn off or delete the imported layers, which you determined are the layers containing the elevation information, prior to actioning *File|Import Contours*.

Tip #3: When required to select the relevant elevation layer(s) in the *Import Contours* dialog, you can highlight more than one by holding down the Ctrl key. In this way more than one layer can be selected before clicking OK.

Tip #4: If you are running Pro Version 9 through to Pro Version 10.5 IRRICAD can only handle 32,750 contour segments and spot heights. You can reduce the number of segments by enabling the "Simplify Contours" check box in *Settings|Irrigation Items*. Start a new design and re-import the elevation layers. If the message still occurs, increase the "Contour Simplification Tolerance" and re-import into a new design. Note simplification only works on polylines. If you have IRRICAD Pro Version 11, IRRICAD no longer has a limit for the number of contour segments or spot heights (using the default ABOS method).

TIPS FOR CHECKING ELEVATION DATA

To help you locate any errors in imported elevation data here are some quick tips:

1. You can use *Delete Type* to delete erroneous contours or spot heights. If you have elevations at zero (where this is in correct) or at the Irricad 'no elevation' value of -3280000ft (-1000000m), simply use *Select All*, then action *Delete Type* and click on a 'bad' contour or spot height. Match on "Height" and all contours or spot heights with the same height will be deleted (Note this must be done separately for contours and spot heights).

2. A great way to check for errors in the imported elevation data is by using *Tools|Highlight Elevations*, where IRRICAD will colour code the highest through to the lowest elevations. This will show up any obvious errors in the data.

3. The *3D DEM View* found in the *Reports* menu will also show up even small errors in the imported elevation data.

4. Running *Design|Calculate Elevation Errors* will show the maximum error between the elevation inputs and the surface of the calculated DEM (see below). If the error is significant, click on the coordinate link to take you to that location. This method typically shows up inconsistencies in the elevation data, such as crossed contours or doubled spot heights. These problems can be fixed by deleting the erroneous data point(s). You may repeat this until the maximum error reported is acceptable, or check *Reports|View Errors* to see a list of the ten largest elevation errors.

LARGE CO-ORDINATES IN YOUR DESIGN?

For those of you who work with a lot of imported drawings this tip will make navigating around, and manipulating, these types of designs much easier.

Many imported drawings use a world coordinate system, typically UTM, to accurately reference the location to a particular part of the world. The resulting X and Y coordinates are often very long and therefore difficult to read both onscreen and in reports. Additionally they may also exceed the formatting limits in some parts of Irricad and not be displayed.

Setting a "User Origin", in *Settings|Grid/Origin*, simply displays all X and Y values relative to the specified origin point. For example let's say you have a design containing objects having coordinates ranging from 20000 to 20500 in X and 10000 to 10300 in Y. After setting a user origin of 20000,10000 all coordinates displayed would now range between 0 and 500 in X and 0 and 300 in Y.

An easy method to set a user origin is:-

1. Place a point, using *Draw|Point*, at the lower left corner of the extents of the drawing. The exact position isn't important.

2. Bring up the *Object Info* dialog for the point (select the point then "Object Info" on the Right Click menu).

3. Now select the coordinates by dragging your mouse and highlighting them, make sure you don't highlight "P1".
   Copy the coordinates (Ctrl +C or click the Copy button) and close *Object Info* dialog.

4. Go to *Settings|Grid/Origin* and Paste the coordinates into the "User Origin" edit fields by highlighting the "0" in the "X" field and pasting using Ctrl +V. The coordinates will automatically be inserted into the X and Y fields.

5. Tick the "Enable User Origin" check box and click [OK] on the dialog. Now the coordinates displayed on the screen, in reports and warning messages will now be much more manageable.

Notes:

The original world coordinates are still retained internally in IRRICAD. This means that when importing another drawing (with the same coordinate system) into the same design, or exporting the design, the world coordinates will be used.

You can toggle between the world coordinates and your user coordinates by using the "Enable User Origin" check box.

The coordinate "Copy and Paste" method, described in 3. and 4. above, may also be used to insert coordinates into the *Goto Coords* dialog. Note in versions older than Pro Version 10, each coordinate will need to be copied in to their box individually.
The exact position of the user origin can be set to a specific item on the plan e.g. end or corner of a fence line. In this way the coordinates on the design will reflect the distance from this item on the plan.

TRIM ELEVATIONS TOOL

Preparing a design often requires that elevation data is imported from an external file. In some cases (from some government websites for example) the data you obtain may cover a much larger area than what is required for your particular design.

The *Trim Elevations* tool enables contours to be trimmed to a specified polygon. Contours, and spot heights, may then be deleted within or outside the lasso.

Advantages of reducing the quantity of elevation data in this way are:-

- In IRRICAD Pro Version 10.5 and older there is a limit on the number of contour segments that can be processed. Decreasing the number of contour segments by trimming the elevations, so that they just span the hydraulic design area, will help to comply with this limit. Note that Pro Version 11, due for release shortly, can handle an unlimited number of contour segments.
- Decreasing the number of contour segments will increase the speed of redrawing, and interpolation of, elevation data.
- Increasing the accuracy and performance of the Digital Elevation Model (DEM). The DEM grid is calculated over the area spanned by the elevation data and therefore a larger area of contours requires a larger DEM grid size to maintain the same accuracy. The calculations for DEMs with large grid sizes can take some time.
- *Zoom All* will zoom only to the extents of your irrigation design area.

Trim Elevations is accessed from the *Tools* menu, instructions for its use may be found in the Tool and Command manual under *Help|Help Topics*.

UNDERSTANDING ELEVATION METHOD SETTINGS

When preparing a design many plans contain elevation data. Various settings in IRRICAD control how elevation data is interpolated and utilised during the design process. The following information will help to understand the effect and use of some of these settings.

Pro Version 11 introduced the ABOS method which is generally faster and better represents likely topography for non-uniform slopes and in situations where elevation data is sparse. Some points to note for this method are:-

Unlike the AEI method there is no limit on the number of contour segments or spot heights that can be processed.

Continuing to simplify contours, during *Import Contours*, is however desirable as this will improve both general graphical performance and the speed of interpolation.

If this method is used, it may be best to set the "Contour Simplification Tolerance" to a lower value (for example 0.2 m) to ensure that imported contours are reasonably smooth (*Settings*| *Irrigation Items* "Contours")

Using the ABOS method means that every elevation, used in a design, is calculated from the DEM grid.

If the "D.E.M. Grid Size" to set to **0** the grid size will be determined automatically so that a reasonable level of accuracy is maintained. Note that in some circumstances this may result in a large grid and consequently interpolation may be slow on low powered machines.

Some other useful tips are:-
ABOS or AEI methods can be selected in *Design|Design Parameter|Analysis Parameters* - "D.E.M. Options". The ABOS method is the default for all new designs.

Regardless of the elevation method used (ABOS or AEI), the grid spans the area covered by elevations. Therefore if the extents of the elevations are much greater than the hydraulic design, care should be taken that effective grid size is sufficient.

Trimming elevations to the extents of the hydraulic design will also increase accuracy as the grid will be finer over the smaller area.

The "Max Error" reported in the "Elevation Limits" dialog is a useful indication if the grid size is acceptable and/or there are some inconsistencies in the elevation data. The top 10 inconsistencies will be listed in the *View Errors* Report, if any of these errors are significant then the elevation data at the specified location should be checked. Some typical problems with elevation data include: contours crossing or very close together; spot heights inconsistent with neighboring contours or spot heights. If no elevation inconsistencies are found, increase the grid size and re-run.

1.3.6.2 IMPORTING

After importing a file such as a dxf or dwg, sometimes the drawing appears very small in one corner. Zoom into the imported drawing and using the *Select Window*, draw a window around the drawing. Now go to *Modify|Invert Selection*. The reason you see what you see is because the drawing also contains a point or object far away from the rest of the information. We have effectively now selected this object (which in some cases cannot be seen or selected via traditional methods). Now select *Delete* (accept [Yes] if asked) and now *Zoom All*. Your drawing should now fill the screen.

Notes

1.4.1 SIMPLE DRIP TAPE DESIGN

Tasks covered in this tutorial:

- Drawing a block of tapes
- Changing symbol size on the screen
- Connecting to multiple zone items quickly
- Snapping to the midpoint of an object

This tutorial shows the steps required for drawing and designing a drip tape irrigation scheme. Read the notes below and then proceed with the exercise. This exercise will run through a drip tape block with no pressure regulation within the block.

1.4.1.1 TAPES - AN OVERVIEW

A drip tape is a thin walled pipe tube with emitters built into the wall of the pipe. Tapes are treated differently in IRRICAD because their hydraulic characteristics are different to a standard pipe with a sprinkler or dripper attached. Reasons for this are primarily because of the low operating pressures and the extent of flow variations down a tape run with varying lengths and input pressures. Some hard wall tubing products are also treated as tapes because of these reasons.

1.4.1.2 STARTING THE TUTORIAL

1. Double-click on the IRRICAD icon or select *Start|All Programs|IRRICAD|IRRICAD Pro 14* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.

2. Go to *Settings|Irrigation - Design Specific* and [Browse] for the **Tutorial.mdb** database. Highlight and select [Open].

3. Change the "Zone Pipes" line width to **2** and the "Mainline Pipes" line width to **3**.

4. Go to the *Units* tab and click the [Metric] button to restore the default units for this tutorial. These settings can be retained for each design by clicking the [Save As Default] button.

5. Select the *Misc* tab and click the **Medium** "Design Size". Change the "Base Database Symbol Size" to **3m**. This determines the size of the symbols according to the size of the design. When you are finished click [OK].

6. Select *Draw|Rectangle|2 Point* and place the first point on the screen by left-clicking. Move the cursor and click again to place the opposite corner of the rectangle (the second point). Select *Modify|Change*, or if in *Select|Object* mode double-click, on the boundary of the rectangle. In the dialog change the "Width" to **60m** and "Height" to **50m** as in Figure SD1. Click [OK]. Select *View|Zoom All* then *View|Zoom Out*.

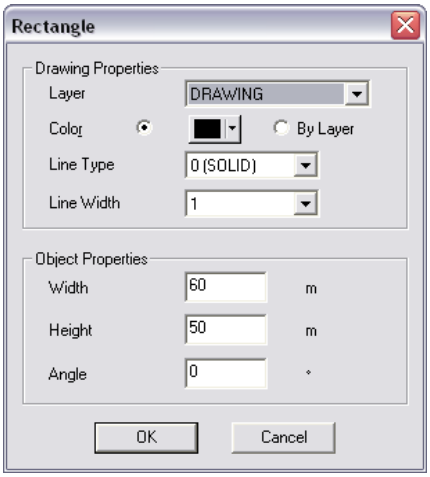


Figure SD 1

7. Using *Modify|Select|Object*, highlight the rectangle border by clicking on it once and then select *Zone|Tape Block* and click [Yes] on the message about converting the object.

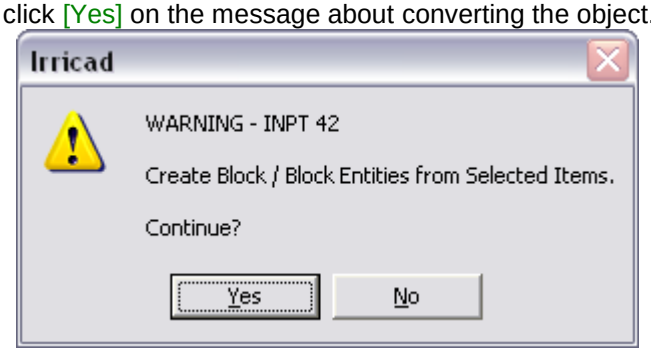


Figure SD 2

8. Select the **Drip tape** from the dropdown list of tapes. Leave the "Depth" as **0**, as the tapes will be at ground level. Type in the default inlet pressure as **10m** and make sure the "Regulated" check box is unchecked. This "Regulated" option would mean you have PRVs at the start of each tape, which we do not have in this case.

9. Type in **2m** for the "Lateral Spacing" and leave the "Number of Laterals" as **0**. Make sure the "Determine Automatically" option for the "Lateral Direction" is selected as in Figure SD 3. Click [OK].

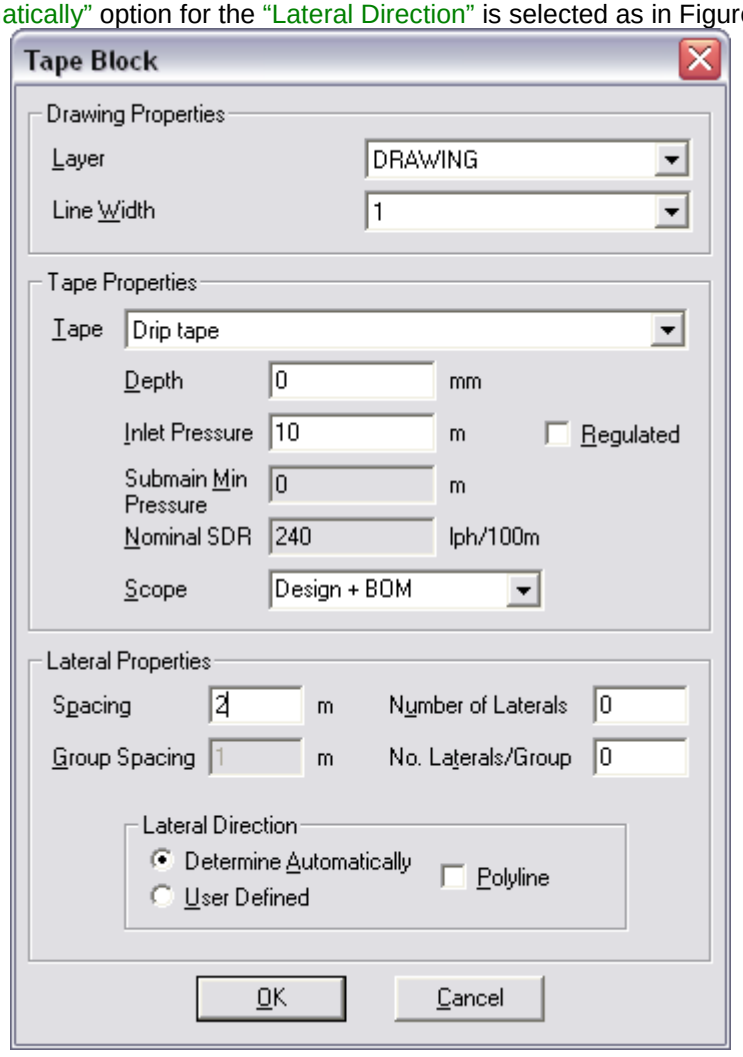


Figure SD 3

10. Now we need to select the lateral direction. Because "Determine Automatically" was selected, we can just click on the boundary we wish to align the laterals with. The block will automatically fill with tapes 2m apart. Select *View|Zoom All*. The block should look similar to Figure SD 4.

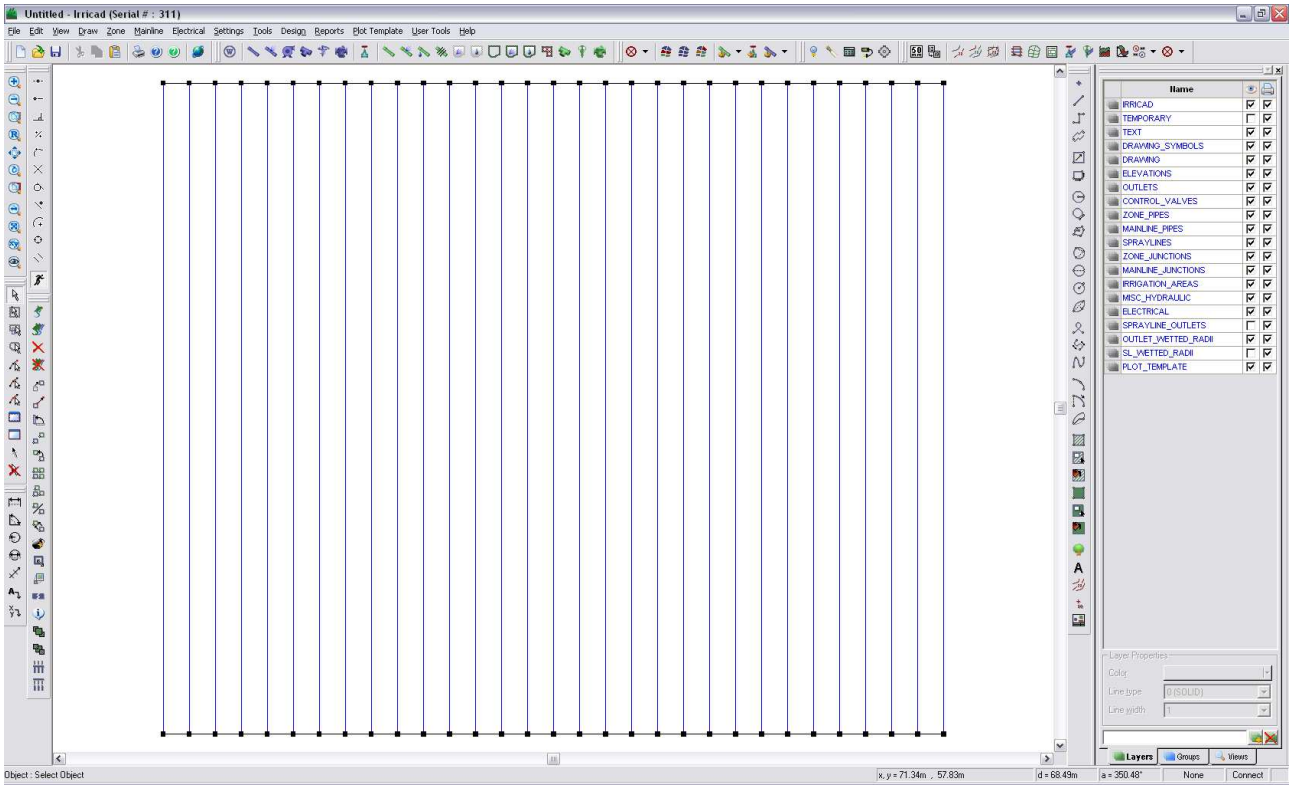


Figure SD 4

11. Now select *Settings|Snap* and then click the [Running Snaps] button. Check the "RN Snaps On" option and check the "Show Preview" option. Click the [Enable All Snaps] button. Now click [OK] and [OK] on the *Settings|Snap* dialog to close it.

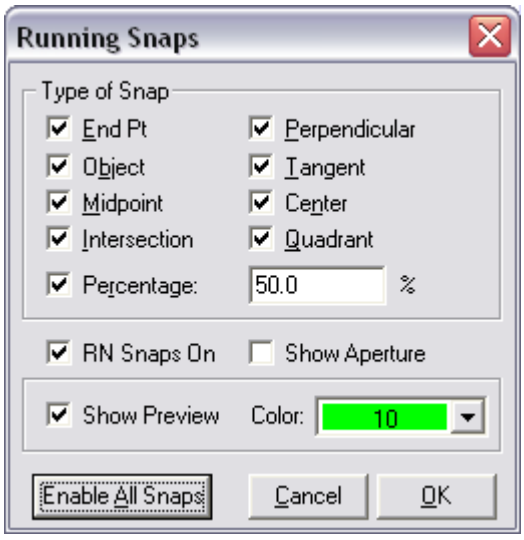


Figure SD 5

12. Now select *Zone|Cut Pipe*. We wish to place a submain through the middle of the block. In the *Cut Pipe* dialog leave the layer as **<DEFAULT>**. Make sure the pipe selected is "Computer Selected". Leave the "Depth" as **0**, and click [OK].

13. Click near the middle of the left outer lateral (the preview of the Running Snaps should show you when you are in the middle). Now click near the middle of the right outer lateral. IRRICAD will draw in the submain and connect to each lateral it crosses. Continue the pipe for approximately **4m** past the last lateral. *Right-Click* and select *Restart* to finish the pipe.

14. Select *Zone|Control Valve*. From the dropdown list select the **1" (25mm) Electric Valve**, leaving the "Depth" as **0**, and place this on the end of the submain on the right side of the screen. Accept the default zone name.

15. Now select *Mainline|Pipe*. Leave the pipe as "Computer Selected" at **0** depth. Click [OK]. Connect the mainline pipe to the control valve with a left click and draw upward for approximately **10m**. Left click to place the end then *Right-Click* and select *Restart*. Select *Mainline|Water Supply* and place on the end of the mainline pipe with a left click as in Figure SD 6. Leave the Water supply details as the default; simply click [OK].

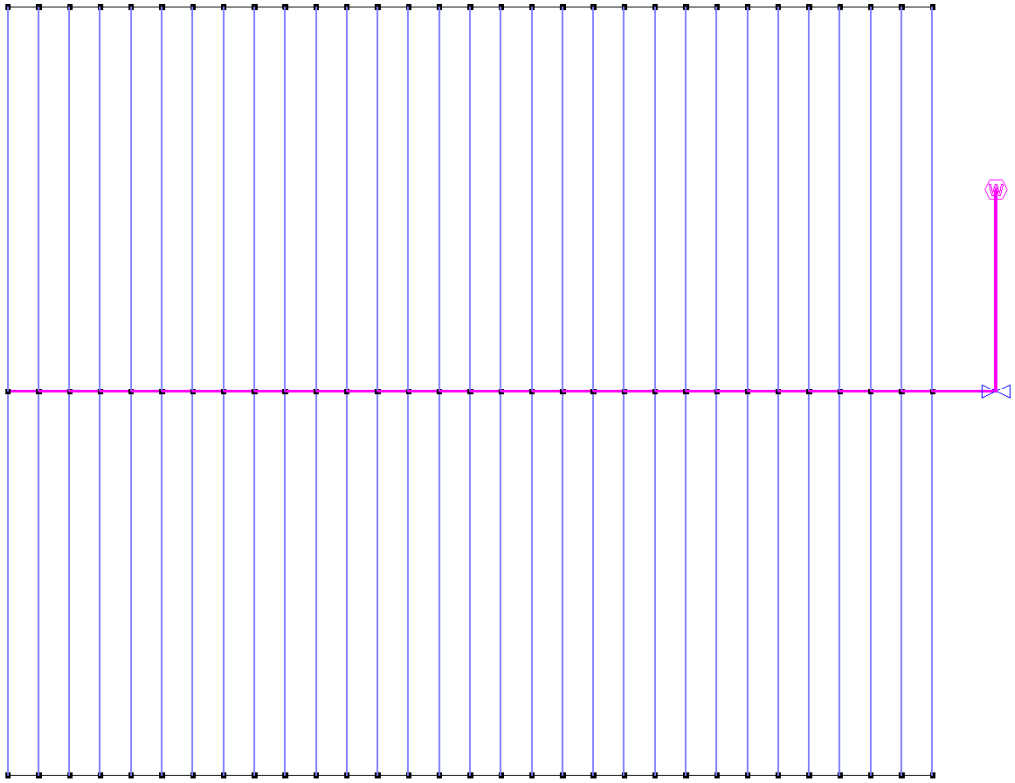


Figure SD 6

1.4.1.3 Checking Connections

16. Run *Design|Check Outlet Connectivity*. If no error messages appear, continue. If you do get an error message regarding an unattached item, go to the co-ordinates noted in the error message and connect the item to the pipe.

1.4.1.4 Zone Design

17. Select *Design|Design Parameters|Hydraulic Parameters* and enter the "Maximum Zone Pipe Velocity" as **1.5m/s**. Click [OK].

18. The first step is to size the submain pipes. Select *Design|Zone Design|LP Design*. It is always a good idea to look at some reports before continuing.

19. Look at the *Reports|Zone Design Reports|Zone Design Summary*. The *Zone Design Summary* report gives a good indication of what is happening in the zones. It should look something Figure SD 7.

Zone Name :	Zone no. 1	**Valve Description :**	1" (25mm) Electric Valve
Zone Head (D/S) :	10.42 **(m)**	**Zone Head (U/S) :**	15.86 **(m)**
Total Zone Flow :	3.79 **(m3/h)**	**Valve Headloss :**	5.45 **(m)**

	Allowable Flow (lpm)	Actual Flow (lpm)	Allowable Pressure (m)	Actual Pressure (m)
Minimum Outlet	0.02	0.02	9.00	9.00
Maximum Outlet	0.02	0.02	11.00	10.31
Outlet Variation (%)	0.00	0.00	18.18	12.79
Oulet Locations (X,Y)	Minimum :	-21.0 , 32.8	Maximum :	39.0 , 57.8

Figure SD 7

The present maximum dripper pressure is 10.31m and the minimum is 9.00m. The actual pressure variation in the zone is calculated from the actual minimum and maximum outlet pressures relative to the nominal inlet pressure and is 12.79%. This pressure variation includes the submain friction loss as well as the loss in the tapes. Close the report window by clicking the X.

1.4.1.5 ENTERING MANAGEMENT REQUIREMENTS

20. Now we wish to assign the zones to system flows. Select *Design|Assign All Zones to One System Flow* as we only have one Zone (control valve or block). You will notice that Zone no. 1 will operate on System Flow 1 as in Figure SD 8. Click [OK].

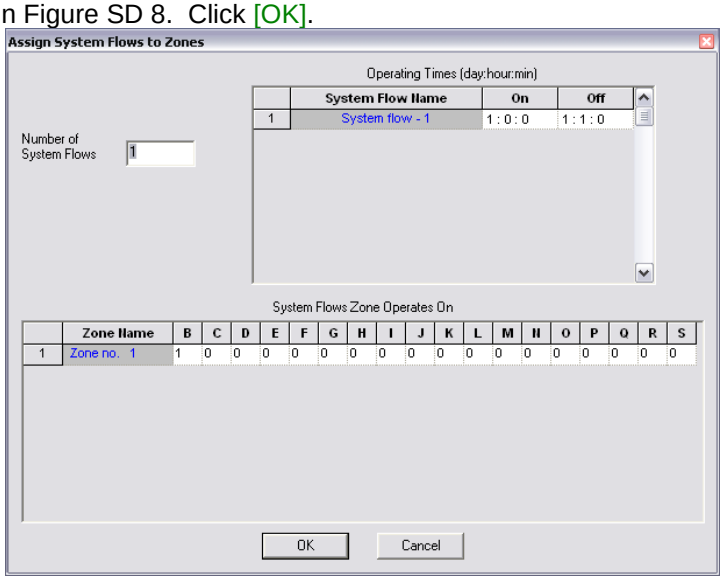


Figure SD 8

1.4.1.6 MAINLINE DESIGN

21. Run *Mainline|Mainline Design|LP Design*.

22. Look at reports such as *Reports|Mainline Design Reports|System Duty* to see the demands on the water supply for each system flow. Save the design as **simple dripline.des**.

1.4.1.7 TASKS COMPLETED IN THIS TUTORIAL:

- Drawing a block of tapes
- Changing symbol size on the screen
- Connecting to multiple zone items quickly
- Snapping to the midpoint of an object

1.4.2 SIMPLE AUTOMATIC DRIP TAPE DESIGN

Tasks covered in this tutorial:

- Drawing an automatic block of tapes
- Setting a valve pressure
- Automatic Labeling
- Moving an item

This tutorial shows the steps required for drawing and designing a drip tape entity. Read the notes below and then proceed with the exercise.

1.4.2.1 TAPES - AN OVERVIEW

A drip tape is a thin walled pipe tube with emitters built into the wall of the pipe. Tapes are treated differently in IRRICAD because their hydraulic characteristics are different to a standard pipe with a sprinkler or dripper attached. Reasons for this are primarily because of the low operating pressures and the extent of flow variations down a tape run with varying lengths and input pressures. Some hard wall tubing products are also treated as tapes because of these reasons.

1.4.2.2 STARTING THE TUTORIAL

1. Double-click on the IRRICAD icon or select *Start|All Programs|IRRICAD|IRRICAD Pro 14* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.

2. Go to *Settings|Irrigation - Design Specific* and [Browse] for the **Tutorial.mdb** database. Highlight and select [Open].

3. Change the "Zone Pipes" line width to **2** and the "Mainline Pipes" line width to **3**.

4. Go to the *Units* tab and click the [Metric] button to restore the default units for this tutorial. These settings can be retained for each design by clicking the [Save As Default] button.

5. Select the *Misc* tab and click the **Medium** "Design Size". Change the "Base Database Symbol Size" to **3m**. This determines the size of the symbols according to the size of the design. When you are finished click [OK].

6. Select *Draw|Rectangle|2 Point* and place the first point on the screen by left-clicking. Move the cursor and click again to place the opposite corner of the rectangle (the second point).

7. Select *Modify|Change*, or if in *Select|Object* mode double-click, on the boundary of the rectangle. In the dialog change the "Width" to **60m** and "Height" to **50m** as in Figure AD1. Click [OK]. Select *View|Zoom All* then *View|Zoom Out.*

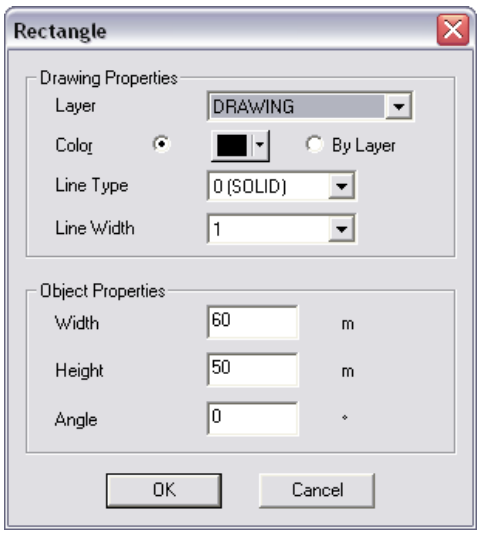


Figure AD 1

8. Using *Modify|Select|Object*, highlight the rectangle border by clicking on it and then select *Zone|Tape Irrigation Block* and click [Yes] on the message about converting the object.

9. Select the **Drip tape** from the dropdown list of tapes. Leave the "Depth" as **0**, as the tapes will be at ground level. Leave the default "Inlet Pressure" as **10m** and make sure "Regulated" is unchecked. This Regulated option would mean you have PRVs at the start of each tape, which we do not have in this case. Type in **2m** for the "Lateral Spacing" and leave the "Number of Laterals" as **0**. Make sure the "Determine Automatically" option for the "Lateral Direction" is selected.

10. Now click on the Block tab. Here we can choose to have our submain and valve drawn automatically if required. In the "Submain" area of the dialog box set **Centre** as the "Position" but leave as "Computer Selected". In the "Valve" area of the dialog box set the "Position" to **End** and specify the valve as the **1" (25mm) Electric Valve** (Figure AD 2) and set the "Submain Stub" to **4m**. Click [OK].

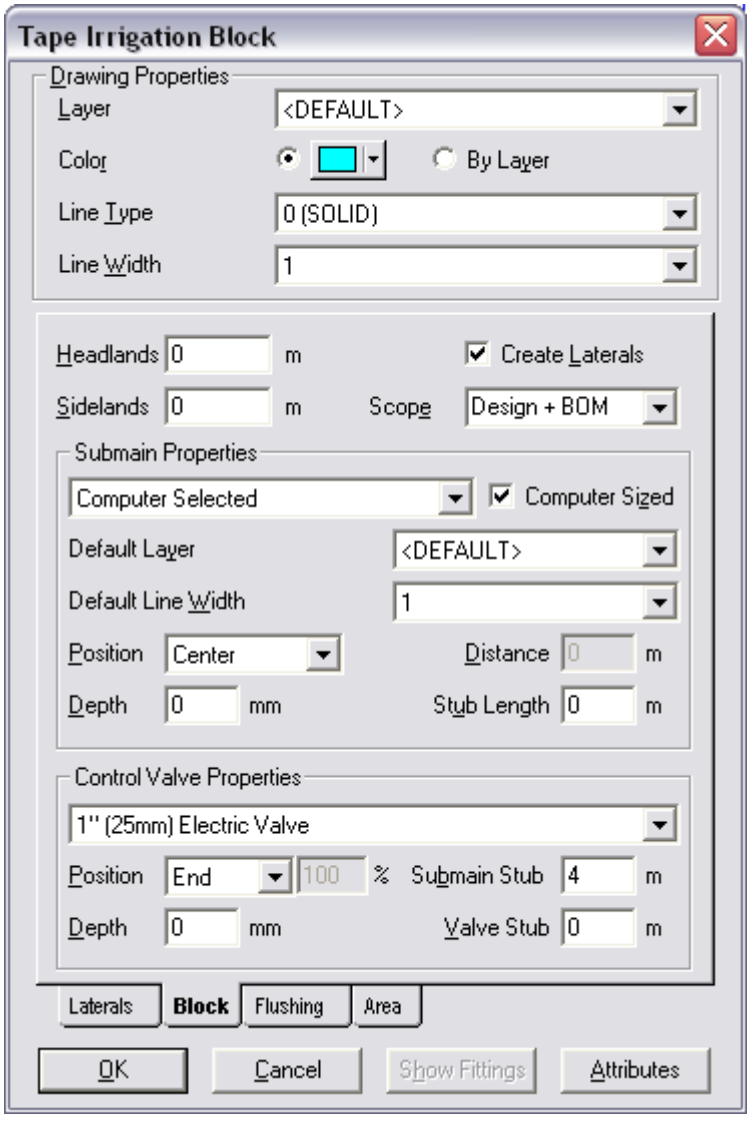


Figure AD 2

12. Now we need to select the lateral direction. Because "Determine Automatically" was selected, we can just click on the boundary we wish to align the laterals with. The block will automatically fill with tapes 2m apart. Select *View|Zoom All*. Once this is completed the laterals are automatically drawn, with a submain through the centre of the block and with a central valve as in Figure AD 3.

13. Now select *Mainline|Pipe*. Leave the pipe as "Computer Selected" and the "Depth" as **0**. Click [OK]. Connect the mainline pipe to the control valve with a left-click and draw upwards for approximately **10m**. Left-click to place and then *Right-Click|Restart*.

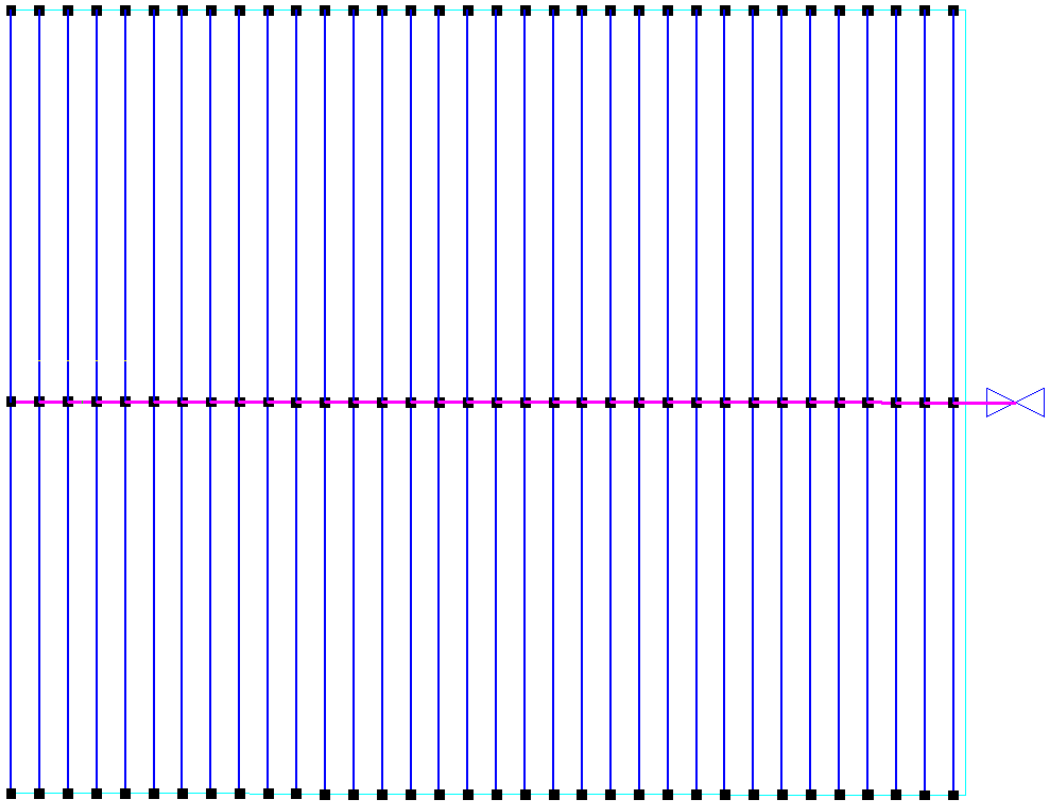


Figure AD 3

14. Select *Mainline|Water Supply* and place on the end of the mainline pipe with a left-click as in Figure AD 4. Leave the Water supply details as the defaults; simply click [OK]. Now select *View|Zoom All*.

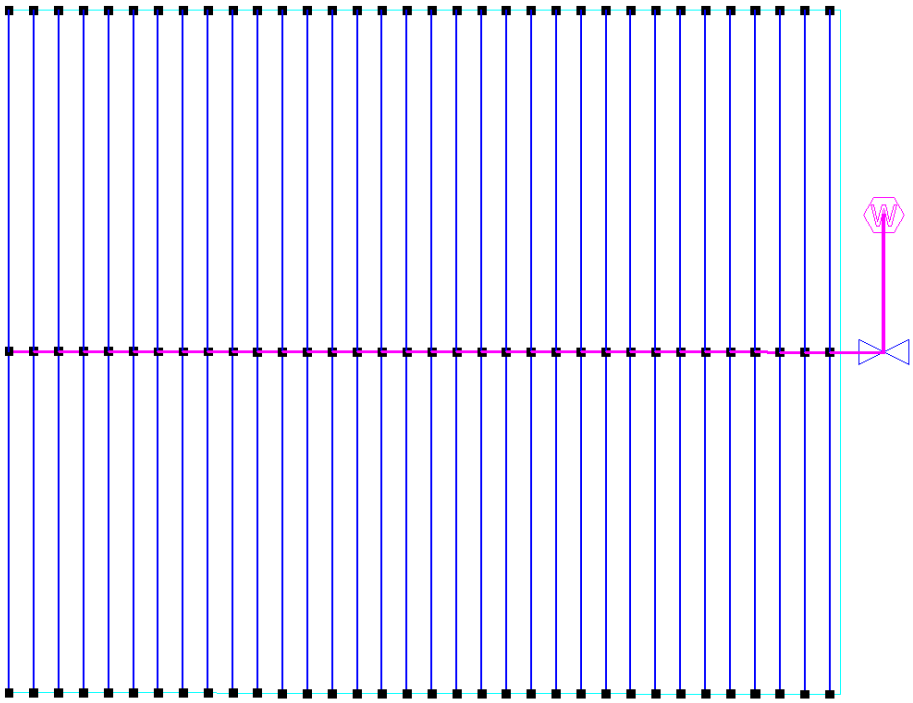


Figure AD 4

1.4.2.3 CHECKING CONNECTIONS

15. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with *Design*. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design|Clear Connectivity Marks.*

If any outlets or control valves are marked as unconnected , check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View|Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify|Select Object* and click on the item) and move the item to the centre of the junction (*Modify|Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check the "Default Snap Mode" in *Settings|Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

1.4.2.4 ZONE DESIGN

16. Select *Design|Design Parameters|Hydraulic Parameters* and enter the "Maximum Zone Pipe Velocity" as **1.5m/s**. Click [OK].

17. The first step is to size the submain pipes. Select *Design|Zone Design|LP Design*. It is always useful to view some reports before continuing. Look at the *Reports|Zone Design Reports|Zone Design Summary*, this report gives a good indication of what is happening in the zones. It should look something similar to Figure AD 5.

The present maximum dripper pressure is 10.75m and the minimum is 9.43m. The actual pressure variation in the zone is calculated from the difference between the actual maximum and minimum outlet pressures relative to the actual maximum outlet pressure and is 12.27%. This pressure variation includes the submain friction loss as well as the loss in the tapes. Close the report window by clicking the [X].

Zone Name :	Area no. 1	**Valve Description :**	1" (25mm) Electric Valve
Zone Head (D/S) :	10.85 **(m)**	**Zone Head (U/S) :**	10.85 **(m)**
Total Zone Flow :	3.79 **(m3/h)**	**Valve Headloss :**	0.00 **(m)**

	Allowable Flow (lpm)	Actual Flow (lpm)	Allowable Pressure (m)	Actual Pressure (m)
Minimum Outlet	0.02	0.02	9.00	9.43
Maximum Outlet	0.02	0.02	11.00	10.75
Outlet Variation (%)	0.00	0.00	18.18	12.27
Oulet Locations (X,Y)	Minimum :	12.6 , 21.0	Maximum :	72.6 , 46.0

Figure AD 5

When this block is installed the control valve is going to be pressure-reducing and the downstream pressure will be set to **10.5m**.

18. To specify this go to *Design|Zone Design Configuration* and enter **10.50** in the "D/S Valve Pressure" column for Area no. 1. Click [OK] and run *Design|Zone|Detailed Analysis*.

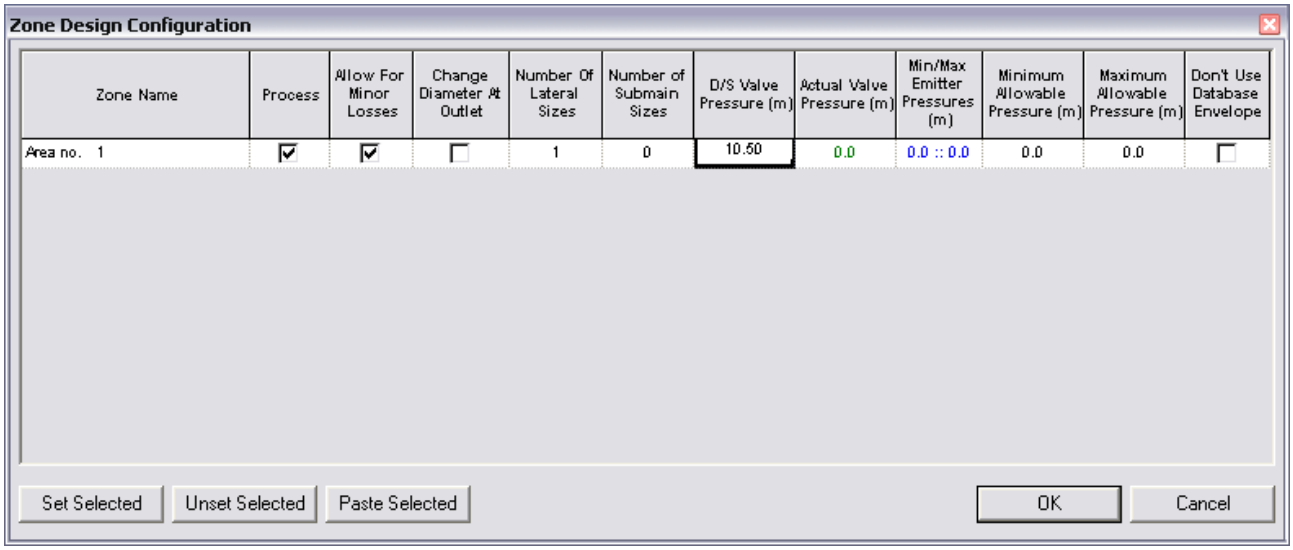


Figure AD 6

19. Open the *Reports|Zone Design Reports|Zone Design Summary* and notice that the valve pressure has been set to **10.5** and the resultant pressures throughout the zone have been recalculated from that. See Figure AD 7.

Zone Name :	Area no. 1	**Valve Description :**	1" (25mm) Electric Valve
Zone Head (D/S) :	10.50 **(m)**	**Zone Head (U/S) :**	10.50 **(m)**
Total Zone Flow :	3.79 **(m3/h)**	**Valve Headloss :**	0.00 **(m)**

	Allowable Flow (lpm)	Actual Flow (lpm)	Allowable Pressure (m)	Actual Pressure (m)
Minimum Outlet	0.02	0.02	9.00	9.08
Maximum Outlet	0.02	0.02	11.00	10.40
Outlet Variation (%)	0.00	0.00	18.18	12.68
Oulet Locations (X,Y)	Minimum :	12.6 , 21.0	Maximum :	72.6 , 46.0

Figure AD 7

1.4.2.5 Entering Management Requirements

20. Now we wish to assign the zones to system flows. Select *Design|Assign All Zones to One System Flow* as we only have one Zone (control valve or block). You will notice that "Area no. 1" will operate on **System Flow 1** as indicated Figure AD 8. Click [OK].

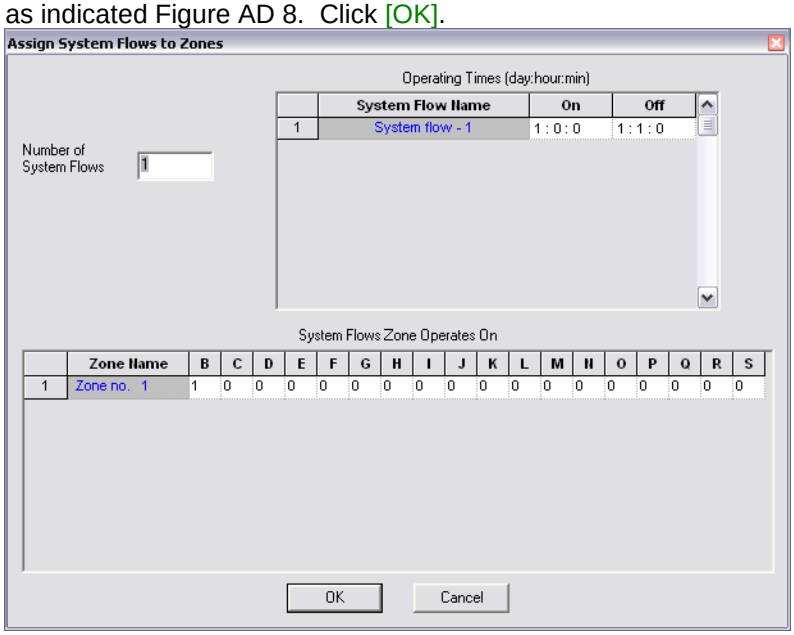


Figure AD 8

1.4.2.6 MAINLINE DESIGN

21. Now we wish to size the mainline, select *Design|Mainline Design|LP Design*.

22. Look at the *Reports|Mainline Design Reports|System Duty Report* to see the required demand on the water supply. This is the pressure and flow that is required downstream of the headworks to operate the system you have designed.

23. Save the design as **automatic dripline.des**.

1.4.2.7 AUTOMATIC LABELLING

24. Now select *Settings|Labels* to open the labelling settings. In this dialog you can select which types of items you want labelled by checking the appropriate check boxes. Check the "Irri. Blocks" option and then click the [Text] button.

We can add other key words into the text boxes so that the automatic label can say as much as we want. The text box is loaded with the default of the area name. We want to add the area size, the name of the tape, the number of rows and the flow with the correct units. To do this, we need to use the appropriate keywords:

#NAME# The name of the Block/Area.
#DESC# The Tape description
#AREA# #AREAUNIT# The area of block including units.
#NUMROW# The number of rows (remember to add a space and then the word 'Rows' after the key word).
#ACTFLOW# #FLOWUNIT# The actual flow, as calculated during the design process, including the units.
#VALVEPRESS# #PRESSUNIT# The valve pressure and pressure unit
#SHIFT# Station or System Flow number

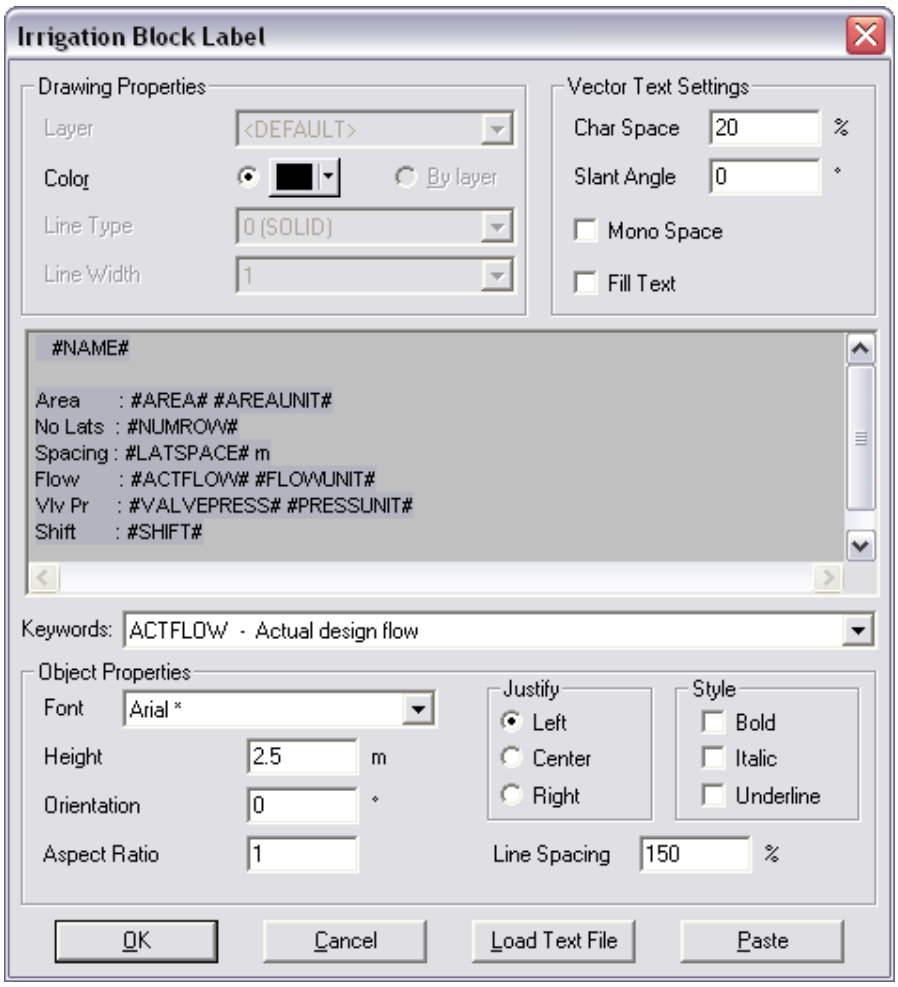


Figure AD 5

25. Add the text and keywords as seen in Figure AD 9. Click [OK] on the text box.

26. Now we can set the [Background] options. We can specify a fill behind the label in a colour of our choice and a border. Select a colour for the fill and a colour and line thickness for the border. Click [OK].

27. Leave the "Layer" set to **[DEFAULT]** – this means that the labels will automatically be placed on the IRRICAD Layer.

28. The next option determines where the label will be placed. It can be BELOW the object (in this case below the Block), ABOVE, INLINE, to the LEFT or to the RIGHT. Select **INLINE**. Click [OK].

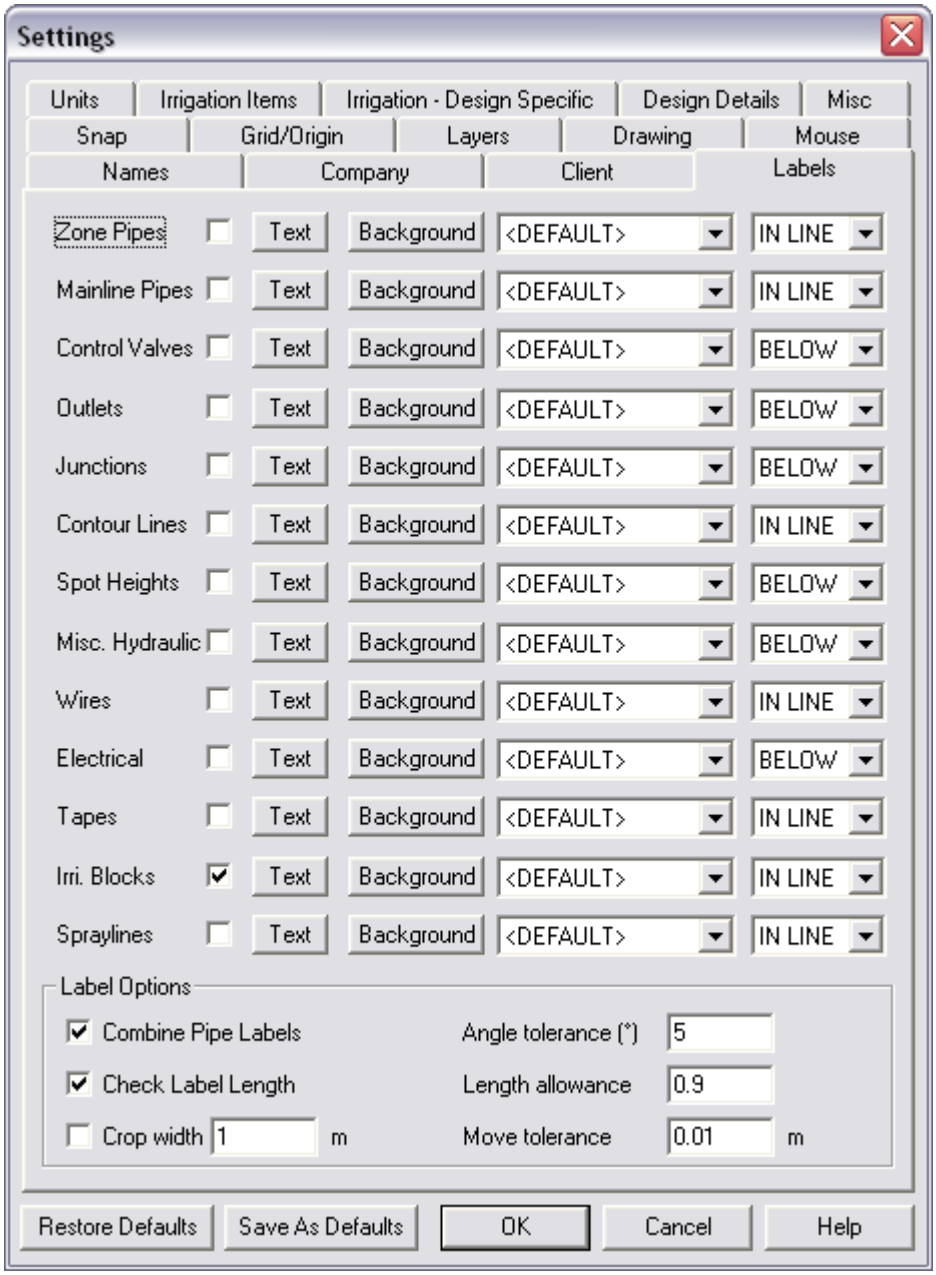


Figure AD 6

29. Now select *Modify|Select All* and then *Tools|Create Labels*. The label will be placed in the centre of the Block.

If you wish to change the style of existing labels, go to *Settings|Labels* and make the changes required. For example, select the [Text] button for "Irri. Blocks" and change "Justify" to "Left" instead of "Center". Click [OK] on both dialogs and then select *Tools|Update Labels*. All existing labels on the design will be updated

to reflect the changes made in the settings. Note: if the fill behind the label does not appear large enough for the label, zoom in and the select *Tools|Update Labels*.

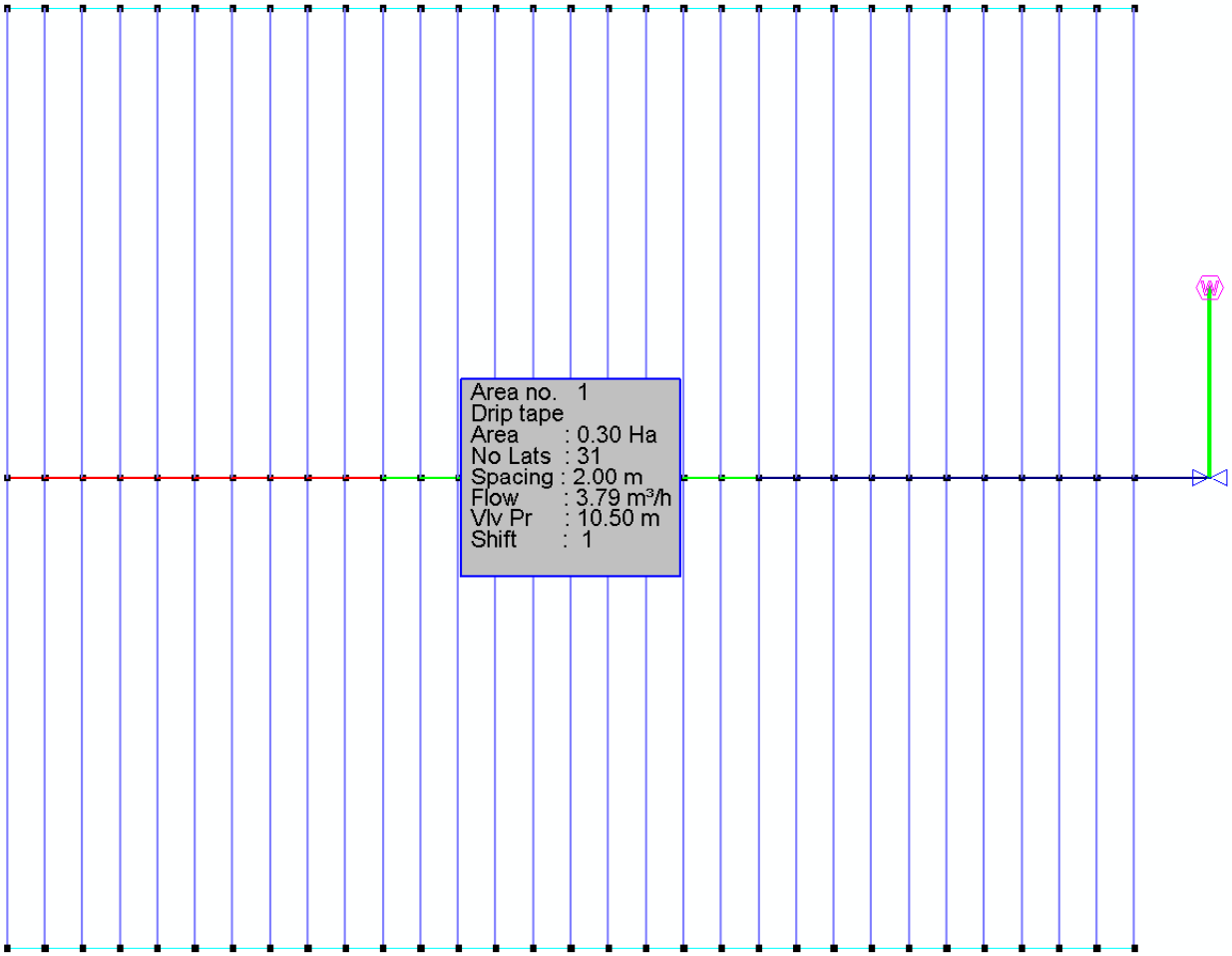


Figure AD 7

1.4.2.8 TASKS COVERED IN THIS TUTORIAL:

- Drawing an automatic block of tapes
- Setting a valve pressure
- Automatic Labeling
- Moving an item

1.4.3 A SIMPLE ORCHARD DESIGN

Tasks covered in this tutorial:

- Drawing simple background information
- Creating sprayline outlets
- Drawing a block of connected spraylines (laterals)
- Specifying lateral and outlet spacing
- Using Circular Cursor as a placement aid
- Connecting up multiple zone items
- Saving a design
- Specifying the maximum allowable velocity
- Limiting number of pipe sizes selected by computer sizing

1.4.3.1 STARTING THE TUTORIAL

1. Double-click on the IRRICAD icon or select *Start|All Programs|IRRICAD|IRRICAD Pro 14* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.

2. Go to *Settings|Irrigation - Design Specific* and [Browse] for the **Tutorial.mdb** database. Highlight and select [Open].

3. Change the "Zone Pipes" line width to **2** and the "Mainline Pipes" line width to **3**.

4. Go to the *Units* tab and click the [Metric] button to restore the default units for this tutorial. These settings can be retained for each design by clicking the [Save As Default] button.

5. Select the *Misc* tab and click the **Medium** "Design Size". Change the "Base Database Symbol Size" to **3m**. This determines the size of the symbols according to the size of the design. When you are finished click [OK].

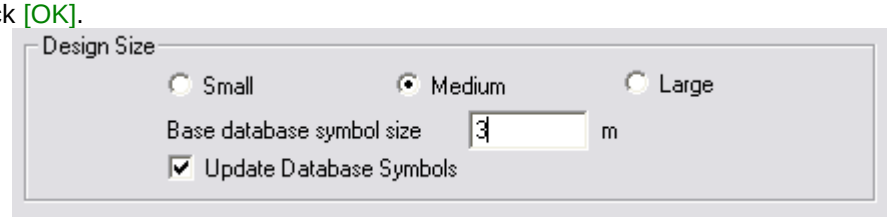


Figure SM 1

1.4.3.2 ENTER BACKGROUND INFORMATION

Background information is information required to position the irrigation system. Examples include boundaries, roads, buildings, text and symbols. For this tutorial we will put in a **120 x 45m** rectangle for the block boundary.

6. Select *Draw|Rectangle|2 Point* and move the cursor to the bottom left of the screen and click the left mouse button to start the rectangle. You will notice that the status bar will ask you to enter the corner point of the rectangle prior to you clicking the mouse and for you to enter the opposite corner after you have placed the first. Draw the cursor away from the first point and left-click to place the second point.

7. Now select *Modify|Change* and click on the border of the rectangle. Edit the "Width" to be **120** and the "Height" to be **45** as in Figure SM 2. Click [OK].

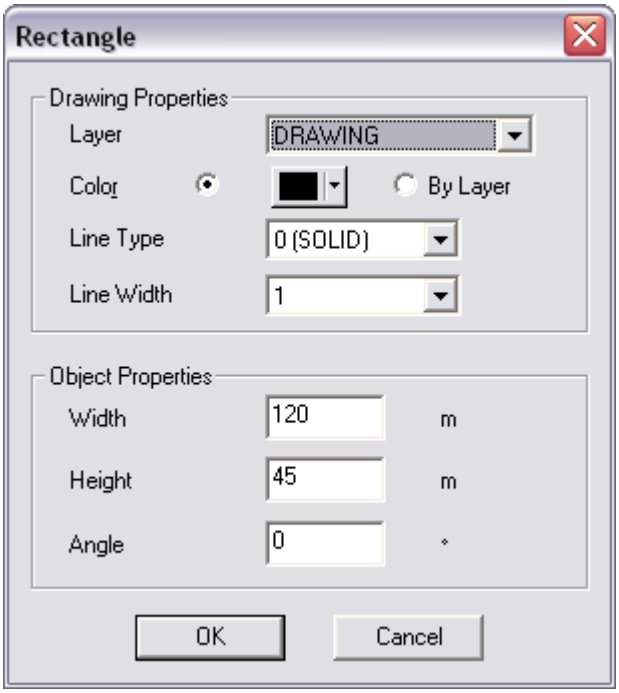


Figure SM 2

8. Select *View|Zoom All*.

Your design should look like Figure SM 3.

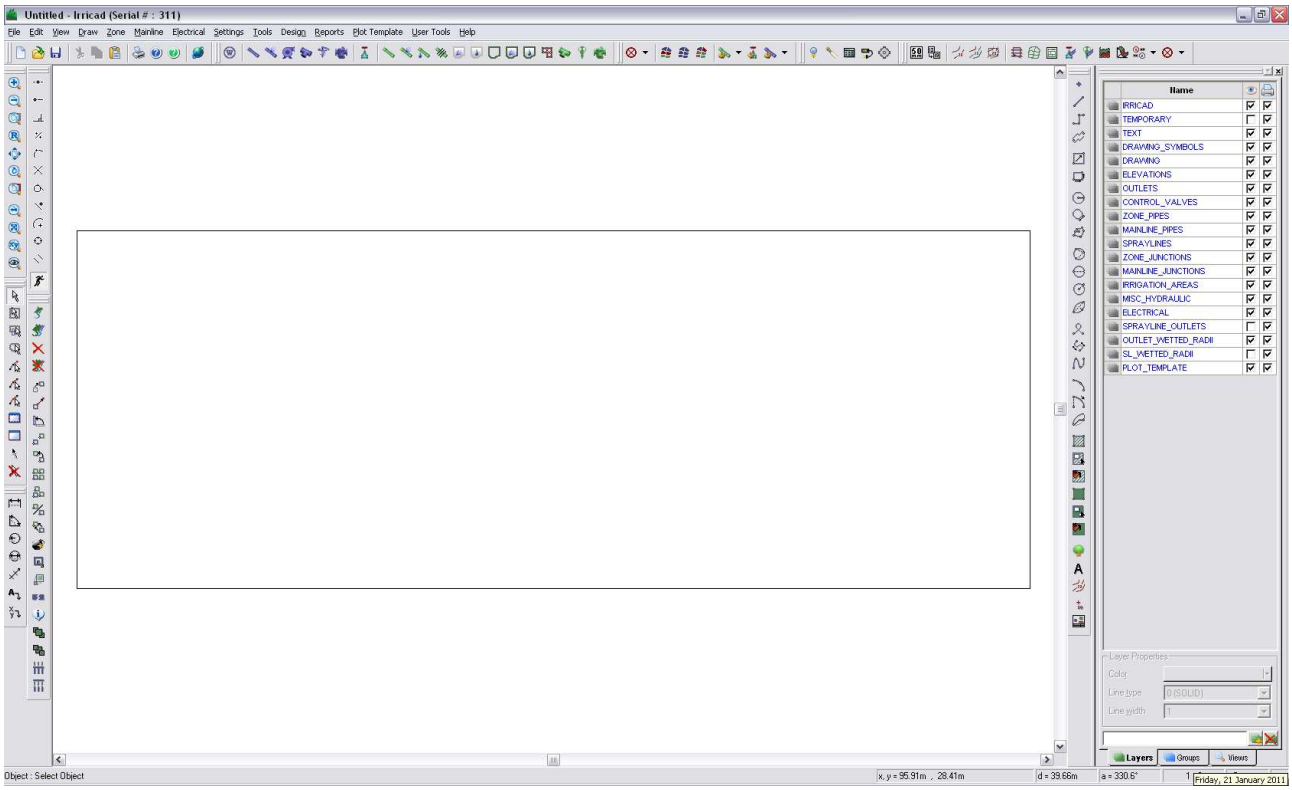


Figure SM 3

1.4.3.3 PLACING THE BLOCK

9. Before placing any laterals select *Settings|Irrigation – Design Specific*. Check the "Create Wetted Radii" and "Create Sprayline Outlets" check boxes (under normal circumstances "Create Sprayline Outlets" should be unchecked as the number of outlets may be high and will consequently slow down redrawing of the design). Click [OK].

10. Now view the layer bar on the right-hand side of the screen or go to *Settings|Layers* and scroll down until you see **SPRAYLINE_OUTLETS**. Check the box to turn this layer on (this layer can also be turned on in *View|Sprayline Outlets*). Click [OK].

Drawing in each sprayline would be very tedious, we can however enter a block of connected spraylines (laterals) by selecting a polygon and 'applying' the required block properties to it.

11. To do this use the *Tool|Select Object* menu and click on the rectangle edge (it should change colour) and then select *Zone|Spray Irrigation Block*. Click [OK] on the message asking if you want to create block entities from the selected item.

12. A dialog for setting the lateral and block properties will now be displayed. As you are completing a new design we want IRRICAD to size the laterals so leave the pipe as "Computer Selected". The laterals will be placed at ground level so the "Depth" field can remain at **0.0**.

13. In the same dialog, select the **Microsprinkler 360 degrees** and click on it to select it. Select the **WHITE 360** as the nozzle in the "Nozzle" field, highlighting the required nozzle and left-clicking the mouse. Enter a pressure of **14m**.

14. Selecting a riser (outlet connector) is optional but in this example we will use a Microsprinkler stake and tube 3/8" (10mm). In the same dialog, select the **Microsprinkler stake and tube 3/8" (10mm)** from the "Riser" dropdown list.

15. Enter the "Lateral Spacing" as **4m**. Enter the "Outlet Spacing" as **3.5m**.

16. Select the [Options] button and check "Determine Automatically" for the "Lateral Direction", make sure that the option checked for "Reference Outlet" is "Determine Automatically". Click [OK].

17. Set the outlet spacing type to "Rectangular" with an "Offset" of **0%**. The dialog should look like Figure SM 4.

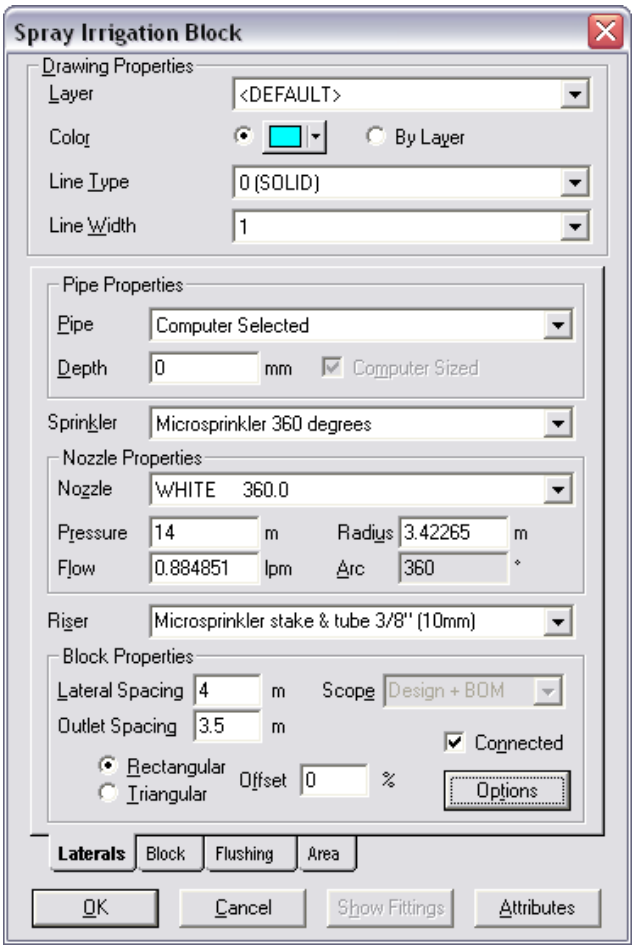


Figure SM 4

18. Now click on the Block tab, this tab contains options for automatically placing submains and control valves.

19. Leave the "Submain" as "Computer Selected" and select **Start** from the "Position" dropdown box. Select the **3" (80mm) Electric Valve** from the "Control Valve" dropdown and select **Centre** as the "Position". Enter a "Valve Stub" of **1.5m**. Click [OK].

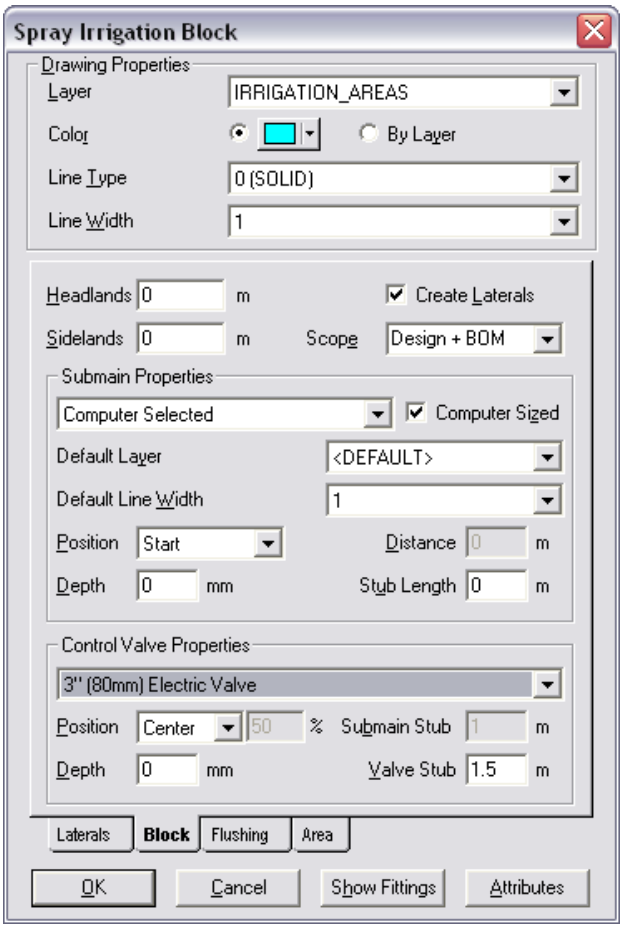


Figure SM 5

20. Because we selected "Determine Automatically" for the "Lateral Direction" we simply need to select the left-hand boundary to indicate the row direction. The laterals are now automatically drawn, with a submain at the top of the block and a central valve with a **1.5m** stub, as in Figure SM 6.

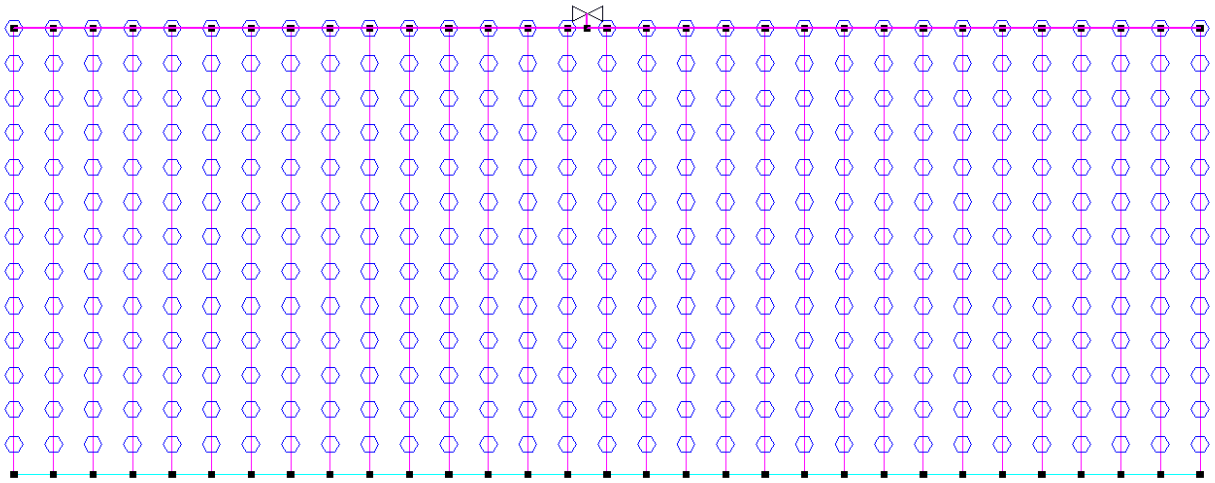


Figure SM 6

21. Now we are ready to enter the Mainline. Select *Mainline|Pipe*. Set the pipe as "Computer Selected", the "Depth" as **0** and the "Line Width" as **3**. Click [OK]. Connect the pipe to the control valve by clicking

on it and then draw the mainline pipe out upwards for approximately **10m**. Note that the status bar indicates the distance travelled since the last left-click via the 'd=' field. Left-click to place the end of the pipe and then *Right-Click|Restart*.

22. Select *Mainline|Water Supply*. Connect to the junction on the left end of the mainline pipe by placing the eater supply on top of the junction. Accept the default name of **Supply No. 1**. Do not enter any flow or pressure requirements (IRRICAD will assume that the water supply is unrestricted and will determine these requirements during design and analysis). Click [OK]. Your design should look like Figure SM 7.

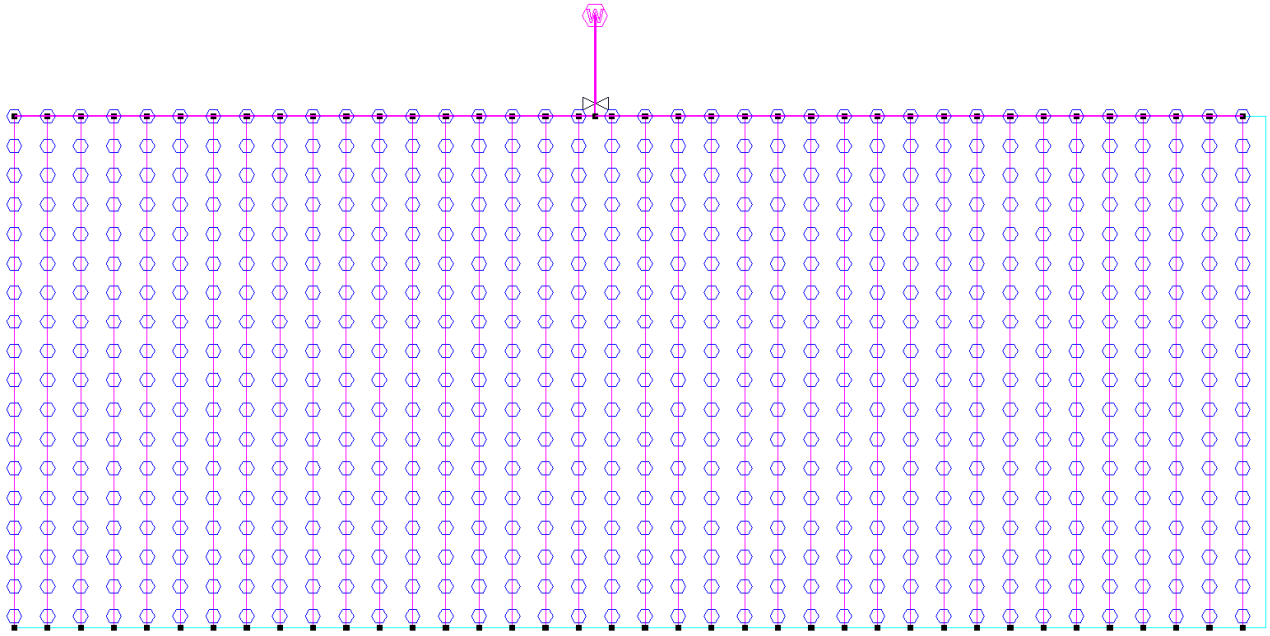


Figure SM 7

23. Select *File|Save* and save the design as **orchard design.des**. This completes the entry of the hydraulic components of the design.

1.4.3.4 THE DESIGN PROCESS

Checking Connections

24. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design|Clear Connectivity Marks.*

If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View|Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify|Select Object* and click on the item) and move the item to the centre of the junction (*Modify|Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check the "Default Snap Mode" in *Settings|Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember that only a control valve can connect to both zone and mainline items.

Zone Design

25. Select *Design|Design Parameters|Hydraulic Parameters* and set the "Maximum Zone Pipe Velocity" to **1.5m/s**. Click [OK].

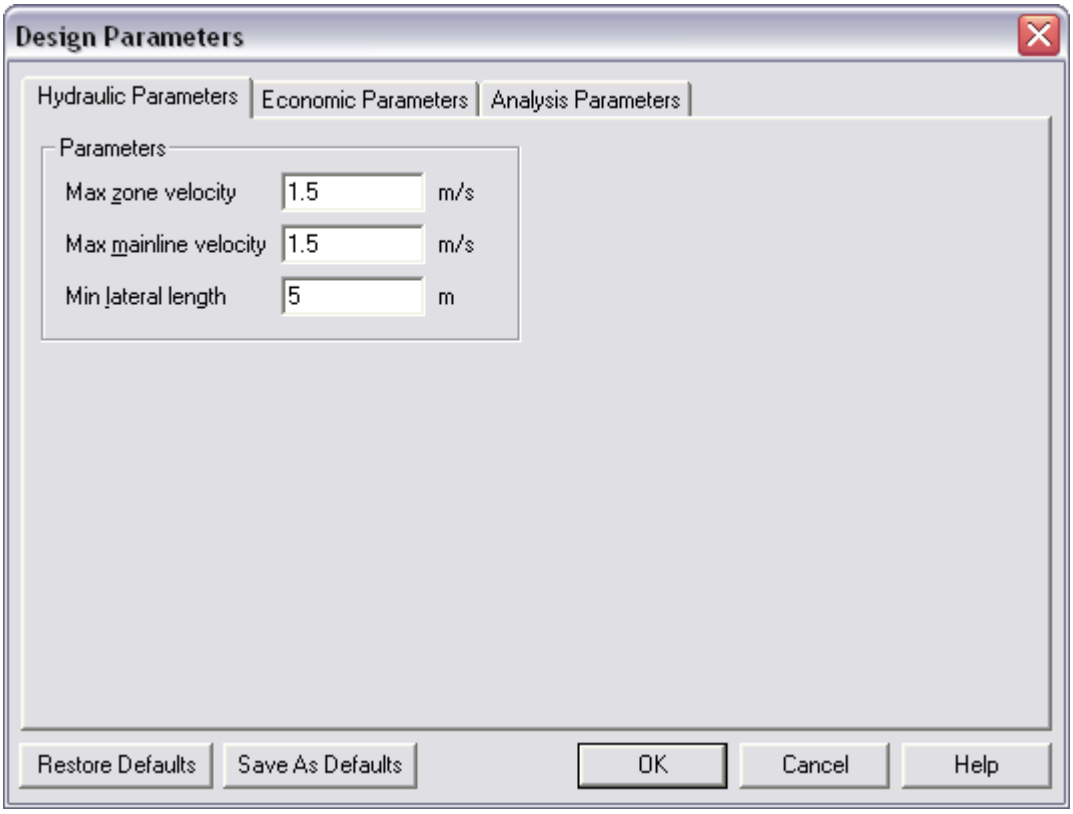


Figure SM 8

26. Select *Design|Zone Design|LP Design*. This method of computer sizing takes into account the maximum allowable velocities (in *Design|Design Parameters|Hydraulic Parameters*) and the pressure requirements of the sprinklers. Select this option to have IRRICAD size the laterals and submain for the zone.

27. You will notice that 5 pipe sizes have been selected for the submain. In order to simplify installation we will limit the number of pipe sizes that can be selected for the submain. Select *Design|Zone Design Configuration* and enter **3** in the "Number of Submain Sizes" column. Click [OK] and re-run *Design|Zone Design|LP Design*.

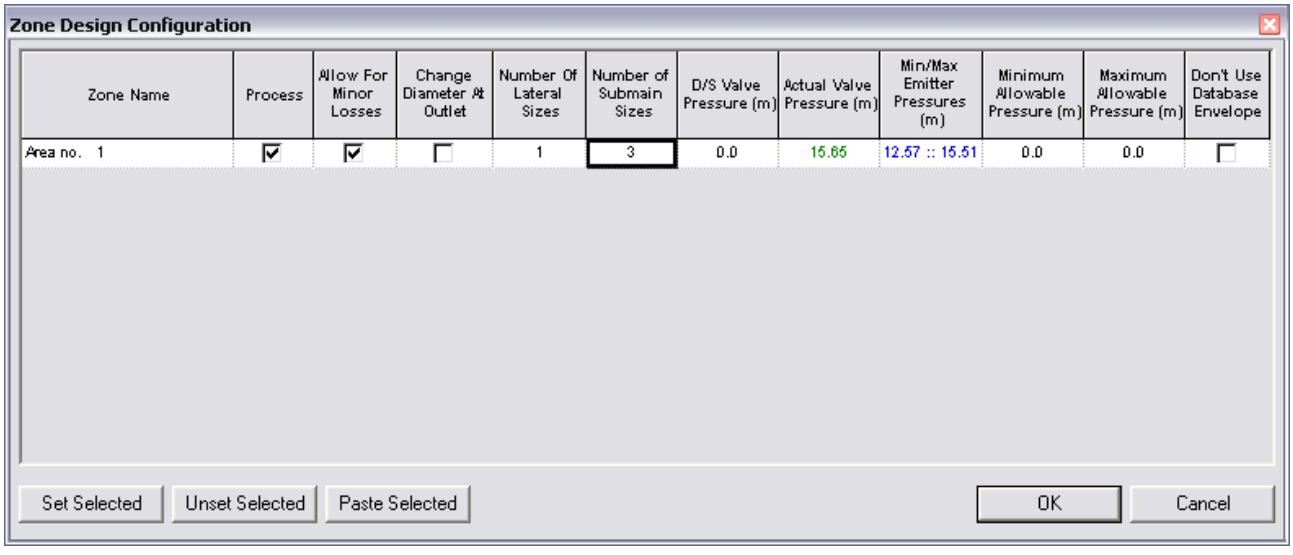


Figure SM 9

28. It is advisable to check the data in the zone reports after zone design (*Reports|Zone Design Reports*). At this stage the Zone Design Summary report gives a good indication of the overall design performance of the zone, showing the allowable range and actual minimum and maximum outlet flows and pressures. Click on the [X] to close the report window.

Entering Management Requirements

The primary purpose of management is to allow you to specify an operating sequence for the zone control valves. This operating sequence is then used to set up a series of flow conditions so that the mainline can be correctly sized and analysed.

29. Select *Design|Assign All Zones to One System Flow*. IRRICAD assigns Area no. 1 to operate on System Flow 1 as in Figure SM 8. The on and off times (one hour operating time), for the system flow, are automatically listed. Click [OK]. We are now ready to proceed with the design process.

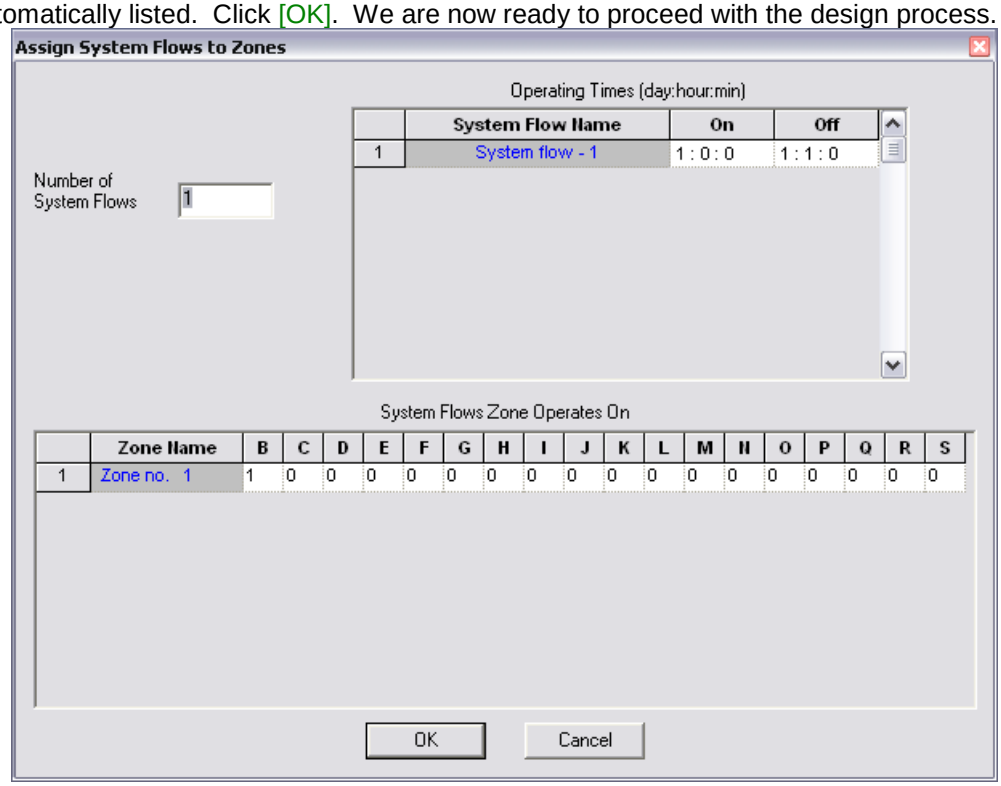


Figure SM 10

30. Having completed the valve analysis, you can now have IRRICAD size the mainline, to do this select *Design|Mainline Design|LP Design*. IRRICAD will then size the mainline and calculate the water supply pressure necessary to ensure that the zone control valve receives the required pressure. You should have results similar to Figure SM 11.

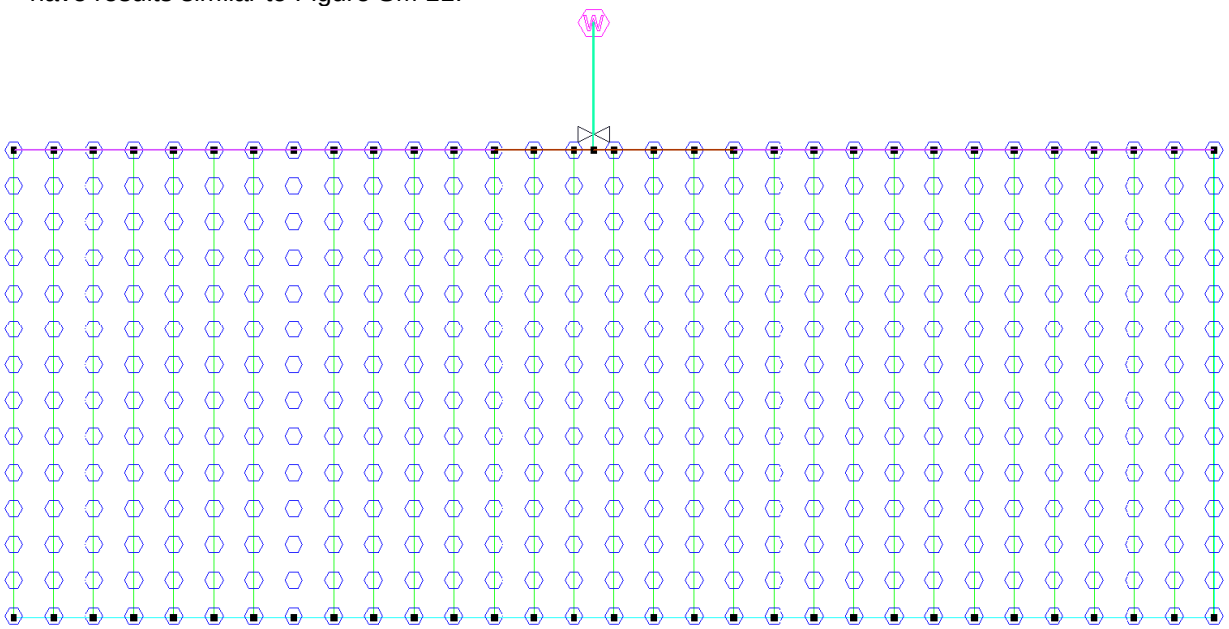


Figure SM 8

1.4.3.5 DISPLAY REPORTS

31. You may wish to view some of the design reports. As described previously the Zone Design Summary Report (*Reports|Zone Design Reports*), detailed in Figure SM 12, shows a summary of the pressure variation in the block.

Zone Name :	Area no. 1	**Valve Description :**	1" (25mm) Electric Valve
Zone Head (D/S) :	14.51 **(m)**	**Zone Head (U/S) :**	14.73 **(m)**
Total Zone Flow :	22.32 **(m3/h)**	**Valve Headloss :**	0.22 **(m)**

	Allowable Flow (lph)	Actual Flow (lph)	Allowable Pressure (m)	Actual Pressure (m)
Minimum Outlet	0.81	0.82	11.56	11.77
Maximum Outlet	0.90	0.90	14.55	14.41
Outlet Variation (%)	9.52	8.42	20.59	18.33
Oulet Locations (X,Y)	Minimum :	5.3 , 22.1	Maximum :	37.0 , 69.8

Figure SM 9

The System Duty Report (*Reports|Mainline Design Reports*) shows the duty required at the water supply. The Mainline Summary Report is a summary of actual and required pressures at the zone control valve.

Other tools that may be helpful, particularly in undulating blocks, are described below.

The hydraulic gradeline tool (*Reports|Hydraulic Gradeline*) allows you to click on a lateral or submain pipe and see a graphical display of the pressure along that section of pipe. For more information on this tool see the Release Notes (*Help|Release Notes*). Another useful tool, *Reports|Show Pressure Zone Limits,* shows visually the location of the emitters with the minimum and maximum pressure within a zone.

If you have had trouble doing this design, please check the following:

Size of the rectangle – select *Modify|Change* and click on the rectangle boundary to check the "Height" and "Width" are **120 x 45m**.

Note this tutorial could be repeated using the *Zone|Tape Irrigation Block* tool for Drip tape blocks.

1.4.3.6 TASKS COMPLETED IN THIS TUTORIAL:

- Drawing simple background information
- Creating sprayline outlets
- Drawing a block of connected spraylines (laterals)
- Specifying lateral and outlet spacing
- Using Circular Cursor as a placement aid
- Connecting up multiple zone items
- Specifying the maximum allowable velocity
- Limiting number of pipe sizes selected by computer sizing

Note this tutorial could be repeated using the *Zone|Tape Irrigation Block* tool for Drip tape blocks.

1.4.4 WORKING WITH MULTI-VALVE DESIGNS

Tasks covered in this tutorial:

- Using the Selection Filter
- Splitting blocks
- Automatically Connecting Valves
- Running more than one valve
- Managing multi-valves in Design
- Limiting the number of pipes selected
- Multiple valves running together

1. Complete the above tutorial (A Simple Orchard Design) if you have not done so already.

We wish to break this block up into more zones, as the flow of the entire block is too great for the water supply.

2. To automatically break the block into 3 even parts we can use the subdivide tool. Go to *Modify|Selection Filter* and set the "Type" to **Area** and check the "Filter" check box. Make sure that all the other fields in this dialog say **[ALL]**. Click [OK].

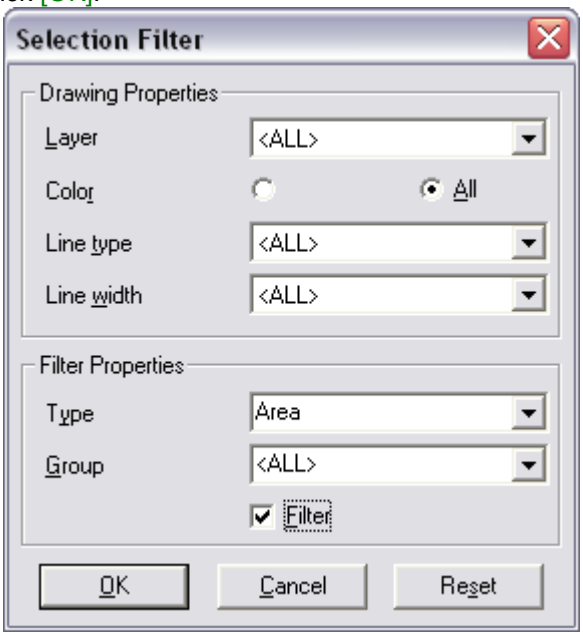


Figure SM 10

The filter ensures that only Irrigation Area items can be selected to make selecting the correct item easy.

3. Go to *Modify|Select Object* first and then click on the cyan Area boundary and then select *Tools|Sub-Divide Block*. In the "Slices" section, select "Number" and type in **3**. In the "Cuts" section, select "None". See Figure SM14.

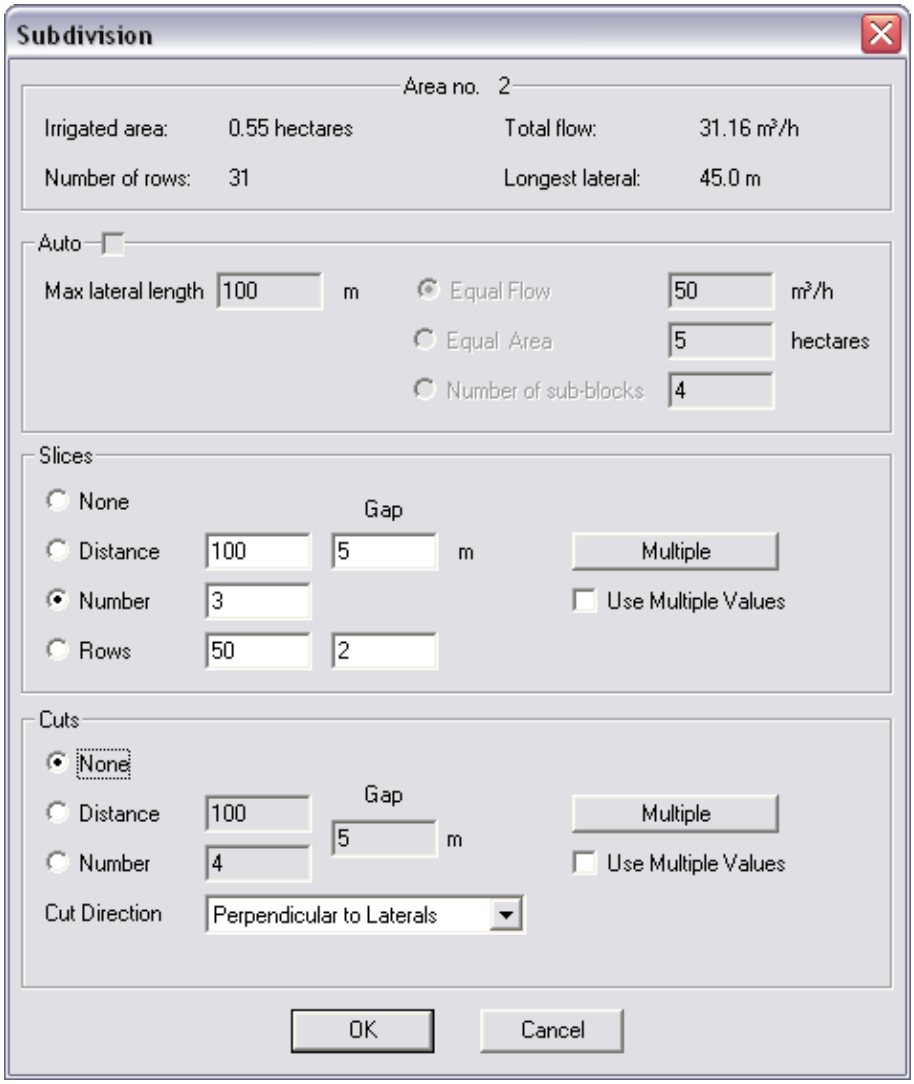


Figure SM 11

4. Click [OK]. A dialog will appear and a preview of the subdivision specified will be shown in the design view. Click the [Accept/View Changes] button to accept the subdivision. See Figure SM15.

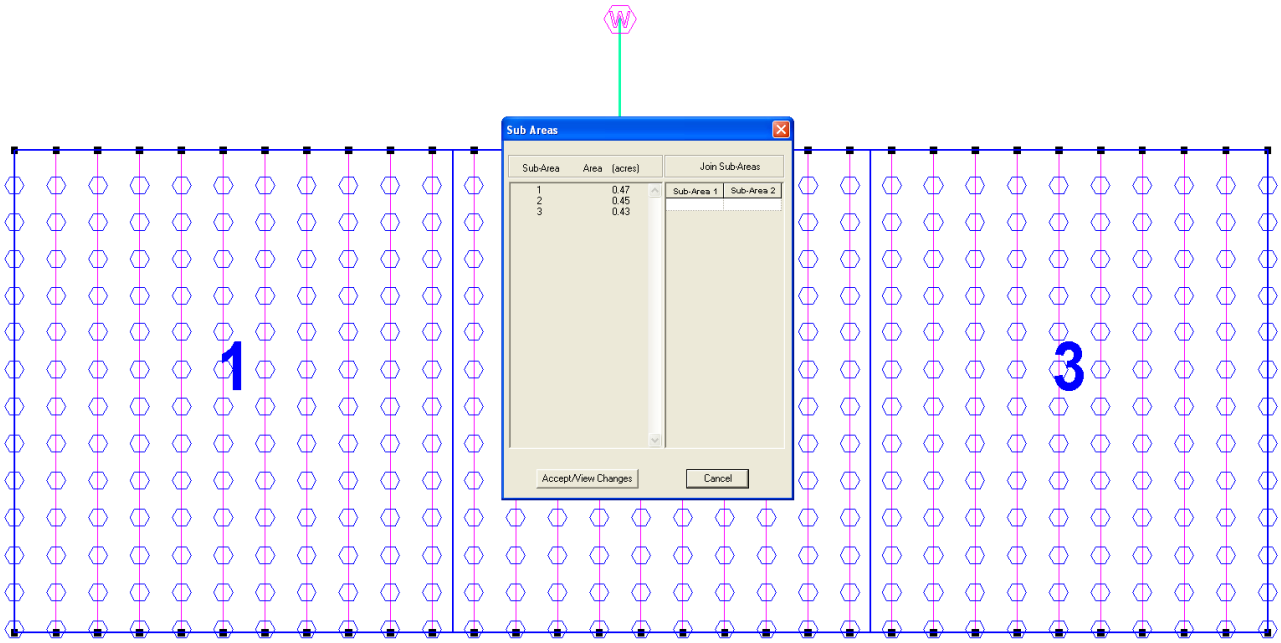


Figure SM 12

IRRICAD will automatically subdivide the block and connect submains and control valves to each new sub-block, thereby creating three new zones.

5. Now to go back to the *Selection Filter* and turn it off you can left-click on the red field at the bottom right of your status bar.

Figure SM 13

6. Now select *Tools|Connect Valves* for IRRICAD to automatically connect mainline pipe to the new valves. See Figure SM 17.

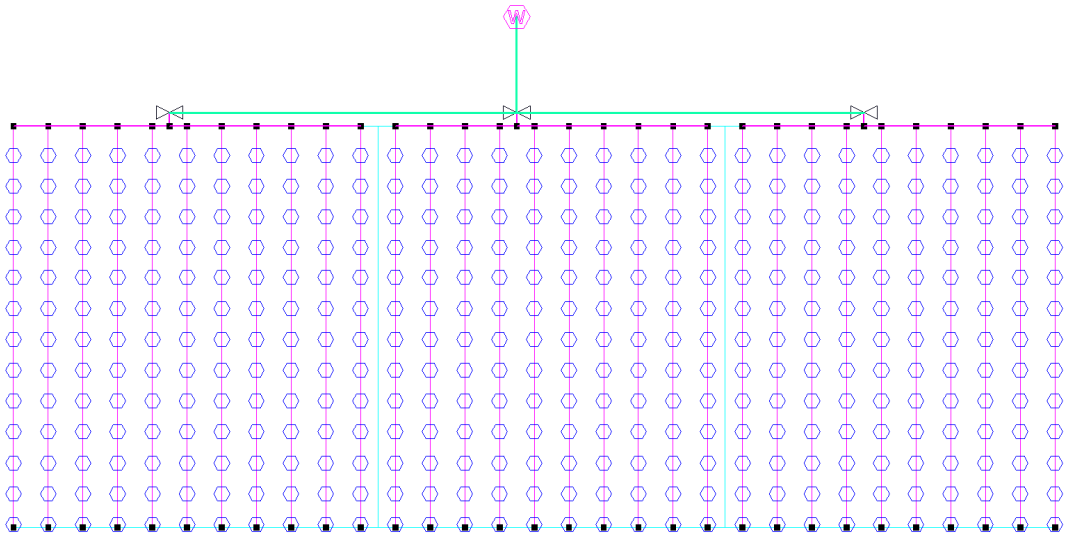


Figure SM 14

7. Now we will specify how the zones will be operated. As we want each zone to run by itself select *Design|Assign Each Zone to a Unique System Flow*. The dialog will automatically assign system flows to our zones. Note also that each zone has been given a new name based on the original block area name. See Figure SM 18. Click [OK].

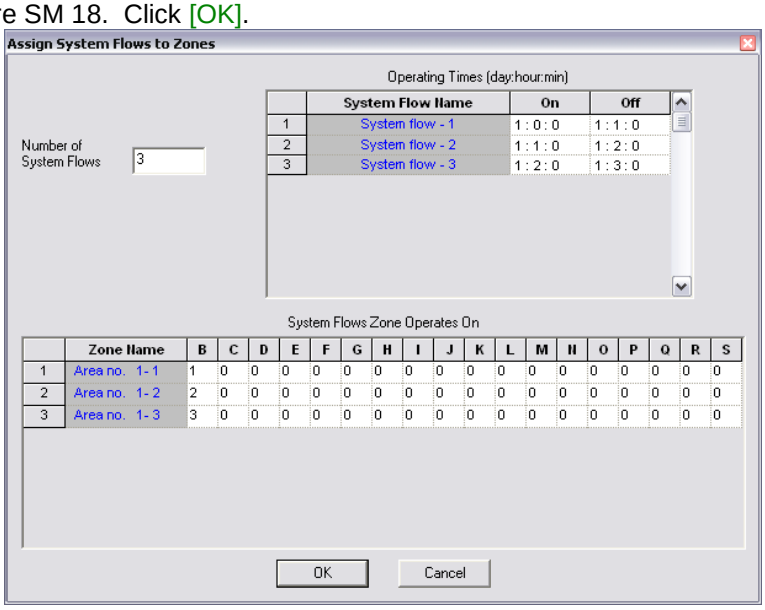


Figure SM 15

8. Select *Design|Zone Design|LP Design*. Once again you will notice that multiple submain sizes have been selected.

9. Go to *Design|Zone Design Configuration* and change the "Number of Submain Sizes" to **3** for all zones, rerun *Design|Zone Design|LP Design*.

10. Run *Design|Valve Analysis* and then *Design|Mainline Design|LP Design*. View the System Duty report when complete (*Reports|Mainline Design Reports|System Duty*), your results should look similar to Figure SM19.

Water Supply : Supply no. 1

Duty Number	On time	Off time	Pressure (m)	Flow (m3/h)
1	1: 0: 0	1 : 1 : 0	14.82	7.35
2	1: 1: 0	1 : 2 : 0	14.94	6.68
3	1: 2: 0	1 : 3 : 0	15.01	6.68

Figure SM 16

1.4.4.1 VALVES RUNNING TOGETHER

Throughout the above tutorials we have usually specified that all valves operate independently regardless of the number of valves in the system. We will now look at different scenarios where more than one valve is operating at the same time.

11. Select *Design|Assign Zones to System Flows*. Increase the total "Number of System Flows" to **4**. Click [OK] to refresh the screen and create a field for the new system flow. Leave the "Operating Times" as the default (the actual running time is unimportant in this case) and click [OK] again.

Now you can visually select which zones will operate on which system flow.

As Area no. 1-1 is already allocated to System Flow 1, Area no. 1-2 is already allocated to System Flow 2 and Area no. 1-3 is already allocated to System Flow 3, we simply need to add the 4th System Flow.

12. Now click on all three areas – 1-1, 1-2 and 1-3 one after the other with the mouse to highlight each area. Once again *Right-click|Assign to Sys Flow* and change the "System Flow Number" to **4**. Uncheck the "Replace existing system flows in Zones" check box. In this way we have specified that we want to allow for these three zones operating independently AND also at the same time. Click [OK].

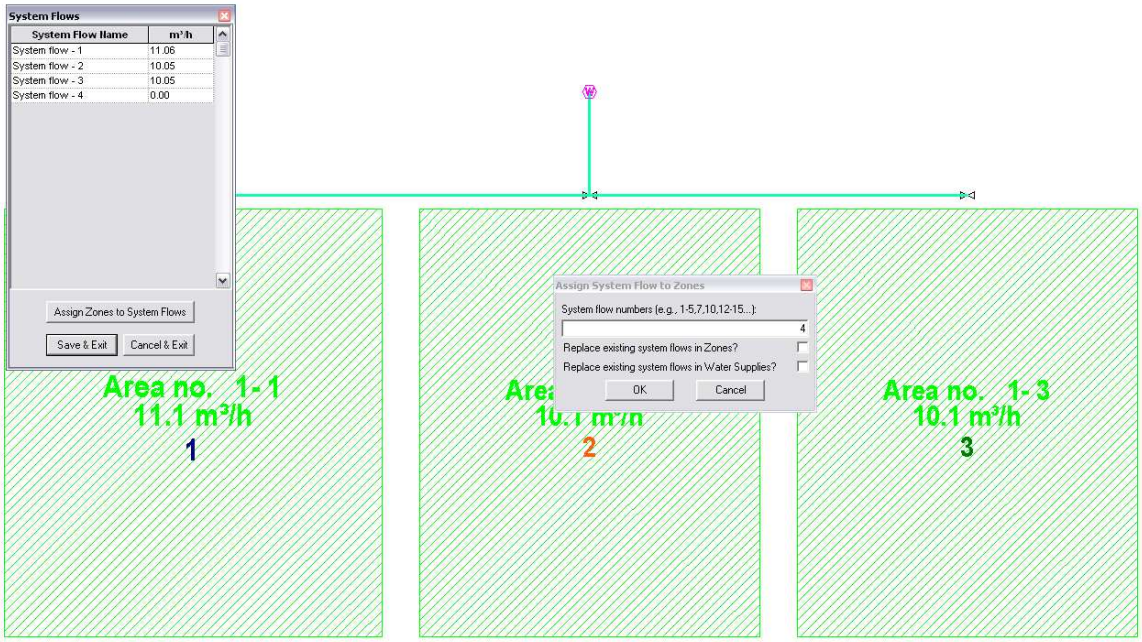


Figure SM 17

The "System Flows" dialog box should now show all three individual flows and also the combined flow of all three zones in System Flow 4. In addition, the symbols for the zones will display the system flows that they are assigned to. For example Area no. 1-1 is assigned to system flows 1 and 4. See Figure SM 21.

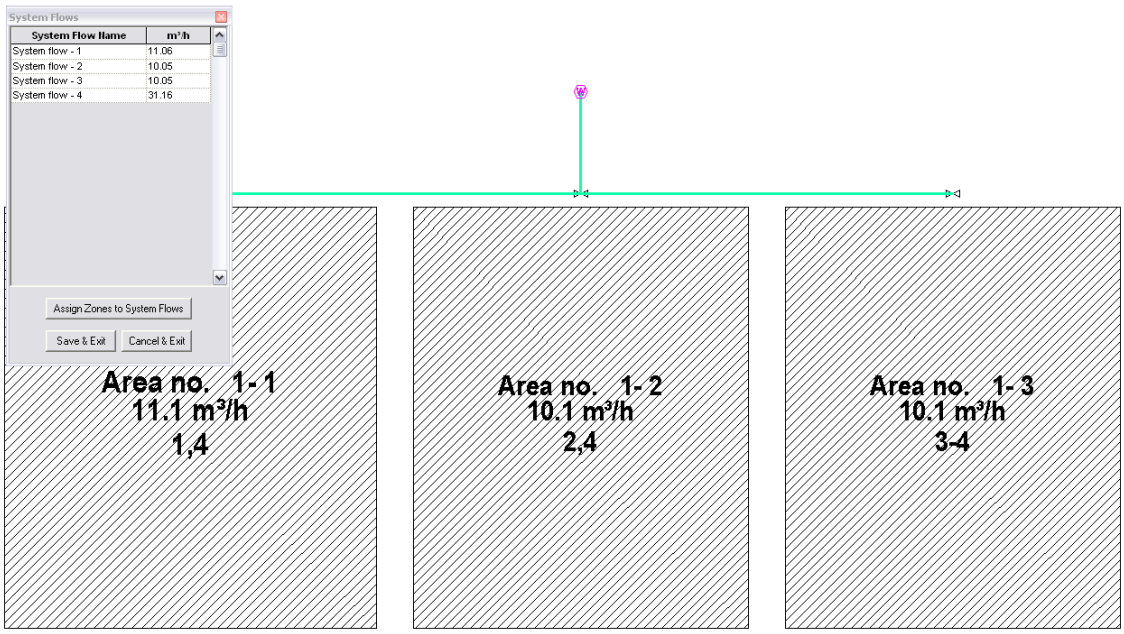


Figure SM 18

13. Re-run *Mainline Design|LP Design*. Note that you do not need to re-run *Zone Design* or Analysis since nothing has changed in the zones. However, you will need to run *LP Design* for *Mainline Design* because the required pipe sizes may well change with the different flow regime.

14. Now open the System Duty report (*Reports|Mainline Design Reports|System Duty*). Your results should look like Figure SM 22.

Water Supply : Supply no. 1

Duty Number	On time	Off time	Pressure (m)	Flow (m3/h)
1	1: 0: 0	1 : 1 : 0	14.44	7.35
2	1: 1: 0	1 : 2 : 0	14.36	6.68
3	1: 2: 0	1 : 3 : 0	14.47	6.68
4	1: 3: 0	1 : 4 : 0	14.62	20.72

Figure SM 19

1.4.4.2 TASKS COMPLETED IN THIS TUTORIAL:

- Deleting items
- Running more than one valve
- Managing multi-valves in Design
- Limiting the number of pipes selected
- Valves running at the same time

Note this tutorial could be repeated using the *Zone|Tape Irrigation Block* tool for Drip tape blocks.

1.4.5 USING COMPUTER SELECTION OF FITTINGS

Tasks covered in this tutorial:

- Changing more than one item at the same time
- Setting up Riser Selection Rules
- Running Computer Selection of Fittings
- Using the Bill of Materials Reports

Complete the above tutorial (A Simple Orchard Design with Multiple Valves) if you have not done so already.

1.4.5.1 SETTING UP

We will now have a quick look at IRRICAD completing the fitting selection for us. We have kept the above tutorials relatively simple, but to receive a bill of materials that is useable, we do need to put the pipes at their relative depths so the correct fittings are selected.

1. Select the whole drawing by using *Modify|Select All*. Now select the *Modify|Change Type* tool and click on one of the mainline pipes e.g. the pipe coming down from the water supply. In the dialog box enter a "Depth" of **600** and click [OK].

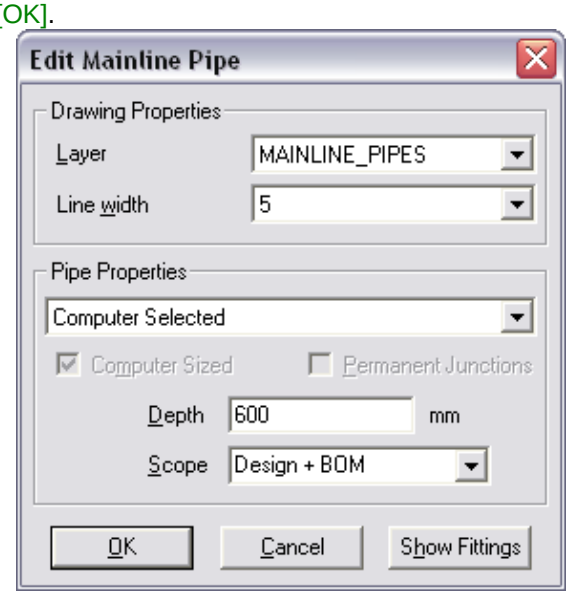


Figure CS 1

2. The next dialog box helps us to filter those items we want to change. Uncheck "Pipe" in the "Match" column.

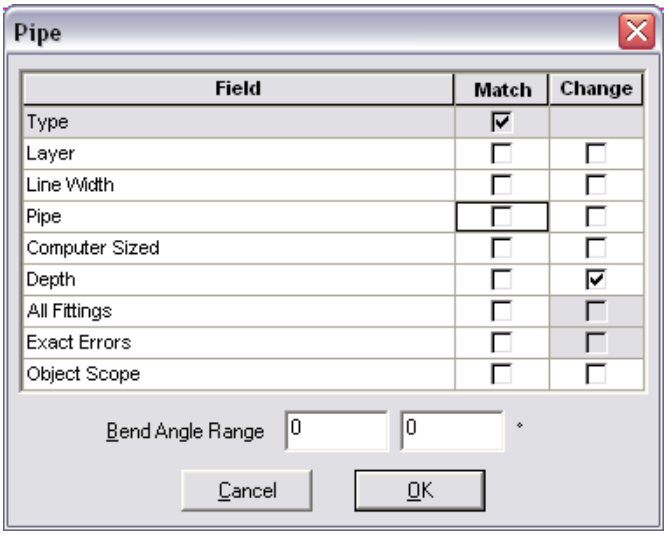


Figure CS 2

This means that all pipes will be changed, not only the same size ones as the one we clicked on. As we want both the Zone (excludes spraylines) and the Mainline pipes to change to the same depth, we will not specify that it has to match the same layer as the pipe we clicked on. See Figure CS 1. The only item checked is "Depth" in the "Change" column.

3. Click [OK]. The Status Bar will tell you how many items matched the criteria and therefore how many were changed. It should be 37. Now our mainline and submains are all at this depth.

Next we want to change the height of the control valves. You may or may not do this out in the field however, a height difference between the valves and the spraylines means you can have specific rules for each group.

4. Once again *Select All* and then click on one of the valves. In the dialog box enter **-100** as the "Depth" of the valve will be just above ground level. Click [OK].

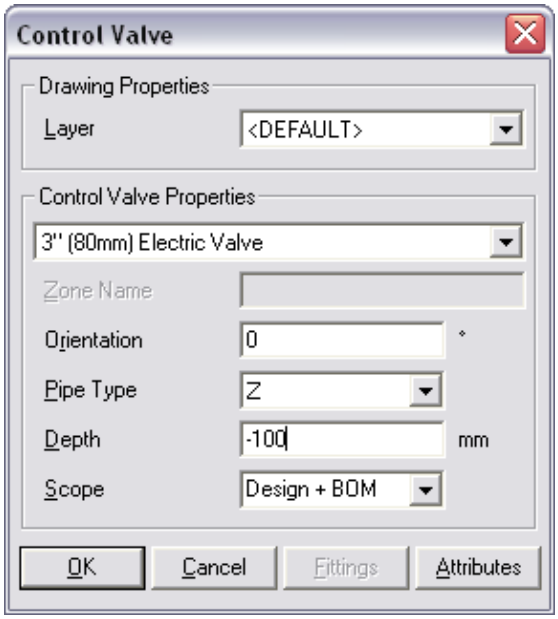


Figure CS 3

5. In this case it doesn't matter if you match the valves or not as all three are the same. Make sure the "Change" "Depth" is checked before clicking [OK] as in Figure CS 4. The Status bar should say 3 matched.

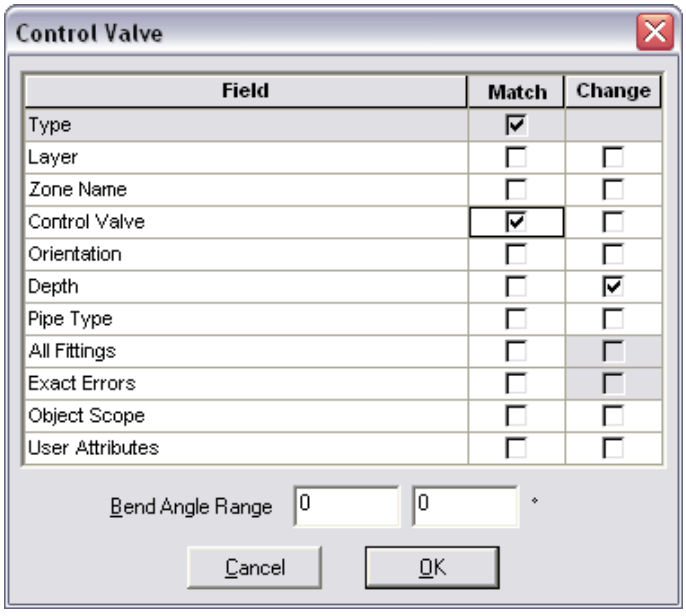


Figure CS 4

1.4.5.2 RISER SELECTION RULES

Riser selection rules enable us to change the rules to how we want risers selected or by specifying the riser ourselves.

If the *Rules* are not changed, IRRICAD will assume that the diameter of the vertical riser pipe is equal to the diameter of the largest pipe or valve at the higher of the two depths being connected. IRRICAD will also assume that the type of material for the riser pipe is the same as the largest item at the lower of the two depths. (Size of the Top and Type of the Bottom).

However, usually in Sprayline blocks or Tape blocks we have specific ideas of what the riser should be. This means we will need to change the rules or select a specific riser from the Pipe database.

4. Select *Design|Riser Selection Rules*. "Depth 1" is always the top depth, in this case **0** as this is the depth of the spraylines. "Depth 2" is the depth of the submain so type in **600**. To have the riser the same size and type as the Sprayline itself we will leave **Rule** checked for "Riser" and also check **Top** for "Size" and **Top** for "Type". See Figure CS 5.

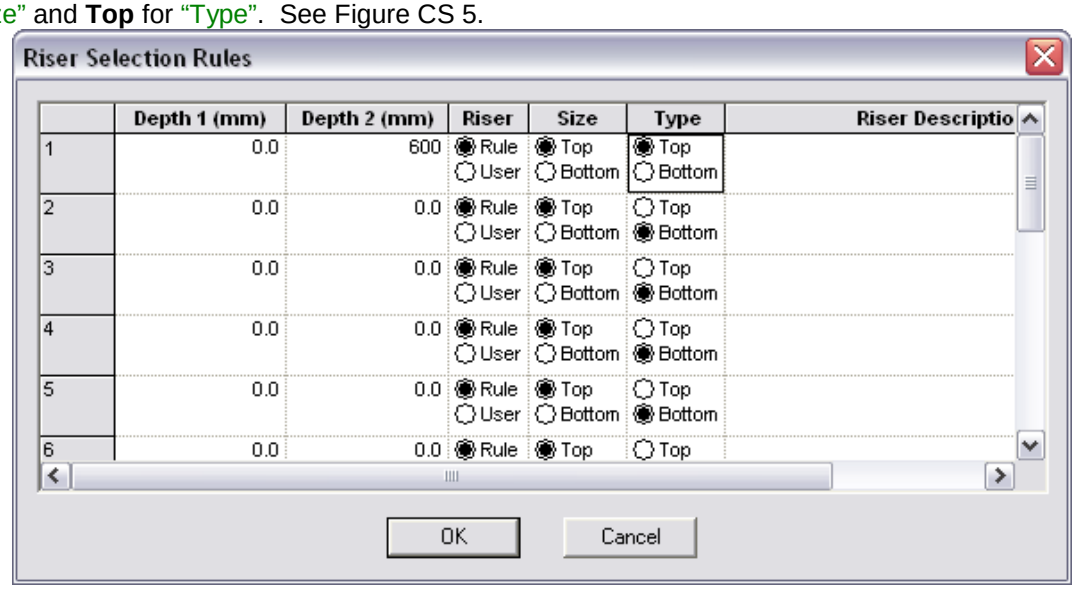


Figure CS 5

However we wish to specify a particular riser to be selected. Select **User** for "Riser" and then selected the **3/4" (20mm) Polyethylene Hose** as the riser we wish use in this sort of design. Then the size and type of what is in the block ignored when selecting a riser from the pipe database.

5. Now we can set the "Rule" for the control valves. Set "Depth 1" to **-100** and "Depth 2" as **600**. As our riser is going to be the same size and type as the submain itself so we will leave **Rule** checked for "Riser" and also check **Top** for "Size" and **Bottom** for "Type". See Figure CS 6.

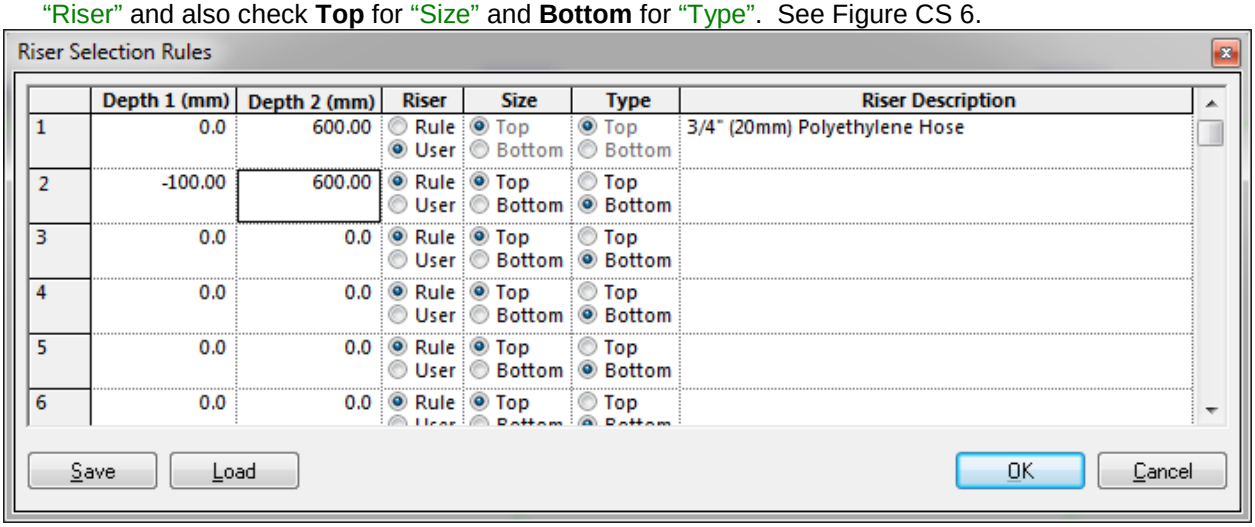


Figure CS 6

If we had left the valves at ground level then the ¾" riser would have been selected to join the valves on the pipes. Having the valves at a different depth stops this.

6. Now you are ready to run *Design|Computer Selection of Fittings*. Once this is done have a look at the *Report|Costing/BOM Reports*. There are several to choose from and these can be printed as required.

7. You can zoom into a junction and using *Select Object*, highlight the junction and by using *Change* can access the [Show Fittings] button on the junction dialog to see the the fittings IRRICAD has selected to solve that junction. Note if there is no suitable lateral take-off in the database enabled for selection a tee will be selected instead.

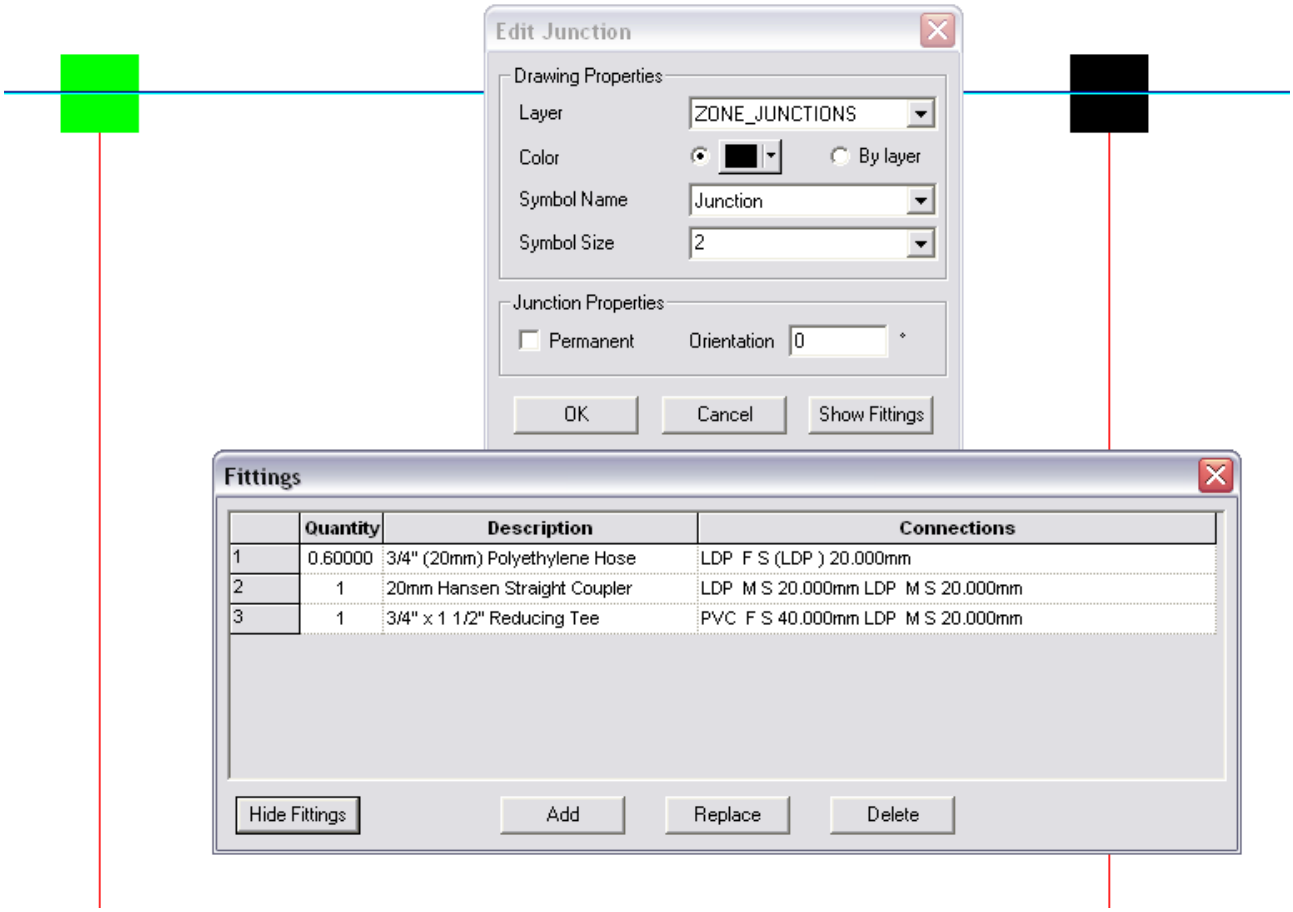


Figure CS 7

1.4.5.3 TASKS COMPLETED IN THIS TUTORIAL:

- Setting up Riser Selection Rules
- Running Computer Selection of Fittings
- Using the Bill of Materials Reports

1.4.6 SIMPLE K-LINE DESIGN

Tasks covered in this tutorial:

- Turning off layers
- Changing the default name for control valves
- Drawing unconnected spraylines
- Methods to draw the drag hose length for K-lines

1.4.6.1 DRAWING THE SYSTEM

1. Open the design **K-line.des** by selecting *File|Open* and highlighting the required design. Click [Open]. This is the outline of a property. The left-hand side of the property will be irrigated via K-line systems.

2. This design uses our agricultural database **Agricultural.mdb** and you may need to browse for it your \IRRICAD Pro 14\Designs folder.

3. Highlight the solid drawing line present by using *Select Object*. Convert to mainline pipes by selecting *Mainline|Pipe*. Leave the "Pipe Properties" as **Computer Selected**. Click [OK]. The highlighted lines will be converted to mainline pipes.

4. Zoom in to the Well area by using *Zoom|Window*. Place the well using *Mainline|Water Supply,* leaving all the fields at **0**.

5. The drawing lines are on the "Temporary" layer so you can turn these off once the mainline is drawn by selecting and unchecking the "Show" check box for the TEMPORARY layer in the Layer Bar on the right-hand side of your screen or in *Settings|Layers.*

6. Select the *Settings|Miscellaneous* and change the "Design Size" to **Large**. Click [OK].

7. Go to *Settings|Names* and change the "Default Zone Name" from Zone No. ~~~ to **Hydrant** ~~~. Click [OK].

8. Select *Zone|Control Valve* and select the **Camlock 50mm Hydrant**. Click [OK]. Place a control valve on all four ends of the vertical mainline pipes as in Figure KL1.

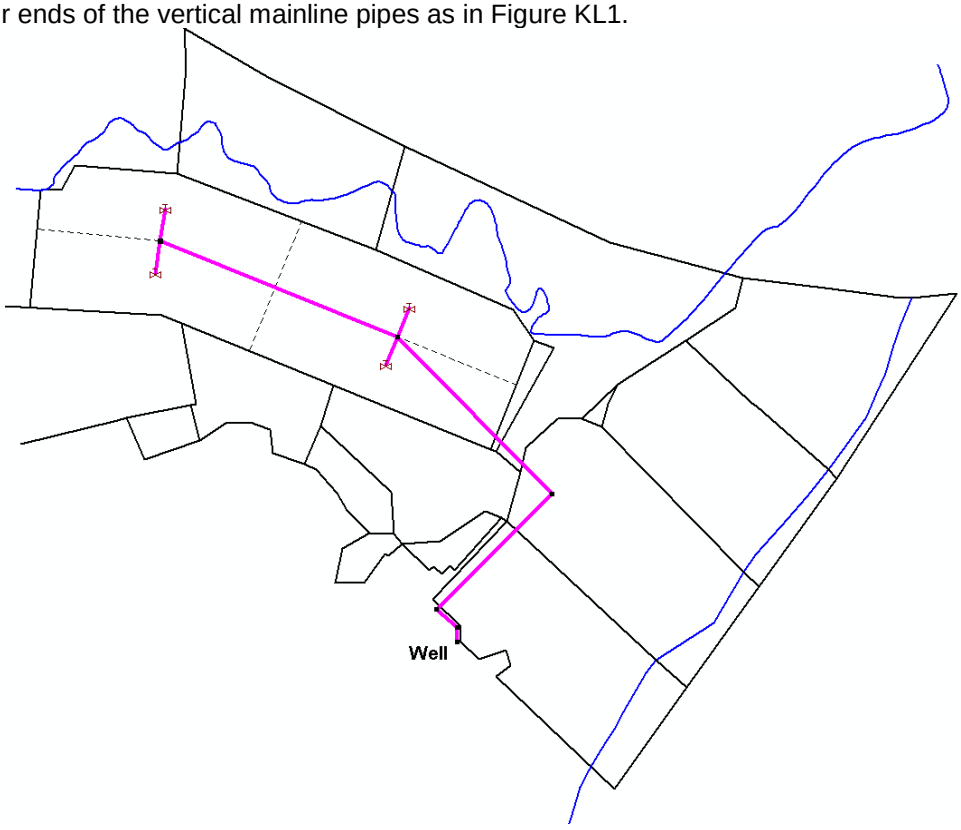


Figure KL 1

We will use an unconnected sprayline to draw the K-lines. Remember that an unconnected sprayline is simply a tool to draw evenly spaced sprinklers and pipe in one action. We draw K-lines as unconnected spraylines because there are only a small number of sprinklers on each line.

8. Select *Zone|Sprayline* and leave the pipe as "Computer Selected" (you can select the pipe size but if you wish to have a combination of 40mm and 32mm LDP pipe then you can let IRRICAD design it. Also, I know that there is a high chance that IRRICAD will select these pipe sizes for the K-lines so it is quicker to let IRRICAD design them and make any changes later than try and work out where the change in hose size should take place manually).

9. Select the **K-Line Naan 5022** as the "Sprinkler" and the **Orange 2.8mm** as the "Nozzle" for this particular design. Enter the "Pressure" as **30m**. Do not select a "Riser", but enter the "Outlet spacing" as **15m**.

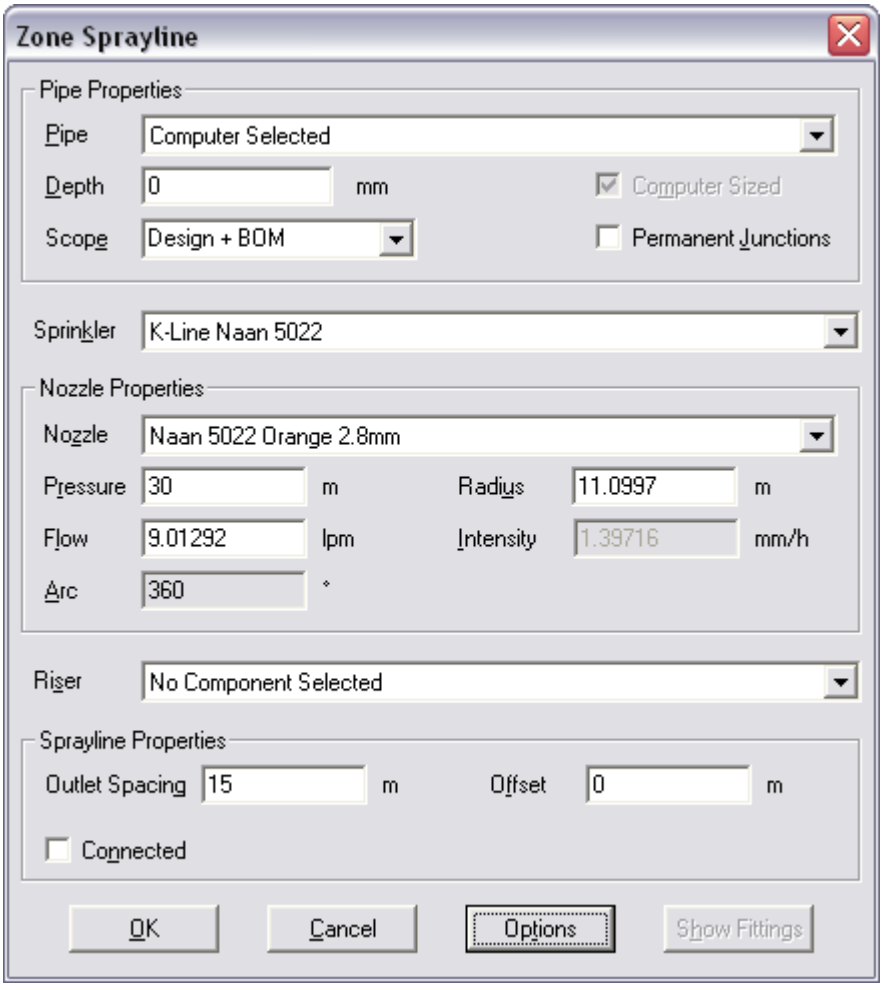


Figure KL 2

There are two ways to draw K-lines:

A. Know what the drag hose length is for each e.g. **50m** (based on the longest length of the paddock) and enter this as the "Offset" in the *Sprayline* dialog. Now when you draw each K-line starting at the hydrant, the first 50m will be hose only. Delete the extra outlets and pipe on the end of the K-line to have the correct number of pods.
B. Draw your K-line first (no "Offset" entered in the dialog) along the furthest edge of the paddock. Delete any extra outlets and pipe on the end closest to the hydrant. Select *Zone|Pipe* and draw in the drag hose, connecting to each K-line to the hydrant. This method is usually used if you do not know the length required for the drag hose, or if the drag hose length varies for each sprayline.

We will use the second method for this design as the drag hose length varies.

10. Uncheck the "Connected" check box. Click the [Options] button and make sure the "Fixed Spacing" option is checked. Click [OK] on both dialogs. You will receive a message about the outlet spacing as it is less than 40% (where 50% is head-to head spacing).

11. Use *Zoom|Window* to zoom in to the top left-hand hydrant area. Draw the first K-line along the top fence line starting at the far end, making sure that you have at least 7 pods on this line (as pre-determined by paddock size, required precipitation, etc). Finish the K-line by selecting *Right-Click|Restart*. Now delete any extra pods or lengths of pipe on the side closest to the hydrant. Select *Zone|Pipe* and connect the last sprinkler to the hydrant as in Figure KL 3.

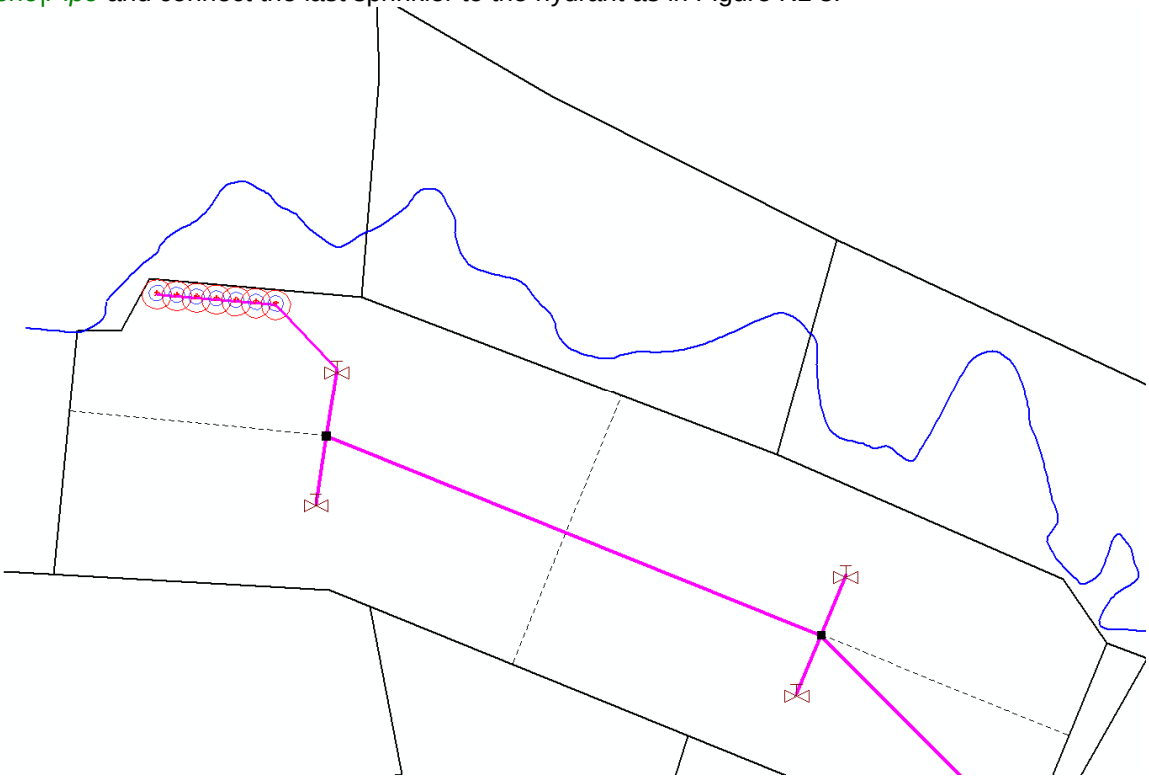


Figure KL 3

12. This hydrant will also have a K-line running in the opposite direction, with 8 pods on it. Also now enter two K-lines for the bottom left hydrant with 7 pods each, as in KL4. You can use *Reports|Show Flow* and draw a lasso around the K-line to determine the number of outlets within the lasso. It is also quicker the draw all the K-lines, making sure there are at least or more of the required pods on each, then delete the unnecessary outlets and pipe on all, then draw in the drag hose. You can move the entire sprayline to position it in its block by using *Modify|Select|Window* and *Modify|Move*.

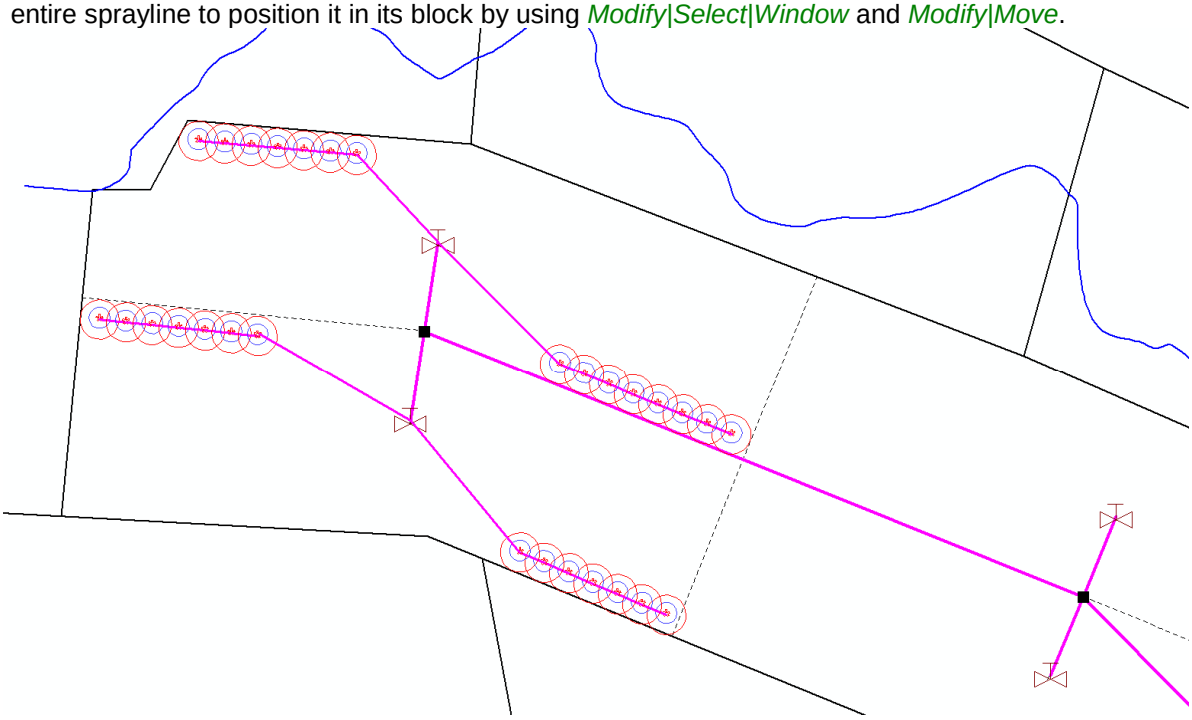


Figure KL 4

13. Repeat the process for the remaining two hydrants, both hydrants feed two K-lines and all K-lines have 7 pods. See Figure KL5.

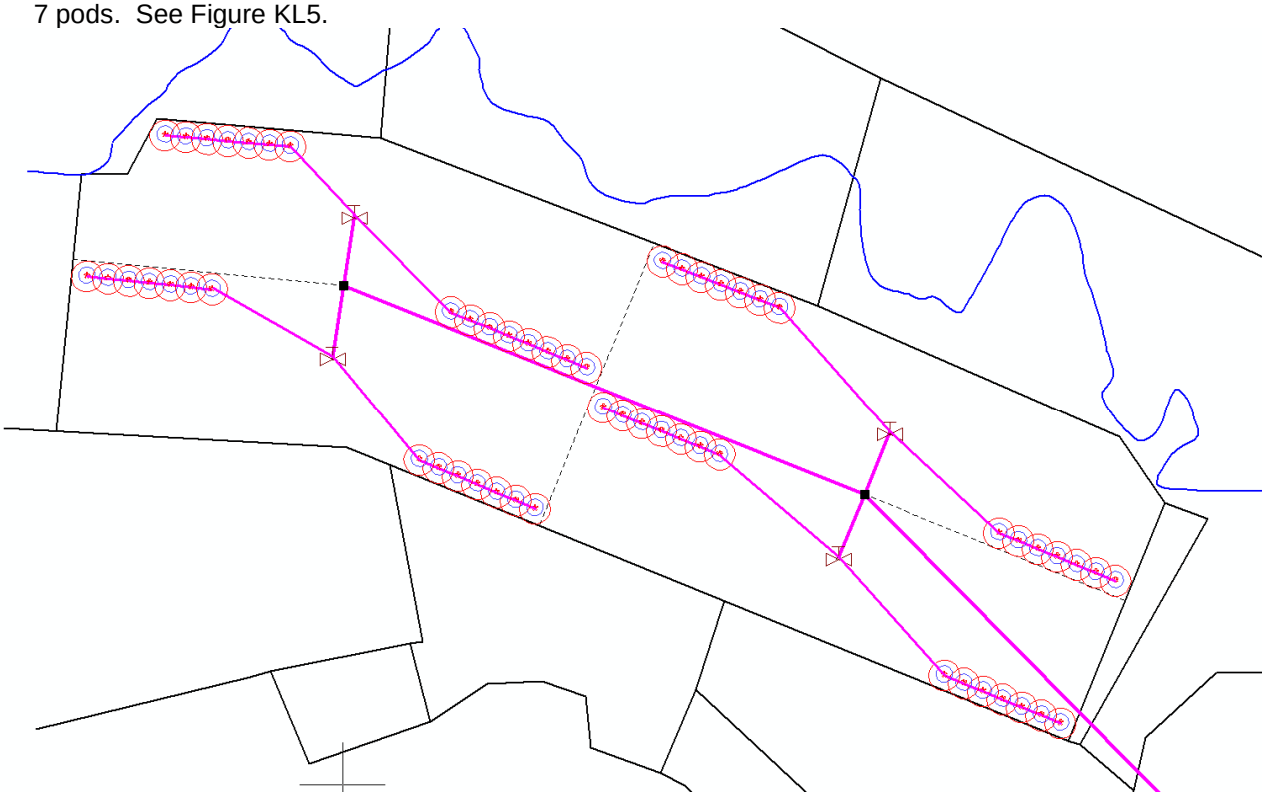


Figure KL 5

1.4.6.2 THE DESIGN PROCESS

14. Select *Design|Zone Design|LP Design* to size the K-lines. IRRICAD has selected a combination of 40mm low-density pipe and 32mm low-density pipe.

15. Most K-lines systems are managed so that all K-lines are running at once. Select *Design|All Zone to One System Flow*. The table should look like Figure KL6, where all four zones are operating together.

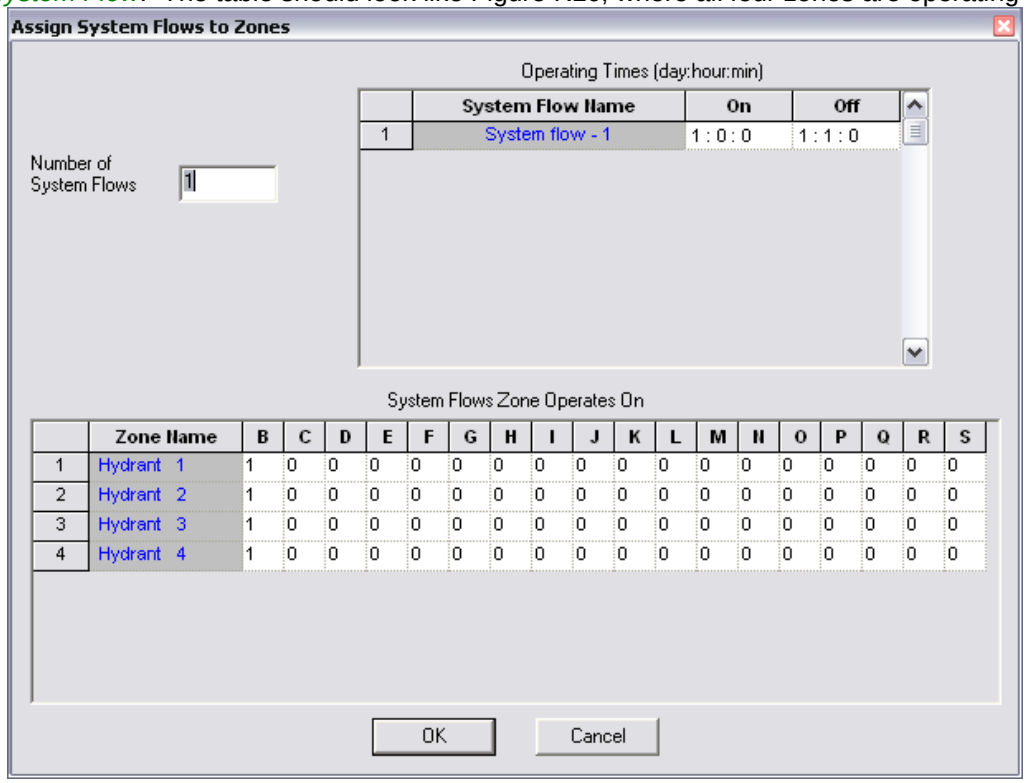


Figure KL 6

16. Select *Design|Mainline Design|LP Design* to size the mainline.

1.4.7 ADVANCED K-LINE DESIGN

What if you have some K-line hydrants that may not be used? You may have 10 k-lines but 15 hydrants, depending where on the farm you might want to concentrate watering at differing seasons.

For a fittings & materials point of view, you want to have these hydrants on the design but they physically won't be doing anything during the design process. If we used the same hydrant (from Control Valves), and leave out attaching a k-line, then IRRICAD will tell you that a particular hydrant (or zone) does not have any outlets and it cannot complete Design.

The solution is to have a replica of the hydrant in the Misc. Hydraulic database. This means that when used on the design the correct fittings and materials will be selected but Design will not complain as Misc. Hydraulic objects can be placed anywhere on the design, providing they are selected from the correct dropdown list and attached to the correct type of pipe (Zone or Mainline).

However if you need IRRICAD to size the pipe, or you need to produce hydraulic reporting for this section, enter the hydrants and *Mainline|Outlet* demand points.

Notes

1.5 MAINLINE DESIGNS

A mainline design can be any pipe delivery system from a rural water supply, stock water reticulation, etc.

The difference between a mainline design and the designs we have looked at previously is that a mainline design has the valve and outlet in one. Normally a system is laid out with a water supply, some mainline pipe, control valves, some zone pipe and then zone outlets, where the control valves are the connection between zone and mainline items and the on / off control for each zone. In a mainline design we have a water supply, mainline pipe and mainline outlets. Each mainline outlet is seen by IRRICAD as a valve-in-head outlet – i.e. has its own on / off control. Therefore each mainline outlet is the zone and control valve all in one. The principles behind IRRICAD design have not changed; it is simply that the zone items and control valve are condensed into one object.

In terms of the designs and analysis of a mainline design, zone design is still required before running mainline design options.

These tutorials assume you have completed at least the Basic Start chapters and the Simple Design Tutorials. These tutorials assume you know how to select items, connect items, and select the working database and the units of preference.

1.5.1 USING DEMAND POINTS

Demand points are used most often in mainline designs. The common use of demand points may be in large golf designs where it is known how much pressure and flow is required at certain points, or large agricultural designs where a hydrant is required to have a specific pressure and flow.

Demand points are only useful if you know the pressure and flow required at a particular point. Remember that hydraulic analysis is only as correct as the information you put in. Demand points can be used to make a quick mainline analysis. Remember that Demand Points have no Pressure/Flow relationship and are simply going to supply the pressure and flow you put in, with the limits set in the database for that particular demand point.

Notes

1.5.2 A RURAL WATER SUPPLY

1. Double click on the Irricad icon or select *Start|Programs|Irricad|IRRICAD Pro 14* to start IRRICAD. If already running IRRICAD select *File|New* to start with a clean screen.

2. In *Settings|Irrigation – Design Specific* [Browse] for the tutorial database **Tutorial.mdb**. This should be found in the \IRRICAD Pro 14\database folder.

3. Go to the *Units* tab and click the [Metric] button to restore the default units for this tutorial. For this tutorial change the "Outlet Flow" to **lph**.

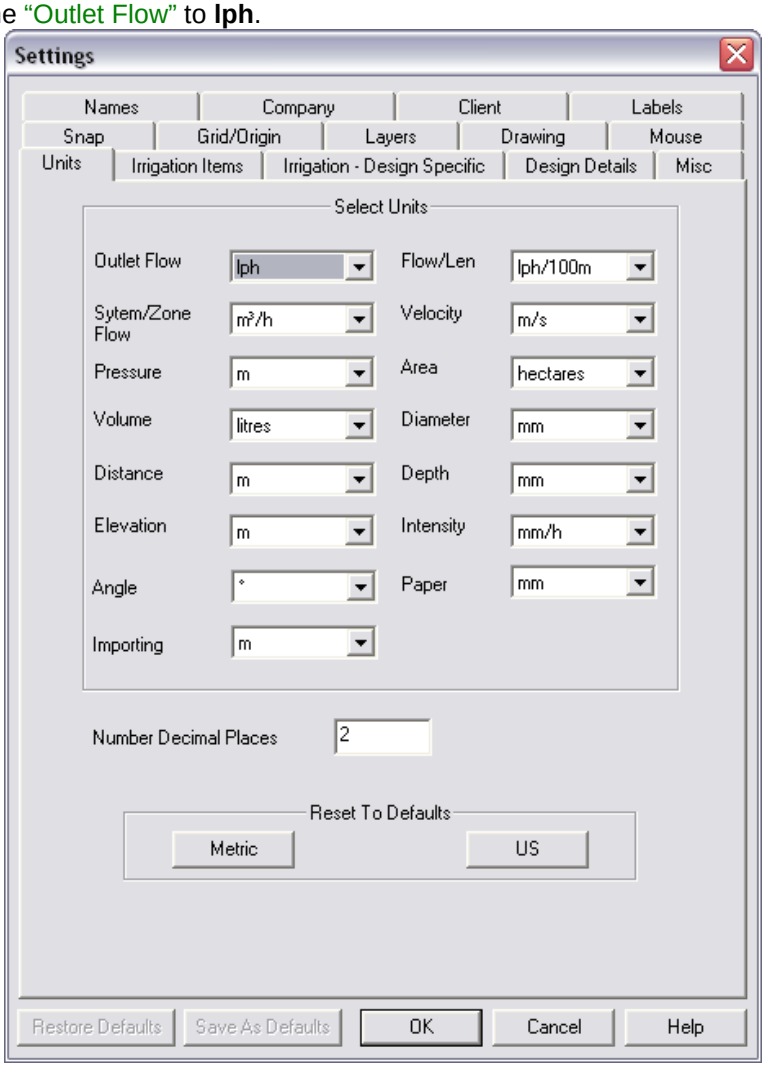


Figure RW 1

1.5.2.1 DRAWING THE LAYOUT OF THE SYSTEM

4. Select *Mainline|Water Supply* and place the water supply on the screen, near the right-hand side. Leave the entries as **0**, so that IRRICAD will calculate the system duty for the system you draw. Click [OK] to accept and close the dialog.

5. Select *Mainline|Pipe*. Leave the pipe as "Computer Selected" so that IRRICAD will select the pipe size for you. Click [OK] and click in the centre of the water supply to place the start point of the pipe (left click on the screen). The pipe will rubberband with the cursor until you place the end point or next point of a pipe (if the pipe is bent). The pipe tool is like a continuous line tool and will rubberband between points until you end the pipe by selecting *Right-Click|Restart*.

6. Select *Mainline|Outlet* and select **Demand Flow**. This type of outlet is called a Demand Point. It does not have a pressure / flow relationship but simply allows us to specify the flow and pressure required at a particular point. Enter **30m** and **5m^3/h**. Click [OK].

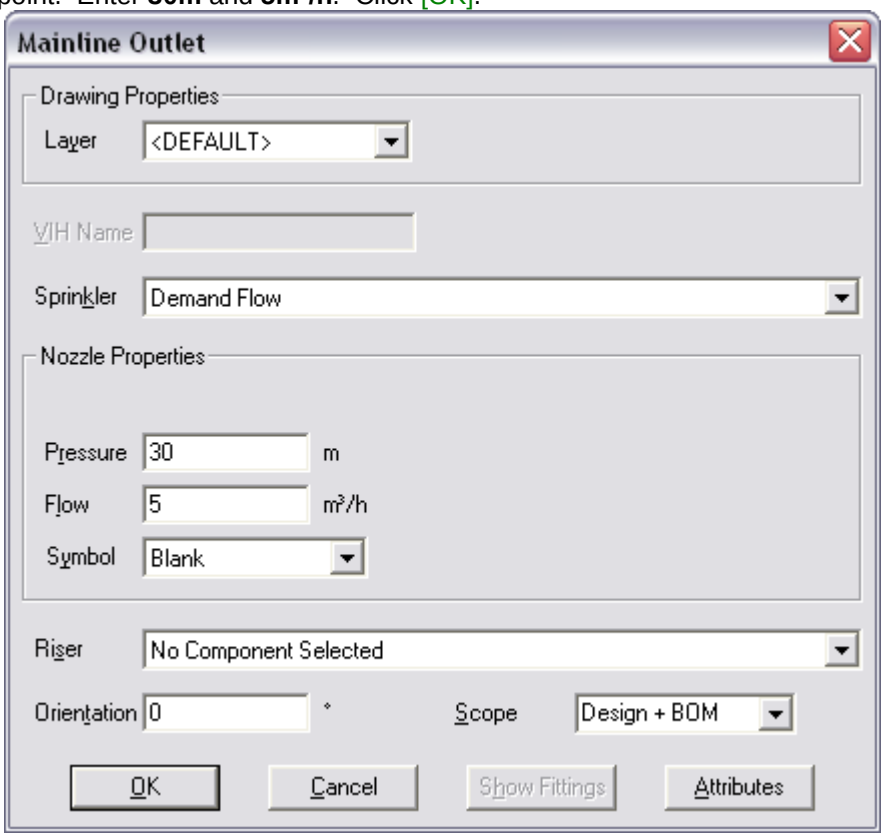


Figure RW 2

7. Left click on the mainline pipe where you wish to place a demand point or node. The outlet will automatically connect to the pipe. You will need to assign each outlet a zone name. Accept the default names for each node placed. Place 3 to 4 outlets as in Figure RW 3.

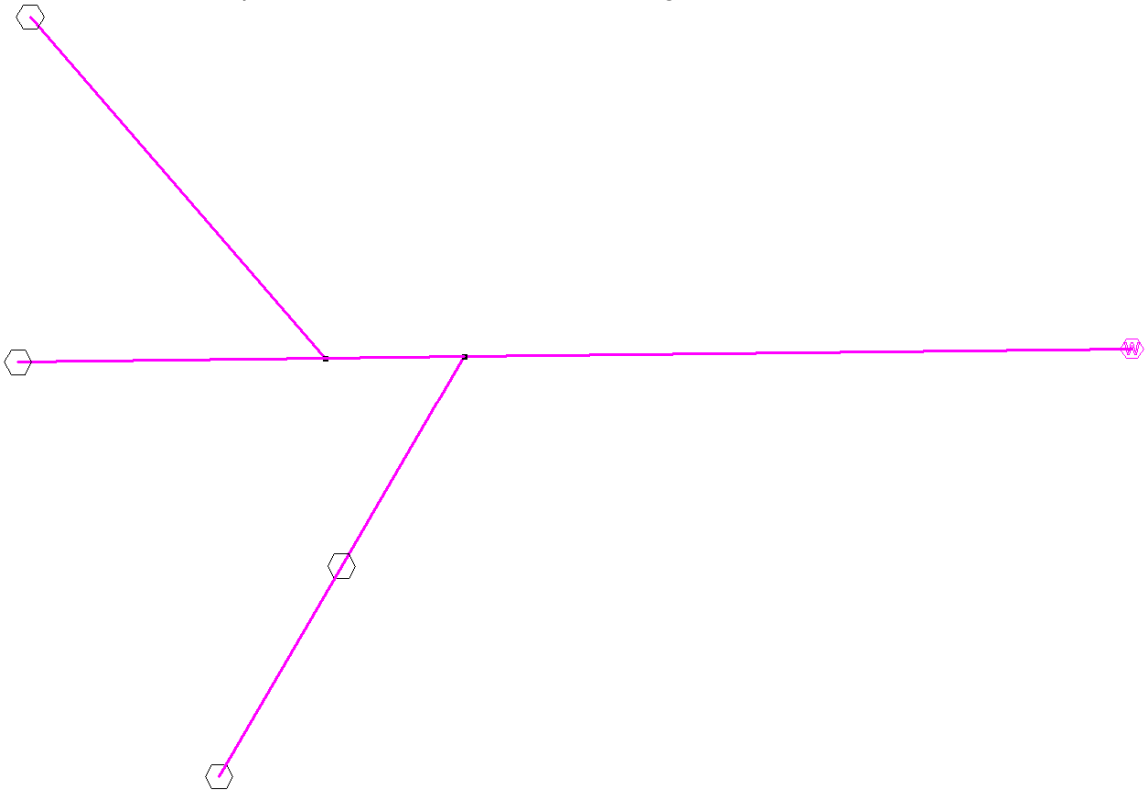


Figure RW 3

1.5.2.2 DESIGN

8. First, select *Design|Check Outlet Connectivity* to make sure that all outlets are connected to the water supply via mainline pipes. If you receive no messages, continue with design.

If you do receive messages, check you cannot see a black pipe junction where the water supply or outlets connect to pipes. Pipes require pipe junctions, but where point objects connect, the junction should disappear. If an outlet is not connected, highlight the outlet by selecting *Modify|Select Object* and clicking on the outlet. Then select *Modify|Move* and move the outlet until the centre of the outlet is central to the black junction and left-click. The black junction will disappear when the outlet is connected. If you are still having problems, make sure the default snap mode in *Settings|Snap* is set to "Connect".

9. Even though we only have mainline items present in the design, we will still need to analyse the zones so the mainline knows what it will be sized or analysed for. Select *Design|Zone Design|Analyse*. This should be quite quick.

10. Once all outlets are placed we must tell IRRICAD how the system is to run. We call this Management. If all nodes are to run at one time (as is assumed the usual or the worst case scenario for rural water supply systems) select *Design|Assign All Zones to One System Flow*. IRRICAD will automatically fill out the table with 1 system flow running for a default time of 1 hour (the running time is not important, we just want to know what happens when it is running) and all zones assigned to run on system flow 1. Click [OK].

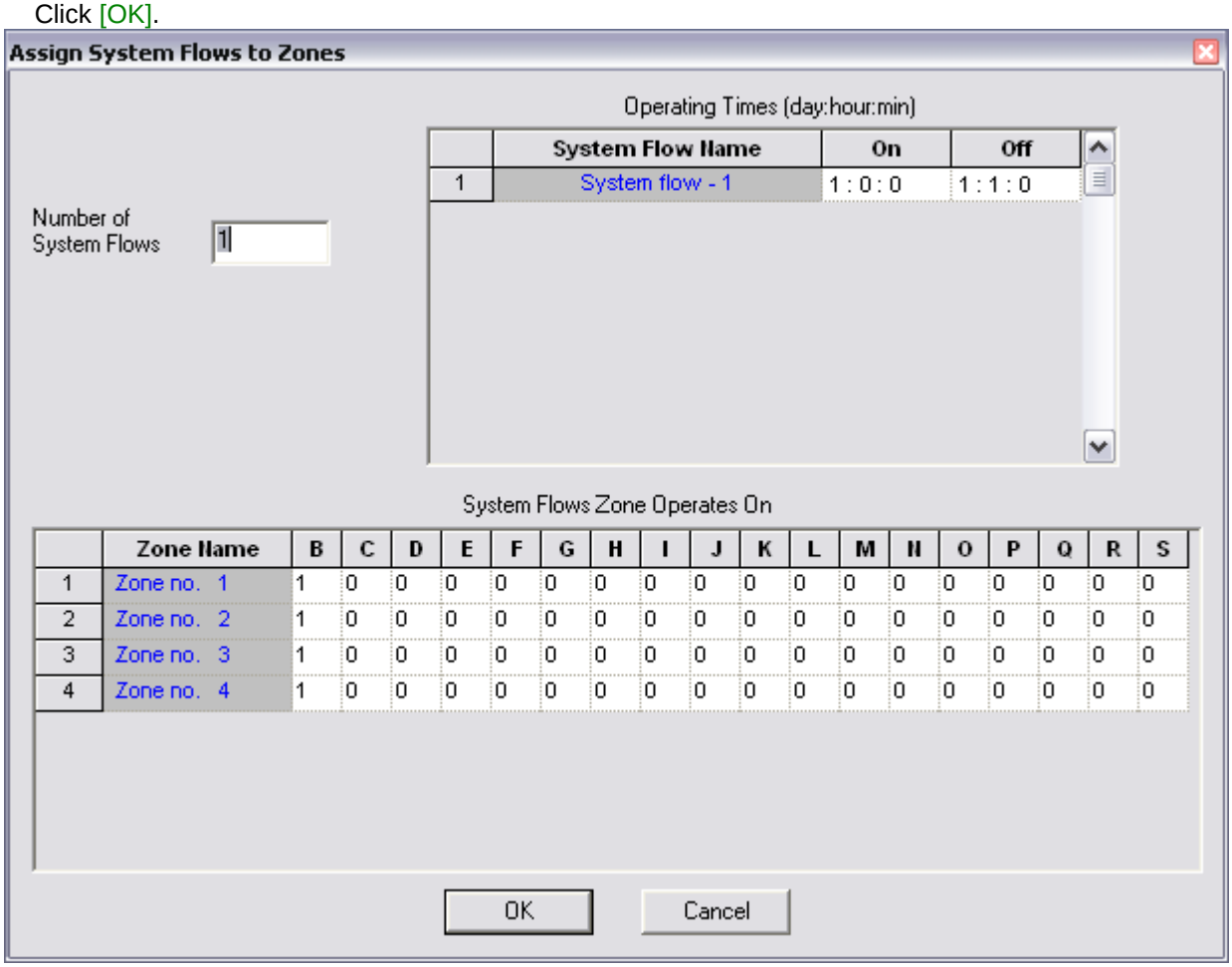


Figure RW 4

11. Now select *Design|Mainline Design|LP Design*. LP design a computer design option that will select pipes based on the pressure required at the outlet.

12. Now view the reports.

Because this is a mainline design, the mainline design reports will be most useful. Select *Reports|Mainline Design Reports|System Duty Report*. IRRICAD reports the pressure and flow required at the water supply to run the system you have designed. A pump can be sized from this data. The *Mainline Full Report* is useful if you wish to know the velocity in the pipes, length of pipes and head difference. The *Mainline Summary Report* gives a summary of actual and required pressures at the zone control valve. The *Mainline Pipe Report* lists the pressures in the pipes, and also lists the elevations of start and end point so the pipes.

1.5.2.3 VARIATIONS

A. Draw some contours or spot heights on the design. Elevation information can also be imported using *File|Import Contours*. Keep in mind that the elevation information needs to span all hydraulic input. Now redesign the system and view the reports.

B. Size the pipes using *Design|Mainline Design|Velocity Design*. You can set the maximum mainline velocity in *Design|Design Parameters|Hydraulic Parameters*. Keep in mind that *Velocity Design* does not know about the pressure that you are trying to achieve at the outlet. It is simply choosing a pipe size which will achieve a velocity as close as possible to the maximum allowable velocity set.

C. Run *Design|Computer Selection of Fittings*. IRRICAD will find fittings for each junction.

D. Note you do not have to layout a design in a specific order. You can place the nodes first, then pipe than water supply if you wish. IRRICAD is very flexible until the design section where management is required, then zone design, then control valve analysis, and then mainline design in that order. Remember the items available in the tutorial database are only a small set of items available in full IRRICAD databases. Databases are also easily changed or added to.

Notes

1.5.3 A SIMPLE TRAVELLING IRRIGATOR DESIGN

After having drawn or imported the necessary background information it is time to layout the system.

As this is a mainline design all the hydraulic items are selected from the *Mainline* menu for input. The *Sprayline* tool can be used for correctly spacing the hydrants. No control valves are used in this design as the *Mainline Outlets* are the on / off control.

1. Open the Travelling Irrigator design by selecting *File|Open* and browsing for the **Travelling Irrigator.des** file. Highlight the file and click [Open]. This design uses our agricultural database **Agricultural.mdb** and you may need to browse for in the \IRRICAD Pro 14\Design folder. This design shows the outline of the property and the placement of the proposed mainline.

2. Start with placing the water supply on top of the spot height at the centre of the main block (at co-ordinates 345,331). Leave the fields at **0** so IRRICAD calculates the system duty for us.

3. Now select *Mainline|Sprayline* (alternatively you can select *Mainline|Outlet*, place the outlets and then connect with *Mainline|Pipe*). Leave the pipe as "Computer Selected" and select the "Sprinkler" as **TurboRain Irrigator**. Select the "Nozzle" as **38L/S 360** and leave the "Pressure" as **24m**. The method we are using for this travelling irrigator design allows for the pressure loss through the turbine of approx. 7m, 3m height lift to the boom and an operating pressure of 14m at the actual sprinkler (Nelson Rotators) (7+3+14 = 24m). Type in a "Radius" of **105m**. Select the **200m 127mm Angus hose (+2m)** as the "Riser" or outlet connector. This item has an extra 2m added to the headloss calculation to cover any hydrant losses or other minimal losses. Enter the "Outlet Spacing" as **105m**. Click the [Options] button and uncheck the "Fixed Spacing" check box so the hydrants will be evenly spaced along the length of this mainline. Click [OK] on both dialogs (note you will receive 2 warnings that can be ignored. They are merely warning messages about the expected spacing not error messages – click [Yes] to ignore).

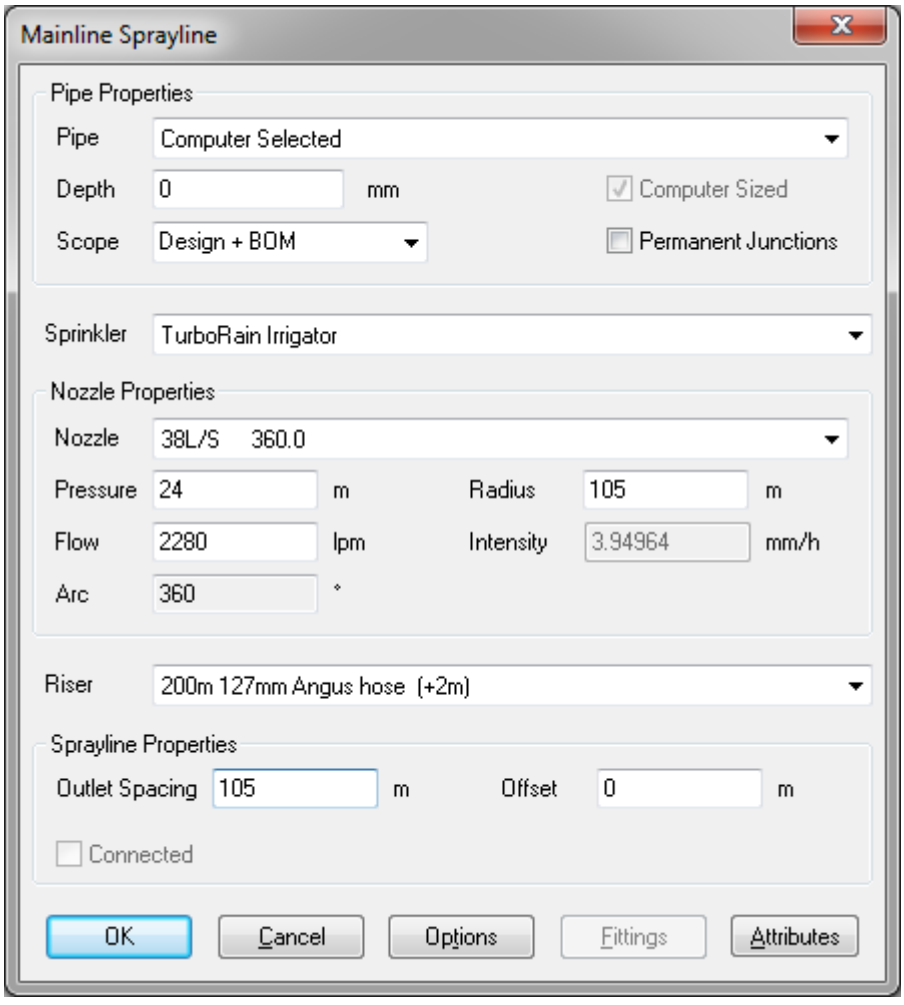


Figure TI 1

4. Start the sprayline at the top of the far left vertical line and finish the sprayline at the bottom of this far left line. Select *Right-Click|Restart* to finish the pipe. The sprayline will be automatically named Sprayline 1 - ^^, where each outlet placed will be called Sprayline 1 – 1, Sprayline 1 – 2 and so on.

5. Select *Mainline|Sprayline* again and change the "Radius" and "Outlet Spacing" to **100m**. Click [OK]. Start the next sprayline 3rd vertical line from the left. You should now have 5 hydrants here named Sprayline 2 – 1, Sprayline 2 – 2 and so on. Lastly, run the short sprayline on the last vertical line. You should have 3 hydrants named Sprayline 3 – 1, Sprayline 3 – 2 and Sprayline 3 – 3. You system should look like Figure TI 2.

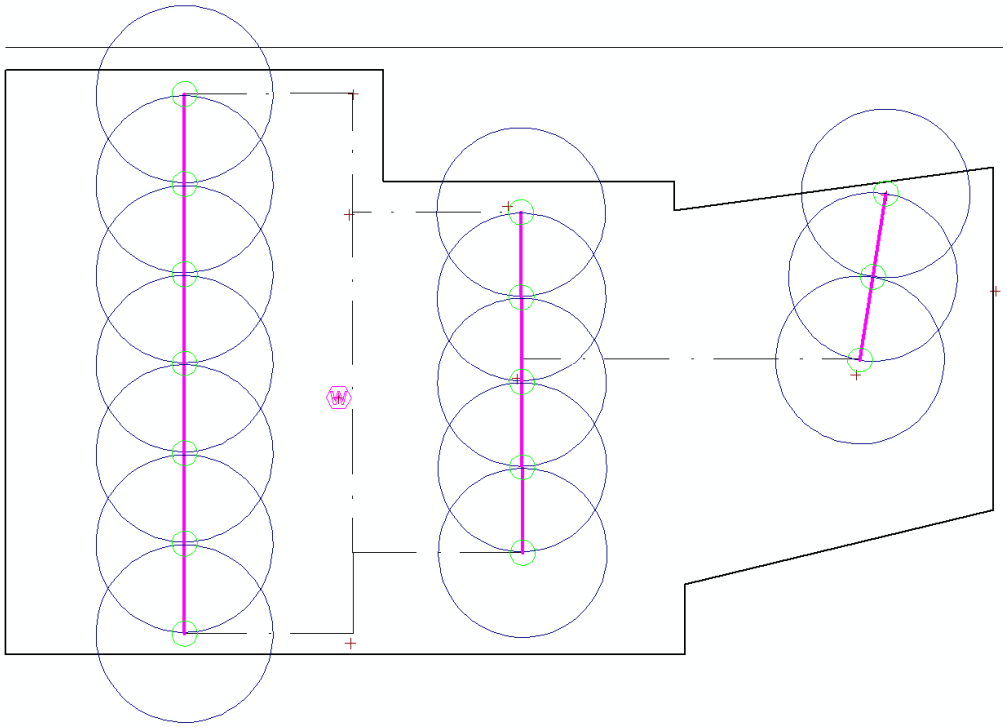


Figure TI 2

6. Now select *Mainline|Pipe* and run the pipe along the lines given, connecting the existing hydrants and pipe to each other. Connect the water supply to the closest pipe as in Figure TI 3.

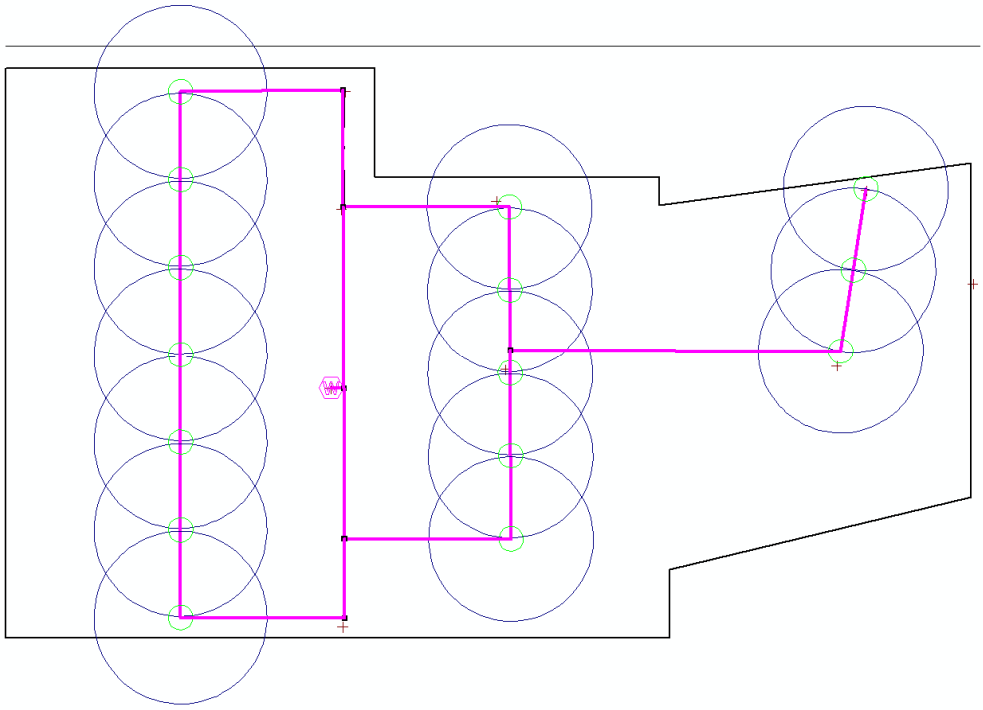


Figure TI 3

7. Because this is a mainline design, we only need to analyse the zone as no zone pipe exists to size. Select *Design|Zone Design|Analyse*. Select *Design|Valve Analysis*.

8. Select *Design|Assign Each Zone to a Unique System Flow* as each hydrant will be operating separately (only one irrigator owned). There are 15 system flows – 1 for each zone / hydrant as in Figure TI 4. Click [OK].

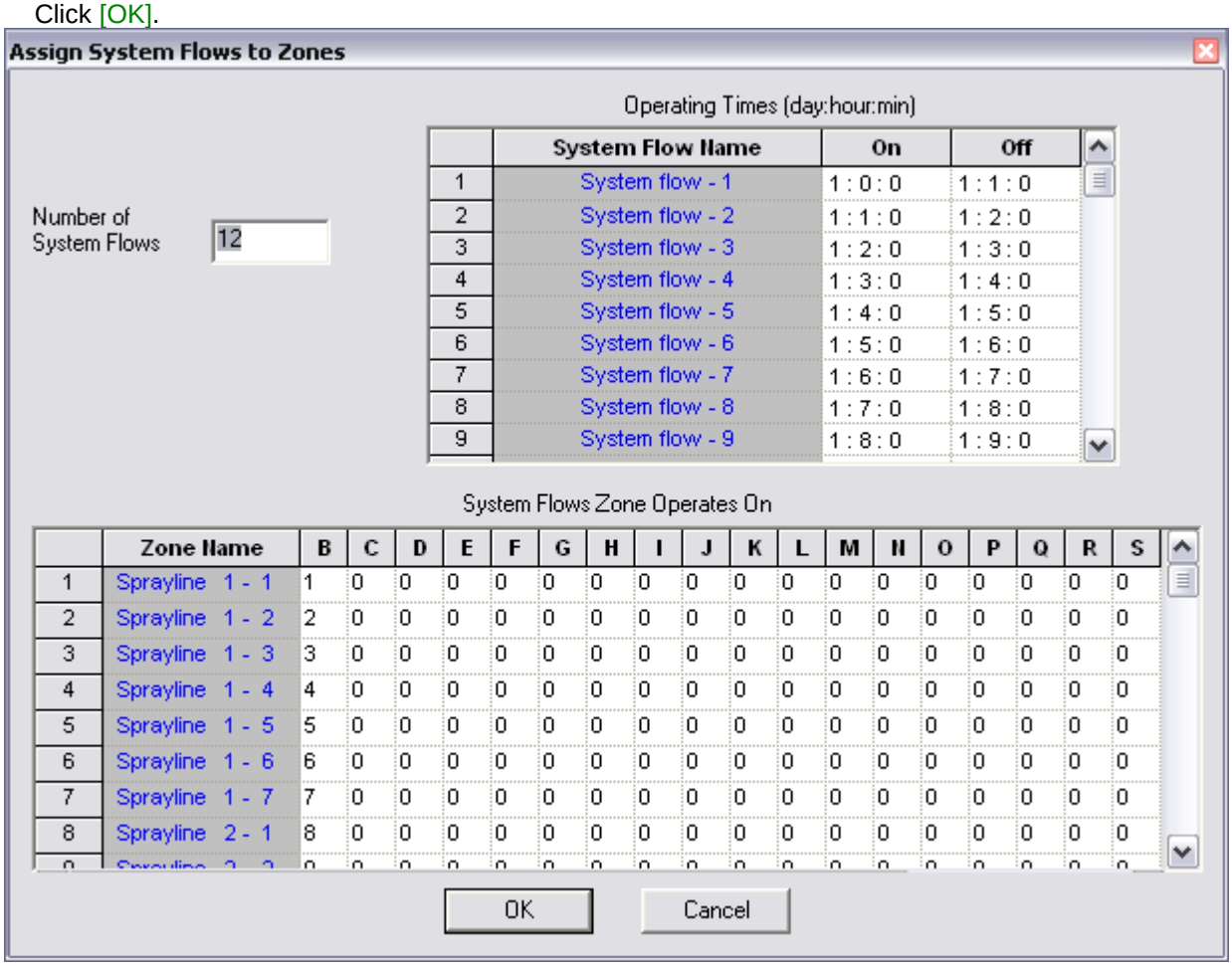


Figure TI 4

9. Because this is a looped system, Velocity Design must be used if sizing pipes. Select *Design|Mainline Design|Velocity Design*.

Remember that Velocity Design only chooses pipe sizes based on the maximum mainline velocity (trying to get as close to the maximum as possible). Because of this, it is not uncommon for the outlets to be below or over pressure. The TurboRain outlet used here has a tolerance of 5% below and 90% above the nominal pressure (24m) entered in the dialog. This tolerance range can be tightened in the database for that outlet. In many cases Velocity Design is a starting point and you can change the pipes manually until you are happy with the results.

1.5.3.1 More Than One Irrigator Running at One Time

If the property above has more than one irrigator then any two hydrants may be operating at the same time. Because we have 15 hydrants, and the two irrigators could be operating anywhere, according to the property owner we need to analyse or design for these situations. It would be quite a long process to try to analyse every conceivable combination of the two irrigators so we will use what we call Partial Management.

Partial Management allows us to select a number of combinations that we would view as 'worst case'. This may the irrigators working as far apart as possible, next to each other at the far end of the property or close to the water supply (if too much pressure is viewed as a worst case).

We have decided to have 6 worst case scenarios, hence we have 6 system flows. Our first scenario will be 3-1 and 1-1 operating together, our second will be 3-1 and 1-7 operating together. These two scenarios cover the case if the hydrants are working far away from each other. The next cases will be if the irrigators are working in the same area e.g. 3-1 and 3-2, 1-1 and 1-2, 1-1 and 1-7, 2-1 and 2-2.

System Flow or Scenario	Hydrants running together
1	3-1, 1-1
2	3-1, 1-7
3	3-1, 3-2
4	1-1, 1-2
5	1-1, 1-7
6	2-1, 2-2
7	1-6, 1-7
8	1-3, 1-4

10. Now that we have clearly marked out our system flows, we need to edit the *Design|Other Management Options/Assign System Flows to Zones* table so that only the above zones / hydrants are running on each allocated system flow as in Figure TI 5.

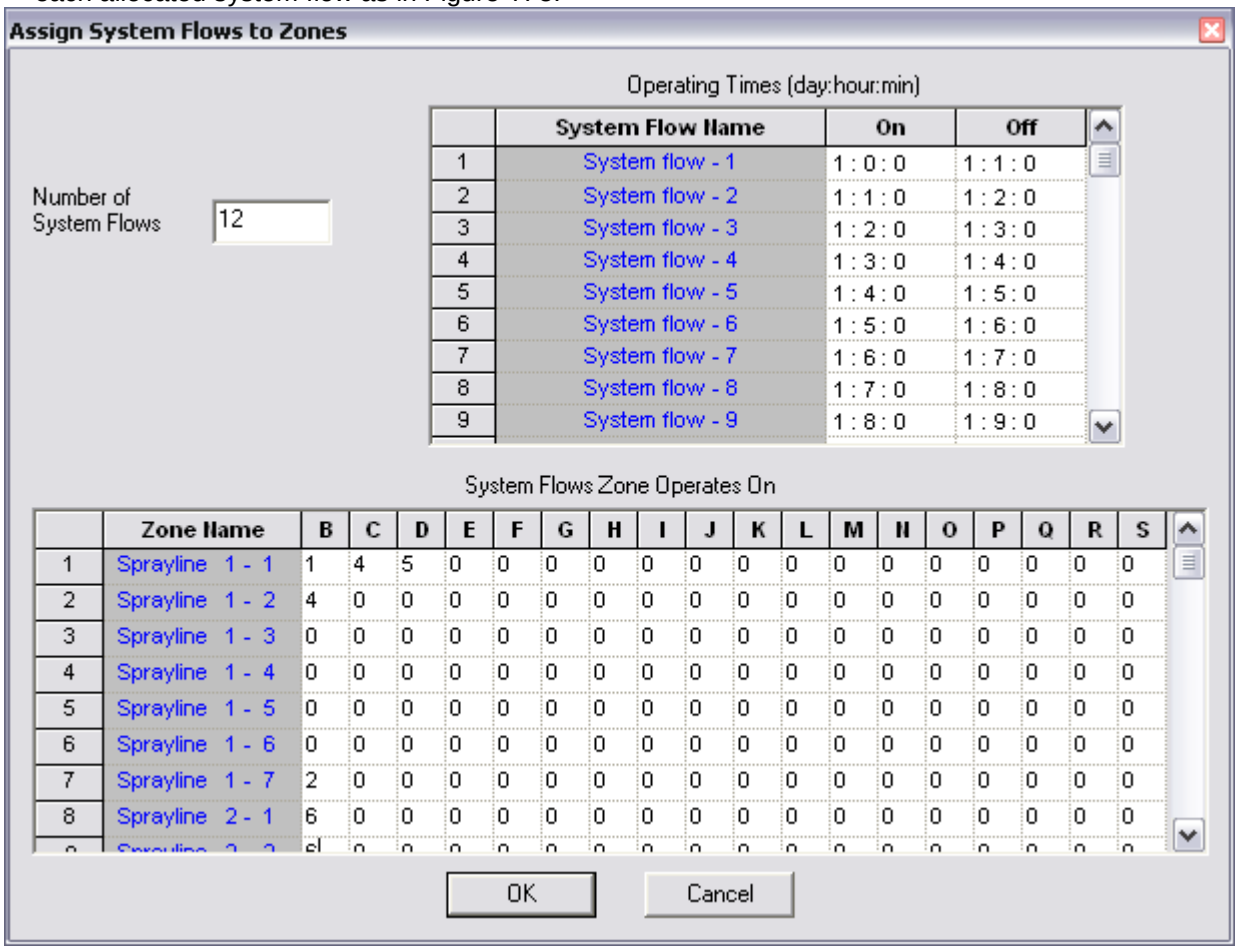


Figure TI 5

11. Click [OK] and click [Yes] to the warning message. This message appears because some zones have not been allocated to a system flow. It just checks in case you meant to have assigned all zones.

12. Now run *Design|Mainline Design|Velocity Design*. Open the *Reports|Mainline Design Reports|System Duty Report* to find the worst case scenario. Your *System Duty Report* should look similar to Figure TI 6. As you can see all the results are fairly similar in this system.

Water Supply : Supply no. 1

Duty Number	On time	Off time	Pressure (m)	Flow (m3/h)
1	1: 0: 0	1 : 1 : 0	53.97	273.60
2	1: 1: 0	1 : 2 : 0	53.06	273.60
3	1: 2: 0	1 : 3 : 0	56.01	273.60
4	1: 3: 0	1 : 4 : 0	52.00	273.60
5	1: 4: 0	1 : 5 : 0	51.57	273.60
6	1: 5: 0	1 : 6 : 0	51.65	273.60

Figure TI 6

The *Reports|Management Reports|System Flow Report* is helpful in listing which zones are running together and is a good check.

Notes

1.6 DATABASE AND FITTING SELECTION

Fitting Selection is a great tool to save time and produce a complete Bill of Materials without tearing your hair out! IRRICAD uses rules to solve junctions with fittings so if it can't find the fittings it needs it will list the unsolved junctions at the end of any Bill of Materials report or Costing report.

1.6.1 CUSTOMISING YOUR DATABASE

Using the Irricad database editor, new items can be added to the database, deleted from the database, turned on or off for selection or edited. The on-line help or the hard copy manual explain the fields in database item dialogs so you can easily enter your own items or customise the existing items.

1. Enter a new pipe by running the database editor (*Start|Programs|Irricad|Irricad Pro Database Editor*) and clicking on the New Pipe button. (Note the database the editor opens with is your default database – set in IRRICAD in *Settings|Irrigation – Design Specific* and clicking the [Save As Default] button).

2. A usage code is required for all items in the database if you want to be able to select this item in IRRICAD, either manually or during design or fitting selection. Most items have a Yes, No usage code, but pipes are designated to be used for either Laterals, Zone pipes or Mainline pipes. Laterals are connected spraylines, zone pipes are any pipes (other than laterals) used downstream from a control valve, and mainline pipes are all pipes used upstream from a control valve. Pipes can have more than one usage code; any combination of L, Z or M you wish. If the usage code is blank then this item cannot be used or selected.

3. Enter a name for your pipe, describing its basic qualities e.g. 50mm PVC Class 6. Now enter a unique warehouse code for the pipe. This can be your ordering code or an inventory code.

4. Enter a supplier code (you can make your own in IRRICAD – *Reports|Supplier Code Multipliers*). Enter a pipe type for your pipe, e.g. PVC, LDP etc. You can make your own in IRRICAD – *Design|Pipe Fitting Matching Table* but be warned IRRICAD uses this pipe type to select fittings so it should match the appropriate fittings.

5. The nominal diameter is the size the pipe is usually referred to by, e.g. 50mm.

6. The actual diameter is very important to be entered precisely as this is the diameter IRRICAD uses in its pipe friction loss calculations.

7. The pipe roughness is the Hazen-Williams C factor, which can be found in Appendix B for all smooth pipes.

8. Enter the maximum allowable pressure as per manufacturers' specifications for that pipe.

9. Enter a wholesale cost and retail price and select a plotting colour and line type for this pipe. Click the Save button and then Save Changes on the database.

10. You now have a new pipe to use in a design.

The other item dialogs do not differ too much from this format; you can find information on this in the IRRICAD Database Editor section of the manual. Probably the most future time saving task will be to create separate databases for the different types of designs you do. This is particularly true if you do quite different design work which all use different materials. One database may be Residential.mdb, another Vineyard.mdb, etc. Now instead of turning items on and off in the database depending on the type of design you are doing today, you will only have the items you use for that particular system. This means your databases are smaller and you have more of them, and that you do not have multitudes of extraneous items you will never use present. After you have either split up your databases to be design specific, or have deleted all the extraneous items out of them, you will either have the exact fittings you use or a range of fittings for IRRICAD to choose from. If you only use saddles instead of tees (both available in the Tees component group) then you will only have saddles available. If you decide to use tees in a particular design, instead of saddles, you can turn the saddles off in the database (select N) before running Computer Selection of Fittings. IRRICAD will select on price so therefore you must turn off the cheaper saddles.

1.6.2 How IRRICAD Selects Fittings and Understanding the Fitting Selection Rules

Read **Appendix G: Fitting Selection Details** in the online Help Topics (*Help|Help Topics*). This chapter covers the rules that IRRICAD uses to solve the different types of junctions.

1.6.2.1 Quick Notes on Making IRRICAD Select the Fittings You Want

IRRICAD will select the items you want if you keep in mind the rules that are used during Fitting selection.

In summary IRRICAD will always search the Lateral Take-Off component group first, then search the cross, tee, bend and coupler groups as needed. IRRICAD always looks for the single cheapest item which has the correct connection codes required. An assembly is seen as a single item. Hence an assembly containing all the fittings required will be chosen if it is the only item that has the correct inlet and outlet connections. If a single item can not be selected, IRRICAD will choose the cheapest option of multiple components to solve the junction.

If there are many options for IRRICAD to choose from but you wish a particular item or set of items to be selected change the connection codes to be unique to those items so there is no other choice for the selection. Instead of BSP F T try BSPS F T making sure the item it is connecting to also has been given the unique connection code for this design. You can also make the item cheaper (retail price) than its competitors.

1.6.2.2 Using Riser Rules

IRRICAD uses internal riser selection rules, but you can override these with creating your own.

The internal rules are: select the riser pipe that is the same size as the top item and the same type as the bottom item. This means that if the submain (100mm PVC MS) is buried at 500mm and the valve (80mm BSP FT) is at –300mm (above ground) the riser pipe selected will be an 80mm PVC MS pipe.

You can override the internal rule by either specifying your own rule or selecting the pipe you want used in a particular situation. Select *Design|Riser Selection Rules*. Enter the depths to which this rule applies. The first depth entered must be the smaller number. Now either select Rule or User. If you select Rule, you have the options of specifying how the size and type of the riser is determined. If you select User, select the pipe you wish to be used from the drop down list on the far right.

Select *Design|Riser Selection Rules*. The rules you set can only be applied to a particular change in depth. Therefore you can set a riser rule for the riser selection between a submain and the laterals. This will not effect the riser selection between the mainline and valve **providing** the valve is at a different depth than the laterals or the mainline is at a different depth than the submain.

When creating a rule, remember that depth 1 needs to be smaller than depth 2. Remember that 0 is at ground level and a negative number is above ground. If you select User, you can select the pipe you wish to be used as the riser in that particular case. If you select Rule, you can select the size and type of pipe to be used based on the existing items in the design. For example if the valve is 80mm BSP valve and the mainline is 100mm PVC, do you wish the riser to be 80mm PVC, 100mm BSP, 80mm BSP or 100mm PVC? Select Top and Bottom appropriately for size and type.

1. Using the **Tutorial.mdb** draw a block of tapes using *Zone|Tape Block* any size you wish.

2. Use *Zone|Cut Pipe* to place a submain through the middle of the block, setting the "Depth" to **500mm**.

3. Select a valve and the mainline pipe (at **500mm** depth) to connect to the water supply. Select your own pipe sizes as you place the pipes or use *Design* to size them for you.

4. Now run *Design|Computer Selection of Fittings*.

5. Using *Select Object* or *Select Window*, select one junction where the submain connects to a lateral. Select *Modify|Change*, then click the [Show Fittings] button. See what IRRICAD selected as the riser. IRRICAD has selected tape as the riser but it cannot find the correct tee to complete the junction.

6. Go in to *Design|Riser Selection Rules* and set the depths as required (**0mm** for "Depth 1" and **500mm** for "Depth 2") and set the "Rule" to be "Top" for "Size" and "Bottom" for "Type" and re-run *Design|Computer Selection of Fittings.*

7. Using *Select Object* or *Select Window*, select one junction where the submain connects to a lateral. Select *Modify|Change*, then click the [Show Fittings] button. Because IRRICAD is now looking for a 16mm PVC pipe and there is none available or turned on in the database, it cannot solve the junction.

8. Now change the "Rule" to "User" in *Design|Riser Selection Rules*. Select the pipe you wish to use for the riser, such as the **20mm Polyethylene hose**. Now re-run *Design|Computer Selection of Fittings* and using *Select Object* or *Select Window*, select one junction where the submain connects to a lateral.

9. Select *Modify|Change*, then click the [Show Fittings] button to view the changes.

Note: If there are more than 40 fittings for IRRICAD to choose from, when solving a particular junction, a warning message will be issued just to let you know.

1.6.2.3 Using Pipe Fitting Matching Settings

The *Pipe Fitting Matching Table* in the *Design* menu allows you to insert new pipe types and designate their connection codes and to what fitting types they can connect.

More than one type of pipe can connect to a fitting type, but each pipe type can only connect to one fitting type, e.g. PVC, PV1, PV2 and PV3 pipe types can all connect to PVC fitting type, but PV1 pipe type can only connect to PVC fitting type.

The Bill of Materials will round up the lengths of pipes, whereas the costing reports will display the exact length. The rounded lengths in the BOM reports can be altered by the extra allowance, the rounding, and the rolls / lengths.

Remember that for an item to connect to another item it must have the same nominal diameter, the same connection type and be the opposite gender.

1.6.2.4 Explaining Supplier Codes and Multipliers

Supplier codes can be used to view or print a bill of materials for the different sources of product for a job.

Supplier codes can also be used to increase across the board prices for a particular manufacturer.

Open the *Reports|Supplier Code Multipliers* table. Each supplier code can have a multiplier that can be used to calculate the final prices displayed in the costing reports. These multipliers will increase or decrease the final job cost using a base price, either the retail price or wholesale cost as entered into the database for that item. If the multiplier is a number other than 1 and the above check boxes for B, C, and / or D have been checked, *and* if the default pricing type in *Design|Design Parameters|Economic Parameters* is set to **Multiplier**, the costing of the job will be calculated accordingly.

If "Retail" or "Wholesale" is the default pricing type *Design|Design Parameters|Economic Parameters* then the costing reports will show the relevant prices or costs.

Remember the Bill of Materials will round up the lengths of pipes, whereas the costing reports will display the exact length. The rounded lengths in the BOM reports can be altered by the extra allowance, the rounding, and the rolls / lengths in the Pipe Fitting Matching Table.

1.6.3 CORRECTING FITTINGS ERRORS

1. After rerunning *Design|Computer Selection of Fittings*, there may be a few junctions that IRRICAD can't solve. This is due to that fact that the items it looks for are not in the database.

The first error may be similar to:

Problem selecting suitable Tee

X: 102.20 Y: 263.82

PVC M S 50.00 PVC M S .00 40.00

2. Use *View|Window* and zoom in on a piece of your design.

3. Select *View|Go To Coords* and type in the X and Y co-ordinates displayed on your report, using the tab key to tab between the two fields. Let go of the mouse and use the [Enter] key as [OK]. The cursor will now be at the co-ordinate you entered, and this co-ordinate will be at the centre of the page.

4. Select *Modify|Change* and click on the item at this co-ordinate. Click the [Show Fittings] button. Here will you see all the fittings selected to solve this junction.

IRRICAD reports the connection types of the existing items in the design in the fittings errors, not the items it requires. In some instances it is straightforward where we could enter an item in to the database based on the information above, just reversing the gender so the items connect. In more complicated situations, it a good idea to go and look at the junction to see what junction IRRICAD is trying to solve. Reading up on the Fitting Selection Rules will help you understand the items IRRICAD needs to solve the junction.

5. Run IRRICAD Databases by clicking on the *Start|Programs|Irricad|Irricad Pro Database Editor* or double-click on the icon if one is present on your desktop. IRRICAD loads the current default database, so click Save Changes to close the currently open database if the database you wish to edit is not the default on (note the name and path of the database is displayed in the top blue bar of the database editor. Select *File|Open* and [Browse] for the required database in the \Irricad\database folder. Open this database and select the required component tab, entering the item or items required to solve the junction.

6. Return to IRRICAD and rerun *Design|Computer Selection of Fittings*. If any other fitting errors are still present in the *Reports|Costing/BOM Reports|BOM Report*, solve the next junction in the list using the above method to help you.

7. Use the tape block you drew above. Solve the missing End Cap.

8. Try an example of your own.

1.6.4 USING ASSEMBLIES

You may wish IRRICAD to select different fittings than it has chosen.

You can create an assembly of the items you require, as long as those items are in the database.

For example, if you wish to make an assembly in the Tees group:

1. Go to the Tees component group and select the Tee you would like to use in your assembly (this is only so that most of the description is available for you to make changes to).

2. Now click the [New Assembly] button.

3. Change the usage code to **X**.

4. Change the description so you know this item is an assembly, and possibly what use it has e.g. 63mm compression tee with expanding coupler to 90mm Assembly.

5. Change the warehouse code.

6. Change the major and minor connection codes to reflect the ends you wish to connect to e.g. 63mm MDP FS and 90mm MDP FS.

7. Now click the [Continue] button.

8. Most importantly, select the tee you wish to use in this assembly e.g. 63mm Female Tee and either click on the grey box to the left of the description, or click on the description and click the [Select] button to the right of the screen.

9. Now select the Reducing Coupling 90 x 63mm.

10. When you have completed adding items into your assembly, click the [Finish Assembly] button. It is your job to make sure the items you are selecting will connect together.

11. Now run *Design|Computer Selection of Fittings* for your assembly to be selected.

12. View the *Bill of Materials Reports*. You will notice that an **X** usage code will list the assembly name in the main part of the list, and then afterwards list all the items that make up that assembly.

Notes

1.6.5 ADDING NEW OUTLETS INTO THE DATABASE

All water outputting devices exist in IRRICAD as an Outlet body and a nozzle or collection of nozzles, regardless whether the device physically has nozzles or not.

To enter a new outlet into the database:

1. Enter the nozzle data. To do this you require the manufacturers sheet for the nozzle.

2. Open the Database Editor and if the database that automatically opens is not the database you wish to add the new product to, then click the [Save Changes] button and select *File|Open* and browse the working database you wish to edit.

3. Use the arrows at the top of the right-hand-side of the open database to scroll along until you see the **Nozzles** tab.

4. Click the [New Nozzles] button and start entering the relevant information into each field.

5. When you get to the "Radius Equation(K)" and "Radius Equation(n)" fields, we will use the manufacturers data in the *Utilites|Curve Fitting|Outlet Radius* to calculate the Constant (K) and Index (n).
6. The table you see requires at least three sets of data. Firstly make sure that the units above each column are set to match the units you are reading off the manufacturers data. Enter the Pressure and the resultant Radius from the data sheet into the table.

7. Click the [Fit Curve] button. The Constant and Index will be calculated for you. Make sure that R^2 is above 90% or re-check your data. Copy the Constant in to the "Radius Equation(K)" field and the Index into the "Radius Equation(n)" field.

8. When you get down to the "Constant (K)" and "Index (n)" fields below, you need to go to *Utilites|Curve Fitting|Outlet Flow*. Once again read the data off the manufacturers sheet for this nozzle. Firstly make sure that the units above each column are set to match the units you are reading off the manufacturers data. Enter the Pressure and the resultant Flow from the data sheet into the table.

9. Click the [Fit Curve] button. The Constant and Index will be calculated for you. Make sure that R^2 is above 90% or re-check your data. Copy the Constant in to the "Constant (K)" field and the Index into the "Index (n)" field.

10. Finish by selected a plotting symbol, size and colour. Click the [Save] button.

11. Repeat this process for as many nozzles as you which to add into the nozzle component group.

12. Now use the arrows at the top of the right-hand-side of the open database to scroll along until you see the **Outlets** tab.

13. Click the [New Outlet] button and start entering the relevant information into each field.

14. For Outlets the inlet connect type (how the outlet connects to a riser or on to the pipe) can be NONE but still requires a gender and connect type e.g. NONE F S (or T for threaded, or B for barbed)

15. Leave the "Default Nozzle" field at this stage. The inlet diameter is the size of the outlet body e.g. 20mm for a popup body or 4mm for a dripper.

16. The "Arc Type" determines how the outlet operates – is it a **Fixed** outlet e.g. the arc cannot be adjusted?, Is it a **Variable** outlet – the arc can be adjusted? Is it a **Matched** outlet – as the arc is adjusted the amount of flow is also adjusted accordingly? "Flow Tolerance" is usually 5% above and 5% below as a rule of thumb.

17. Finish filling in the fields and [Save] the new outlet

18. Now with your new outlet highlighted, click the [Add Nozzles] button. This will take you to the **Nozzles** component group. If you click on the little grey box to the left of the nozzle name, it will automatically be added to your outlet.

19. Click on the nozzle name, click the [Select] button to add it to your outlet. Select the new nozzles you have just created for this outlet. You can see the added nozzles below.

20. Once you have added all the required nozzles, click the [Finish Adding] button.

21. Click the [Save Changes] button to save the additions to your database and to close the database.

Notes

1.7 PRINTING USING PLOT LAYOUTS

This is a simple tutorial that explains how to prepare your design for printing.

Before starting this tutorial you need to have completed one of the above tutorials.

1.7.1.1 SETTING UP

1. Open the **Lawn.des** design by using *File|Open.*

Before printing, we will make a few additions that will make the printed plan more presentable.

2. Select *Settings|Design Details* and enter **Bellamy Road Block** in the "Site" section.

3. Click the *Company* tab and enter **ACME** as the "Company Name".

4. Select the *Client* tab and enter the client's name as **Bob Jones**.

5. Enter your "Designer" name in the *Misc* tab. Click [OK].

These will appear on the legend.

6. Go to *Settings|Layers* and uncheck the "Show" checkbox for ZONE_JUNCTIONS. Similarly, if there are any other layers that you do not want to be printed, turn off the layer by unchecking the appropriate checkbox.

1.7.1.2 PLOT LAYOUT TOOL

7. Select *Draw|Plot Layout*. Initially the printer and paper size will be set to the Windows defaults. Click [OK].

8. Choose **A (A4)** from the "Paper Size" dropdown list and select **Landscape** as the "Orientation". Leave the "Margins" as the defaults. The default margins indicate the smallest margin the printer will physically allow. Note to check if the margins are set to the minimum, enter 0 into each margin field. The default values will be set when you click on another field.

9. The [Calculate] button can be used to automatically calculate the "Print Scale" for you. In this case the current zoom state is used to select a sensible scale. This means that if you only wish to print a small part of the design, you can zoom in to the area you wish to print and IRRICAD will calculate the size of the plot layout required.

10. In this tutorial we will be sending the whole design to the printer so enter a print scale of **1:90**. Select **A A4 Key Right** from the "Drawing Template" (plot layout) dropdown list. You should always select a template that matches your selected paper size.

11. Check "Keep Fills", this puts a white fill behind the legend area, preventing other parts of the design from obscuring the legend. If you are printing the entire drawing you can choose to not keep the fills. Your dialog should look like Figure PP 1. Click [OK].

The plot layout will be created at the specified scale and the Zoom State will be altered so that the extents of plot layout can be seen on the screen.

12. The plot layout may need to be moved so that the design is in the center of the plot layout. To do this, select *Modify|Move* and click on a part of the layout, and move it so that the plan is in the center.

13. You can insert images and symbols on to your plot layout if they are not saved with the template itself. In this example, use *Draw|Symbol* and [Load] the **IrricadLogo.vcs**. With "Dynamically Size" and "Maintain Shape" ticked, draw the symbol to fill the top area on the legend.

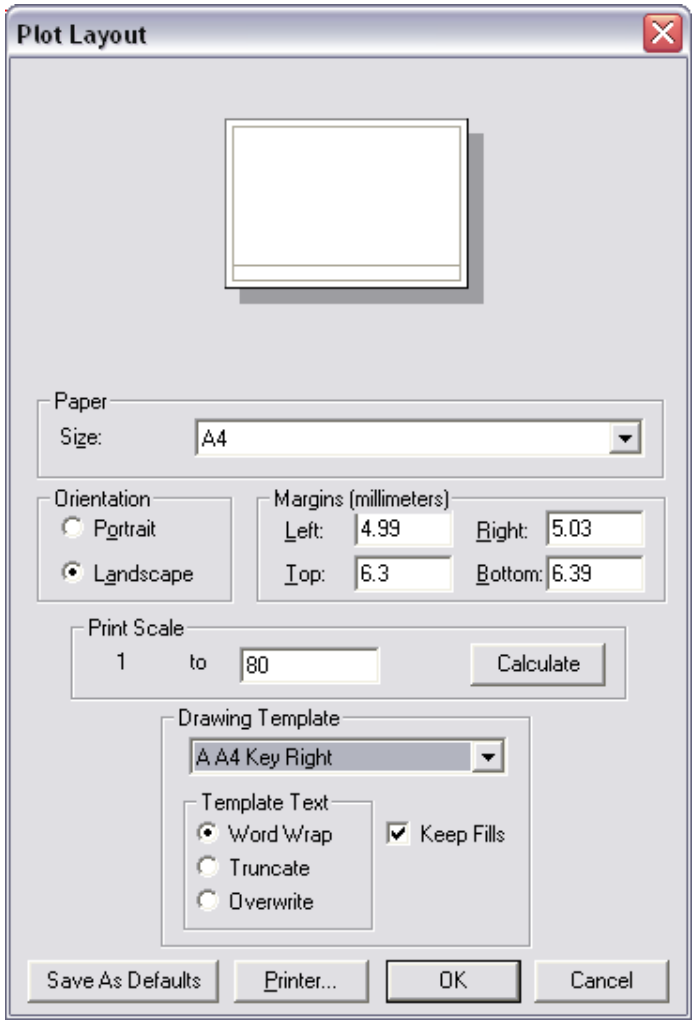


Figure PP 1

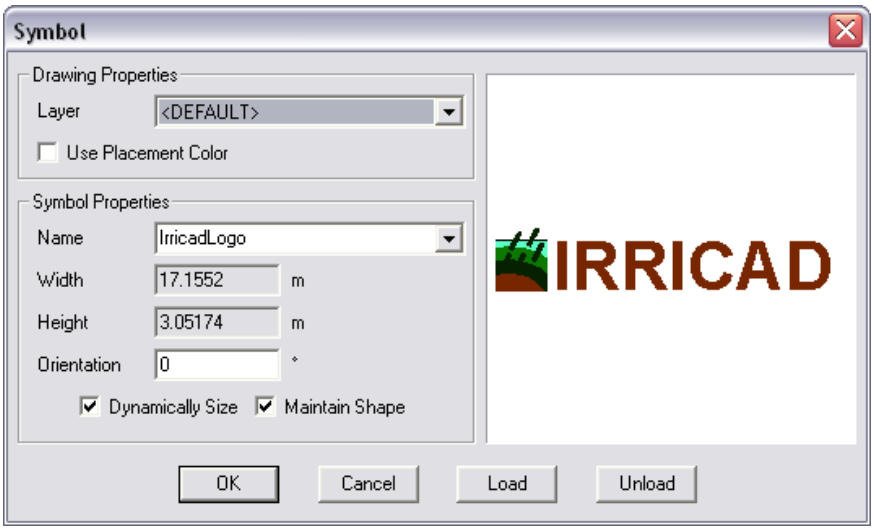


Figure PP 2

14. Now select *File|Print*.

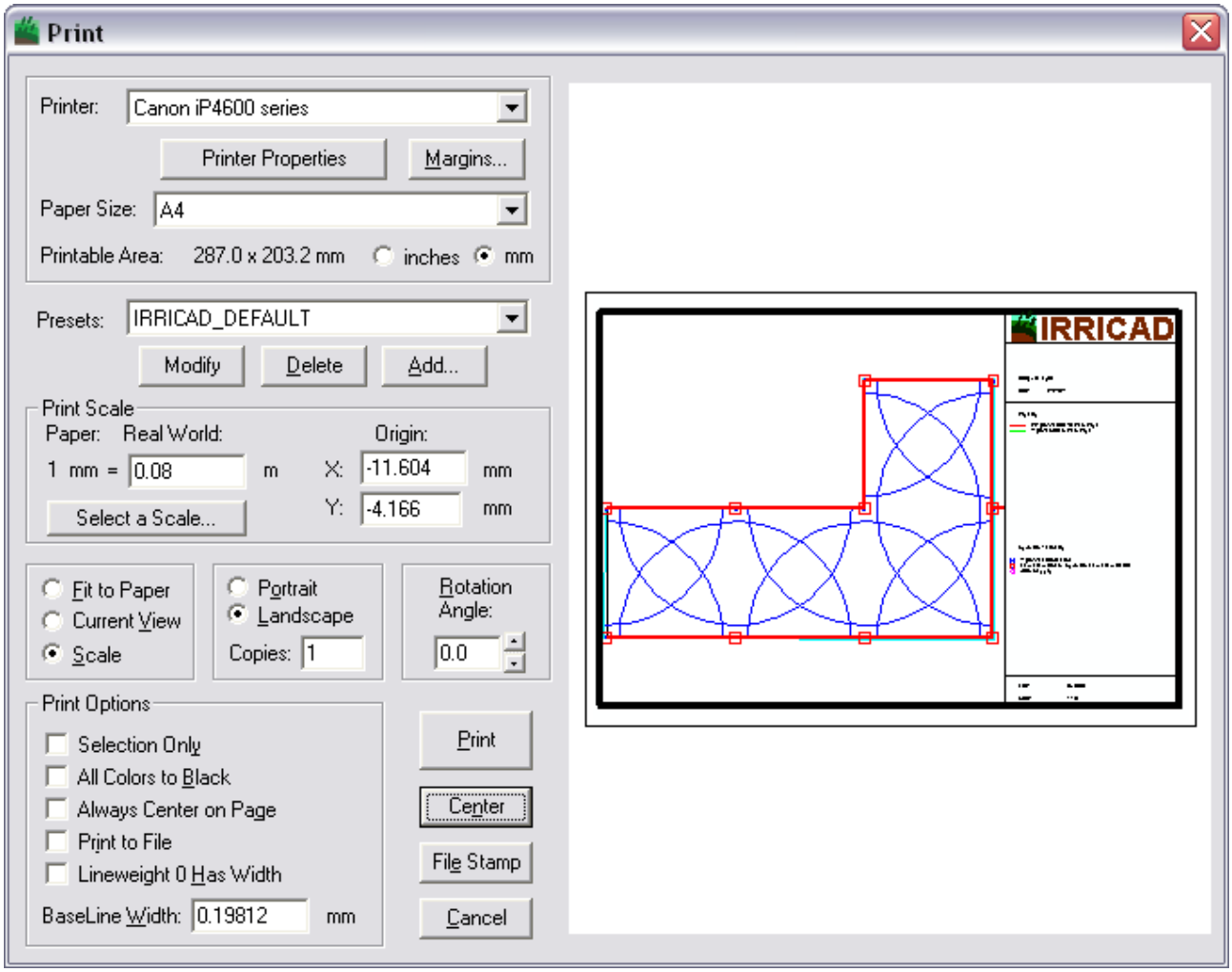


Figure PP 3

15. If the preview needs centering on the page, click the [Centre] button.

16. Click [Print] to print to your selected printer.

Notes

1.8 CREATING AND USING SYMBOLS

This exercise will cover the process of making a new symbol and setting up a block of tree symbols.

1.8.1 CREATING NEW SYMBOLS

Firstly we will create a simple symbol representing a pine tree. The process is to use the drawing tools to draw the symbol on screen, then to use the Create Symbol tool to save it for later use. The symbol will consist of a small horizontal line with four curved branches protruding from it.

If you wish this symbol to be a green tree, this can also be done by setting the "Current Color" in *Settings|Drawing* before drawing the symbol.

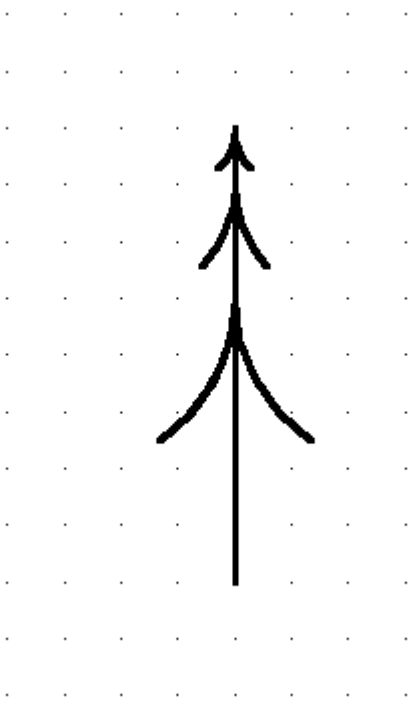


Figure CMS 1

1. Select *Settings|Grid* and enter "X" and "Y" spacings of **6** and check the "Display Grid Points" checkbox.

2. Now select the *Snap* tab and select the "Snap to Grid" option. Click [OK].

3. Select *Draw|Line|Single* and draw a vertical line of **48m** for the trunk. Left-click to place the start and draw the line vertically until the status bar d=**48** and the line cover **8** grid points then click to place the end.

4. Select *Draw|Arc|Center Start End*. Move to the top of the trunk and one grid point to the left and click. Click on the top of the trunk then move to the grid point vertically below the first (center) arc point and click. Move one grid point to the left of the last end point and click, then two grid points to the right (onto the trunk) and click, then two grid points vertically below the first (center) arc point and click. Move one grid point to the left of the last end point and click, then three grid points to the right (onto the trunk) and click, three points vertically below the first (center) arc point and click. Repeat for the three branches on the right hand side of the tree in mirror image. Your symbol should look like Figure CMS 1.

5. Now select the object by using *Modify|Select|Window* and invoke the *Tools|Create Symbol* command. Type in **Pine Tree** for the "Name" and click [OK].

6. Select *Draw|Symbol*. Uncheck the "Dynamically Size" checkbox. Enter the width as **3.5m**. Click [OK].

1.8.2 SETTING UP A BLOCK OF SYMBOLS

1. Complete the above Tutorial – Creating New Symbols.

2. Select *Draw|Symbol* and [Load] the newly created **Pine Tree** symbol. Place the symbol on a grid point at the top left of the screen.

3. Select *Modify|Copy|Array* and, moving the cursor over the symbol just placed, click the mouse.

4. In the dialog enter **14** as the "Number of Copies", and **14** as the "Number of Rows" and click [OK].

5. Click on the grid point where the tree is placed as the reference point. Move the ghosted symbols to the right of the original symbol and left-click. Then move the cursor down at right angles to the previous ghosted row of trees and left-click. You now have a block of trees 14 x 15. See Figure CMS 2.

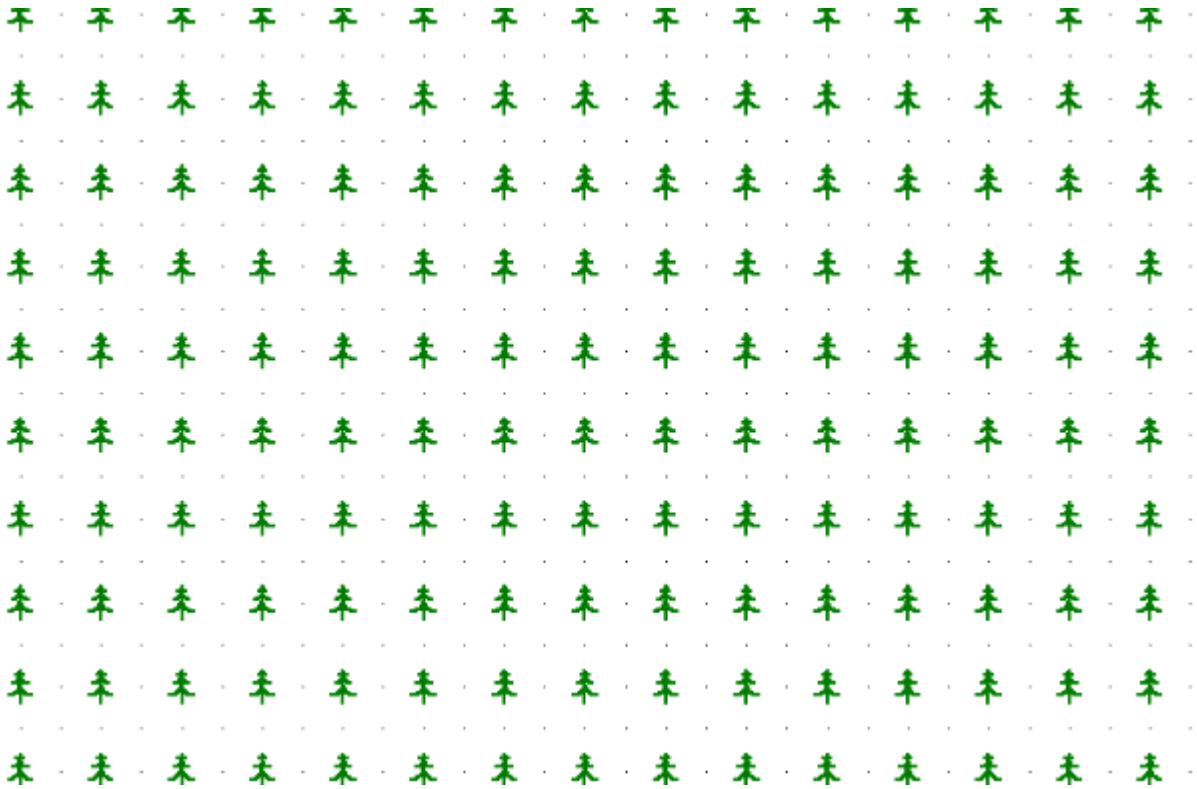


Figure CMS 2

1.9 TIPS FOR ADVANCED USERS

1.9.1 USING A PUMP IN A DESIGN

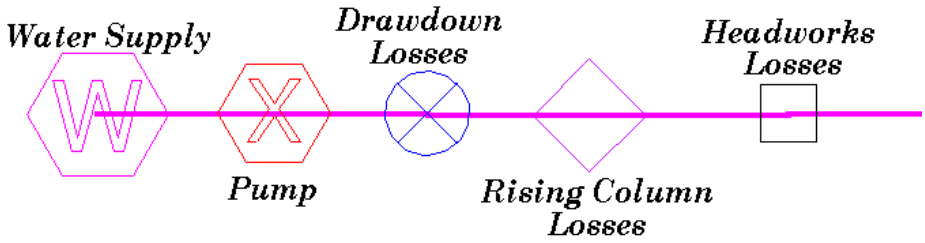
The pump must be placed downstream from the water supply and must not be placed in loops. Remember a water supply can only have one connection and this is the mainline pipe. Enter the water supply details to reflect true conditions of the supply – **the height of water relative to ground level**

If the water supply is a river or open water source and therefore the pressure may be zero, enter a small number for the water supply design and maximum pressures so that IRRICAD will not calculate the pressure required to run the system (e.g. 0.1m).

If the water supply is a tank enter the height of the water level above ground level as the design and maximum pressures (e.g. 2m).

If the water supply is a well, enter the pressure as a negative pressure, indicating the level of the water below ground level e.g. -2m pressure if the water level is 2 meters below the ground (i.e. the static water level). If the well is artesian i.e. positive static water level, enter a positive number (e.g. 2m).

When a pump is used in a system, there are often more items that result in a headloss. These items such as rising column losses (submersible pump), suction pipe loss (surface pump), drawdown losses (well only), headworks losses, etc. can be entered in to the design and therefore analysed as close to field results as possible.



If the water supply is a well with a static water level below ground level, there will be a negative pressure in the pipe between the water supply and the pump, which will be reported during analysis. It does not matter in which order the above items are placed on the mainline pipe, only that they are placed so that any losses are accounted for. The items above can be entered at the depth they are at, or left at zero for convenience.

1.9.1.1 ENTERING PUMPS IN TO THE DATABASE

Use the manufacturer's data for the pump. From the pump curve supplied read off the pressure and resulting flow for several points along the 6 stage curve. In IRRICAD databases, select the Utilities menu, the Curve Fitting option and the Pumps option. Enter at least three sets of data into the curve fitting utility for pumps (make sure the units above each column match the units you are using from the graph). Click the Fit Curve button. The curve fitting generates three numbers to use in the database (coefficients of a quadratic). This produces numbers A, B and C that IRRICAD uses in the pump formula to calculate the pressure the pump will produce based on the flow. The pressure provided by the pump can be seen in the Mainline Full report – seen as a large head difference – -ve or +ve) or using Hydraulic Object Info.

Enter a new pump into the Tutorial database from the attached pump curve.

1. Run Irricad Pro Database Editor. If needed, move the open database (check it is **Tutorial.mdb**) down slightly so you can see the menu bar by dragging the open database down by the top blue bar.

2. Select *Utilities|Curve Fitting|Pumps*. Make sure the units match the units you are reading off the graph. Enter at least 3 sets of points from the curve, particularly around the area you wish to operate the pump in the design. Click the [Fit Curve] button. Make sure the R^2 is greater than 90. If it is not, re-enter the points. Leave this dialog open.

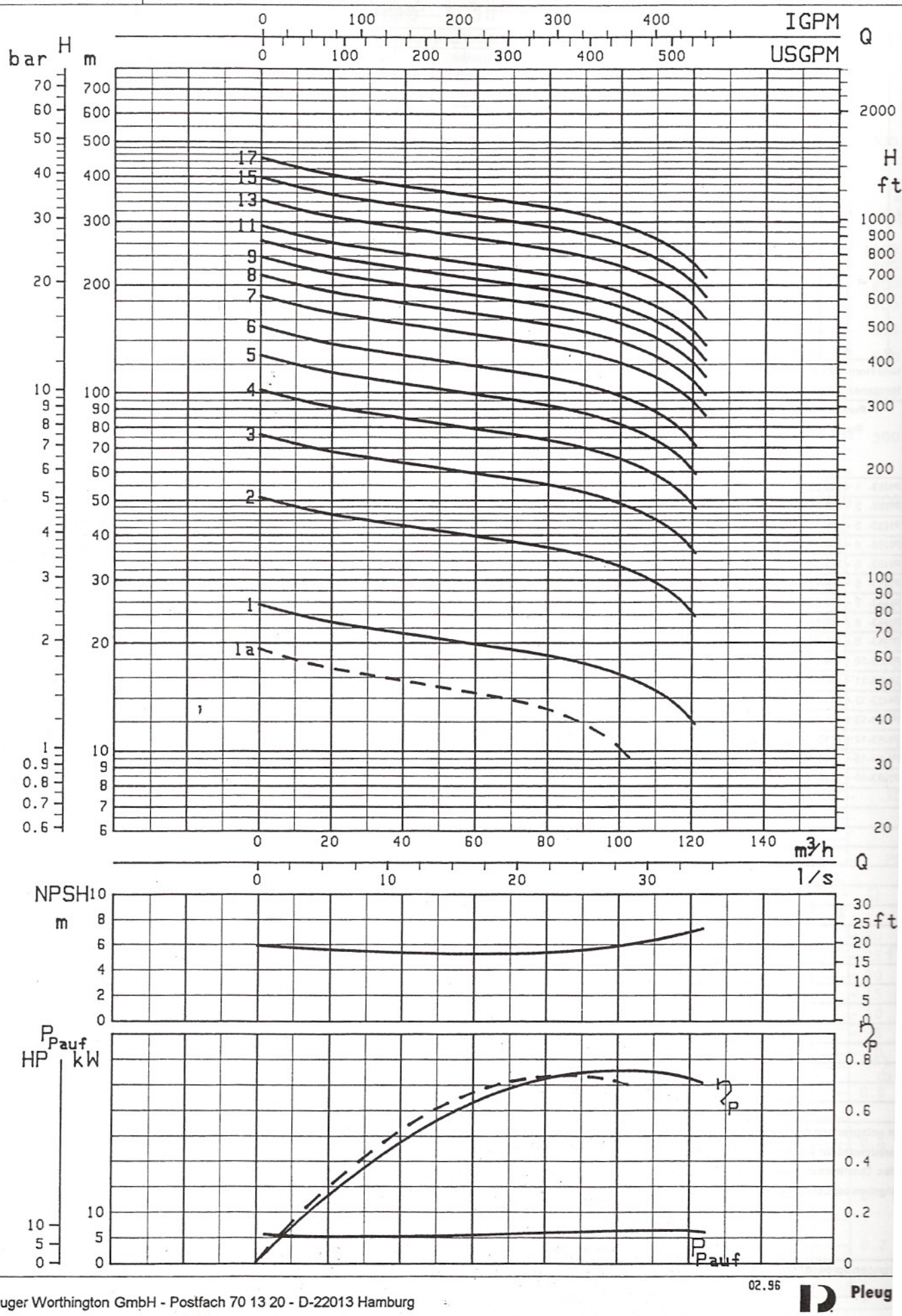
3. Click on the Pump component group tab and click [New Pump].

Ingersoll-Dresser Pumps

Unterwasserpumpe 3~Drehstrom
Submersible Pump 3-Phase AC

PN84

2900 1/min 50 Hz



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4. Enter the usage (**Y**), name, warehouse code, connection types (use **PUMP F S** so it easy to identify in the reports) and diameters.

5. Click the green arrow to paste the numbers from the pump curve fitting into the appropriate fields in the Pump Details dialog.

6. Enter the minimum and maximum flows for that pump and select a plotting symbol, symbol size and plotting colour for the new item.

7. Save the new pump.

If a surface pump model is 100 x 65: 100 is the suction diameter, 65 is the diameter of the discharge (outlet) in mm. If an extra number is present in the description – size of the impeller. For a submersible pump, enter the inlet and outlet diameter the same.

1.9.1.2 MISCELLANEOUS HYDRAULIC ITEMS IN YOUR SYSTEM.

These are items that have a pressure loss in the system. These losses can be based on flow or can be a fixed loss.

If fitting selection is not important, it is convenient to enter the connection type for Misc. Hydraulic items to reflect the description e.g. DD for drawdown. This makes it easier to find them in the Mainline Full Report. Also you can change the connection codes after design but prior to fitting selection easily if required.

Drawdown Losses

Drawdown losses are based on well tests. Determine the drawdown for the well (pumping level - static water level).

Solve the formula used for Misc. Hydraulic items: $H = K \times Q^n$ where H is in metres and Q is in m^3/hr.

The drawdown is equal to the headloss (e.g. if the dd = 9.6m, then the headloss = 9.6m).

Q is the flow at the well, e.g. $49m^3/h$. I is the exponent.

For alluvial aquifers:
If there is only one well test (Q-dd pair) available estimate the index is around 1.5. For a large flow use 1.7 (> 50 l/s). Find the value of the constant e.g. $K = H/Q^n$.
If there are two points supplied (2 well tests) on the same well can calculate the index (exponent). N = log (D1/D2)/log (Q1/Q2). $K = D1/Q1^n$.

For wells that are uncased in rock or limestone use an index (n) close to 1.

Enter the constant (K) and index or exponent (n) in to the correct edit fields in the Other Hydraulic component group in the database. The intercept (C) is 0.

Enter a new Drawdown loss item in to your database. The data you have is a flow of $49m^3/h$ and with 9.6m drawdown. Calculate the Constant K and the Index (exponent) n.

1. Go to the Other Hydraulics component group tab in the Tutorial database.

2. Click on [New Item].

3. Select the usage as **Y**, enter a name, and warehouse code, connection types (use **DD F S** so it easy to identify in the reports) and diameters.

4. Enter the constant and index as you have calculated in the correct fields.

5. Leave the Fitting Type blank (only used for PRVs).

6. Enter the minimum and maximum flows for the item and select a plotting symbol, symbol size and plotting colour for the new item.

7. Save the new item.

Rising Column (Rising Main) Losses in a Submersible Pump

This item can also be the suction pipe loss in a surface pump.

Use a friction loss chart for the type of rising column used.

Enter at least three sets of numbers read from the chart for the correct flow and rising column size into the curve fitting utility for valves (same as Misc. Hydraulic but no intercept) making sure the units above each column match the units you are using from the chart. Click the Fit Curve button. The curve fitting generates two numbers to use in the database. This produces constants and intercepts that IRRICAD uses in the Misc. Hydraulic formula to calculate the headloss through the rising column. It is easier to calculate for 100m and then adjust for the actual length.

For galvanised rising columns use the following: These have been calculated for a column 100m long

Pipe Size	Constant	Index
8”	0.0001479	1.834
6”	0.00049076	1.84
5”	0.001254	1.810
4”	0.003307	1.852
3”	0.01174	1.855
$2^1/_2$"	0.02448	1.874

Alter the constant relative to the length of the rising column

E.g. $\frac{\text{constant x length (m)}}{100\text{m}}$

for an 8" rising column which is 85m long ➔ 0.0001479 x 85 / 100 = 0.000126

Enter 0.000126 in to the Constant field in the database. Make sure the description specifies the length.

The rising column of the pump we will be using is 150mm (6”) and is 65m long. Calculate the constant relative to the length (as above).

1. Go to the Other Hydraulics component group tab in the Tutorial database.
2. Click on [New Item].
3. Select the usage as **Y**, enter a name, and warehouse code, connection types (use **RCL F S** so it easy to identify in the reports)and diameters.
4. Enter the constant and index as you have calculated in the correct fields.
5. Leave the Fitting Type blank (only used for PRVs).
6. Enter the minimum and maximum flows for the item and select a plotting symbol, symbol size and plotting colour for the new item.
7. Save the new item.

Headworks Losses

This Misc. Hydraulic item can be used to account for other losses relative to the flow.

n = 2

H = for example, if you estimate the pressure loss in the headworks to be 3.5m @ $100m^3/h$ you can assume n=2 (in most cases) and solve for K.

Solve for K $H= KQ^n$

There is no intercept so leave the intercept field (C) as 0.

You can calculate the headloss through each of the items in the headworks or expected to be in the headworks at a particular flow and therefore calculate the constant and the index. The headloss will change as the flow increases or decreases. Note that existing systems tend to have high headloss at the headworks.

Enter a new Miscellaneous loss item in to your database – where the pressure loss is 3.5m @ 100m^3/h.

1. Go to the Other Hydraulics component group tab in the Tutorial database.

2. Click on [New Item].

3. Select the usage as **Y**, enter a name, and warehouse code, connection types (use **HWL F S** so it easy to identify in the reports)and diameters.

4. Enter the constant and index as you have calculated in the correct fields.

5. Leave the Fitting Type blank (only used for PRVs).

6. Enter the minimum and maximum flows for the item and select a plotting symbol, symbol size and plotting colour for the new item.

7. Save the new item.

Miscellaneous Fixed Losses

Misc. losses can be added to account for any other possible losses. These can be added into the Other Hydraulics component group by entering an intercept and leaving the constant and index as zero. Use only if you want to include a fixed loss regardless of flow.

1. Go to the Other Hydraulics component group tab in the Tutorial database.

2. Click on [New Item].

3. Select the usage as **Y**, enter a name, and warehouse code, connection types (use **MFL F S** so it easy to identify in the reports)and diameters.

4. Enter the **intercept as 2m**, leaving the constant and index as 0.

5. Leave the Fitting Type blank (only used for PRVs).

6. Enter the minimum and maximum flows for the item and select a plotting symbol, symbol size and plotting colour for the new item.

7. Save the new item.

1.9.1.3 Draw a Design with a Pump and All Components

1. Now draw a design with the new pump in it, place the drawdown losses, rising column losses, headworks losses and miscellaneous losses you have just entered in the database.

2. Enter the water supply head as **-10m** for both the "Design Head" and "Max Head".

3. Place a demand point (with **P as 70m and Q as 100m^3/hr**) on the end of the mainline to represent a hydrant. Design the system and view the reports to see the effect on the system the above items have.

5. The best report to see this in is the *Mainline Full* report and you can easily see the pump, the drawdown, the rising column losses etc because of the fitting codes we used in the database.

6. Now change the demand point to a **P of 70m and Q of 50m^3/hr**. Re-run *Zone Analysis*, *Valve Analysis* and *Mainline Design|Analyse* and re-look at the *Mainline Full Report*.

1.9.2 MULTIPLE WATER SUPPLIES

IRRICAD design more than one system on one design.

If only one water supply exists in a design or there are completely separate systems on the same design you can leave the pressure and flow at 0 in each water supply for IRRICAD to calculate based on each system duty. However, if there are more than 1 water supply supplying the same system and you are not concerned about pumps, you must enter at least the pressure in to all water supplies. You can increase or decrease the pressure to achieve the flow you require from each.

If a PRV on the water supply is required, in a design containing multiple water supplies, do the following:
Make the water supply the PRV – enter the water supply pressure equal to the PRV pressure setting e.g. if the PRV is to be set at 50m, enter the water supply pressure as 50m. Never put PRVs in loops. Manually check the PRV is able to regulate at that set pressure and at that flow.
Remember, if you have more than one water supply or have a looped system you must use Velocity design to size the pipes.

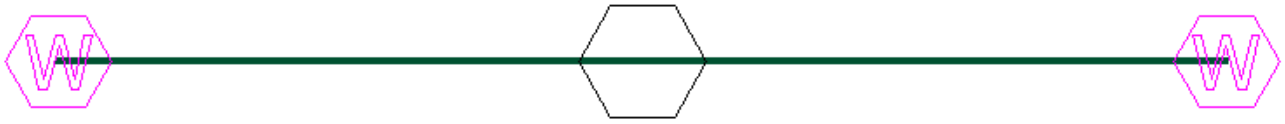
Draw a design with 2 water supplies, one on each end of a mainline pipe, with a demand point in the middle.

1. Make your *Mainline Pipe* **8"** and **50m** long and set the *Mainline Outlet* **Demand Flow** "Pressure" to be **50m** and the "Flow" to be **50m^3/hr**.

2. Use *Right-Click|Snaps|Midpoint* to connect the demand point halfway along the pipe.

3. Enter the pressures for the water supplies to be **50m**. After completing Management, Zone analysis and Valve analysis, run *Mainline Design|Analyse.*

4. View the System Duty Report.



5. Now select the demand point and move it closer to the left-hand water supply. Re-analyse the mainline and view the *System Duty* report.

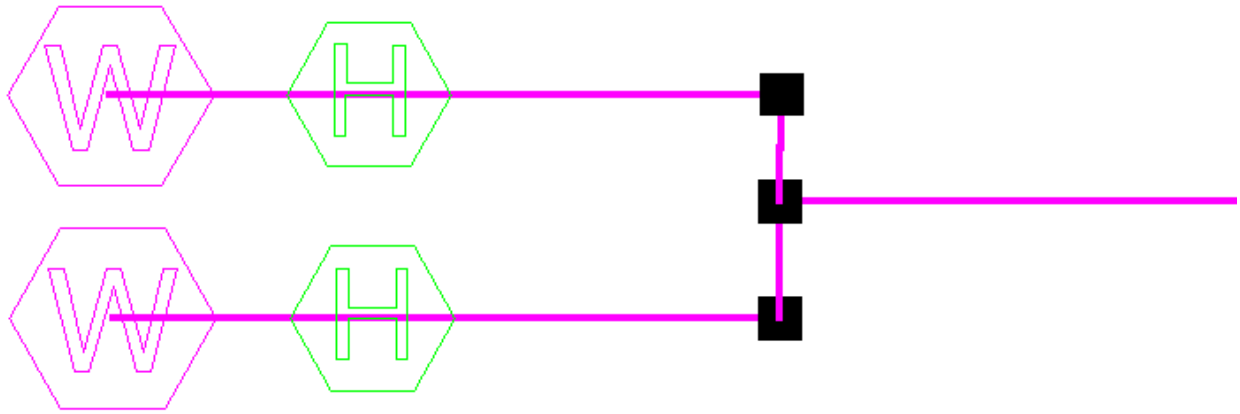
6. Now select the demand point again and move it closer to the other right-hand water supply. Re-analyse the mainline and look at the *System Duty* report.

This exercise highlights the effects on the water supplies under changing conditions.

1.9.3 USING PUMPS IN PARALLEL

If two pumps are in parallel – they are effectively in a loop – NEVER put pumps in a loop. If this is the case, draw two water supplies with a pump each and connect the mainline after the pumps:

E.g.:



Remember using the same pump in parallel doubles the flow.

1. Draw a small design like the above picture using the **Tutorial.mdb**.

2. Enter **0.1m** as the "Design Head" and "Max Head" for both water supplies.

3. Select an **8"** pipe for the *Mainline Pipe*.

4. Select the **Pump 1320lpm @ 50m** as the *Pump* and use the **Demand Flow** outlet as the *Mainline Outlet* and enter a "Pressure" of **48m** and a "Flow" of **150m^3/hr**.

5. *Assign All Zones to One System Flow* and enter System Flow 1 to be supplied by both water supplies.

6. Analyse the Zone and run Valve Analysis.

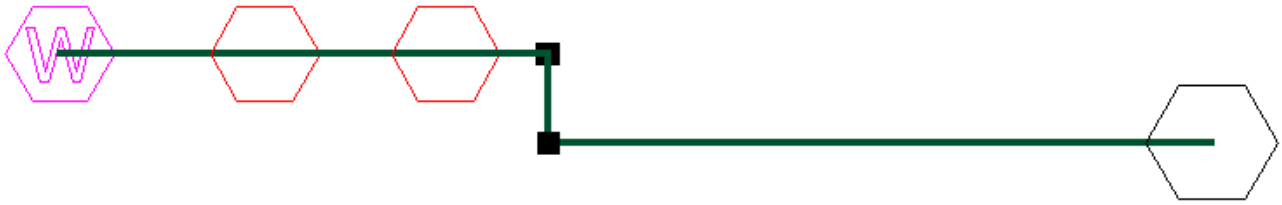
7. Run *Mainline Design|Analyse* and view the *Mainline Full* report. Click [OK] on both warning messages about not having pumps in loops.

8. Turn "Hydraulic" *Object Info* on in *Settings|Miscellaneous* and click on items in the design to highlight them, select *Right-Click|Object Info* and view the hydraulic results of each component.

1.9.4 PUMPS IN SERIES

Pumps can be placed in series. Once again, no pump should be placed within a loop.

1. Edit the above drawing so that there is only one water supply.
2. Add an extra pump on the same pipeline.
3. Change the demand point to require **90m pressure and 75m^3/hr**.
4. Re-run management, zone analysis, valve analysis and mainline analysis.
5. Check the Mainline Full report.
6. Turn "Hydraulic Object Info" on in *Settings|Miscellaneous* and click on items in the design to highlight them, select *Right-Click|Object Info* and view the hydraulic results of each component.



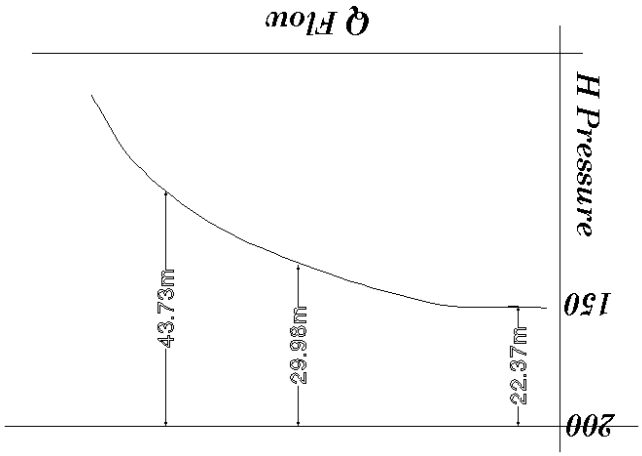
Remember using the same pump in series doubles the pressure output.

Notes

1.9.5 USING MULTIPLE WATER SUPPLIES WITH PUMPS

If multiple pumps are used in an asymmetrical design, or if the pumps are totally different, particularly if one large and one small pump are used, you may get the message 'Pump Head is less than 0'. The smaller pump has run off its curve. In practice this is not true.

Draw a line above the highest point on the pump curve e.g. if the highest point is 150, draw a line at the 200 mark. Turn the pump curve upside down and take readings from the 200 line **up** to the pump curve.



Use these readings in the Misc. Hydraulic curve fitting to calculate the constant, index and intercept. Place the pump in the design as a Misc. Hydraulic item. If you are using this method, set the water supply pressure (where this pump is situated) as the straight line ration +/- the original water supply level (pressure) e.g. if 400 is the straight line drawn above, and the water level is –9.6m, the new water supply pressure is 400-9.6=390.4m. If the water supply level is positive, add the level e.g. 400+2 (where 2 is the static level of the water supply).

Use the below figures to enter the pump as a Miscellaneous Hydraulic item. The 3 sets of points are:

Flow (m^3/hr)	Pressure (m)	Inverted Pressure Reading (m) from 400m
120	230	170
160	205	195
200	172	228

Now do the same with the pump curve you have been given (leave off the first 25% of the curve, starting at approx. 30m^3/h for a better result). Enter this pump as a Miscellaneous Item also.

1. Draw a design with 2 water supplies, one on each end of a mainline pipe, with a demand point in the middle.

2. Make your mainline pipe **8”** and **50m long** and set the demand point **pressure to be 100m and the flow to be 100m^3/hr**.

3. Use *Right-Click|Snaps|Midpoint* to connect the demand point halfway along the pipe.

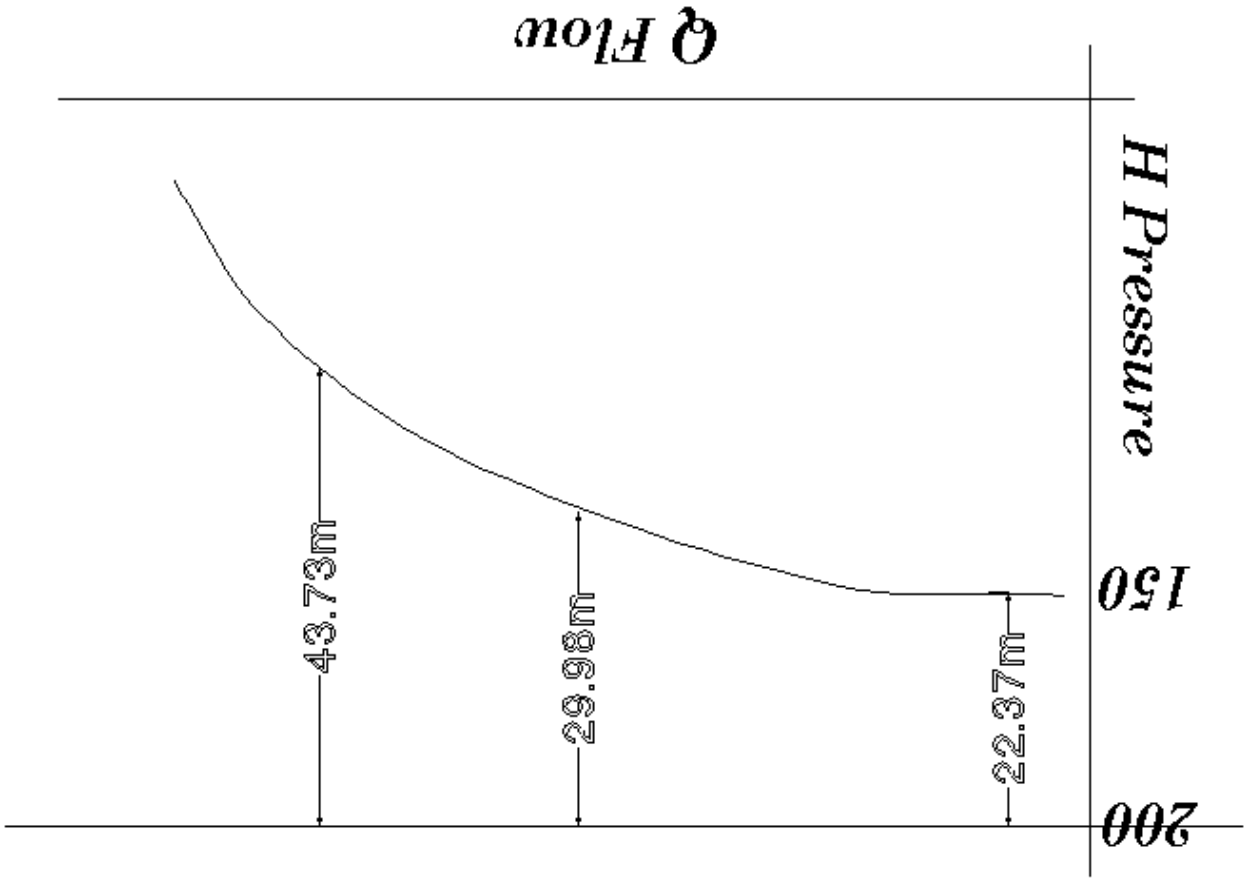
4. Place the PN84 inverted pump (from the above data) just downstream from each water supply.

5. Enter the pressures for the water supply to be **190.4m** (200-9.6=190.4m where the water level is at –**9.6m**).

6. After completing Management, Zone analysis and Valve analysis, run *Mainline Design|Analyse*.

7. View the Mainline Full Report.

The H difference is the ‘pressure loss’ hence 200 – 75 = 125m is the pump head.



8. Now replace one inverted pump with the other inverted pump (from the above table) and change the water supply pressure nearest this pump to **390.4m** (remember the arbitrary line was set at 400m for this inverted curve).

9. Change the corresponding demand point **pressure to 120m and the flow to 280m^3/hr**. Re-analyse and view the *Mainline Full* report.

We have selected a wrong pump for this item, so the operating pressure of the demand point is below what we require. The principal behind using more than one pump is the important thing to learn. Also, you will probably run into the case where a wrong pump has been selected.

Detailed Analysis example: convert this demand point into an outlet.

1.9.6 FLUSHING MAINS – THE THEORY

Because IRRICAD cannot have two submains on a block of tapes, the following method must be used to analyse tapes under flushing conditions.

The flushing valves used need to be entered as outlets in the database. The radius equation is unimportant so use a K of 1.0 and an n of 0.0. Values for the pressure / flow equation (Constant and Index) should be derived using the tabulated headloss vs. flow values for the valve in the Outlet Flow curve fitting utility.

Tape needs to be mirrored as a sprayline as tapes cannot have a submain on both ends.

Entries to mirror the tape need to be made in the pipe and outlet databases.

In the outlet database make an entry for the tape outlet. The constant and index (from the Iteration calculation method for this can be derived in a number of ways:

- Directly from tape manufacturers data
- From manufacturers data using Outlet Flow curve fitting utility
- Assuming the index is 0.5 and calculating the constant by substitution in the equation (this method is normally accurate enough) Flow (lph) = Const * Pressure (M) ** (0.5) (for PC emitter the index is 0 and the constant is equal to the flow rate)
- Contact AEI Software

In the pipe database add a pipe with the same internal diameter as the tape entry (do not forget to give it a unique warehouse code). The roughness for the pipe can be determined from trials to achieve the same headloss through the pipe that the tape gives. To do this, in a clean design, run out the tape a set length, e.g. 100m. Then run out your new pipe as a sprayline with your new outlet to the same length. Connect with a large submain pipe and a control valve. Analyse the zone and check the Zone Full report. Change the roughness factor for the new pipe until it achieves the same headloss through the pipe that the tape is giving.

1.9.6.1 CREATING THE FLUSHING DESIGN

1. Draw a block of tapes.

2. It is generally better to duplicate your tape design and make the changes required to carry out the flushing analysis on a separate copy. To do this, use the *File|Save As…* command and save it with a different file name.

3. In the copy of your design select the tape block and change the tapes to connected spraylines (use *Modify|Select|Window* then select *Tools|Tapes to Spraylines)*. Select the tape pipe you entered above then the tape outlet in the dialog.

4. Add the flushing main to the tape block using *Zone|Cut Pipe*.

1.9.6.2 FLUSHING VALVES

Firstly, look at the flushing valves pressure loss curves and select one that has approx 2psi headloss at the expected flow. The expected flow can be worked out by:
required velocity x Area x number of laterals on the manifold
The enter the data from the valve's pressure loss curves into the Outlet Flow Curve Fitting Utility.

Under detailed analysis this flushing outlet will need to have a pressure of 1.4-2.1psi and the flow you are expecting from above. You can change your manifold sizes or select a flushing valve size which will give you the values from Detailed Analysis that you require. It is important to focus on the Object Info data for the flushing outlets rather than the pressure you entered into the outlet dialog as Detailed Analysis will tell you the actual pressure and the actual flow at the outlet.

1.9.6.3 SIZING MANIFOLDS

If you wish to size the manifold and/or submain (note we think it best to LP design the submain initially) then it will be again be trail and error process. Remember that velocity design will only give you a starting point and you may need to change these pipes to achieve the results you want.
Also note that when trying to achieve the correct flushing velocities and expected flow through the flushing valve, you can change the manifold sizes to try and achieve these goals.

1.9.6.4 ANALYSIS

5. Set the valve pressure required for the zone in *Design|Zone Design Configuration* (you can get this from the Zone Summary report from the design of the real tape block).

6. Run *Design|Zone Design|Detailed Analysis*, this will analyse the tape block under normal conditions.

7. Now insert flushing valves where required (from the Outlet database) onto the flushing main. You can vary the valve pressure as you wish and examine the results in reports.

Note: *A word of warning - Do not use a flush valve that is too big, i.e. make sure you use one that has 2m or 3m of headloss at the flushing flows you expect (use Curve Fitting to create the correct data to input). If you use a flushing valve that has too low a headloss, you will have problems getting a solution.*

If you do have problems with convergence, there is a detailed analysis factor in *Design|Design Parameters|Analysis Parameters* that you can increase (e.g. use 0.85 rather than 0.75). Remember to return the parameter to its original value after you have finished this design.

The required flushing velocity rule of thumb is 0.305m/s (1ft/s) down the tapes. Set the valve pressure to achieve the correct velocity.

So the process should be:
1. Draw a Tape Block Entity complete with flushing manifold (BOM Only for Scope) - select a size you think might be suitable for the flushing manifold.

2. Use LP design to size the submain.

3. Explode the block and convert Tapes to Spraylines using the pseudo pipe and sprinkler you have made to mirror this particular dripline.

4. Change the Scope of the flushing manifold to Design + BOM.

5. Set the control valve pressure to the same pressure as the tape block had previously.

6. Place the flushing valve that will be open in Situation # 1.

7. Run Detailed Analysis and check the velocities in the 'Tapes' - aim for approx 1ft/s. Check the pressure and flow at the flushing valve (Object Info).

8. Remove the flushing outlet from Situation #1 and place it at situation #2. Run Detailed Analysis again and check the velocities in the 'Tapes' - aim for approx 1ft/s. Check the pressure and flow at the flushing valve (Object Info).

9. Repeat steps 7 & 8 for as many flushing outlets as you will have on your manifold(s) that operate one at a time (assuming you are not opening all flushing valves at one time).

If the velocity and the outlet pressure and flow is what you are aiming for, then you are finished. If not, change the manifold sizes and see what effect that has, or change the flushing outlet for one more appropriate. It would be best not to change the control valve pressure as the grower will simply want to open the flush valves when flushing is required.

1.9.7 TROUBLESHOOTING

1.9.7.1 LP DESIGN

DESIGNING WITH LP

LP design works best when the number of submain sizes is not restricted. If you are only going to use one submain size, you should either put in a pipe size yourself and see how it analyses, or use Velocity Design. Velocity Design knows nothing except to choose a pipe close to 2m/s (or what ever you have set the max. zone pipe velocity to). As with velocity sizing and LP Design you can always change the pipe sizes if you don't like them, or make larger pipe sizes not available for selection in Zone Design.

LP DESIGN ERRORS

The main problems experienced with LP design are the error messages similar to 'Fixed pipe sizes too small' or 'Fixed pipe sizes too big'.

To avoid these problems, look for the following:

- Make sure that the elevation data is correct and that there are adequate contours or spot heights in and around the design
- Fixed pipe sizes – this constricts the choices IRRICAD can make as it cannot change those pipes
- Leave the number of submain pipes as zero in *Design|Zone Design Configuration* so as not to limit the number of pipes that IRRICAD can choose for your system
- Leave the valve pressure as zero so as not to limit LP Design by a valve pressure to work to (or the Water Supply pressure as zero if Mainline Design)
- Make sure that all possible pipes (lateral, zone and mainline) are enabled in the database editor and that all information entered for these pipes is correct
- If you are having trouble trying to get LP to work, then adjust the maximum allowable velocity to 10m/s and try again. This means that the velocity will not be a limitation as LP tries to find a pipe size. This does not necessarily mean that the resulting velocity in the pipes will be excessively high in the system
- Allow 2 or 3 lateral sizes to be used in *Design|Zone Design Configuration*
- Increase the tolerances on the outlets
- Add a very small pipe (e.g. 5mm) and a very large pipe (e.g. 1m) to the database so IRRICAD will find a solution and you can see where the problem is. Make changes to the design manually.

COMMON ERROR MESSAGES RELATING TO LP

- Maximum number of iterations for LP exceeded
- LP sizing failed - unbounded objective function
- LP sizing failed because of the constraints given
- Constraint counts do not match in input data to LP solver
- Negative values appear in LHS of array passed to LP solver
- Only use LP with single water supplies and branched systems
- Your design is too big to use LP pipe sizing
- Large enough pipe not enabled - LP may not achieve solution
- User selected pipe diameter too small - headloss too high
- Use selected pipe diameter too large - headloss too low
- No pipe sizes have been enabled for:
- Solution not found - fixed pipe sizes too big in path:-
- Solution not found - fixed pipe sizes too small in path:-

The error messages are to give you some idea why LP failed. While some messages are self-explanatory, following the checklist above (LP Design Errors) will solve most. Others, however, are a little more complicated and may stem from memory limitations, program limitations or some form of corruption to the Linear Program solver. An error message may also occur if, for a particular design configuration, the Linear Program solver is not converging towards a solution. In this case, Velocity Design should be used, or the design layout changed in some way.

1.9.7.2 DATABASE ISSUES

Opening Databases in Microsoft Access

It is very dangerous to play around with an IRRICAD database in Microsoft Access when you do not know what you are doing.

The main problem we have with users in this respect is if they create a “Replica” of the database. A replica cannot have new items added to the database and IRRICAD does not like the database in this form either. Once you have created a replica and moved or deleted the master (original) there is not going back. You will need to start again with a normal database. If you have edited and added a lot of product to your database, this can be a heartbreaking loss of work.

Updating pricing / database reports

1. Open the IRRICAD Database Editor and go the Query tab. (If the Query tab (past Nozzles) is not displayed go to *Tools|Options* and enable the "Show Query tab" option.

2. Click the down arrow (far right) and select the query **Update Wholesale and Retail Prices of SUP1 Pipes, Increasing by 6%**.
3. In the bottom part of the window you will see the formula for updating all SUP1 pipes with price increase for both the wholesale and retail prices.
   Reals 7 = wholesale price
   Reals8 = retail price
   1.06 = a price increase of 6%
   SUP1 = the required supplier code
   Database number = the required database number (1 is for pipes and tapes).

4. Edit the formula carefully for the changes required. For example if the price increase is only 5% change the 1.06 to 1.05. If the chnages are 5% for all items from SUP1, remove the "AND ((Components.[Database Number])=1))" entry.

6. When ready select *Query|Execute Query*.

Read Only files

IRRICAD cannot open a design if the working database is read only, the internal database is read only, the .des or.vcd files are read only or if any of the temporary files in the computer’s Temp folder are read only.

The main reason you will get this problem is if you have backed up a design on a CD and are trying to open the design on the CD or have copied the files to your hard drive off the CD. CDs are read-only by definition so when you copy files off a CD you must change the properties so that the file(s) are not read only. Highlight the file or files in Explorer or My Computer. Right click and select Properties. Uncheck the Read Only check box.

Skeleton.mdb

The Skeleton.mdb is required when running IRRICAD or starting a new design. If it is not in the Irricad folder or is Read Only you will not be able to run IRRICAD. Make sure the file is present, or if it is not, either re-install IRRICAD or email AEI Software for a new one.

Merging Databases

Select *File|Merge* in the Database editor. This option works fairly similar to the old DOS Joindbs. In the first field select the database which is not your working database. This database stays the same. In the second field select your working database. This database is updated with the new product from the database in the first field. IRRICAD generates a text file to tell you the things that were not added to the working database. Items will not be added if the following fields match:

- same name

- same warehouse code

Getting Designs from Someone Else

If a design is sent to you the minimum you require is the .des, .vcd and .mdb for that file name, or the dez files (from Version 13). If your database is very different from the database the design was created with, you will also need their working database if you are to continue analysis or design on the system.

A problem may arise if the design was created using Irricad.mdb and you use Irricad.mdb. The databases could be quite different but with the same name. Upon opening the design IRRICAD will find your Irricad.mdb (if it is in the same place as the one used to create the design). If you are aware of this and you have been sent the Irricad.mdb which belongs to the design and have saved it elsewhere, select *Settings*|*Irrigation – Design Specific* and [Browse] for the required database. Save the design and re-open it. It will remember which database it is to use.

To avoid confusion it is a good idea to re-name this database before setting it as the database to be used with the design.

Order of Items

The databases have an in-built ordering system that determines the order items are displayed in the Database editor and drop down list in IRRICAD. This is set out below to help you understand the ordering of items in each component group. Items in each component group are ordered alphabetically or numerically in ascending order based upon each of the fields below in turn. For example, Controllers are ordered numerically by the [Order] field then alphabetically by [Description] and so on.

Note that the [order] field is an internal one that is not available in the IRRICAD Database Editor. It can, however, be accessed via Microsoft Access. By default, the order field for all items is the same and therefore has no effect. If you wish to give the order field another number to change the ordering, you can do so in the column labelled 'Order Number'.

Controllers	[Order], [Description], [Number of Stations]
Couplers	[Order], [Major Connection Type], [Minor Connection Type], [Major Diameter], [Minor Diameter], [Description]
Crosses	[Order], [Major Connection Type], [Minor Connection Type], [Major Diameter], [Minor Diameter], [Description]
Elbows / Bend	[Order], [Major Connection Type], [Minor Connection Type], [Major Diameter], [Bend Angle], [Minor Diameter], [Description]
LTOs	[Order], [Major Pipe Type], [Minor Connection Type], [Minimum Submain Diameter], [Lateral Diameter], [Description]
Lights	[Order], [Description], [Rating]
Misc. Items	[Order], [Description], [Size/Diameter 1], [Size/Diameter 2]
Nozzles	[Order], [Description], [Arc], [Constant]
Other Elec.	[Order], [Description], [Rating]
Other Hyd.	[Order], [Inlet Connection Type], [Outlet Connection Type], [Inlet Diameter], [Outlet Diameter], [Description]
Outlet Conn.	[Order], [Inlet Connection Type], [Outlet Connection Type], [Inlet Diameter], [Outlet Diameter], [Description]
Outlets	[Order], [Description], [Inlet Connection Type], [Inlet Diameter]
Pipes	[Order], [Pipe Type], [Nominal Diameter], [Allowable Pressure], [Description]
Pumps	[Order], [Inlet Connection Type], [Outlet Connection Type], [Inlet Diameter], [Outlet Diameter], [Description]
Tapes	[Order], [Description], [Nominal Diameter]
Tees	[Order], [Major Connection Type], [Minor Connection Type], [Major Diameter], [Minor Diameter], [Description]
Valves	[Order], [Inlet Connection Type], [Outlet Connection Type], [Inlet Diameter], [Outlet Diameter], [Description]
Wires	[Order], [Description], [Nominal Diameter]

The other way to change this order is in the registry editor. Be very careful using this method as you could quite easily destroy IRRICAD.

The order of the fields can be changed in the registry of IRRICAD.

1. Select *Start|Run* and type **Regedit**.

2. Open HKEY_CURRENT_USER and then Software.

3. Open AEI Software and then IRRICAD.

4. Open Database Settings and double-click on Sort order.

5. On the right-hand side you will see the component groups and their order.

6. Double-click on the icon to the right of the component group a dialog will appear and the fields can be re-ordered. Be careful to retain the square brackets and commas in the correct place when moving the fields.

Updating Entities

In *Settings|Irrigation Items* there is a check box named "Update Entities From Database". If you change a symbol, colour or line type for a database item e.g. pipe, valve, outlet, etc. You need to re-load the design (select *File|New*, then *File|Open* and re-load your design) for these visual changes to take place. However, if this check box is not checked, the existing items in the design will not be updated with the changes. All new items placed, however, will have the new colours, symbols or line type.

Updating Internal

When you make a change to your working database while you are doing a design, the internal database (where all the items in that design are stored) needs to be updated also.

If the database editor is open when you load a design, it will automatically update the internal database.

The design keeps a time / date stamp of the working database so if the time / date stamp on the working database is now newer than the one the design remembers, the internal database will be updated.

If the design (and hence the internal database) is open at the time, the internal database will be updated during *Design*.