User Guide

Developed By
AEI Software
A division of
Lincoln Agritech Ltd
PO Box 69133
Lincoln
Christchurch 7640
Canterbury
New Zealand

Tel: (64) 3 325 3718
        (64) 3 325 3723
Fax: (64) 3 325 3725

This manual was produced using *ComponentOne Doc-To-Help.™*

Contents

4 Tutorials

The purpose of these tutorials is to have you enter a small yet complete irrigation system, have it designed and costed, and the plans prepared. You will simply be asked to do things, explanation as to 'why?' will be limited - enough to show the process without getting involved in possible alternatives. The intention is to illustrate how IRRICAD works and to do this as simply as possible. Consequently, the system layouts used have been devised with this in mind and the siting of some componentry may not be ideal from an irrigation designer's viewpoint.

4.1 INTRODUCTION TO DESIGN TUTORIALS

The types of tutorials are listed:

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. References to the *Irricad Options|Help Topics* are made where appropriate.

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.

The following conventions are used in this manual:

- When directed to select a command from a menu the default menu and command will be listed. For example, *Design|Zone Design|Zone Detailed Analysis* refers to selecting the *Zone Detailed Analysis* option from the *Zone Design* sub menu which is located in the *Design* menu.
- When directed to click on a button in a dialog or message on the screen, the button will be displayed in square brackets; e.g., [Save as Defaults].
- When directed to press a key on the keyboard, the key will be displayed in angle brackets; e.g., <Shift> key.
- Any measurements will be given in US units first and the metric unit will be supplied in brackets e.g., **300ft** (**91.5m**).
- Any CAD tool will be written in the command line format, e.g., MOVE.
- For any IRRICAD tools that are not available in the default menus will be written in the command line format, e.g., IRR_DELETETYPE. Note that these tools may be available on the default toolbar.

4.1.1 HELPFUL HINTS

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

4.1.1.1 TERMINOLOGY

Designs in IRRICAD consist of Mainline Pipes (pipes connecting a water supply or water supplies to Zone Valves), on/off Control Valves, Zone Pipes (pipes connecting Zone Valves to laterals or outlets, e.g., submains), and Spraylines/Tapes (equivalent to laterals) or outlets.

A Zone becomes defined when a Zone Control Valve is entered and Zone Pipes, Spraylines and / or Outlets are connected to it, i.e., items connected downstream of the Zone Control Valve.

Zone|Spray Block and *Zone|Tape Block* are options for laying out an area of equally spaced spraylines or tapes, nothing more. Use of a block tool does not define an irrigation block.

IRRICAD Block tools may be used to layout all of the laterals for a design at one time. The laterals may then be modified using IRR_CUTLASSO (*Irricad Tools|Cut Lasso*) to remove areas that are not required, Delete to take out unwanted rows and so on. The Zones only become defined when these laterals are connected to Zone Control Valves.

IRR_TAPEBLOCKENT or IRR_SPRAYBLOCKENT tools (*Zone|Tape Irrigation Block* or *Zone|Spray Irrigation Block*) do define an irrigation block. These are dealt with as a complete entity and can be subdivided using the IRR_SUBDIVIDE (*Subdivide*) option.

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 *Irricad 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 preventers, air release valves that are connected into or onto a mainline pipe.
Misc. Hydraulic Items (zones):	Items such as isolating valves, backflow preventers, 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. Typically the emitter connection is small (such as a barb) and therefore the minor losses are calculated using a different method. The pipe selected for connected spraylines has the L usage code. Always use if there are 30 or more emitters per lateral size. Turn **on** the "Connected" option in Sprayline/ Spray Block, Spray Irrigation Block dialog.
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. For Zone spraylines

	use 'unconnected' when there are 10 or less emitters per lateral size. The pipe selected for unconnected zone spraylines is the Z or U usage code. Always use if there are 10 or less emitters per lateral size. Turn **off** the "Connected" option in Sprayline/ Spray Block, Spray Irrigation Block dialog.
Management:	The process of telling IRRICAD which valves will be running at any one time.
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 period. Also known as stations, sets or groups.
System Flow:	Also known as stations, sets or groups. Zones are assigned to system flows for the system duty to be determined for a particular duration when specific control valves are designated to be running. The process of assigning system flows is referred to as "Management".
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.

4.1.1.2 ELECTRONIC HELP

The on-line Help is available via *Irricad Options|Help Topics*. It contains all the topics and chapters available in the manual and is divided into five main divisions:

- The Overview contains information about using Help and comments and tips for new users.
- 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.
- Tutorials – this section.
- The Tool and Command Reference describes each menu item and describes how to mechanically use the tool.
- 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.

In addition, new information about the current version is available via *Irricad Options|Release Notes* which explains new features added or differences and also details addenda to the manuals.

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

4.1.1.3 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.

4.1.1.4 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 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.

4.1.1.5 IRRICAD USERS FORUM

The IRRICAD Users Forum, accessed through *Irricad Options|Support 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.

4.1.1.6 MOUSE OPERATION

IRRICAD uses the mouse installed with Windows operating systems.

The settings for mouse and mouse wheel operation are located in the Host's settings. Clicking the left mouse button selects or places. Clicking the right mouse button will finish tasks when using IRRICAD tools.

When using IRRICAD tools do not hold down the left mouse button after placing the first click of a pipe, lasso, or similar. Simply left-click then move the mouse and left-click again.

4.1.1.7 SNAPS

Before starting an IRRICAD design ensure that the snap settings in BricsCAD® or AutoCAD© are set to more than just "Endpoint". The most useful snaps when drawing a design are "Nearest" and "Endpoint". Additional snaps can be turned on by entering OSNAP in the command line and pressing the <Enter> key.

4.1.1.8 ORTHO MODE (STRAIGHT LINES)

Ortho mode can be enabled by entering ORTHO in the command line and pressing the <Enter> key. If present on the status bar or toolbar it can be enabled or turned off at any time by a single click.

4.1.1.9 METHOD FOR CYCLING THROUGH SELECTABLE ITEMS

In IRRICAD Pro we had introduced the Ctrl + click method a number of years ago to aid with selecting the correct item when there are many in the same proximity. AutoCAD© and BricsCAD® methods are somewhat more involved however the process can be achieved by following the below steps:-

BricsCAD®
To select overlapping entities if SELECTIONPREVIEW is ON (this is options 1-3 for this command – note option 3 is the default):-

1. Move the cursor to the overlapping entities. The entity lying on top highlights.
2. Press and hold the shift key.

3. Hit the space bar repeatedly. The overlapping entities highlight one by one until you see the required item.
4. Release the shift key, then press <Enter> to select the currently highlighted entity. Now perform the required action on this item.
5. Repeat steps 1 through 4 to select more entities.

To select overlapping entities if SELECTIONPREVIEW is ON or OFF:-

1. Press and hold the Shift key then press and hold the space bar.
2. Click on the overlapping entities. The entity lying on top highlights. The command bar reads: <Cycle on>
3. Release the space bar, then the Shift key.
4. Click anywhere in the drawing to highlight the next entity.
5. Right click, hit the space bar or press Enter to select the highlighted entity. The highlighted entity is selected. The command bar reads: <Cycle off>
6. (optional) Repeat steps 1 through 5 to select more entities.

AutoCAD©

First enable the Selection Cycling option:-

1. At the command line, type **DS** (Drafting Settings) and press <Enter>.
2. In the Drafting Settings dialog box click the Selection Cycling tab.
3. Select "Allow selection cycling" and click OK.

Now when you click near or on items that are overlapping a list will always appear for you to select from.

4.1.2 THE FIRST STEPS

It is helpful when starting your first designs to ensure that you are using the IRRICAD templates. To ensure this, first go to CONFIG.

In AutoCAD locate in the Files tab locate the "Template Settings" option. Under the "Default Template File Name for QNEW" browse for the **Irricad-Default-ft.dwt** (US units) or the **Irricad-Default-m.dwt** (metric units) dwt file. These will be located in your AutoCAD Templates folder (commonly located in C:\Users\vivierj\AppData\Local\Autodesk\AutoCAD 20XX\R2X.X\enu\Template, where 'X' is your CAD version number).

In BricsCAD open "Program Options -> Files->Templates. For the "Template" option, if not already set, browse for the **Irricad-Default-ft.dwt** (US units) or the **Irricad-Default-m.dwt** (metric units) dwt file. These will be located in your C:\Users\vivierj\AppData\Local\Bricsys\BricsCAD\ V2Xx64\en_US\Templates, where 'X' is your CAD version number).

The new drawing will now have two IRRICAD layouts attached, and include the IRRICAD scaling and display functions.

Before starting a design:-

1. Go to the *Irricad Options|Company* tab to input your company details. This information is automatically saved for use in all future designs.

2. Set display properties for hydraulic items. Go to the *Irricad Options|Irrigation - Design Specific* tab to customize pipe line widths. Click the [Save As Defaults] button to retain these settings for all future designs. Now go to the *Irrigation Items* tab to customize the display properties for other hydraulic symbols. These are contained in the "Lines" and "Symbols" sections of this tab.

3. Go to the *Irricad Options|Units* tab to select the units to use for each type of value.

4. If you know approximately what size your design will be you can select a "Design Size" via the *Misc* tab. This option makes the symbols on the screen an appropriate symbol size relative to the area the design covers. It can be altered at any time by selecting another "Design Size" or typing in a "Base Database Symbol Size". Note, if the "Update Database Symbols" checkbox is enabled all hydraulic symbols currently in the design will be updated to the new size.

5. Design headings can be entered at any time. However, it is advantagous to specify these at the beginning to avoid any confusion if several copies of the base design are made. Go to the *Design Details* tab and enter the relevant information.

6. You are now ready to enter your design.

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

7. Design the zones first via the *Design|Zone Design|...* options to be able to use actual flows in the management process (step 8).

8. You must tell IRRICAD how the system is to operate before you can design the mainline. Select one of the management options from *Design|Assign...* before designing the mainline via *Design|Mainline Design|...*

Happy Designing!

4.1.3 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 tell IRRICAD how the system is to run (Management), then design the zones, analyze the valves, and then design the mainline as listed below:

Process List for Designing with IRRICAD

1. Enter background information

2. Layout the irrigation system

3. Design / Analyse the Zone. Check the reports

4. Finalise Zone Design via Detailed Analysis (if non-pressure compensating emitters)

5. Management – tell IRRICAD how the system is to run – what zones are operating when

6. Design / Analyse the Mainline. Check the reports

7. Finalise Mainline Design via Detailed Analysis (for non-pressure compensating mainline outlets only)

8. Computer Selection of Fittings and Bill of Materials Report

9. Create a print Layout and then Print.

4.2 BASIC START

4.2.1 VERY BASIC DESIGN

Tasks covered in this tutorial:
- Entering Zone and Mainline items
- Drawing a simple system
- Turning valves on
- Sizing pipes based on required pressures
- Reading reports

This design illustrates the very basic concepts entailed in an IRRICAD design. Understanding these concepts and principles will allow them to be applied to larger and more complex designs.
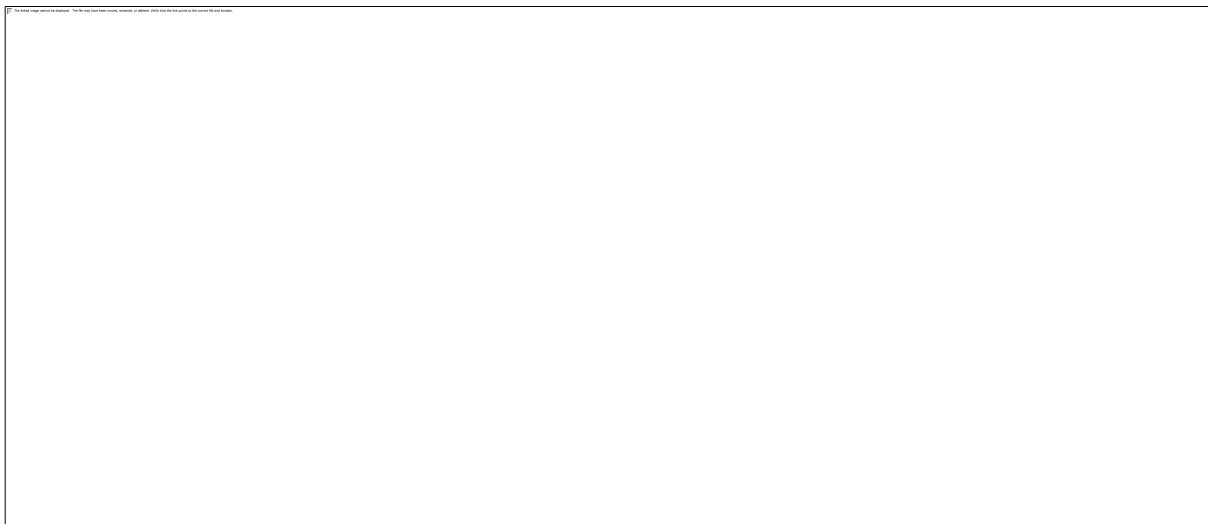
Figure 4-1

4.2.1.1 STARTING THE TUTORIAL

1. Double-click on the Irricad BricsCAD or Irricad Autocad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation - Design Specific* tab. Browse [...] for the **Tutorial.mdb** database. If Irricad was installed in the default location it will be located in the C:\Program Files\Irricad\Irricad Link XX\Database folder. Highlight and select [Open].
3. Go to the *Misc* tab (*Irricad Options|Miscellaneous*) and select the **Medium** "Design Size" option.
4. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. This settings will be retained for each subsequent design by clicking the [Save As Defaults] button and then [OK] to close the dialog. A message will appear if you have changed the units from what was set previously - click [Yes] to scale the drawing.

4.2.1.2 DRAWING THE LAYOUT OF THE SYSTEM

5. Select *Mainline|Water Supply*. Place a water supply on the screen near the left-hand side by left-clicking on the screen. Ensure the "Calculate pressure?" check box is enabled so that IRRICAD will calculate the system duty for the system. Click [OK] to accept and close the dialog. Now press the <Esc> key on the keyboard to finish the tool.
6. Select *Mainline|Mainline Pipe*. Leave the pipe as **Computer Selected** so that IRRICAD will size the pipe for you. Click [OK] and click in the center 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 pressing the <Esc> key. Draw the pipe out towards the middle of the screen and left-click to place the end of the pipe. Press the <Esc> key to finish the current mainline pipe and then press the <Esc> key again to finish the mainline pipe tool.

7. Between mainline and zone items there always needs to be a control valve. Items upstream from the control valves are always designated as Mainline whilst items downstream of a control valve are always designated as Zone. Go to *Zone|Control Valve* and 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. 001** to this control valve. This is because valves need to be identified so they can be referred to later in the design process. Click [OK]. The black junction will disappear when the control valve connects to the pipe. Press the <Esc> key to finish the valve tool.

8. Select *Zone|Zone Pipe*. Leave the pipe as **Computer Selected,** click [OK], and place the start point on the control valve. Draw out the pipe toward the right-hand side and click to place the end point of the zone pipe. When you have completed your zone pipe press the <Esc> key to finish the current zone pipe and then press the <Esc> key again to finish the zone pipe tool.

9. Select *Zone|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 center of the black junction. The black junction will disappear when the outlet connects to it. Press the <Esc> key to finish the outlet tool.

We have drawn the layout of the system (see Figure 4-1), selected valves and sprinklers, and allowed IRRICAD to select pipe sizes and calculate the required system duty.

4.2.1.3 CHECKING CONNECTIONS

10. First check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. 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 via *Design|Clear Connectivity Marks*.)

11. 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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet by clicking on the item and MOVE the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *IrricadOptions|Snap* tab is set to "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.

4.2.1.4 ZONE DESIGN

12. Now we can size the pipes for the zone. You will see that *Design|Zone Design* has four options. *Zone Analysis* is used when you have selected the pipe sizes or after you have made further changes to the design. *Zone LP Design* is used when you wish to size zone pipes based on the pressure required at the outlets. *Zone Velocity Design* is used when you wish to size pipes based on a maximum velocity or when the pipe system is looped. *Zone Detailed Analysis* is normally used at the completion of design and iteratively adjusts the flow at each sprinkler based on the calculated pressures giving a more accurate analysis than that based on nominal flows. Select *Design|Zone Design|Zone LP Design* for IRRICAD to size the zone pipe based on the required outlet pressure. You should now see the pipe change colour. The colours assigned to various pipes are stored in the database.

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

4.2.1.5 ZONE REPORTING
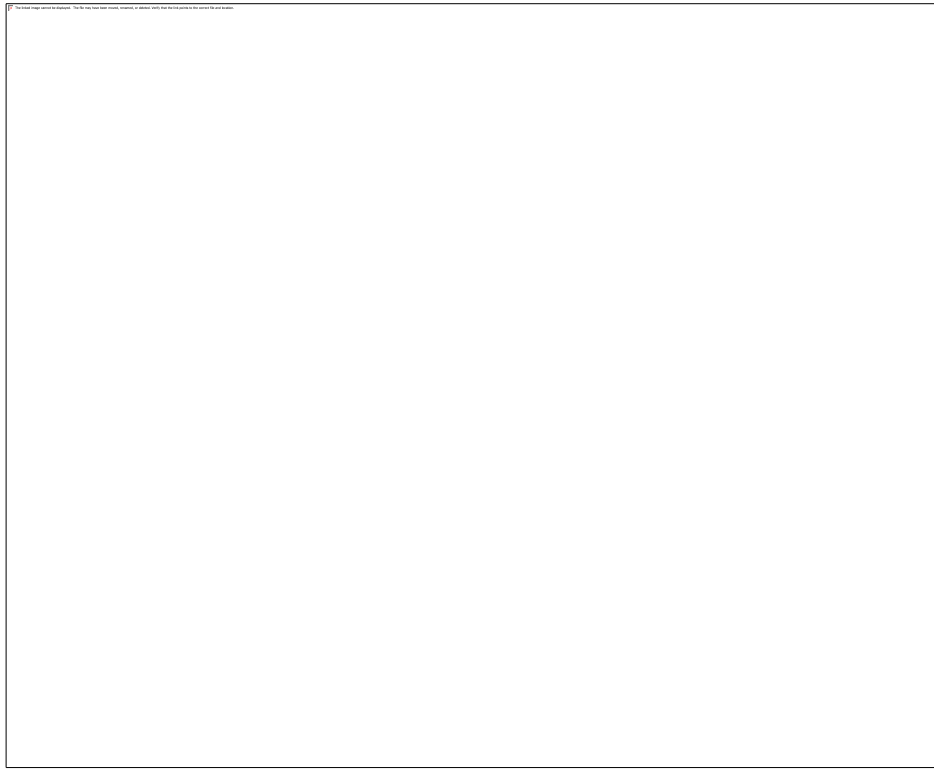
Figure 4-2

13. Select *Reports|Zone Design Reports|Zone Design Summary*. This report summarizes what is happening in the zone – from the outlets to the control valve as seen in Figure 4-2.
14. Possibly the most useful reports are the *Full* and *Pipe* reports. The *Zone Design Full* report will tell you the length of a pipe, its head difference and its velocity (as seen in Figure 4-3) whereas the *Zone Design Pipe Report* will tell you the pressure in the pipe and elevation of the start and end point. Both reports will tell you the pipe size and flow.
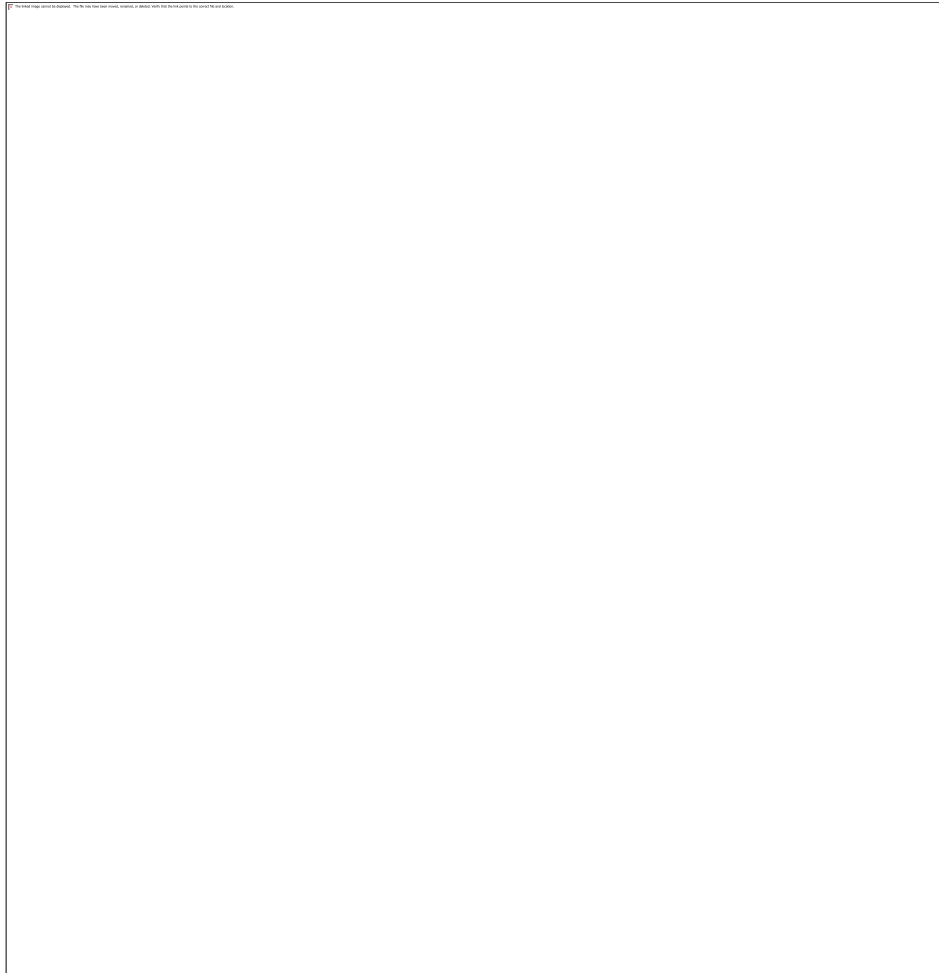
Figure 4-3

4.2.1.6 ENTERING MANAGEMENT REQUIREMENTS

15. 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. In our simple example there is only one valve so the simplest method is to enter *Design|Assign All Zones to One System Flow*. This option automatically assigns "Zone no. 001" to operate on **System Flow 1**. Click [OK].

4.2.1.7 MAINLINE DESIGN

16. We can now size the mainline via *Design|Mainline Design|…*. You will notice that the four options here are the same as were available for Zone Design. The only differences are that *Mainline LP Design* will size pipes based on the pressure required at the control valve and that *Mainline Velocity Design* must be used if the system has more than one water supply connected. Select *Mainline LP Design*. You should see the pipe change colour. Again, the colour for pipes is stored in the database.

4.2.1.8 MAINLINE REPORTING

17. Now select *Reports|Mainline Design Reports|System Duty Report*. Here we see the system duty required to run the system you have designed (Figure 4-4).
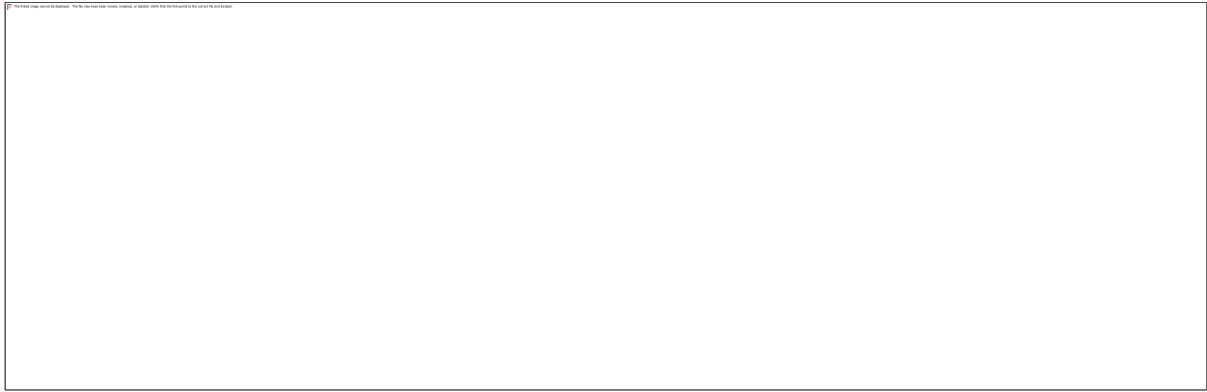
Figure 4-4

4.2.1.9 FINALISE THE DESIGN

When the outlets are non-pressure compensating running *Detailed Analysis* provides the advantage of reporting the actual field flows based on the actual pressure at each outlet. This can be significant if the zone is large, mainline outlets have been used, or elevations have been included.

18. When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure in *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.
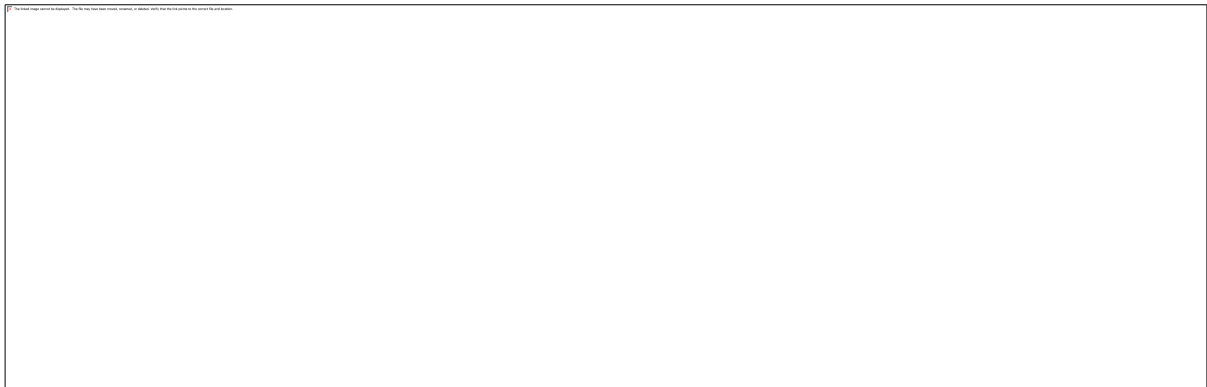
Figure 4-5

19. Now run *Design|Zone Design|Zone Detailed Analysis* to finalise the zone design results. Check the Zone reports by selecting *Reports|Zone Design Reports*.
20. If the Zone reports are good re-run Mainline Design. Because there is only a control valve in this design there is no point in running *Mainline Detailed Analysis*. *Design|Mainline Design|Mainline Analysis* to analyse the changes. Check the Mainline reports.

4.2.2 PLACEMENT AIDS AND TIPS

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

- Circular Cursor: *Irricad Options|Miscellaneous* – "Circular Cursor"
- Connecting Hydraulic Items: *Irricad Options|Snap* – "Default Snap Mode"
- Direct Entry: Keyboard
- Place vs Connect: *Irricad Options|Snap*
- Grid: BricsCAD®/AutoCAD© GRID settings
- Snap to Grid: BricsCAD®/AutoCAD© GRID SNAP settings
- Ortho Mode: BricsCAD®/AutoCAD© ORTHO settings
- Entity or Object Snaps: BricsCAD®/AutoCAD© OSNAP settings.

4.2.2.1 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 and can be actioned via *Irricad Options|Miscellaneous* – "Circular Cursor".

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

4.2.2.2 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 screen distance, set in *Irricad Options|Snap* – "Default Snap Mode", 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.

4.2.2.3 DIRECT ENTRY

Distances, angles and co-ordinates can be entered directly by using the keyboard. This will be specified by the type of drawing tool you are using. If you start a line, for example, you will have the option to enter the angle or length as in Figure 4-6.

Figure 4-6

If you would like the line at a specific angle and a specific length enter the angle first (BricsCAD® only) as in Figure 4-7.
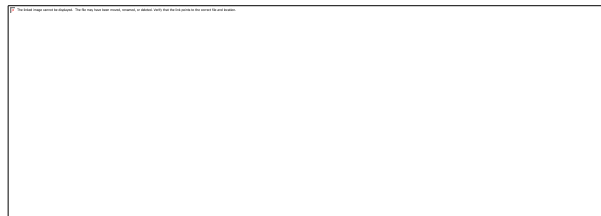
Figure 4-7

Therefore the steps for a line are:-

1. Enter LINE in the command line and press <Enter>.
2. Place the start point on the screen.
3. (BricsCAD®) Enter **A 47 150** in the command line for a 150ft (m) line at a 47 degree angle. (AutoCAD©) enter **150** and press the <Tab> key then enter **47**)

Note: Dynamic Input (DYN on the status bar) must be on to be able to enter lengths etc. on the screen.

Absolute or Relative Coordinates and Dynamic Input

Coordinates can be directly entered as the start or end point of an item. The format is X,Y e.g. 314437.28,678268.62. An item can also have an elevation entered at the same time using the format of X,Y,Z.

Absolute coordinates depict where an item is in the world, based on the projection used. This means that any imported background information is at a specified place in the world. To draw items at specific coordinates enter the absolute coordinates required before clicking on the screen. For example to start a line at world coordinates of 314437.28,678268.62:-

1. Enter LINE in the command line and press <Enter>.
2. Enter the world coordinates in the command line and press <Enter>. See Figure 4-8. The line now has a starting point on the plan at those coordinates.
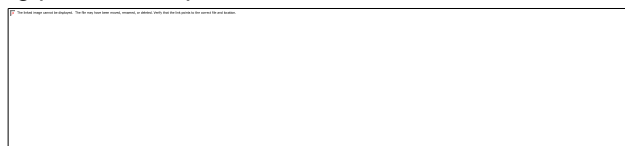
Figure 4-8

Relative coordinates are based on the last point clicked, making this point essentially a 0,0 reference point. Even though the first set of coordinates are always absolute you can toggle between Relative and Absolute for the 2nd set of coordinates by turning "Dynamic Input" (DYN on the status bar) on or off see Figure 4-9.

Figure 4-9

When a coordinate is relative you will see an @ sign appear in the command line, for example

Angle/Length/Follow/Undo/<End point>: @314487,678298

Before pressing <Enter> you can remove the @ sign to get the position at an absolute coordinate.

Note that the @ sign will not appear if you enter the coordinates directly into the command line, therefore these coordinates will be absolute. The @ sign will only appear if you are entering the coordinates in the field on the screen which will appear in the command line with an '@' prefix as soon as you enter the comma.

4.2.2.4 GRID / SNAP TO GRID

A grid of points (BricsCAD®) or lines (AutoCAD©) can be set up to be any spacing desired along the X and Y-axis by using the GRID ASPECT command. Enter a value for the spacing along the "X"-axis (horizontal spacing) and the "Y"-axis (vertical spacing).

If the horizontal and vertical spacing are the same you can use the GRID command.

Quite often when the grid is visible you want to be able to snap to the grid point as you draw the background or irrigation system. You can toggle the Grid Snap on and off via the <Ctrl><B> keys on the keyboard.

4.2.2.5 ORTHO MODE

Ortho Mode aligns each new point horizontally or vertically with the previous point placed for geometric items and pipes and can be turned on via the ORTHO command or by clicking on the status bar (ORTHO or icon).

Holding the <Shift> key down when in Ortho Mode will disengage Ortho Mode. Holding the <Shift> key down when not in Ortho Mode will engage Ortho Mode.

4.2.2.6 ENTITY OR OBJECT SNAPS

Snaps gives you the ability to place or constrain points in relationship to other objects in your drawing. To set the types of snaps use the OSNAP command and enable each type of required snap.

It is recommended to have at least the Endpoint and Nearest snaps enabled for drawing irrigation systems.

Snaps can typically be turned on and off quickly by shortcuts on the status bar.

Try the above tools to see how they work.

4.2.3 A SIMPLE TURF DESIGN

Tasks covered in this tutorial:

- Entering 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 shows 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 relatively small size.
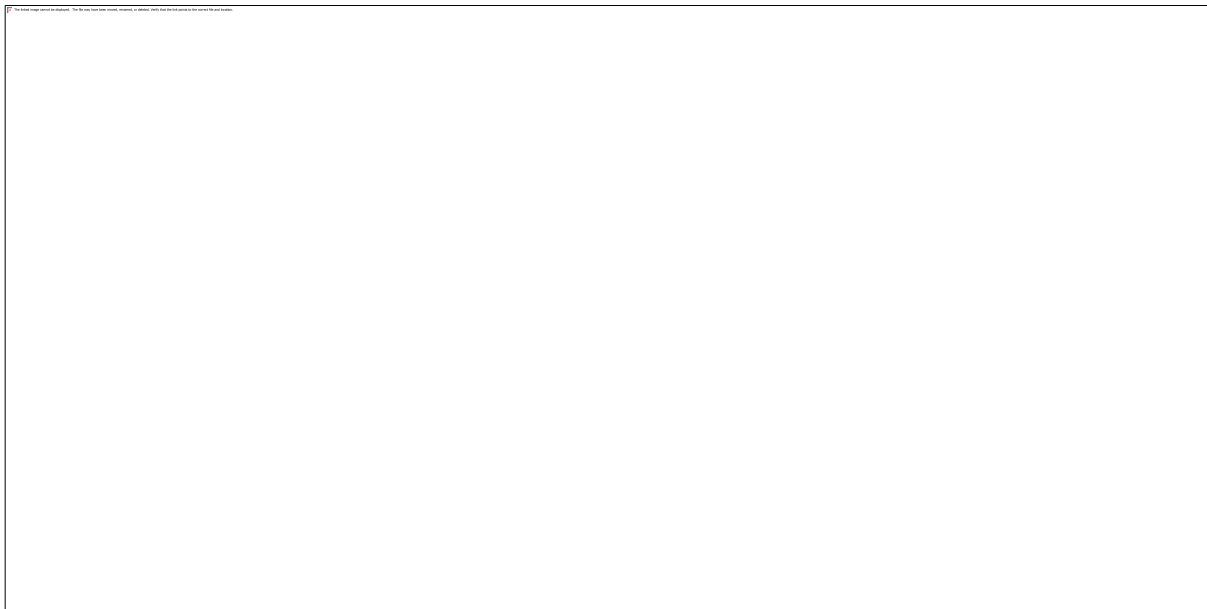
Figure 4-10

4.2.3.1 GETTING STARTED

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation - Design Specific* tab. Browse [...] for the **Tutorial.mdb** database. If Irricad was installed in the default location it will be located in the C:\Program Files\Irricad\Irricad Link XX\Database folder. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021" (0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**.
3. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. This settings will be retained for each subsequent design by clicking the [Save As Defaults] button and then [OK] to close the dialog. A message will appear if you have changed the units from what was set previously - click [Yes] to scale the drawing.
4. 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. This information can be imported however for the purposes of this tutorial we will manually enter some basic background information. Enter RECTANGLE D in the command line press <Enter> and then type the required length and width of **11.5** (**3.5**) when prompted. Place a corner by left-clicking on the screen and move the mouse up or down for

the correct placement (that is, the corner you clicked can be the bottom left corner or top right corner) and left-click to finish. (In AutoCAD© action RECTANG and place the first point on the screen and then enter D and the required length and width).

5. Enter ZOOM EXTENTS and then ZOOM OUT in the command line so there is space around the outside of the square.

4.2.3.2 LAYING OUT THE SYSTEM

6. Select *Mainline|Water Supply*. Place a water supply on the screen near the right-hand side by left-clicking on the screen. Ensure the "Calculate pressure?" check box is enabled so that IRRICAD will calculate the system duty for the system. Click [OK] to accept and close the dialog. Now press the <Esc> key on the keyboard to finish the tool.

7. Select *Irricad Options|Miscellaneous*. Change the "Base database symbol size" to **1.6** (**0.5**), making sure that "Update database dymbols" is enabled. Click [OK]. The hydraulic symbols on the screen will now appear smaller.

8. Select *Zone|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 **28psi** (**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].

9. Place an outlet at each corner of the square by left-clicking and the press <Esc> after the fourth outlet has been placed. You will notice that the arcs are not oriented to water inside the square.
   We will manually fix this by double-clicking on each outlet. In the "Zone Outlet" dialog change the "Orienatation" to be **0**, **90**, **180** or **270** as required (bottom left = 0, bottom right = 90, top right = 180, and top left = 270) as in Figure 4-11. Click [OK]. Repeat for each arc.
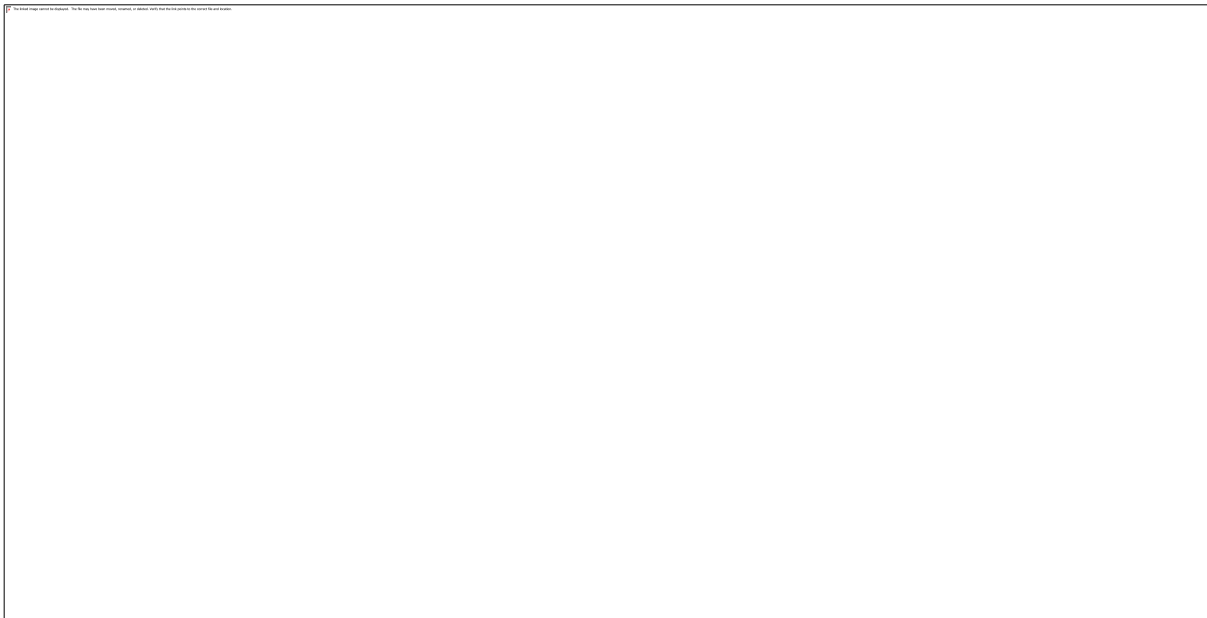
Figure 4-11

10. Connect the outlets by selecting *Zone|Zone Pipe*. Leave the pipe as **Computer Selected** and click [OK]. Click on each outlet to connect to the pipe leaving the left-hand side open. Start at the top left outlet then go to the top right then the bottom right and lastly the bottom left. Right-click to finish. Click near the midpoint 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 press <Esc> to finish the current zone pipe and then press <Esc> again to finish the zone pipe tool.

11. Select *Zone|Control Valve*, and select the **1" (25mm) Electric Valve**. Place the valve on the zone pipe end. The black pipe junction should disappear. Press <Esc> to finish the tool.

12. Select *Mainline|Mainline Pipe*. Leave the pipe as **Computer Selected** so that IRRICAD will size the pipe for you. Click [OK] and left-click on the valve then left-click on the water supply. Press <Esc> to finish the pipe and <Esc> agin to finish the tool. See Figure 4-12.
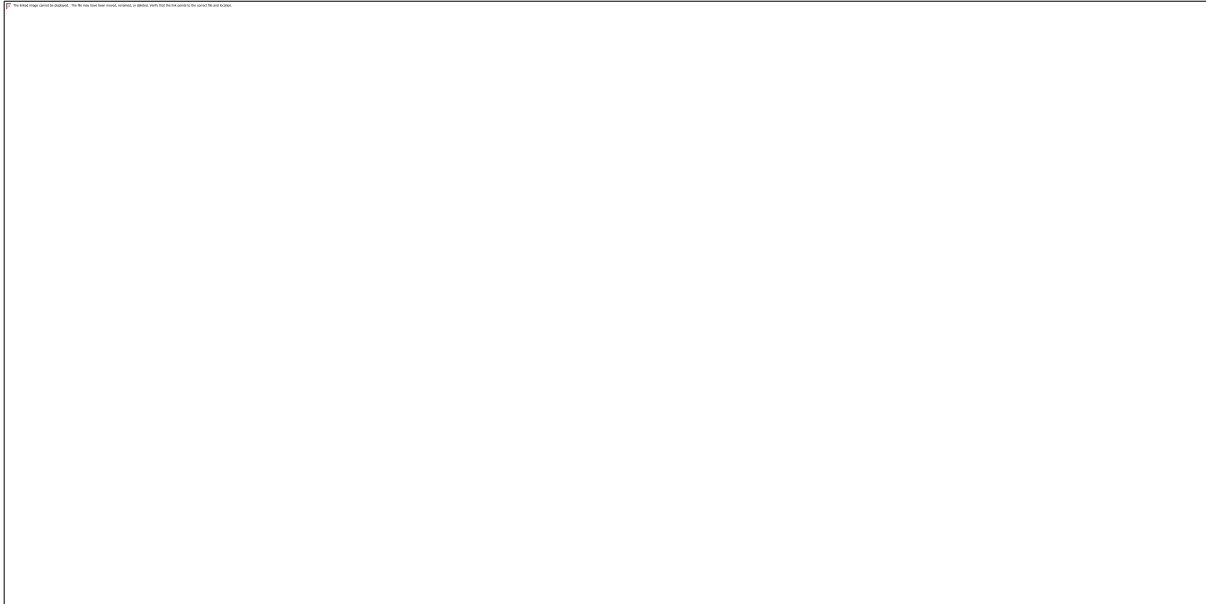
Figure 4-12

4.2.3.3 CHECKING CONNECTIONS

13. First check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. 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 via *Design|Clear Connectivity Marks*.)

14. 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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet by clicking on the item and MOVE the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|Snap* is set to "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.

Tip: If you are zoomed in too much then this can also hinder the connection. Zoom out a little and let IRRICAD's snap tolerance do the work for you.

4.2.3.4 ZONE DESIGN

15. Now we can design the zone by sizing the pipes and analyzing these pipes. Action *Design|Zone Design|Zone LP Design*. You should see the pipe change colour. The colour for pipes is stored in the database. Note that if the pipe selected has the same colour as the computer selected pipe you will not see a colour change.

4.2.3.5 ZONE REPORTING

Figure 4-13

16. Select *Reports|Zone Design Reports|Zone Design Summary*. This report summarizes what is happening in the zone – from the outlets to the control valve as seen in Figure 4-13.

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 11.99%. The actual outlet pressure variation in this system is close to 0%. IRRICAD calculates the required downstream valve pressure and the resulting minimum and maximum outlet pressures in the zone. If your results are different this will be due to the length of pipes you have drawn.

4.2.3.6 ENTERING MANAGEMENT REQUIREMENTS

17. Once again IRRICAD needs to know how the system will 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 running. In our simple example there is only one valve so the simplest method is to select *Design|Assign All Zones to One System Flow*. This option is automatic, IRRICAD assigns "Zone no. 001" to operate on **System Flow 1**. Click [OK].

4.2.3.7 MAINLINE DESIGN

18. We can now design the mainline. Select *Design|Mainline Design|Mainline LP Design* to size pipes and analyse them. You should see the pipe change colour. Again the colour for pipes is stored in the database.

4.2.3.8 MAINLINE REPORTING

19. Now open the *Reports|Mainline Design Reports|System Duty Report*. Here we can see the system duty required to run the system you have designed.
20. Open the Reports|Mainline Design Reports|Mainline Design Full and Reports|Mainline Design Reports|Mainline Design Pipe Report. The "Full" and "Pipes" reports also exist for the zone design.

4.2.3.9 FINALISE THE DESIGN

20. When you are happy with the zone design results and do not need to make any changes run *Design|Zone Design|Detailed Analysis*. In order to do this first set the valve pressure via *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.
21. Now run *Design|Zone Design|Zone Detailed Analysis* to finalise the zone design results. Check the Zone reports.
22. If the Zone reports are good re-run Mainline Design. Because there is only a control valve in this design there is no point in running *Mainline Detailed Analysis*. Run *Design|Mainline Design|Mainline Analysis*. Check the *Reports|Mainline Design Reports*.

4.2.4 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 Section 4.2.3)
- Placing sprinklers at a fixed or even spacing along a pipe length – see Section 4.2.4.2 and Section 4.2.4.3
- Automatically placing sprinklers in irregular areas Section 4.2.4.4

Before we look at these different methods it is useful to note that you do not have 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 IRR_AREA command (*Zone|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.

4.2.4.1 GETTING STARTED

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021" (0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**.
3. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. This settings will be retained for each subsequent design by clicking the [Save As Defaults] button and then [OK] to close the dialog. A message will appear if you have changed the units from what was set previously - click [Yes] to scale the drawing.

4.2.4.2 PLACING SPRINKLERS AT A FIXED SPACING – 1ST METHOD OF 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
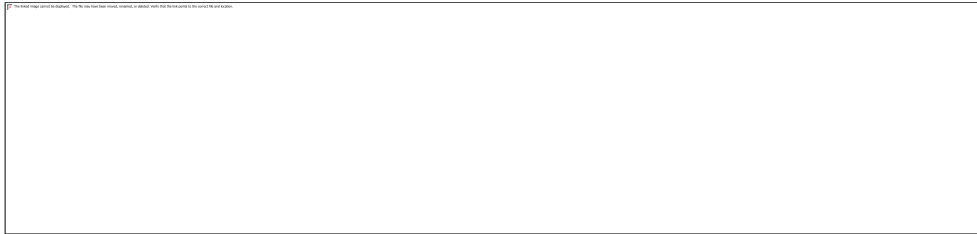
Figure 4-14

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

1. Draw a rectangle 82 x 49ft (25 x 15m) on the screen. Enter RECTANGLE D in the command line press <Enter> and then type the required length of **82** (**25**) and width of **49** (**15**) when prompted. Place a corner by left-clicking on the screen and move the mouse up or down for the correct placement (that is, the corner you clicked can be the bottom left corner or top right corner) and left-click to finish. (In AutoCAD© action RECTANG and place the first point on the screen and then enter D and the required length and width). Enter ZOOM EXTENTS and then ZOOM OUT in the command line so there is space around the outside of the rectangle.

2. Select *Mainline|Water Supply* and place a water supply on the screen near the right-hand side by left-clicking on the screen. Ensure the "Calculate pressure?" check box is enabled so that IRRICAD will calculate the system duty for the system. Click [OK] to accept and close the dialog. Now press the <Esc> key on the keyboard to finish the tool. ZOOM EXTENTS.

3. To decrease the size of the water supply and subsequent hydraulic symbols *Irricad Options|Miscellaneous*. Change the "Base database symbol size" to **4.8** (**1.5**) making sure that "Update database dymbols" is enabled. Click [OK]. The hydraulic symbols on the screen will now appear smaller. Note that the symbol sizes will need to be set for each design because it is dependent on the extents of the design and how you want the symbols to look on the print-out.

4. Highlight the polygon and select *Zone|Area*. Click [OK] on the message "create irrigated area from select items". In the dialog ensure the "Set Arc Orientation Using Area" check box is enabled. See Figure 4-15. Click [OK] to close the dialog. Then press <Esc> to de-select the rectangle.
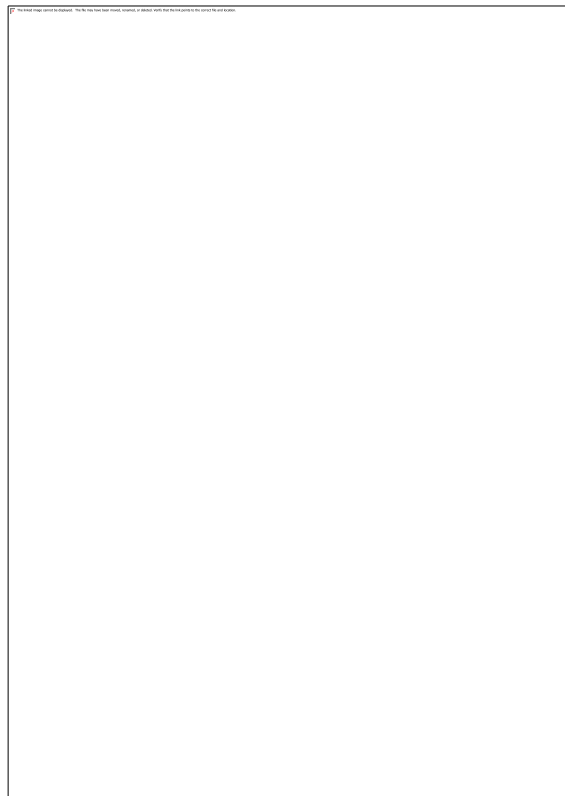
Figure 4-15

5. Select *Zone|Zone Sprayline*, and leave the pipe as **Computer Selected**. 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 **29.869 psi** (**21m**). Leave the "Riser" field as **No Component Selected** and enter **14.5ft** (**4.5m**) as the "Outlet Spacing" (for head-to-head spacing). Uncheck the "Connected" check box, as we want these items to be treated as separate outlets and pipes. Click [OK].

6. Click on the top left corner of the rectangle and then click on the top right corner of the rectangle. Press <Esc> to finish. A line of pipe has been drawn with the sprinklers at fixed spacing.

7. 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 4-16.
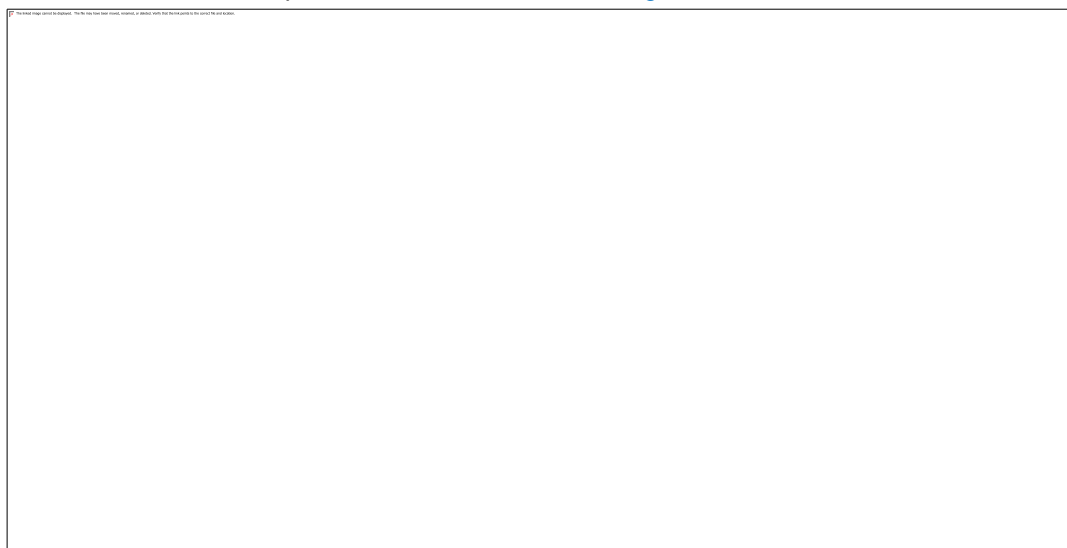
Figure 4-16

4.2.4.3 EVEN SPACING ALONG A PIPE LENGTH – 2ND METHOD OF PLACING SPRINKLERS AT A FIXED SPACING

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
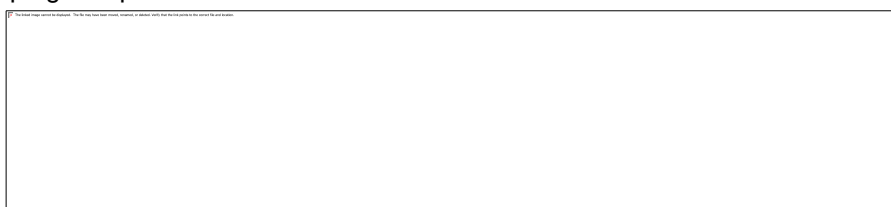
Figure 4-17

This method is similar to the one 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.

1. Do the above tutorial (Placing Sprinklers at a Fixed Spacing – 1st Method of Placing Sprinklers at a Fixed Spacing). Now select *Zone|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.

2. Click on the bottom left corner of the rectangle and then click on the bottom right corner of the rectangle. Press <Esc> to finish. A line of pipe has been drawn with the sprinklers at fixed spacing.

3. 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 4-18. Press <Esc> to finish the spraylaine and <Esc> again to finish the tool.
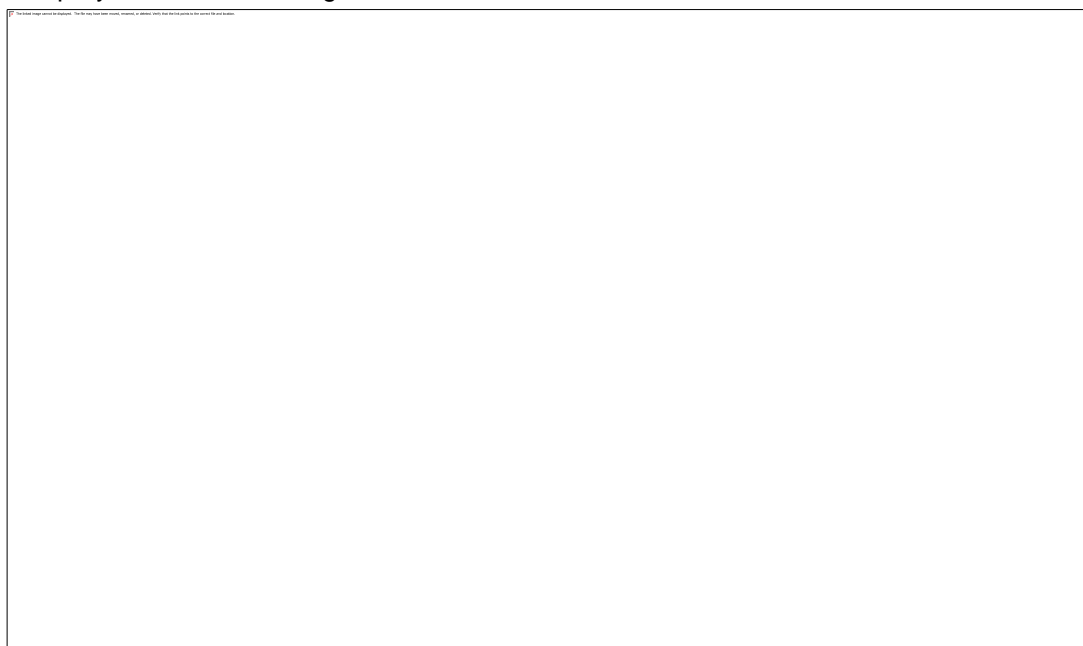
Figure 4-18

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 *Zone|Area* can be altered by double-clicking on the outlet and adjusting the "Arc" and/or "Orientation" as described in the above tutorial (A Simple Turf Design).

5. Connect the spraylines together with **Computer Selected** zone pipe using *Zone|Cut Pipe* and starting on the right-hand end of the laterals. This pipe tool will connect to any zone item it crosses so that you do not have to click on each pipe you want to connect to. Simply start the pipe at the top junction and finish the pipe after clicking on the bottom junction. <Esc> to finish the submain. Then connect to the mid-point of the submain and draw a pipe half-way towards the water supply. Press <Esc> twice to finish the current pipe and tool.

6. Using *Zone|Control Valve* select a **1" (25mm) valve** and connect the valve to the zone pipe end. <Esc> to finish the tool.

7. Action *Mainline|Mainline Pipe* and connect a **Computer Selected** pipe to the valve and to the water supply to complete the system. <Esc> to finish the tool. See Figure 4-19.

Figure 4-19

8. Follow the same design procedure as in the previous tutorials.
9. Run *Reports|Show Zone Pressure Limits* to label the outlet with the minimum pressure and 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 *Zone|Area* tool, without having the arcs or wetted radii showing, and can be used in any application where even spacing or fixed spacing of outlets is required. It can be used in conjunction with Snaps or "Circular Cursor" as placement aids. See Figure 4-20 for the difference of having "Fixed Spacing" on and "Fixed Spacing" off on the same length of pipe.
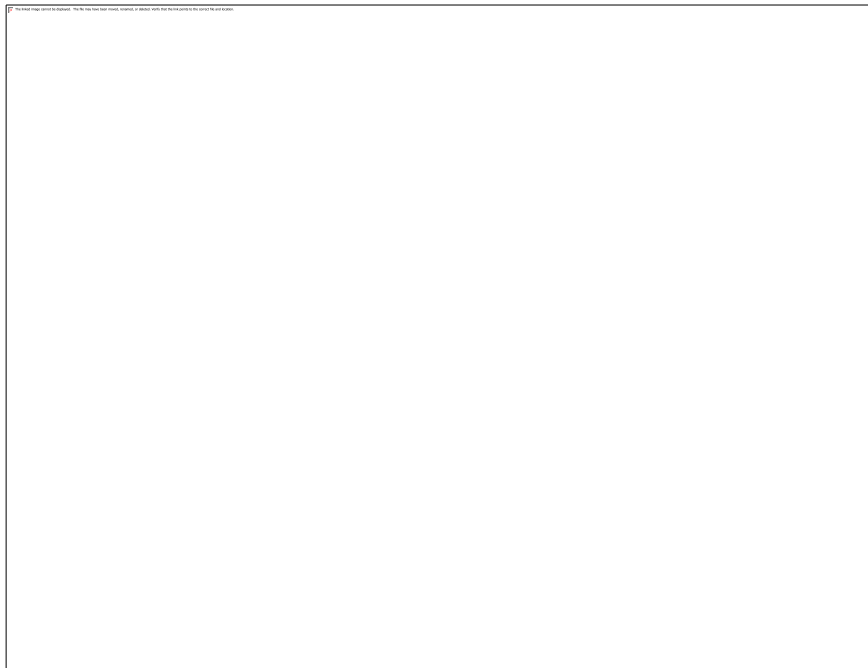
Figure 4-20

4.2.4.4 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

Figure 4-21

The third method used for placing sprinklers is a tool called *Zone|Autohead*. Note *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.

1. To keep straight horizontal and vertical lines turn on ortho mode by entering ORTHO ON in the command line. Action POLYLINE to draw the area outline. Place the first point in the lower left of the screen, move the cursor to right to achieve a straight horizontal line, and type **48** (**15**) on the keyboard and press <Enter>. Move the cursor upwards to achieve a straight horizontal line and type **32** (**10**) and press <Enter> on the keyboard. Using this method continue to draw another line to the left for **16ft** (**5m**), downwards for **16ft** (**5m**), and to the left for **32ft** (**10m**). Now finish the polygon by taking the last line back to the starting point and left-click. Press <Esc> to finish the tool. ZOOM EXTENTS.
2. Highlight the shape from step 1 and action *Zone|Area*. Click [OK] on the message "create irrigated area from select items". In the dialog ensure that "Set Arc Orientation Using Area" is enabled. It should look something like Figure 4-22. Press <Esc> to deselect the polygon. ZOOM OUT.
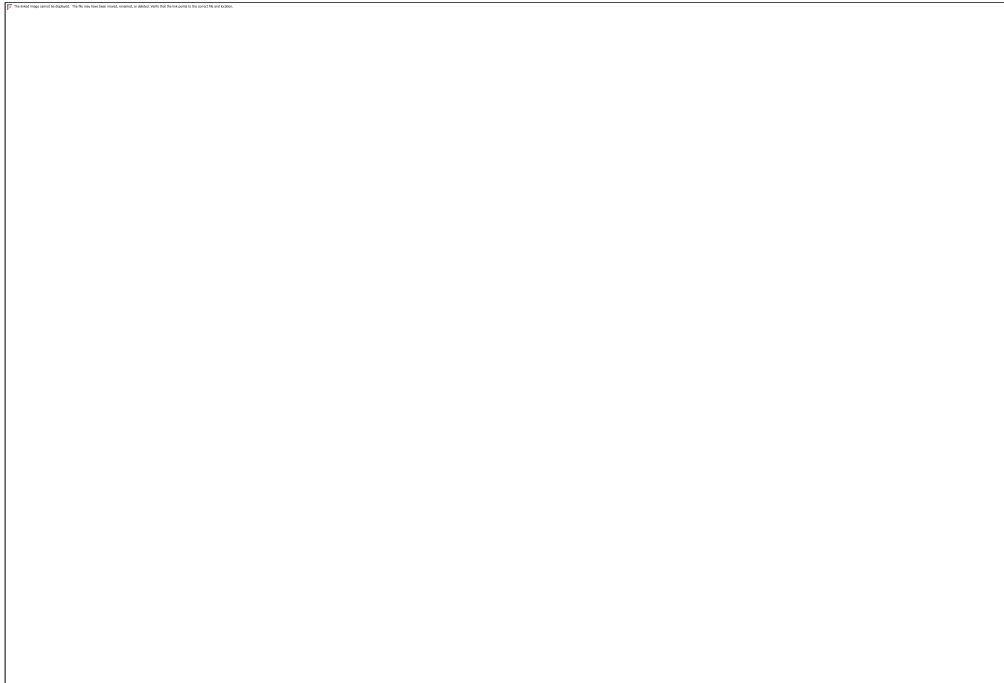
Figure 4-22

3. Select *Mainline|Water Supply*. Place a water supply on the screen near the right-hand side by left-clicking on the screen. Ensure the "Calculate pressure?" check box is enabled so that IRRICAD will calculate the system duty for the system. Click [OK] to accept and close the dialog. Now press the <Esc> key on the keyboard to finish the tool.
4. To decrease the size of the water supply and subsequent hydraulic symbols go to *Irricad Options|Miscellaneous*. Change the "Base database symbol size" to **3** (**1**) making sure that "Update database dymbols" is enabled. Click [OK]. The hydraulic symbols on the screen will now appear smaller.
5. Select the Area boundary and then action *Zone|Autohead*.
6. Select 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 **29.869psi** (**21m**). Leave the "Riser" field as **No Component Selected**. Click [OK]. See Figure 4-23.
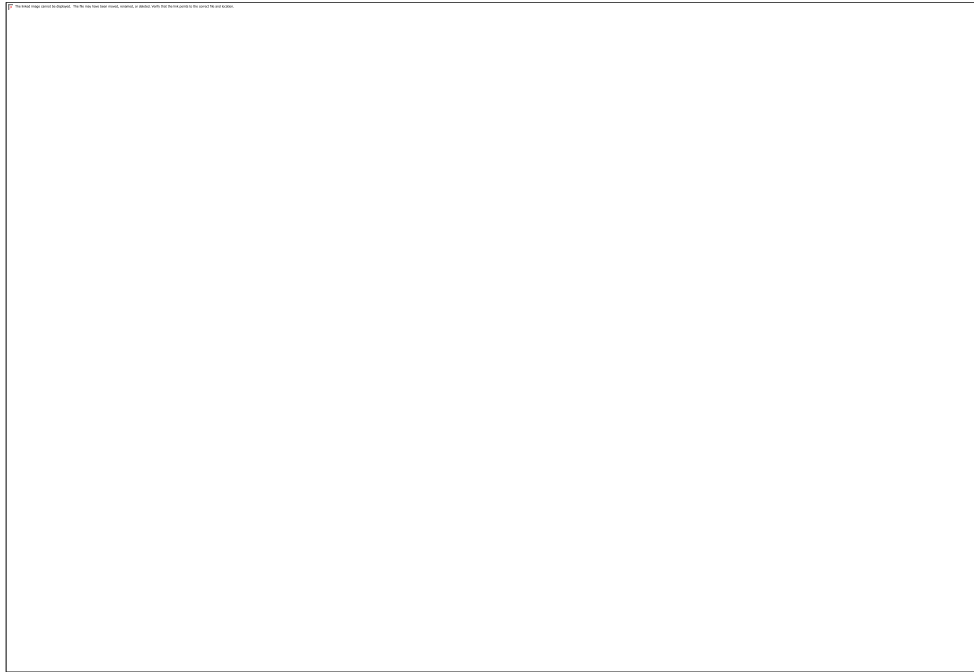
Figure 4-23

7. As the *Area* lasso is on the polygon boundary and so is the *Autohead* lasso you may find that some arcs do not orientate inside the area. Simply move the sprinkler slightly inside the boundary and left-click to place. This method can also be used for moving any sprinkler to a more appropriate place.

8. Action *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. Press <Esc> to finish. Your design should look like Figure 4-24.

9. Then connect a pipe to the center sprinkler on the right-hand side and draw the pipe half-way to the water supply. Place a *Control Valve* and *Mainline|Mainline Pipe* to complete the system.

10. Follow the same zone design procedure as in the previous tutorials.

Figure 4-24

4.2.5 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. 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.

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

1. Double-click on the Area lasso. The *Zone|Area* dialog will appear. See Figure 4-25.
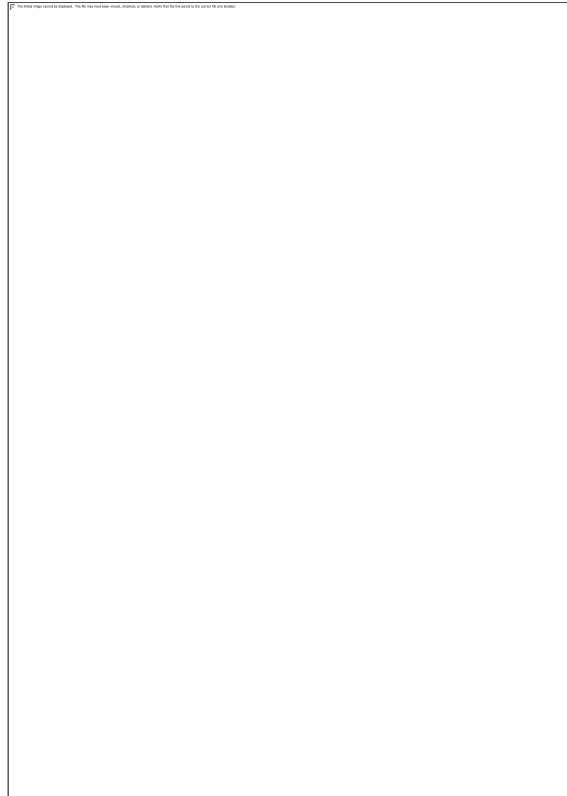
Figure 4-25

4.2.5.1 THE AREA DIALOG

2. The maximum intensity can be specified in in/hr (mm/hr). This is the maximum amount of water per hour that can be applied to that area or soil type. Enter **0.2** (**5**) as the "Max Intensity".
3. 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 **0.08**in (**2**mm). See Figure 4-25. Click [OK].

4.2.5.2 CALCULATING ZONE RUN TIMES

4. When Areas are used you can still use the default running time of 1 hour in *Design|Assign…* options (Management).
5. After management has been completed the Zone Flows report can be viewed via *Reports|Management Reports|Zone Flow Report* and it will specify the time we need to run the zone in order to achieve the required depth or volume entered in the Area dialog. This report has 25 (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. *Water Requirements* report will list the applied volumes and depths based on the <u>current</u> run time (which is 1 hour). See Figure 4-26 (*Zone Flow Report*) and Figure 4-27 (*Water Requirements* Report).
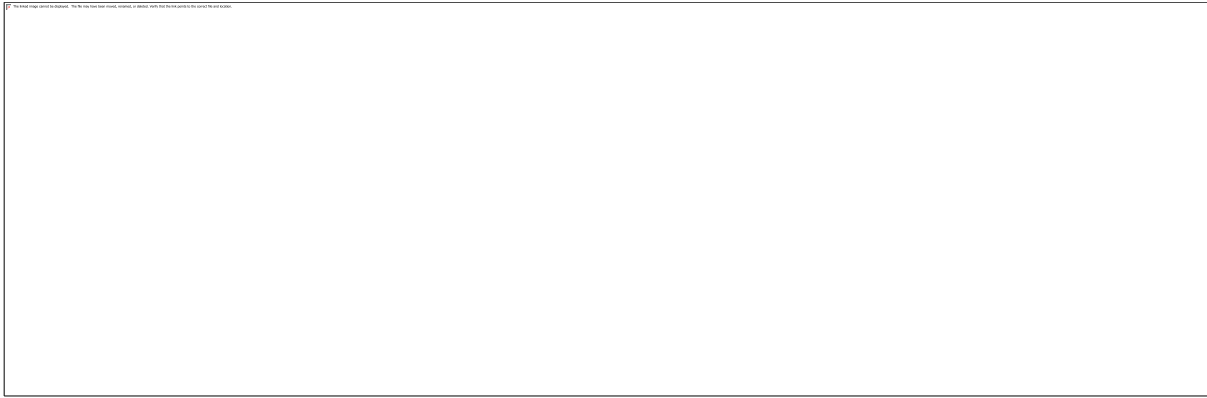
Figure 4-26
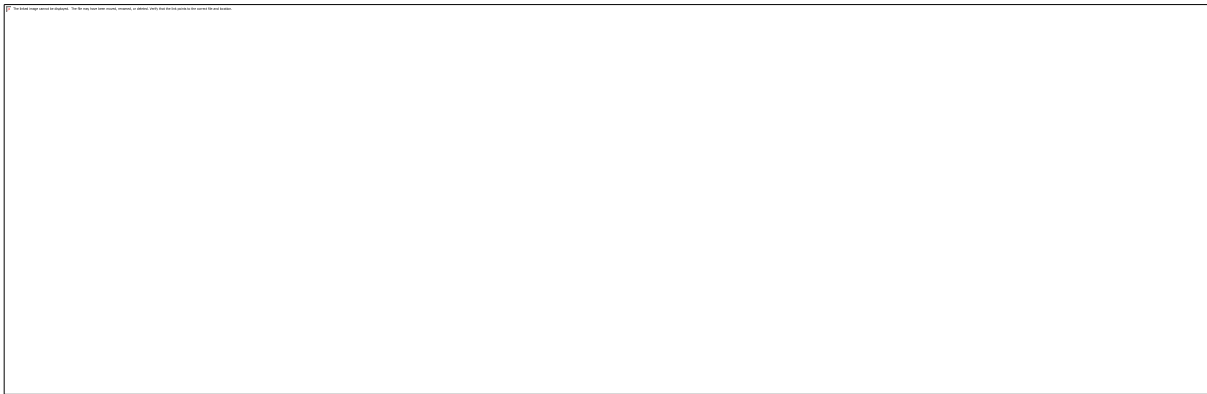
Figure 4-27

You can set the run time *Design|Assign…* options to be that which is reported in the *Zone Flow Report* (25 (26) minutes). Open the *Water Requirements* report with the updated run time of 25 (26) minutes.

Figure 4-28

6. Complete Mainline Design.

4.2.6 IMPORTING OTHER FILE TYPES

Files from other CAD programs can be imported into an IRRICAD design. Supported file formats are:

- .DXF   DXF files – Use OPEN or *Irricad Import|Import Contours*
- .DWG   AutoCAD© drawing files – Use OPEN or *Irricad Import|Import Contours*
- .wmf/wmz Windows meta files - Use IMPORT
- .emf/emz Windows meta files - Use IMPORT
- .dae   Collada files - Use IMPORT
- .skp   SketchUp files - Use IMPORT
- .shp   ESRI maps – Use *Irricad Import|Import Data* or *Irricad Import|Import Contours*
- .txt   text files – Use *Irricad Import|Import Data* or *Irricad Import|Import Contours*
- .kml/kmz Google Earth Keyhole Markup Language files – Use *Irricad Import|Import Data* or *Irricad Import|Import Contours*
- .jpg   JPEG files – Use IMAGEATTACH
- .bmp   Bitmap files – Use IMAGEATTACH
- .tif   TIFF files – Use IMAGEATTACH
- .gif   GIF files – Use IMAGEATTACH
- .tga   TGA files – Use IMAGEATTACH
- .jp2   JP2 files – Use IMAGEATTACH
- .pcx   Paintbrush files – Use IMAGEATTACH
- .png   PNG files – Use IMAGEATTACH
- .j2k   J2K files – Use IMAGEATTACH

- .ecw   ECW files – Use IMAGEATTACH
- .sid   SID files – Use IMAGEATTACH

After importing a file, such as a DXF or DWG, sometimes the drawing is not centerd on the screen or nothing appears. Use ZOOM EXTENTS for the drawing to appear full size in the screen.

4.2.6.1 IMPORTING FAQS

Drawing is Very Small on Screen

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 selection window draw a window around the design area. Now use the IRR_SELINV command for 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 action DELETE and now ZOOM EXTENTS. Your drawing should now fill the screen.

4.2.6.2 IMPORTING ELEVATIONS

Elevations can be imported into IRRICAD as contours and spot heights from DXF, DWG, SHP, CSV, TXT, XYZ, or KML/KMZ files. The file must contain 3-D polylines or point objects that have a Z vertex. Any layer imported as an Elevation layer via *Irricad Import|Import Elevations* will automatically be placed on the IRR_ELEVATIONS layer. When importing the same DXF or DWG file that is already open in IRRICAD Link first save the open drawing to another name.

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 OPEN. By using EDITENTITY or SHOWINFO on items which look like they could be contours or spot heights the layer name can be viewed. You now know which layer(s) to import using *Irricad Import|Import Elevations*.

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 *Irricad Import|Import Elevations*.

Tip #3: When required to select the relevant elevation layer(s) in the *Irricad Import|Import Elevations* 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: IRRICAD reports on the number of contour segments imported. If you are using the "AEI Method" 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 *Irricad Options|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 are using the default "ABOS method" there is no limit however simplification could still be advantageous if there is a large number of segments. The D.E.M methods can be changed in *Design|Design Parameters* - Analysis Parameters.

Tips For Checking Elevation Data

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

1. You can use IRR_DELETETYPE (*Delete Type* icon) to delete erroneous contours or spot heights. If you have elevations at zero (where this is incorrect) or at the Irricad 'no elevation' value of -3280000ft (-1000000m) simply select everything in the plan 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 *Irricad Tools|Highlight Elevation*, where IRRICAD will colour code the highest through to the lowest elevations. This will show up any obvious errors in the data.
3. *Reports|3D DEM View* 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. 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). Repeat this until the maximum error reported is acceptable, or check the command prompt (F2) to see a list of the ten largest elevation errors.

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 *Irricad Tools|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:-

- If using the "AEI Method" 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
- Decreasing the number of contour segments will increase the speed of redrawing, and interpolation of, elevation data.
- Increases 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 EXTENTS will zoom only to the extents of your irrigation design area.

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

The "ABOS Method" 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 *Irricad Import|Import Elevations*, 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 (*Irricad Options|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 "D.E.M. Options" via *Design|Design Parameters* - Analysis Parameters. 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 the 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 command prompt (F2), if any of these errors are significant then the elevation data at the specified location should be reviewed. 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.

4.2.6.3 IMPORT AND SCALE AUTOMATICALLY FROM GOOGLE EARTH

Once you have obtained a API key from Google (see our How To forum post How To Acquire a Google Maps API Key) you can use *Irricad Import|Import from Google Earth* or to import a kml/kmz file that someone has sent you use the FILEGEIMPORTKML command. Browse to the required location and click the [Import] button and OK the discalimer message. By clicking on the screen specify the bottom left and top right corners of the area of interest – a red rectangle will depict the extents of your selection. Once the 2nd point is placed the image, and elevations if enabled, will be imported into IRRICAD.

4.3 DESIGN TUTORIALS

4.3.1 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 designs a drip tape block with no pressure regulation within the block.

4.3.1.1 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.

4.3.1.2 STARTING THE TUTORIAL

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021" (0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**.
3. Select the *Misc* tab and click the "Medium Design Size". Change the "Base Database Symbol Size" to **10ft** (**3m**). This determines the size of the symbols according to the size of the design. When you are finished click [OK].
4. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. This settings will be retained for each subsequent design by clicking the [Save As Defaults] button and then [OK] to close the dialog. A message will appear if you have changed the units from what was set previously - click [Yes] to scale the drawing.
5. We need to draw a rectangle on the screen with the dimensions of 200ft horizontally and165ft vertically (60 x 50m). Enter RECTAGLE D 200 165 (RECTANGLE D 60 50) and press <Enter>. Place a corner by left-clicking on the screen and move the mouse up or down for the correct placement (that is, the corner you clicked can be the bottom left corner or top right corner) and left-click to finish. (In AutoCAD© action RECTANG and place the first point on the screen and then enter D and the required length and width). ZOOM EXTENTS.
6. Highlight the rectangle and action *Zone|Tape Block*. Click [OK] on the message "create irrigated area from select items". 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 **12psi** (**8.5m**) and ensure that "Regulated" is unchecked. Checking this option would mean that you have PRVs at the start of each tape, which we do not have in this case. Type in **6ft** (**2m**) for the "Lateral Spacing" and leave the "Number of Laterals" as **0**. Ensure the "Determine Automatically" option for the "Lateral Direction" is selected as in Figure 4-29. Click [OK].

The linked image cannot be displayed. The file may have been moved, renamed, or deleted. Verify that the link points to the correct file and location.
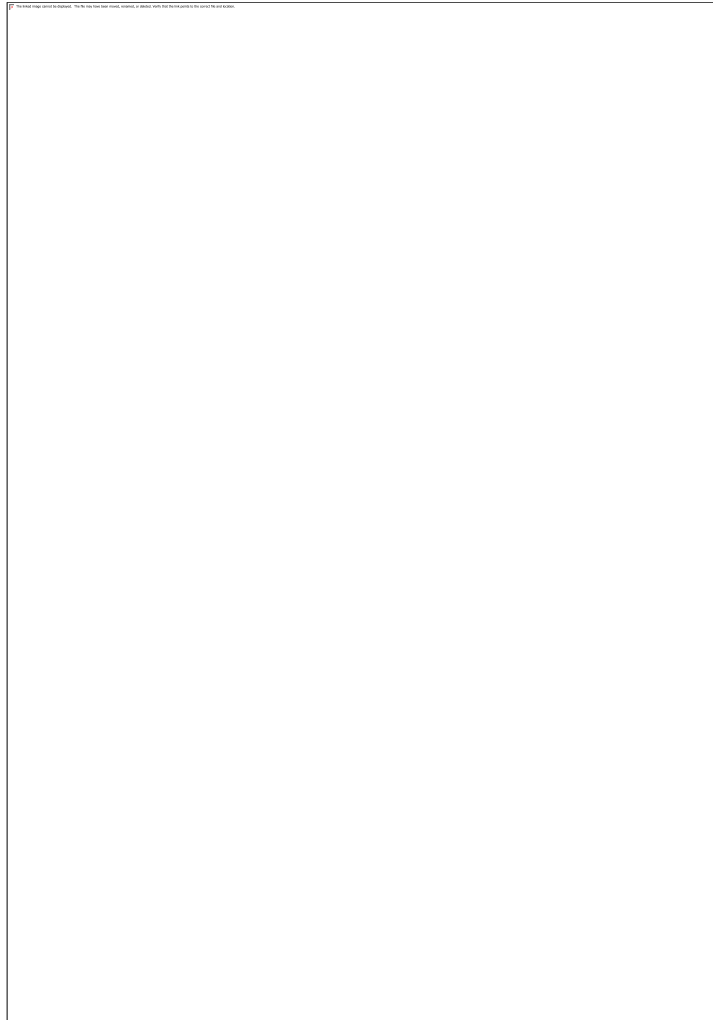
Figure 4-29

7. Click on the left-hand vertical side of the block. The block will automatically fill with tapes **6ft** (**2m**) apart. Press the <Esc> key to de-select the rectangle. The block should look similar to Figure 4-30.
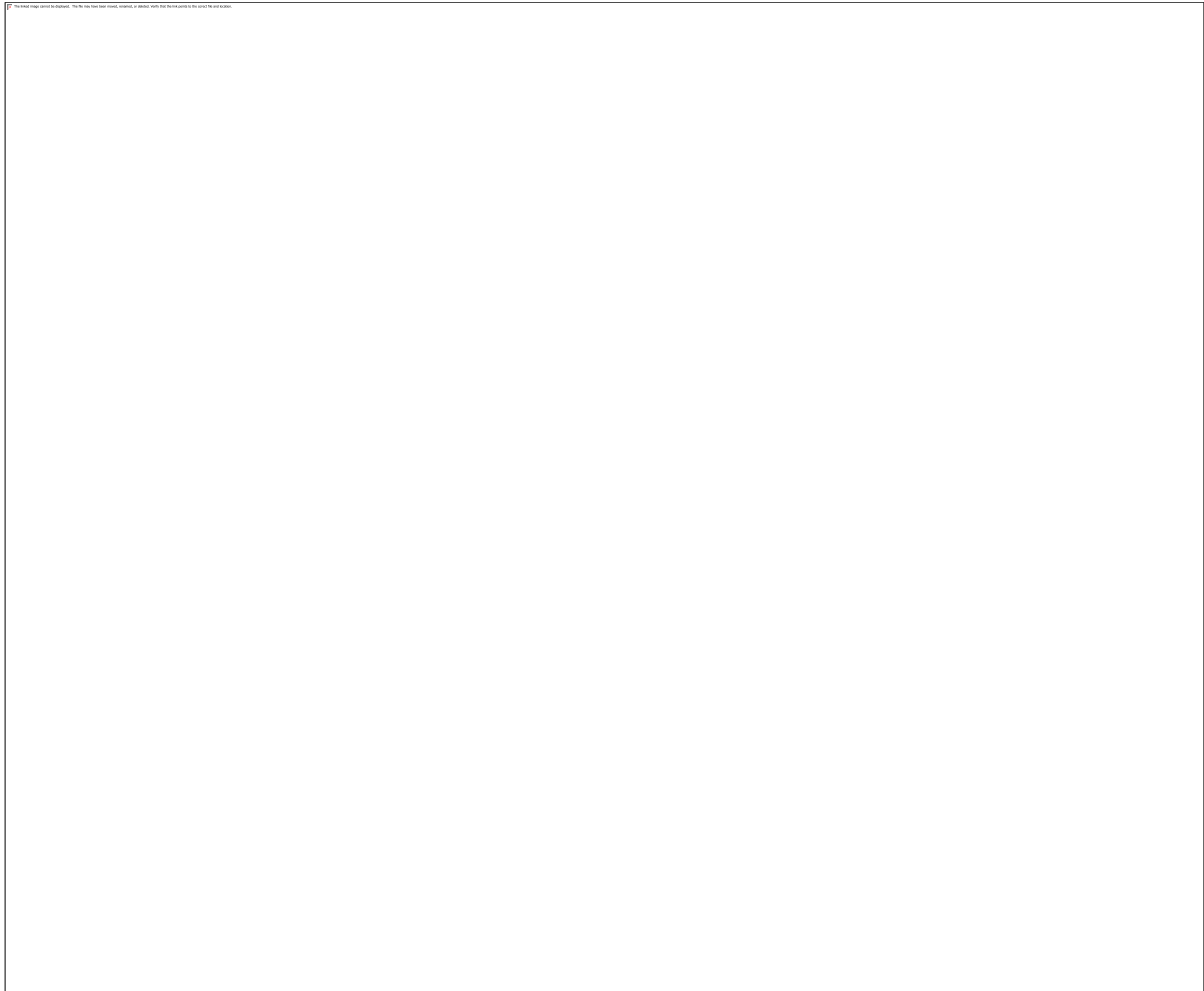
Figure 4-30

8. Action *Zone|Cut Pipe*. We wish to place a submain through the middle of the block. In the *Zone|Cut Pipe* dialog ensure the pipe selected is **Computer Selected**. Leave the "Depth" as **0** and click [OK].

9. Click near the middle of the left outer lateral. 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 **13ft** (**4m**) past the last lateral. Press <Esc> twice to finish the pipe and pipe tool.

10. Using *Zone|Control Valve* select the **1" (25mm) Electric Valve** from the dropdown list, leave 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. Press <Esc> to finish the tool.

11. Action *Mainline|Mainline Pipe* and 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 and enter **33** (**10**) and press <Enter> to get a pipe **33ft** (**10m**) long. Press <Esc> twice to finish the pipe tool.

12. Select *Mainline|Water Supply* and place on the end of the mainline pipe with a left-click as in Figure 4-31 Leave the Water supply details as the default and enable the "Calculate pressure?" check box and click [OK].. Press <Esc> to finish the tool.
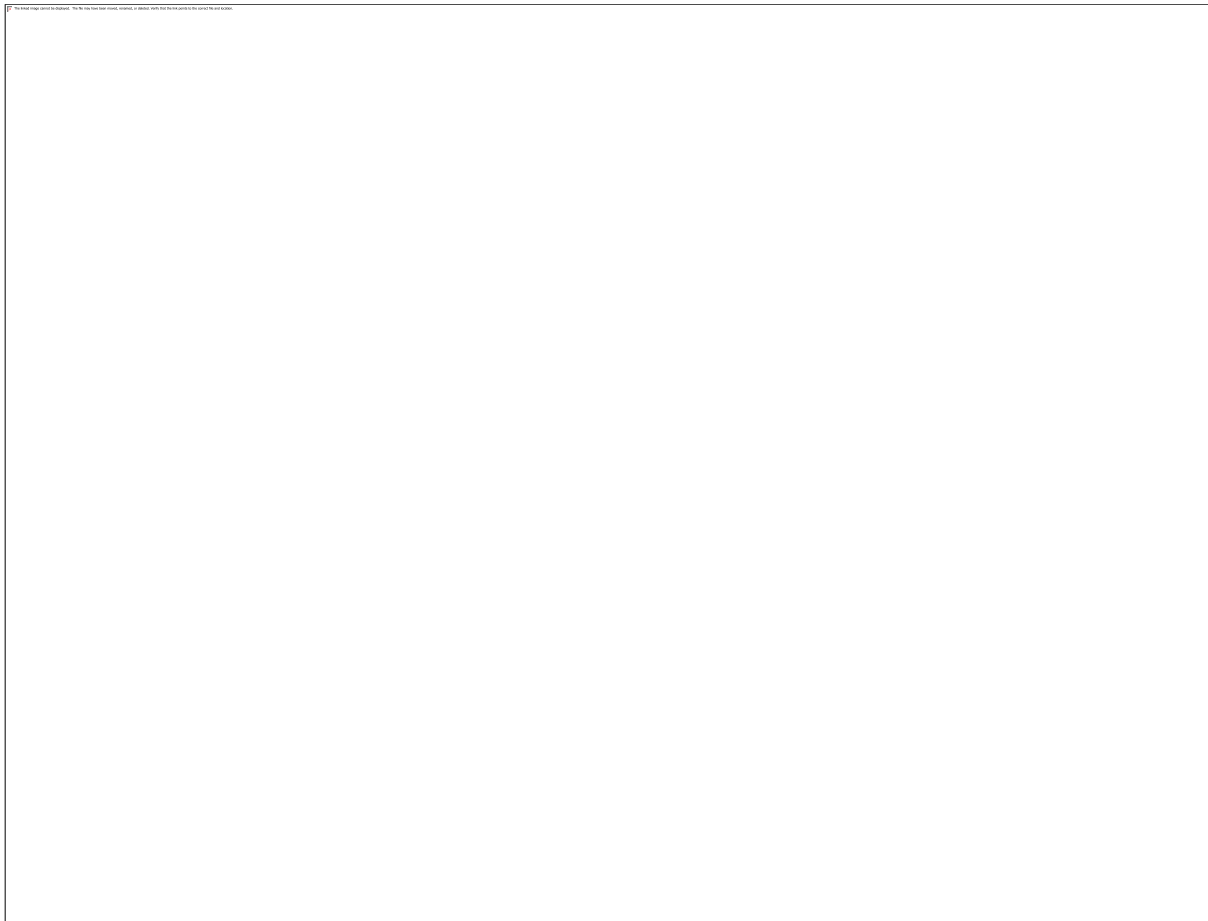
Figure 4-31

4.3.1.3 CHECKING CONNECTIONS

13. First check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. 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 via *Design|Clear Connectivity Marks*.)

14. 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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet and move the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|Snap* is set to "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.

4.3.1.4 ZONE DESIGN AND REPORTING

15. Select *Design|Design Parameters - Hydraulic Parameters*. Enter the "Maximum Zone Pipe Velocity" as **5ft/s** (**1.5m/s**). Click [OK].

16. The first step in Zone Design is to size the submain pipes. Action *Design|Zone Design|Zone LP Design*. It is always useful to view some reports before continuing. Look at the summary report in *Reports|Zone Design Reports|Zone Design Summary* as this report gives a good indication of what is happening in the zone. It should look similar to Figure 4-32. The present maximum dripper pressure is 13.22psi (9.3m) and the minimum is 12psi (8.5m). 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 9.28%. This pressure variation includes the submain friction loss as well as the loss in the tapes. Close the report window by clicking the [X].
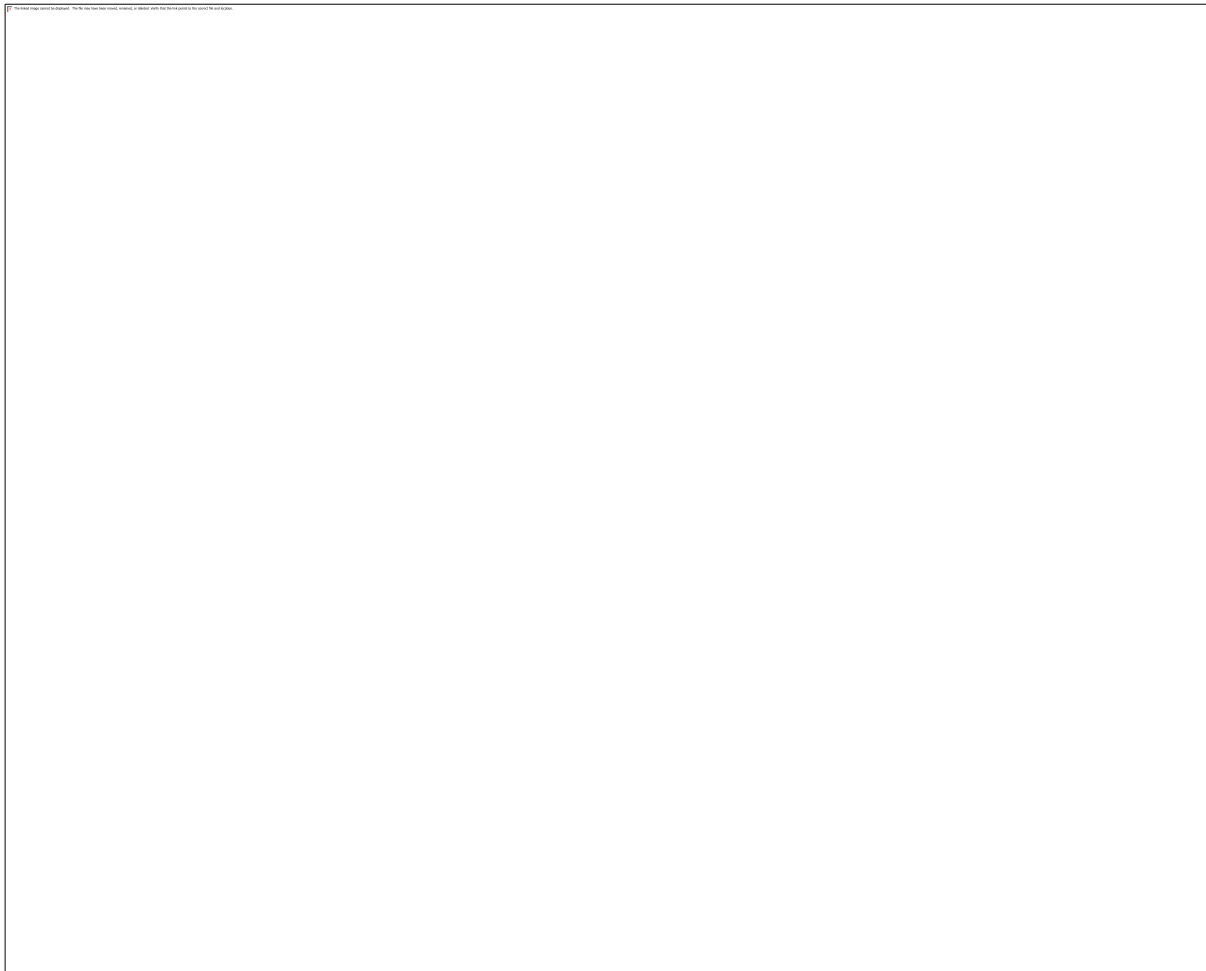
Figure 4-32

4.3.1.5 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/or analyzed.

17. Now we wish to assign the zones to system flows. Action *Design|Assign All Zones to One System Flow* as we only have one Zone (control valve or block). You will notice that "Zone no. 001" will operate on **System Flow 1** as in Figure 4-33. Click [OK].

Figure 4-33

4.3.1.6 MAINLINE DESIGN AND REPORTING

18. Now we wish to size the mainline. Run *Design|Mainline Design|Mainline LP Design*.
19. Look at *Reports|Mainline Design Reports|System Duty Report* to see the water supply requirements for each system flow. Save the design as demo.DWG.

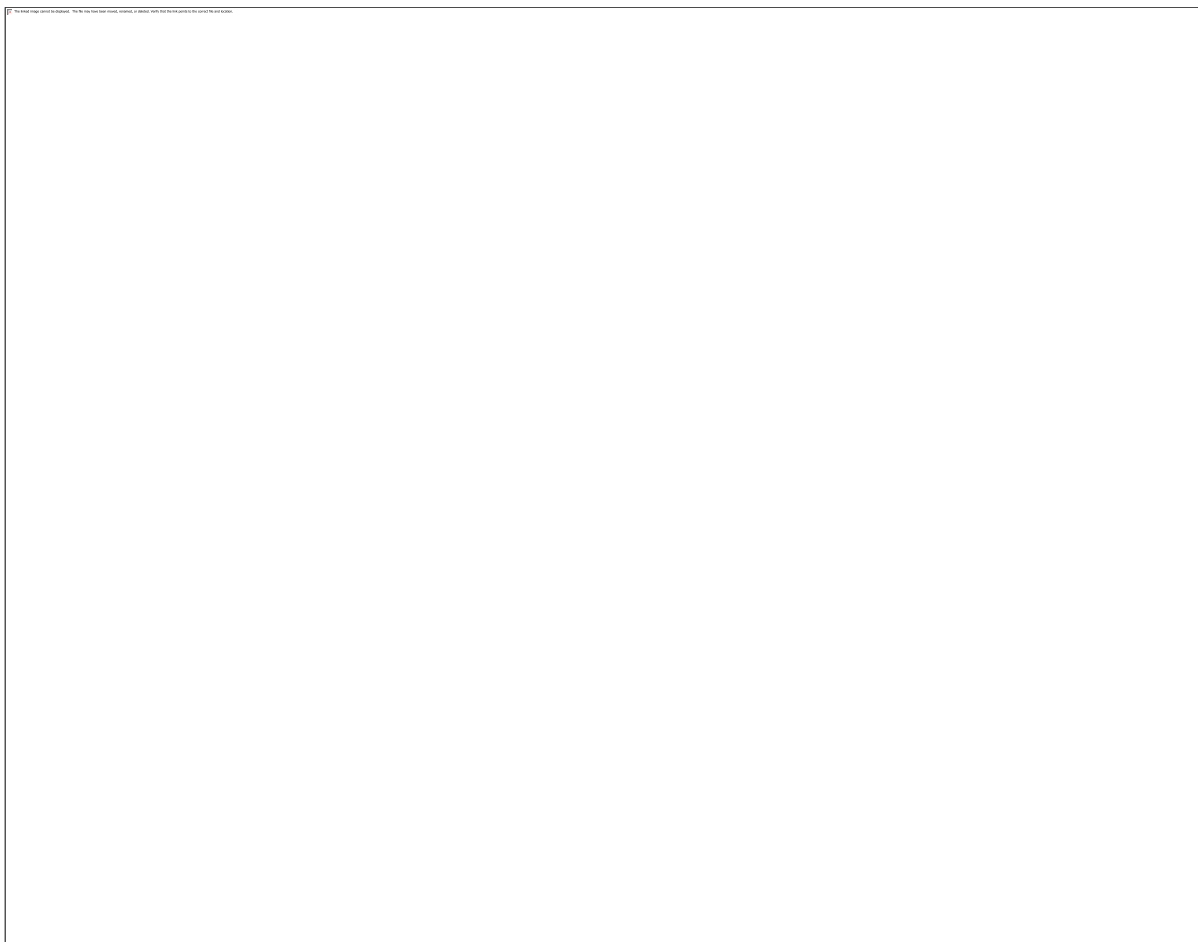### 4.3.1.7 FINALISE THE DESIGN

When the outlets are non-pressure compensating running *Detailed Analysis* provides the advantage of reporting the actual field flows based on the actual pressure at each outlet. This can be significant if the zone is large, mainline outlets have been used, or elevations have been included.

20. When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure via *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.
21. Now run *Design|Zone Design|Zone Detailed Analysis* to finalise the zone design results. Check the Zone reports.
22. If the Zone reports show the pressures are within the required range and no changes are needed re-run Mainline Design. Because there is only a control valve in this design there is no point in running *Mainline Detailed Analysis*. Run *Design|Mainline Design|Mainline Analysis*. Check the Mainline reports.

4.3.2 SIMPLE DRIP TAPE DESIGN USING BLOCK ENTITIES

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.

4.3.2.1 TAPE BLOCK ENTITIES

Using 'Block Entities' i.e. *Zone|Tape Irrigation Block*, is an alternative method to using *Zone|Tape Block*. The advantages of this method are ease and quickness of drawing the block complete with submain, control valve and flushing manifolds if required. When the block is drawn as a 'block entity' it is easy to change the parameters, for example row spacing or lateral direction. Extra labels are available for block entities, such as Area, Actual Flow, and Number of Rows. The only disadvantage of using 'Block Entities' is that the laterals cannot be modified individually and in the case of windmills for example, in the middle of the block, laterals cannot be cut out. However, the block can be exploded once drawn if required.

4.3.2.2 STARTING THE TUTORIAL

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021"** **(0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**.
3. Select the *Misc* tab and click the "Medium Design Size". Change the "Base Database Symbol Size" to **10ft** (**3m**). This determines the size of the symbols according to the size of the design. When you are finished click [OK].
4. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. This settings will be retained for each subsequent design by clicking the [Save As Defaults] button and then [OK] to close the dialog. A message will appear if you have changed the units from what was set previously - click [Yes] to scale the drawing.
5. We need to draw a rectangle on the screen with the dimensions of 165ft vertically and 200ft horizontally (50 x 60m). Enter RECTAGLE D 200 165 (RECTANGLE D 60 50) and press <Enter>. Place a corner by left-clicking on the screen and move the mouse up or down for the correct placement (that is, the corner you clicked can be the bottom left corner or top right corner) and left-click to finish. (In AutoCAD© action RECTANG and place the first point on the screen and then enter D and the required length and width). ZOOM EXTENTS.
6. Highlight the rectangle and click [OK] on the message "create irrigated area from select items". Action *Zone|Tape Irrigation Block* and 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 **12psi** (**8.5m**) and ensure "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 **6ft** (**2m**) for the "Lateral Spacing" and leave the "Number of Laterals" as **0**. Ensure the "Determine Automatically" option for the "Lateral Direction" is selected. Now click on the Block tab. Here we can choose to have our submain and valve drawn automatically if required.
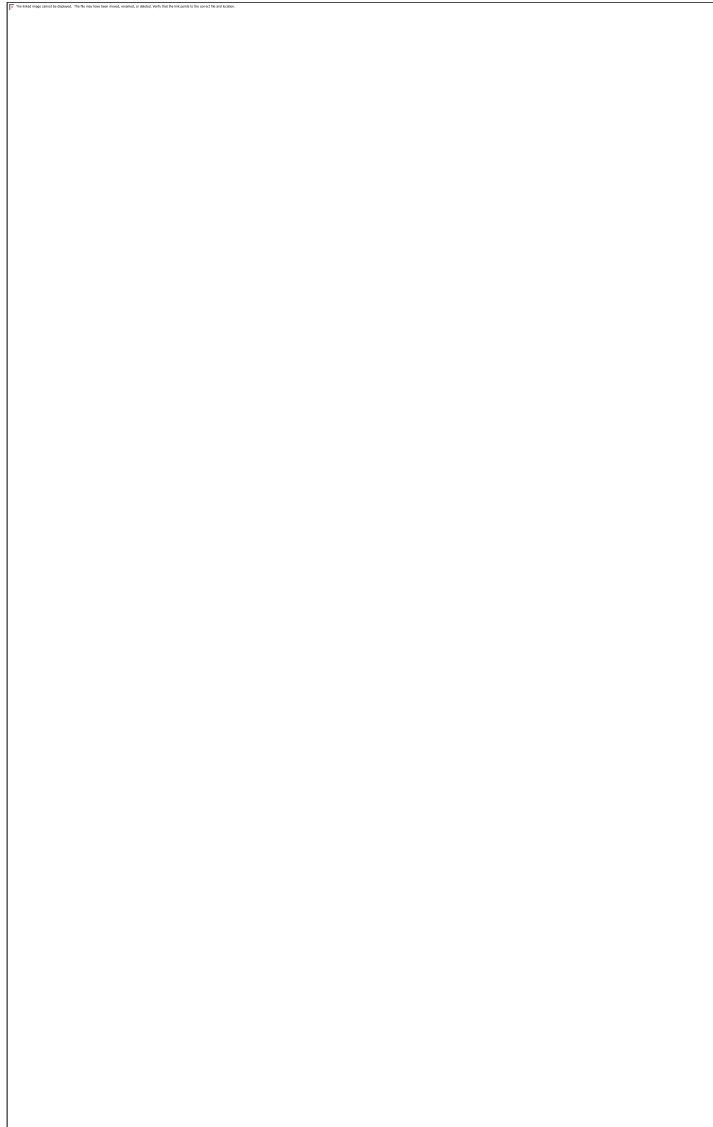
Figure 4-34

7. In the "Submain Properties" area of the dialog box set **Center** as the "Position" but leave as **Computer Selected**. In the "Control Valve Properties" area of the dialog box set the "Position" to **End**, the "Submain Stub" as **13**ft (**4**m), and specify the valve as the **1" (25mm) Electric Valve** (see Figure 4-34). Click [OK]. Because we selected "Determine Automatically" for the "Lateral Direction" we now have to select the boundary which defines the direction by clicking on the left-hand vertical boundary. Once this is completed the laterals are automatically drawn, with a submain through the center of the block and with a valve 13ft (4m) to the right as in Figure 4-35. Press the <Esc> key to de-select the rectangle.
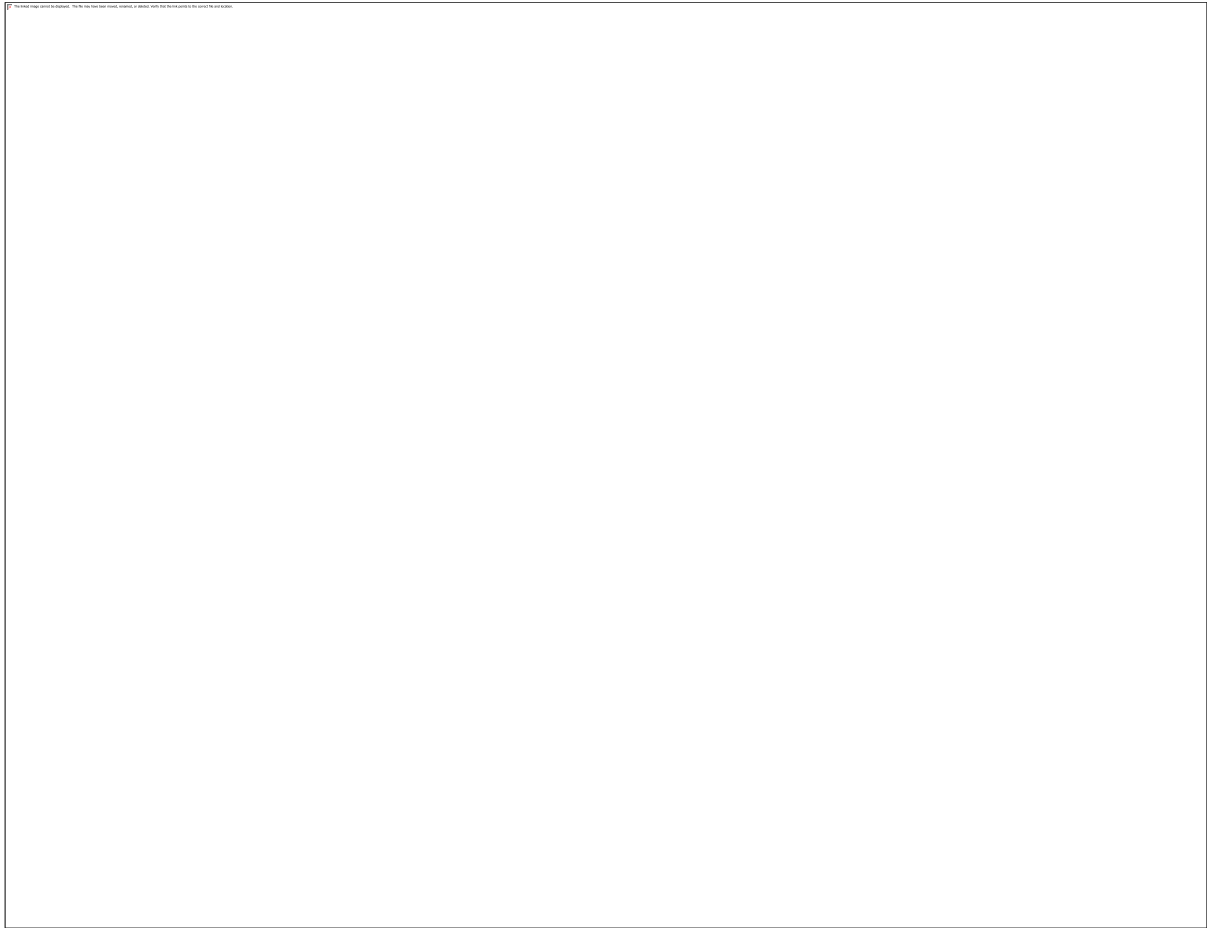
Figure 4-35

8. Now action *Mainline|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 upward and enter **33** (**10**) and press <Enter> to get a pipe **33ft** (**10m**) long. Press <Esc> twice to finish the pipe tool.

9. Using *Mainline|Water Supply* place the water supply on the end of the mainline pipe with a left-click as in Figure 4-36. Enable the "Calculate pressure?" check box and click [OK]. Press <Esc> to cancel to tool. Now ZOOM EXTENTS.

Figure 4-36

4.3.2.3 CHECKING CONNECTIONS

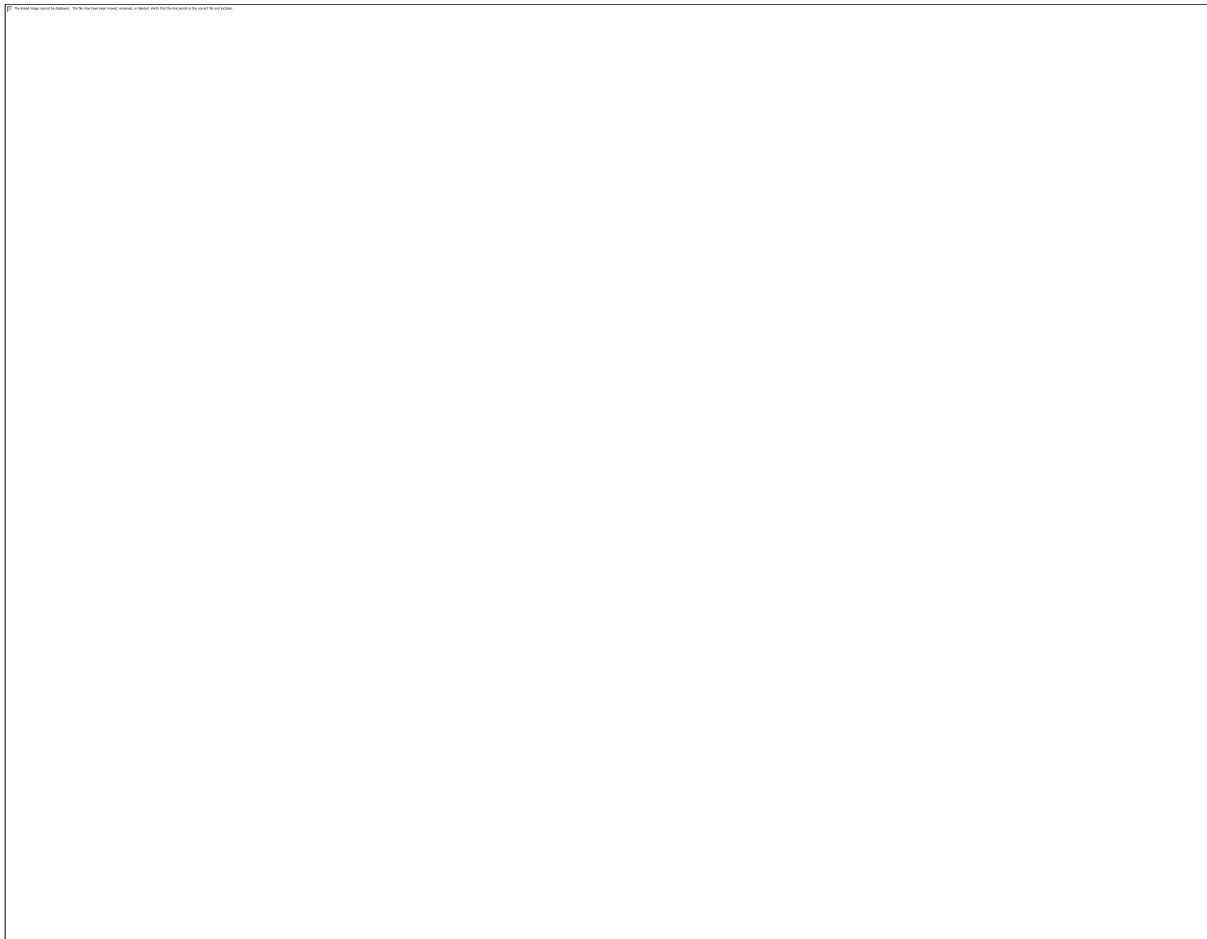10. Check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. (These can be removed via *Design|Clear Connectivity Marks*.

11. 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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet and move the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|Snap* tab is set to "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

4.3.2.4 ZONE DESIGN AND REPORTING

12. Select *Design|Design Parameters - Hydraulic Parameters*. Enter the "Maximum Zone Pipe Velocity" as **5ft/s** (**1.5m/s**). Click [OK].

13. The first step is to size the submain pipes by using *Design|Zone Design|Zone LP Design*. It is always useful to view some reports before continuing. Look at the summary report via *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 4-37. The present maximum dripper pressure is 12.43psi (8.74m) and the minimum is 10.79psi (7.59m). 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 13.17%. This pressure variation includes the submain friction loss as well as the loss in the tapes. Close the report window by clicking the [X].
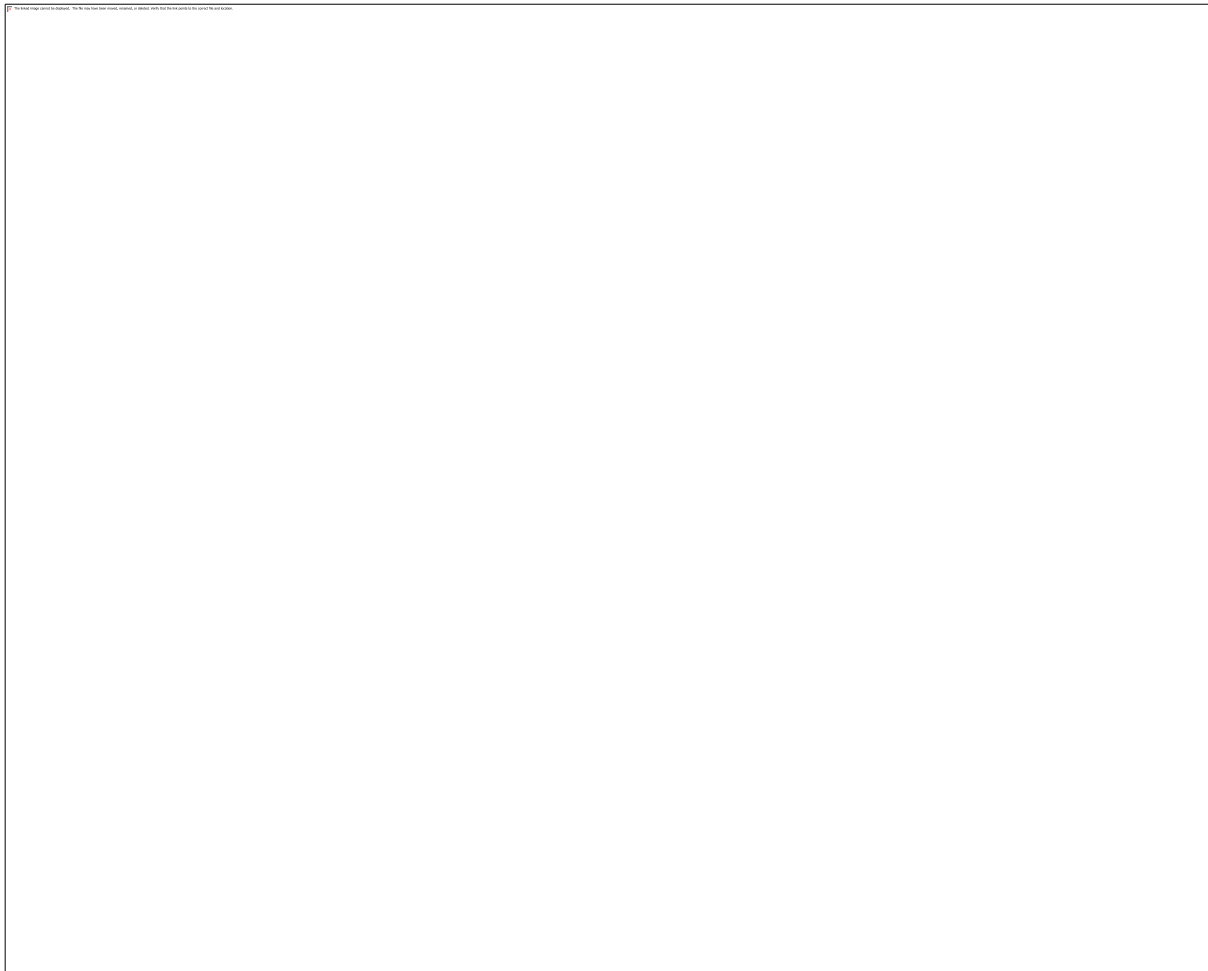

Figure 4-37

14. When this block is installed the control valve is going to be pressure-reducing and the downstream pressure will be set to **13psi** (**9m**). To specify this select *Design|Zone Design Configuration* and enter **13.00** (**9.00**) in the "D/S Valve Pressure" column for Area no. 001. Click [OK] and run *Design|Zone Design|Zone Detailed Analysis*. Open the zone summary report via *Reports|Zone Design Reports|Zone Design Summary* and notice that the valve pressure has been set to **13** (**9**) and the resultant pressures throughout the zone have been recalculated from that. See Figure 4-38. Note that this step also 'finalises' the zone design.
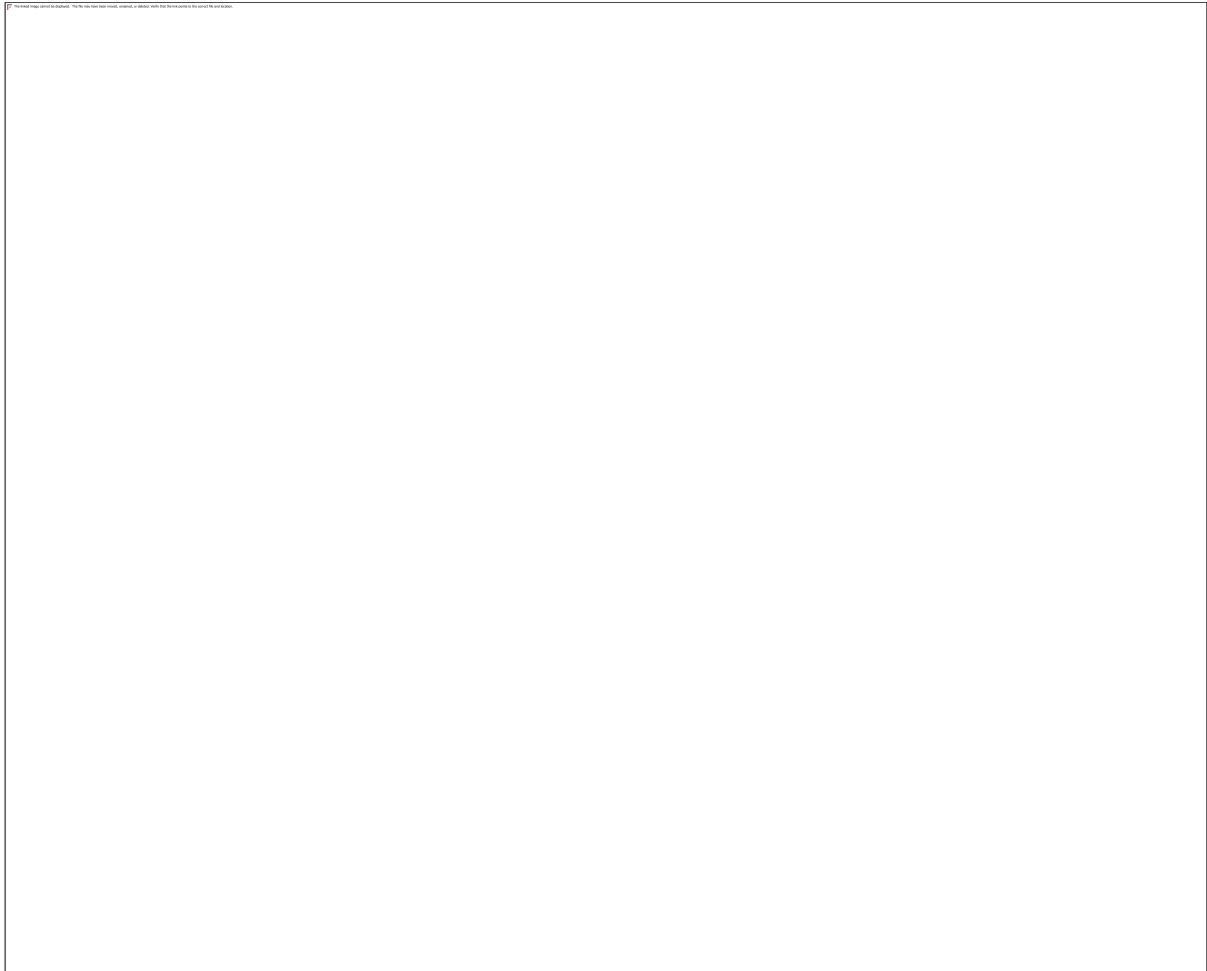
Figure 4-38

4.3.2.5 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/or analyzed.

15. 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. 001" will operate on **System Flow 1** as indicated Figure 4-39. Click [OK].

Figure 4-39

4.3.2.6 MAINLINE DESIGN & REPORTING

16. Now we wish to size the mainline, run *Design|Mainline Design|Mainline LP Design*.
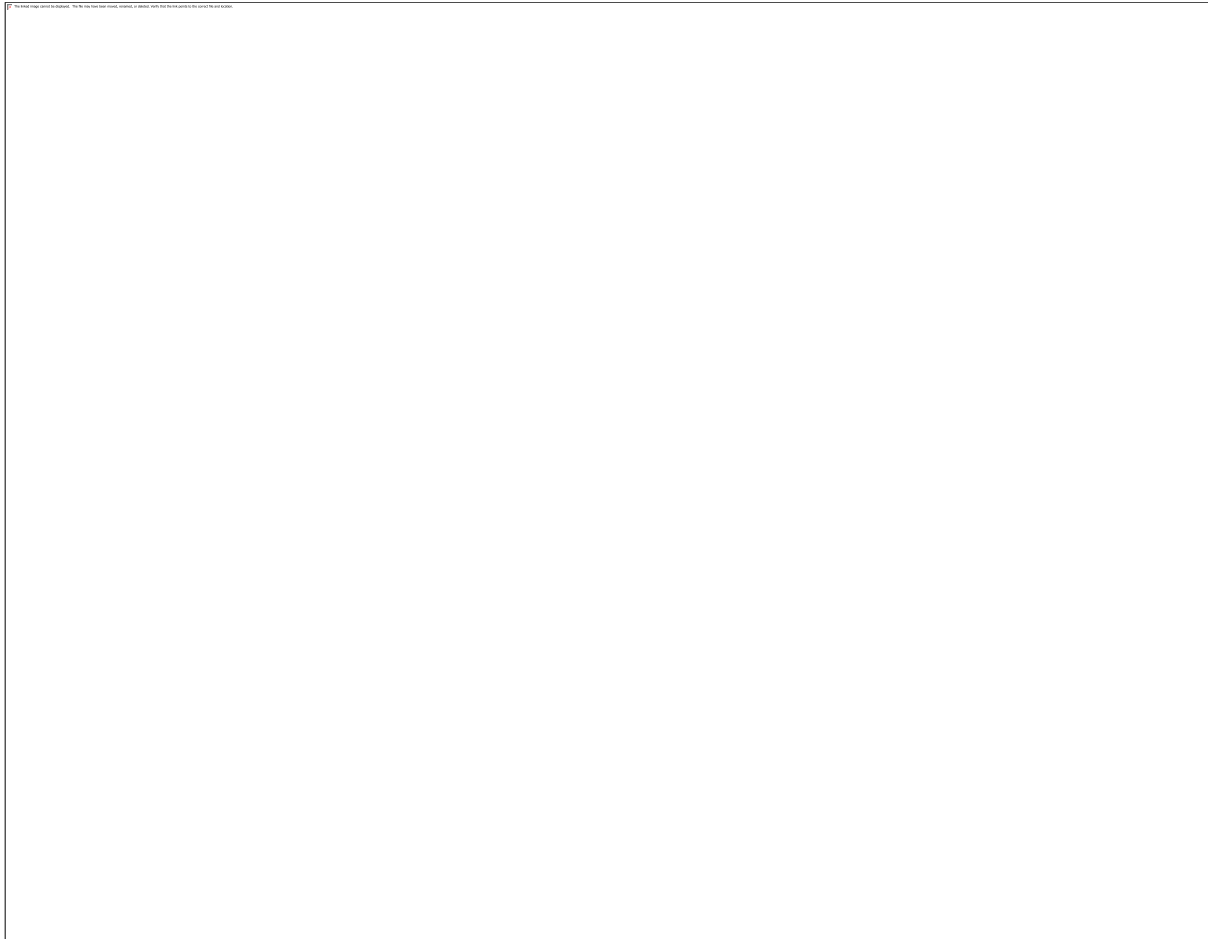17. Look at the *Reports|Mainline Design Reports|System Duty Report* to see the required demand on the water supply. This is the pressure and flow that is required downstream of the headworks to operate the system you have designed. Save the design as demo1.DWG.

4.3.2.7 AUTOMATIC LABELING

18. Select *Irricad Options|Labels* tab. In this dialog you specify which types of items you want labelled by checking the appropriate check boxes. Enable the "Irrigation Block" option and then click the [Text] button. Keywords, that will create automatic labels that contain the text required, can now be added. By default the text box is loaded with the area name key word. We want the labels to include 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 specify the following keywords and if required, descriptive text:

#NAME#   The name of the Block/Zone|Area.
#AREA# #AREAUNIT# The area of block including units.
#DESC#   The Tape description
#NUMROW# Rows   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.

19. Click [OK] when you have finished entering the text, the dialog should look like Figure 4-40 below.
20. Now we can set the [Background] options in the main dialog. Specify a background and a border of the label in a colour of your choice. Select a colour for the background and a colour and line thickness for the border. Click [OK]. Leave the "Layer" set to the **IRR_LABELS** layer. The next option determines the placement of the label. It can be BELOW the object (in this case below the Block), ABOVE, INLINE (centered within the block), to the LEFT or to the RIGHT. Select **INLINE**. Click [OK].
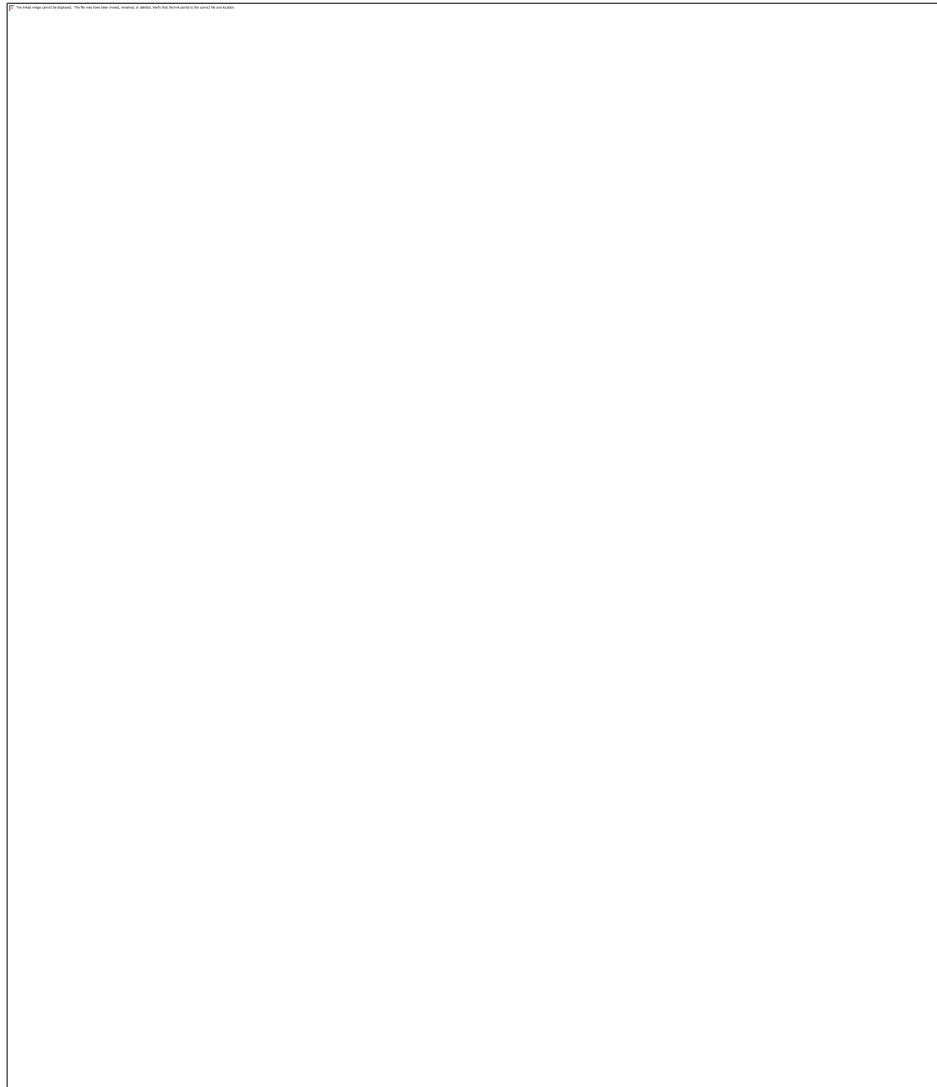
Figure 4-40

21. Now select the block. Action *Irricad Tools|Create Labels*. The keywords will be resolved to appropriate values and a label will be placed in the center of the Block.
22. If you wish to change the style of existing labels go back to *Irricad Options|Labels* and make the changes required. For example, select the [Text] button for "Irrigation Blocks" and change "Justify" to **Left** instead of **Center**. Click [OK] on both dialogs and then run *Irricad Tools|Update Labels*. All existing labels on the design will be updated to reflect the changes made in the settings. See Figure 4-41.
23. Now select the label and move it to below the valve.

Figure 4-41

4.3.3 A SIMPLE ORCHARD DESIGN
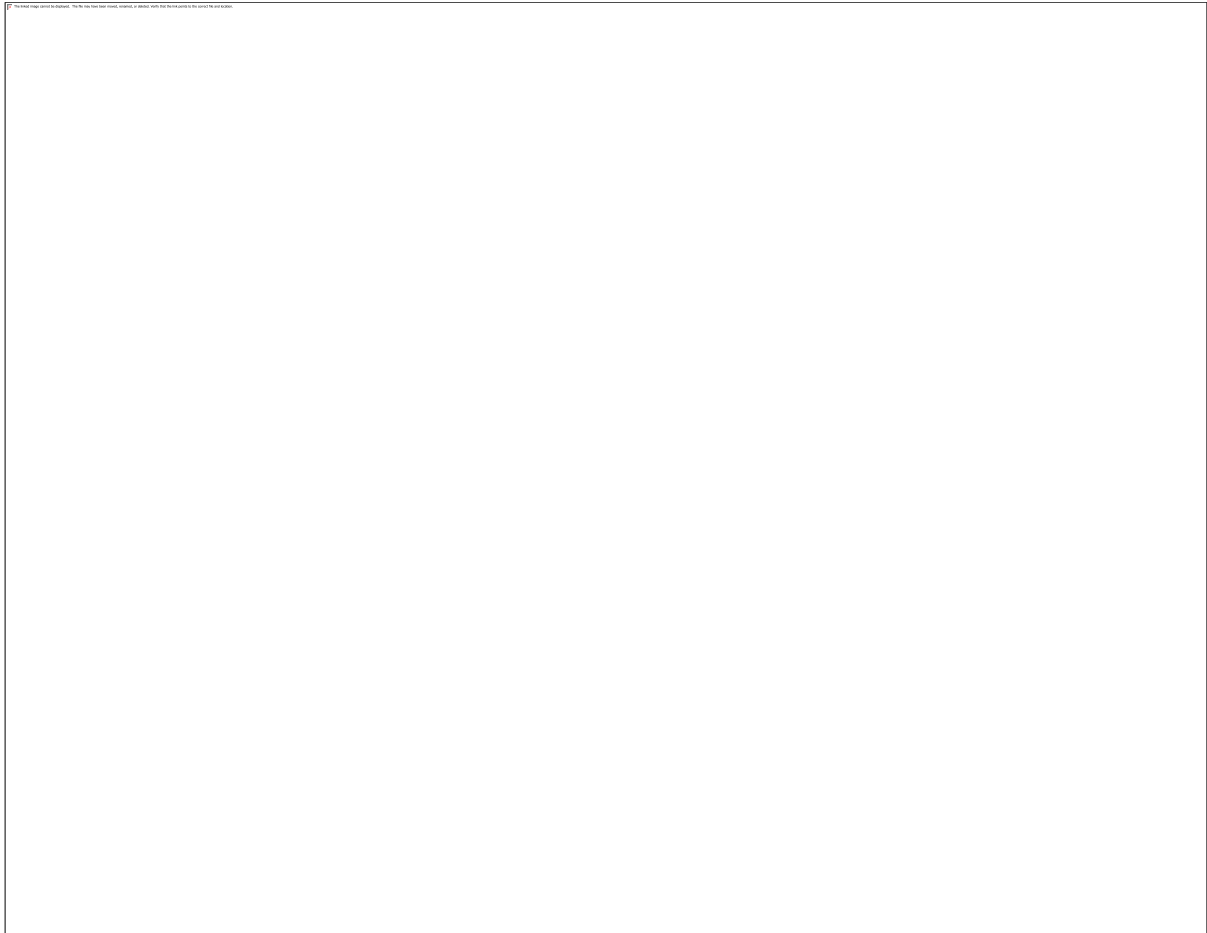
Tasks covered in this tutorial:

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

4.3.3.1 SPRAY BLOCK ENTITIES

Using 'Block Entities', i.e. *Zone|Spray Irrigation Block*, is an alternative method to using *Zone|Spray Block*. The advantages of this method are ease and quickness of drawing the block complete with submain, control valve, and flushing manifolds if required. When the block is drawn as a 'block entity' it is easy to change the parameters, for example row spacing or lateral direction. Extra labels are available for block entities such as Area, Actual Flow, and Number of Rows. The only disadvantage of using 'Block Entities' is that the laterals cannot be modified individually and in the case of windmills in the middle of the block, for example, laterals cannot be cut out. However, the block can be exploded once drawn if required.

4.3.3.2 STARTING THE TUTORIAL

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021" (0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**.
3. Go to the *Misc* tab (*Miscellaneous*) and select the "Medium Design Size" option. Change the "Base Database Symbol Size" to **10ft** (**3m**) as shown in Figure 4-42. This determines the size of the symbols according to the size of the design. When you are finished click [OK].

Figure 4-42

4. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. This settings will be retained for each subsequent design by clicking the [Save As Defaults] button and then [OK] to close the dialog. A message will appear if you have changed the units from what was set previously - click [Yes] to scale the drawing.

4.3.3.3 ENTER BACKGROUND INFORMATION

This is information required to position the irrigation system. Examples include boundaries, roads, buildings, text and symbols. For this tutorial we will put in a 390 x 150ft (120 x 45m) rectangle for the block boundary.

5. We need to draw a rectangle on the screen with the dimensions of 390ft horizontally and 150ft vertically (120 x 45m). Enter RECTAGLE D 390 150 (RECTANGLE D 120 45) and press <Enter>. Place a corner by left-clicking on the screen and move the mouse up or down for the correct placement (that is, the corner you clicked can be the bottom left corner or top right corner) and left-click to finish. (In AutoCAD© action RECTANG and place the first point on the screen and then enter D and the required length and width). ZOOM EXTENTS. Your design should look like Figure 4-43.
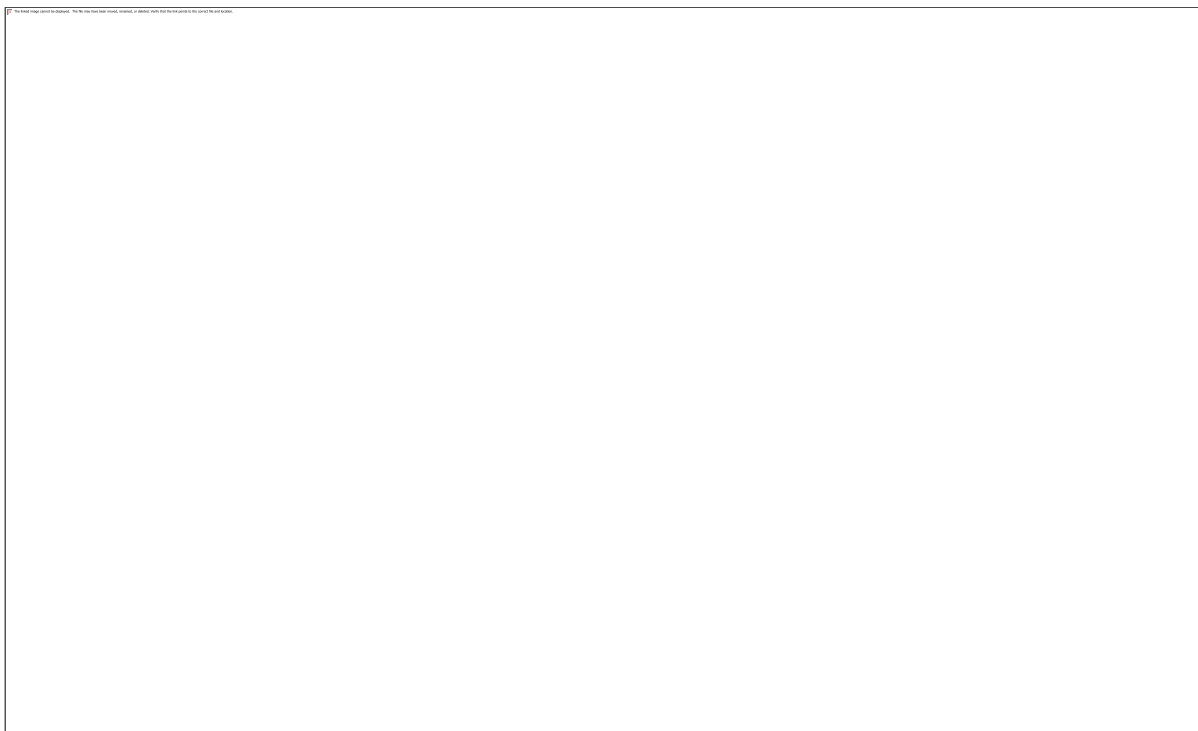
Figure 4-43

4.3.3.4 PLACING THE BLOCK

6. Before placing any laterals select the *Irricad Options|Irrigation – Design Specific*. Enable 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].

7. 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. To do this select the rectangle edge and then action *Zone|Spray Irrigation Block*. Click [OK] on the message asking if you want to create block entities from the selected item. A dialog for setting the lateral and block properties will now be displayed. We want IRRICAD to size the laterals so leave the pipe as **Computer Selected**. The laterals are to be placed at ground level so the "Depth" field can remain at **0.0**.

8. 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 **18.5psi** (**14m**).

9. 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.

10. Enter the "Lateral Spacing" as **13ft** (**4m**). Enter the "Outlet Spacing" as **11.5ft** (**3.5m**).

11. Select the [Options] button and check "User Defined" for the "Lateral Direction", ensure that the option checked for "Reference Outlet" is "Determine Automatically". Click [OK].

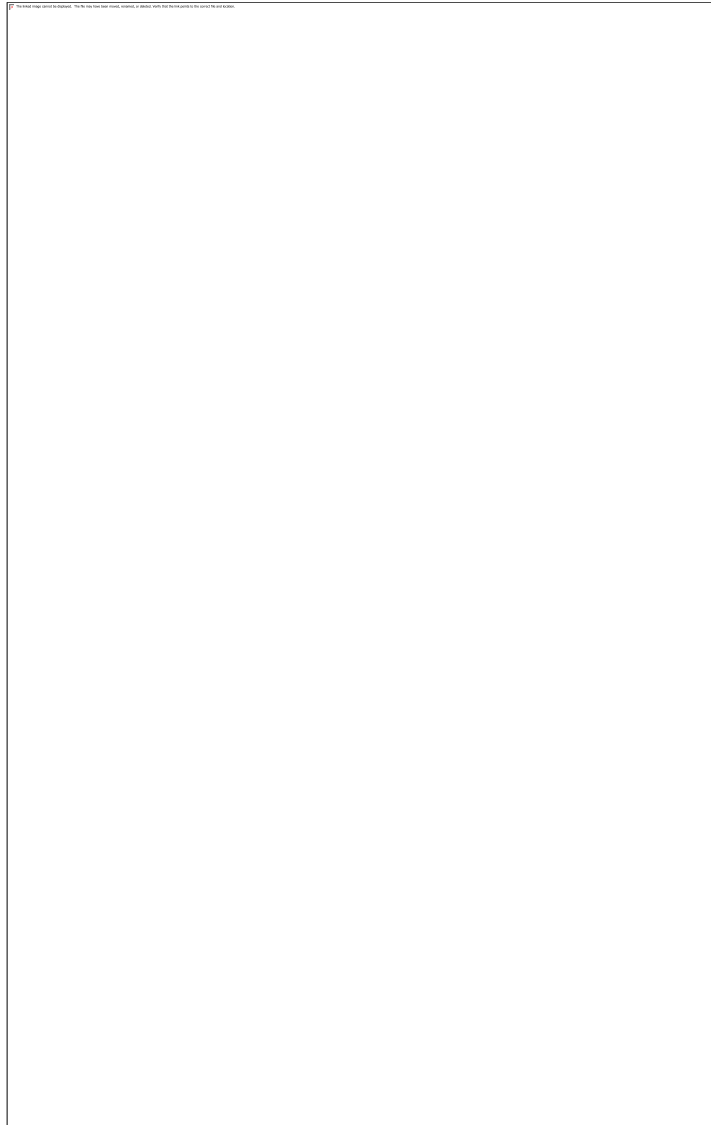12. Set the outlet spacing type to "Rectangular" with an "Offset" of **0%**. The dialog should look like Figure 4-44.

Figure 4-44

13. Now click the Block tab, which contains options for automatically placing submains and control valves.
14. Leave the "Submain" as **Computer Selected** and select **Start** from the "Position" dropdown box. Select **Center** as the Control Valve "Position" and then select the **3" (80mm) Electric Valve** from the "Zone|Control Valve" dropdown list. Enter a "Valve Stub" of **5ft** (**1.5m**). Click [OK].
15. Because we selected "User Defined" for the "Lateral Direction" we now have to enter two points that define the lateral direction (this will be indicated in the bottom left of the status bar). In this example we are aligning with the block boundary, however this option is usually used to achieve a lateral direction that does not align with a block boundary. Click on the left top corner of the rectangle. Now you will notice that the command section is asking for the end point in the block lateral; click on the bottom left corner. Once this is completed the laterals are automatically drawn, with a submain at the top of the block and a central valve with a **5ft** (**1.5m**) stub. In the dropdown layer manager click the 'light bulb' icon for the IRR_SL_WETTED_RADII layer so as to turn off the connected sprayline outlet radii, in order to see the laterals and outlets more clearly as in Figure 4-45.
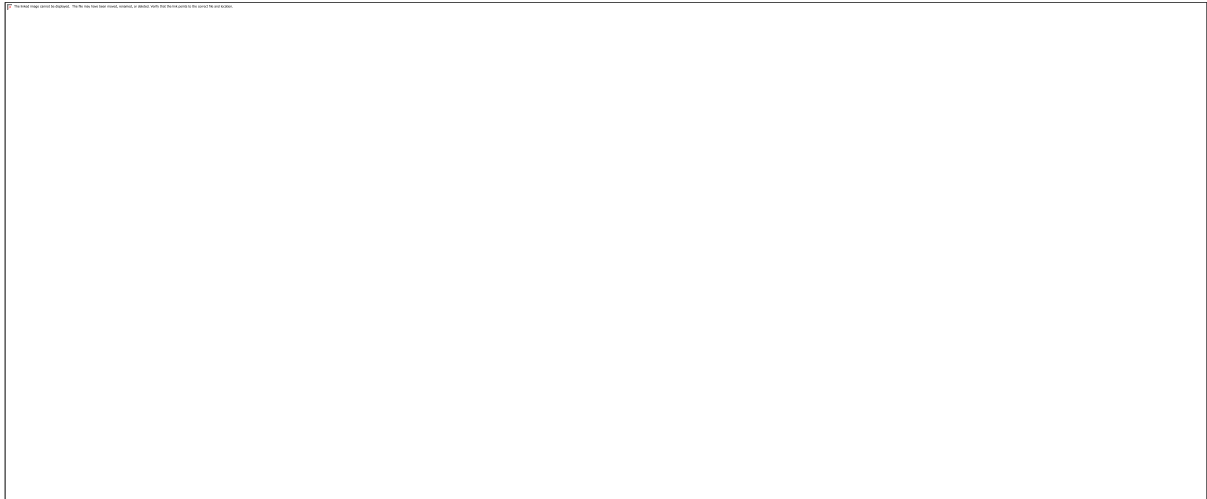
Figure 4-45

16. Press <Esc> to deselect the rectangle. ZOOM OUT. Now we are ready to enter the Mainline. Enter *Mainline|Mainline Pipe* and set the pipe as **Computer Selected** with a "Depth" of **0**. Click [OK]. Connect the mainline pipe to the control valve with a left-click and draw upward and enter **33** (**10**) and press <Enter> to get a pipe **33ft** (**10m**) long. Double <Esc> to finish the pipe tool.

17. Place a *Mainline|Water Supply* to connect to the junction on the end of the mainline pipe. Accept the default name of Supply No. 001. Do not enter any flow or pressure requirements but enable the "Calculate pressure?" check box. Click [OK] and press <Esc> to finish the tool. Save the design as demo2.des. This completes the entry of the hydraulic components of the design. Your design should look like Figure 4-46.

Figure 4-46

4.3.3.5 THE DESIGN PROCESS

Checking Connections

18. First check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. 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 via *Design|Clear Connectivity Marks*.)

19. 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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet and move the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|Snap* tab is set to "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.

Zone Design and Reporting

20. Go to *Design|Design Parameters* - *Hydraulic Parameters*. Enter the "Maximum Zone Pipe Velocity" as **5ft/s** (**1.5m/s**). Click [OK].
21. Run *Design|Zone Design|Zone 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.
22. 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. In *Design|Zone Design Configuration* enter **3** in the "Number of Submain Sizes" column. Click [OK] and re-run *Design|Zone Design|Zone LP Design*.
23. It is advisable to check the data in the reports after zone design via the *Reports|Zone Design Reports*. At this stage the *Zone Design Summary* report gives a good indication of the overall hydraulic 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/or analyzed.

24. Select *Design|Assign All Zones to One System Flow*. IRRICAD assigns Area no. 001 to operate on System Flow 1 as in Figure 4-47. 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.
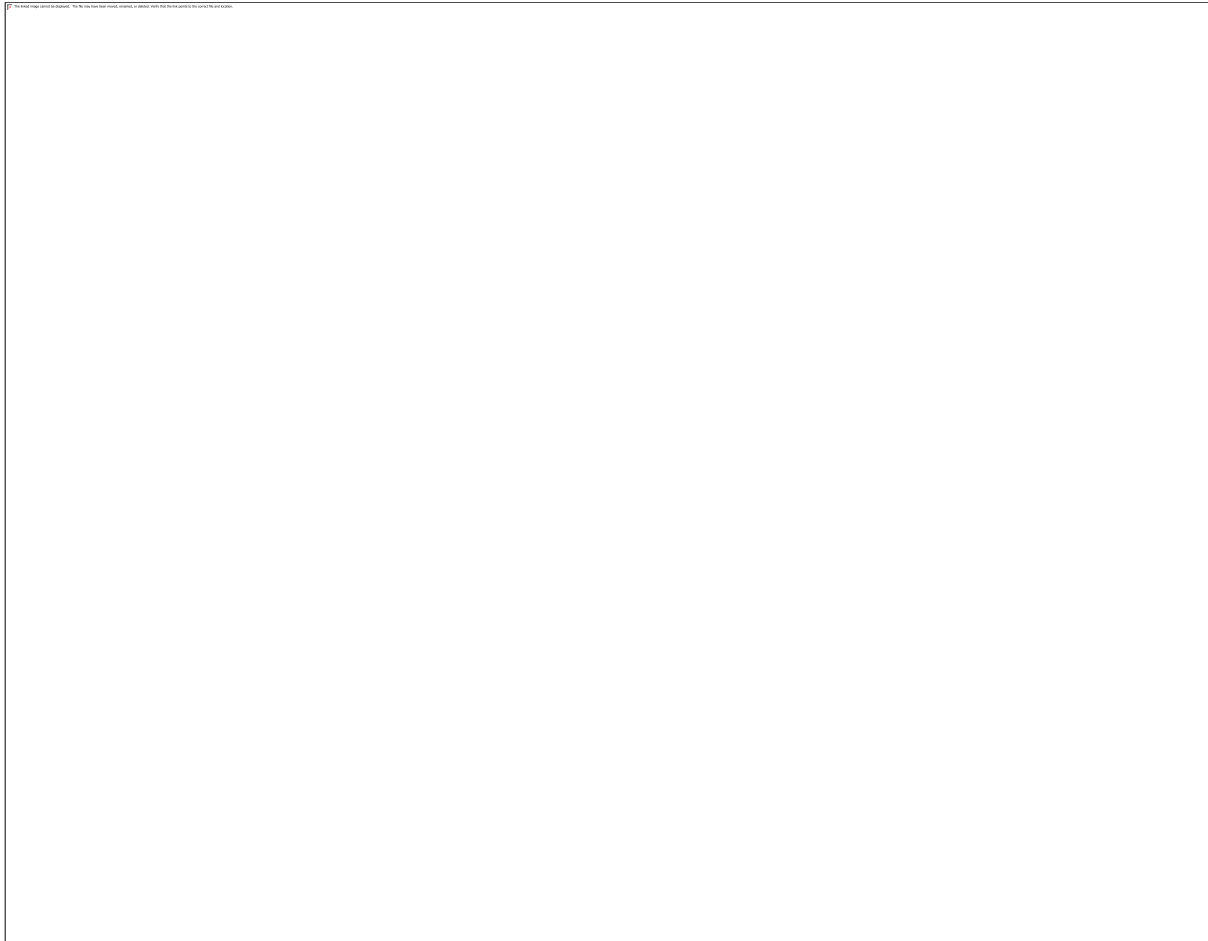
Figure 4-47

Mainline Design

25. You can now size the mainline, run *Design|Mainline Design|Mainline 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 upstream pressure. You should have results similar to Figure 4-48.
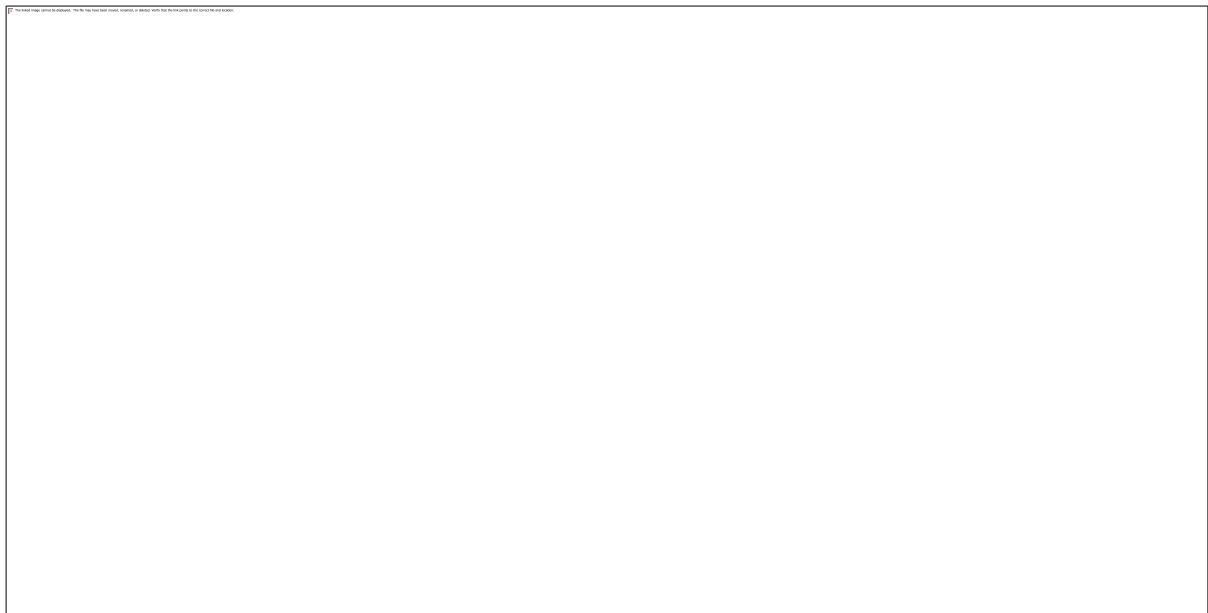
Figure 4-48

4.3.3.6 DISPLAYING REPORTS

26. You may wish to view some of the design reports. As described previously the *Zone Design Summary*, detailed in Figure 4-49, shows a summary of the pressure variation in the block.

Figure 4-49

27. The *Reports|Mainline Design Reports|System Duty Report* 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 view a graphical display of the pressure along that section of pipe. For more information on this tool see *Irricad Options|Help Topics*. Another useful tool, *Show Pressure Zone Limits*, graphically shows the location of the emitters with the minimum and maximum pressure within a zone.

If you have had trouble completing this design please check that the size of the original rectangle is correct.

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

4.3.4 WORKING WITH MULTI-VALVE DESIGNS

Tasks covered in this tutorial:

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

4.3.4.1 GETTING STARTED

1. Complete the above tutorial (A Simple Orchard Design) if you have not done so already.
2. We wish to split this block up into multiple zones because the flow of the entire block exceeds the capacity of the water supply. To automatically split the block into 4 even parts we can use the subdivide tool. Select the cyan boundary and then action *Irricad Tools|Subdivide*.
3. In the "Slices" section, select "Number" and type in **4**. In the "Cuts" section, select "None". See Figure 4-50.

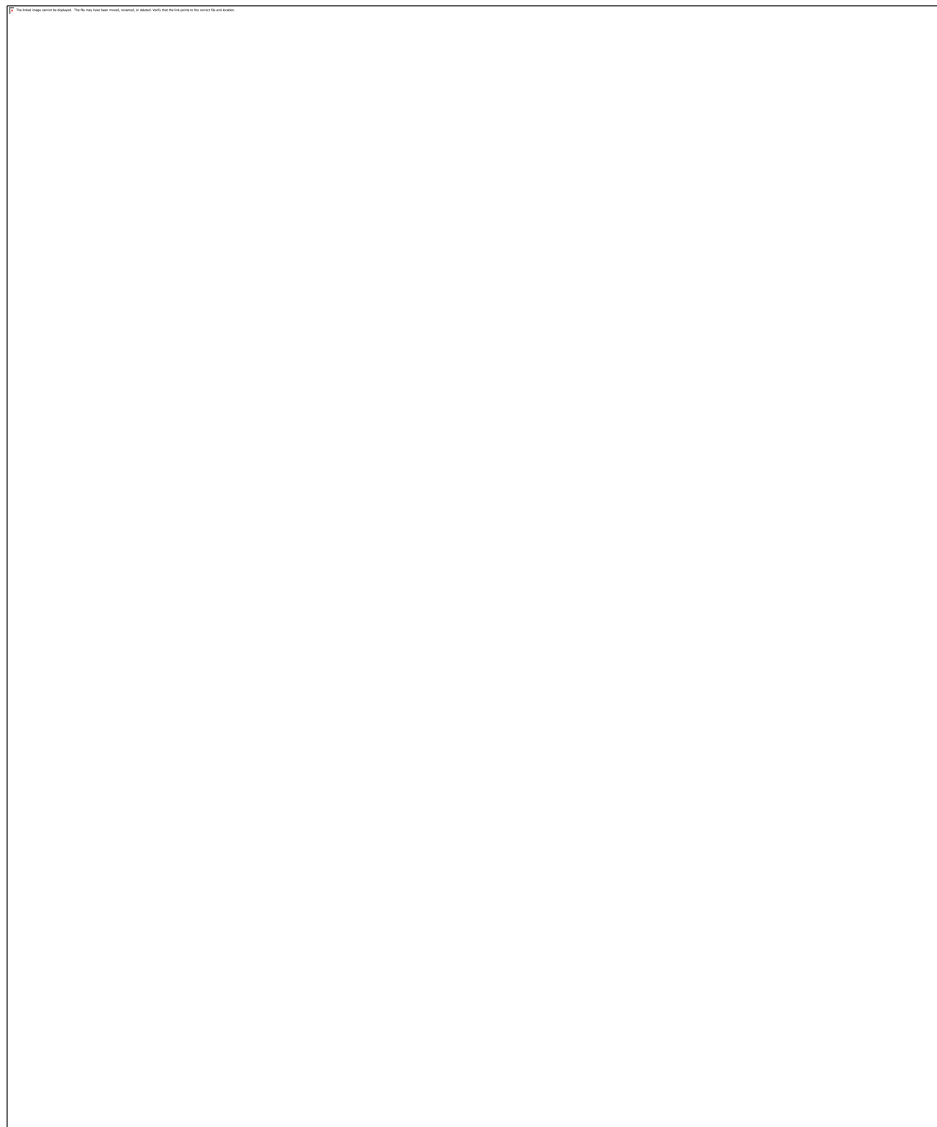*Figure 4-50*

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 4-51.
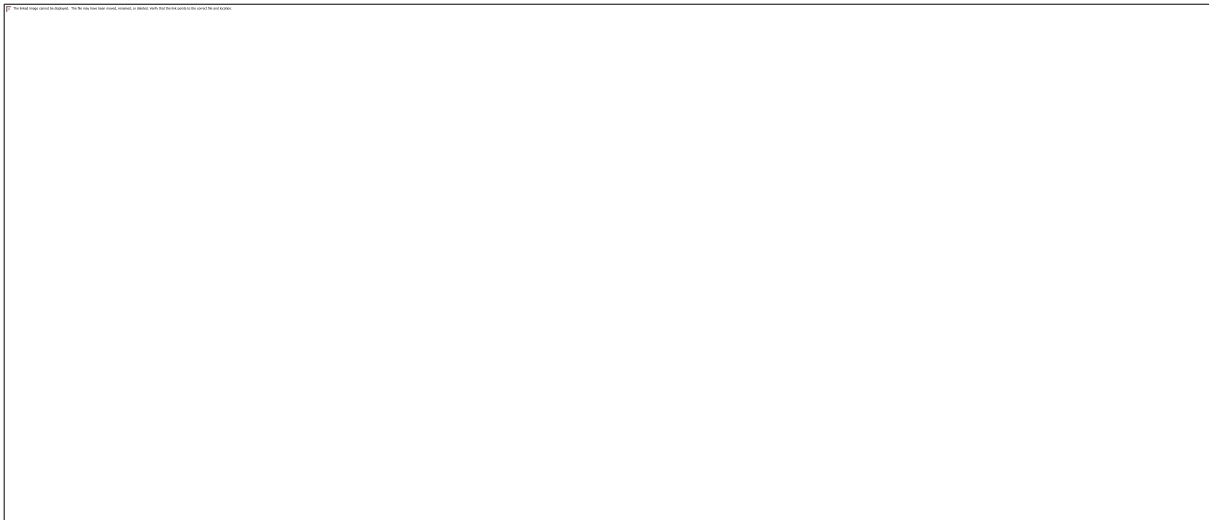

Figure 4-51

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

5. Run a mainline pipe from approximately midway down the existing mainline to the left and to the right above the new valves (but not connected to them). Now select *Irricad Tools|Connect Valves* for IRRICAD to automatically connect mainline pipe to the new valves. See Figure 4-52.
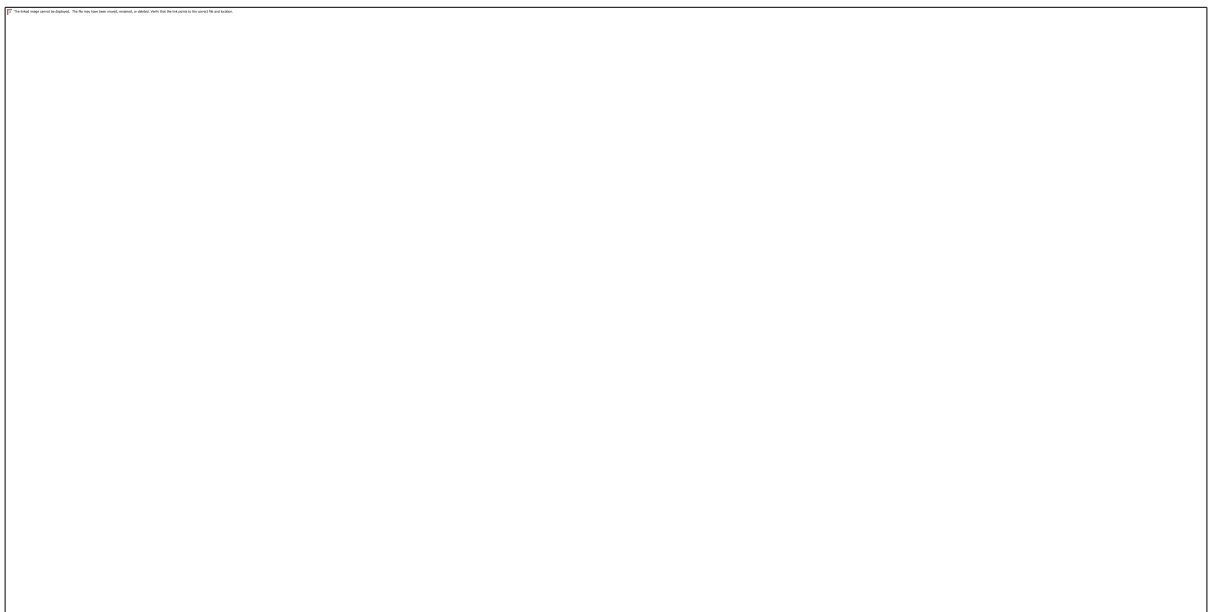

Figure 4-52

6. Select and delete the center mainline pipe below the intersection of the new mainline pipes. Delete any segment of horizontal mainline that extends beyond the connection to the outer-most valves. This is because iRRICAD cannot size pipe that has no flow.
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 4-53. Click [OK].
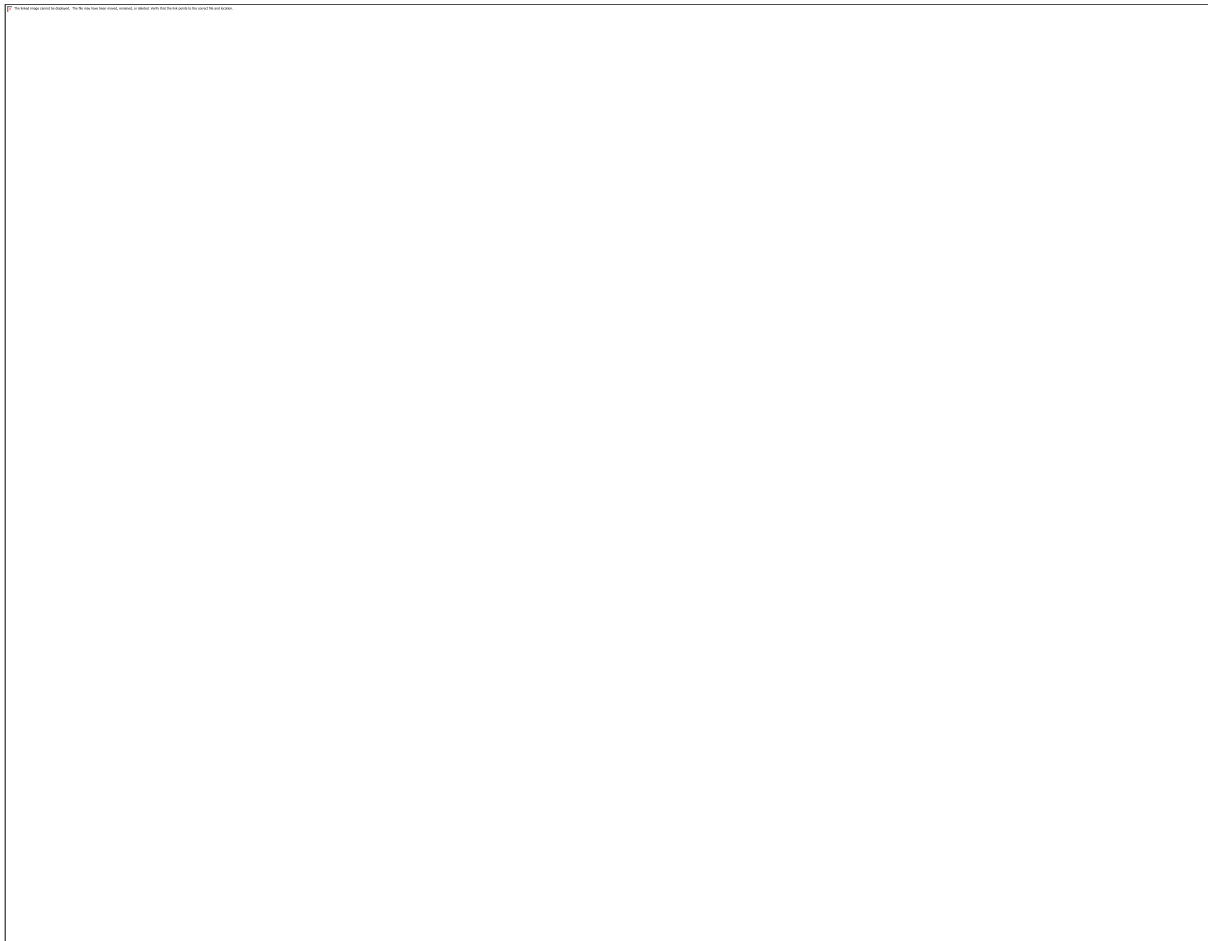
Figure 4-53

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

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

10. Re-run *Zone LP Design*. Click [OK] on each of the warning messages.

11. When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure in *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.

12. Now run *Design|Zone Design|Zone Detailed Analysis* to finalise the zone design results. Check the Zone reports.

13. Run Design|Mainline Design|Mainline LP Design.

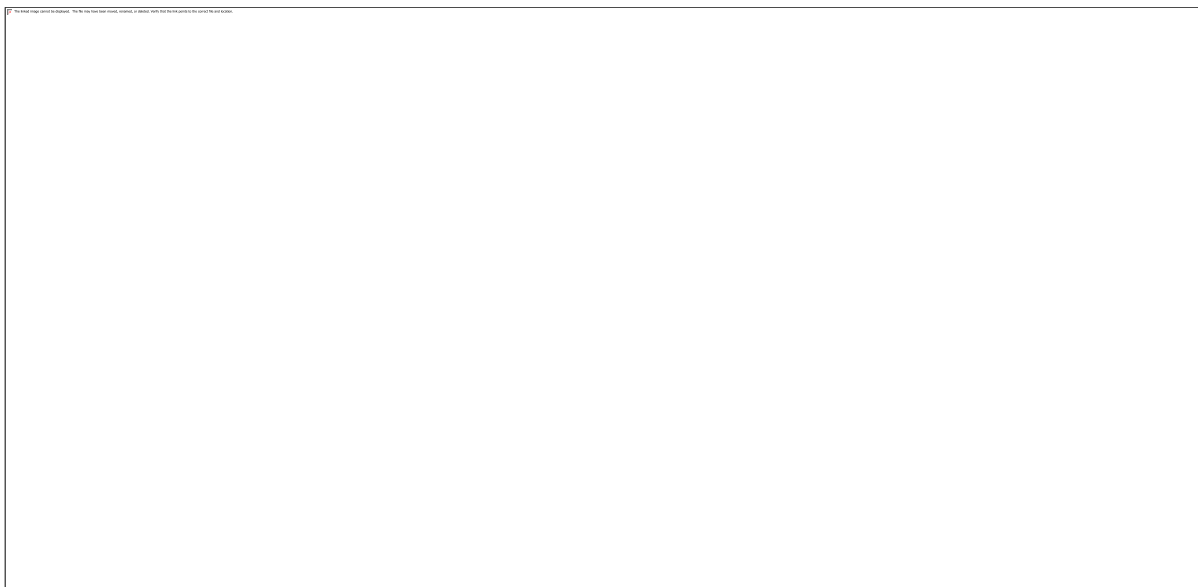14. View the *Reports|Mainline Design Reports|System Duty Report*, your results should look similar to Figure 4-54.

Figure 4-54

4.3.4.2 VALVES OPERATING 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.

15. Select *Design|Clear Management* to clear the current management. We're clearing the management because it is going to be completely different from what was set up in Step 6.
16. Now select *Design|Assign Zones to System Flows*. Change the "Number of System Flows" to **2**. Click [OK] to refresh the screen. Leave the "Operating Times" as the default (the actual running time is unimportant in this case), click [OK] again.
17. Now you can visually select which zones will operate on each system flow. Click on Area no. 002 and Area no. 003 (they will highlight when they are selected) then click the [Assign to System Flows] button. Click [OK] to accept System Flow **1**.
18. Now click on Area no. 004 and Area no. 005 and click the [Assign to System Flows] button. Ensure the "System Flow Number" has changed to **2**. Click [OK]. See Figure 4-55. Now click [Save & Exit].
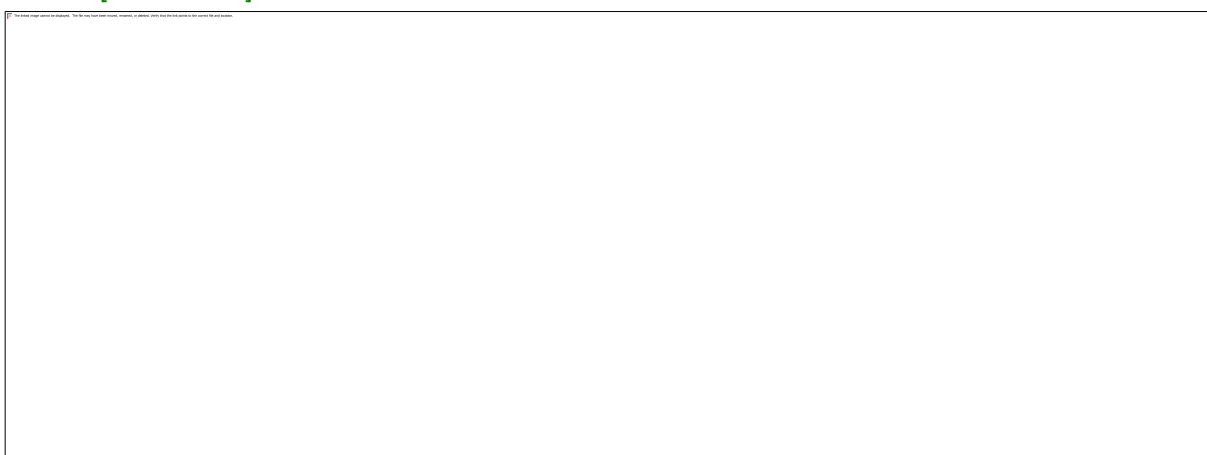

Figure 4-55

19. Re-run *Mainline 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 *Mainline LP Design* because the required pipe sizes may well change with the different flow regime.

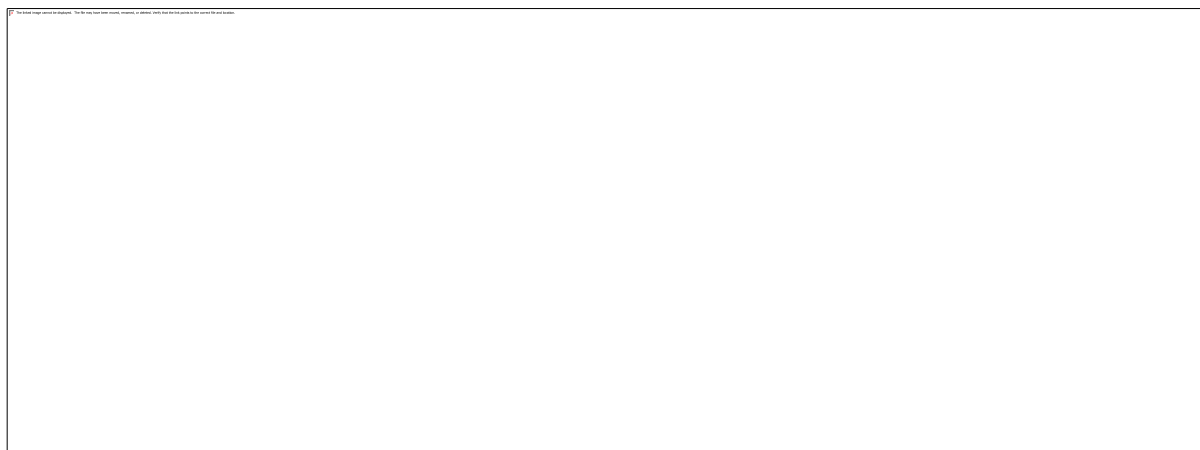20. Now open the *Reports|Mainline Design Reports|System Duty Report*. Your results should look like Figure 4-56.

Figure 4-56

4.3.4.3 FINALISE THE DESIGN

When the outlets are non-pressure compensating running *Detailed Analysis* provides the advantage of reporting the actual field flows based on the actual pressure at each outlet. This can be significant if the zone is large, mainline outlets have been used, or elevations have been included.

21. When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure in *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.
22. Now run *Design|Zone Design|Zone Detailed Analysis* to finalise the zone design results. Check the Zone reports.
23. If the Zone reports are good re-run Mainline Design. Because there are only controls valve in this design there is no point in running *Mainline Detailed Analysis*. Run *Design|Mainline Design|Mainline Analysis*. Check the Mainline reports.
24. Open the *Mainline Summary Report*. Note how one valve will have the same value for the "Valve Pressure" and the "Required Valve Pressure". This is the zone that is driving the pressure requirement in that system flow. The other valve will have a higher "Valve Pressure" than its required pressure.
25. Now double-click on the Water Supply symbol and uncheck the "Calculate Pressure?" option. Enter the "Design Head" as **35psi** (**20m**). The "Maximum Head" can be set to the maximum or static water pressure is known. If not, enter the same value as for the "Design Head".
26. Run *Design|Mainline Design|Anlayze* and open the *Mainline Summary Report*. Note the pressure now arriving at each valve based on the pressure at the water source (downstream of any headworks losses).

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

4.3.5 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.

4.3.5.1 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 design by using the selection window. Now action IRR_CHANGETYPE 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].
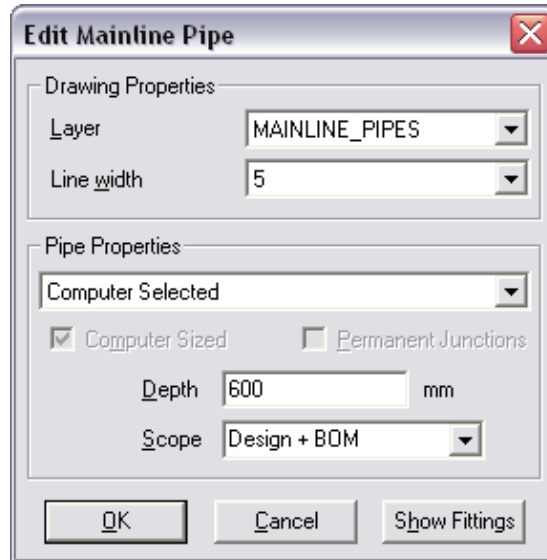
Figure 4-57

2. The next dialog box helps us to filter those items we want to change. Uncheck "Pipe" in the "Match" column.
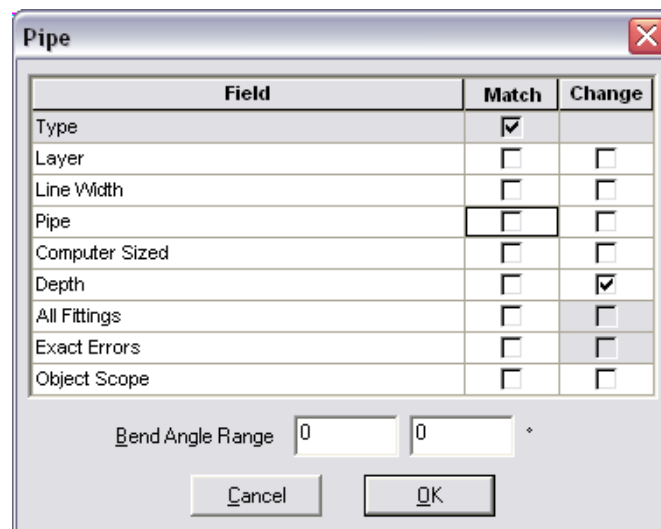
Figure 4-58

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 4-58. 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 draw a selection window around the valves 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 4-59

5. In this case it doesn't matter if you match the valves or not as all three are the same. Ensure the "Change" "Depth" is checked before clicking [OK] as in _d2h_bmk__Ref127198085_90. The Status bar should say 3 matched.

Figure 4-60

4.3.5.2 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 4-68.

Figure 4-61

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 4-69.

Figure 4-62

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 double-click on the junction to access the [Show Fittings] button on the junction dialog. View 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.
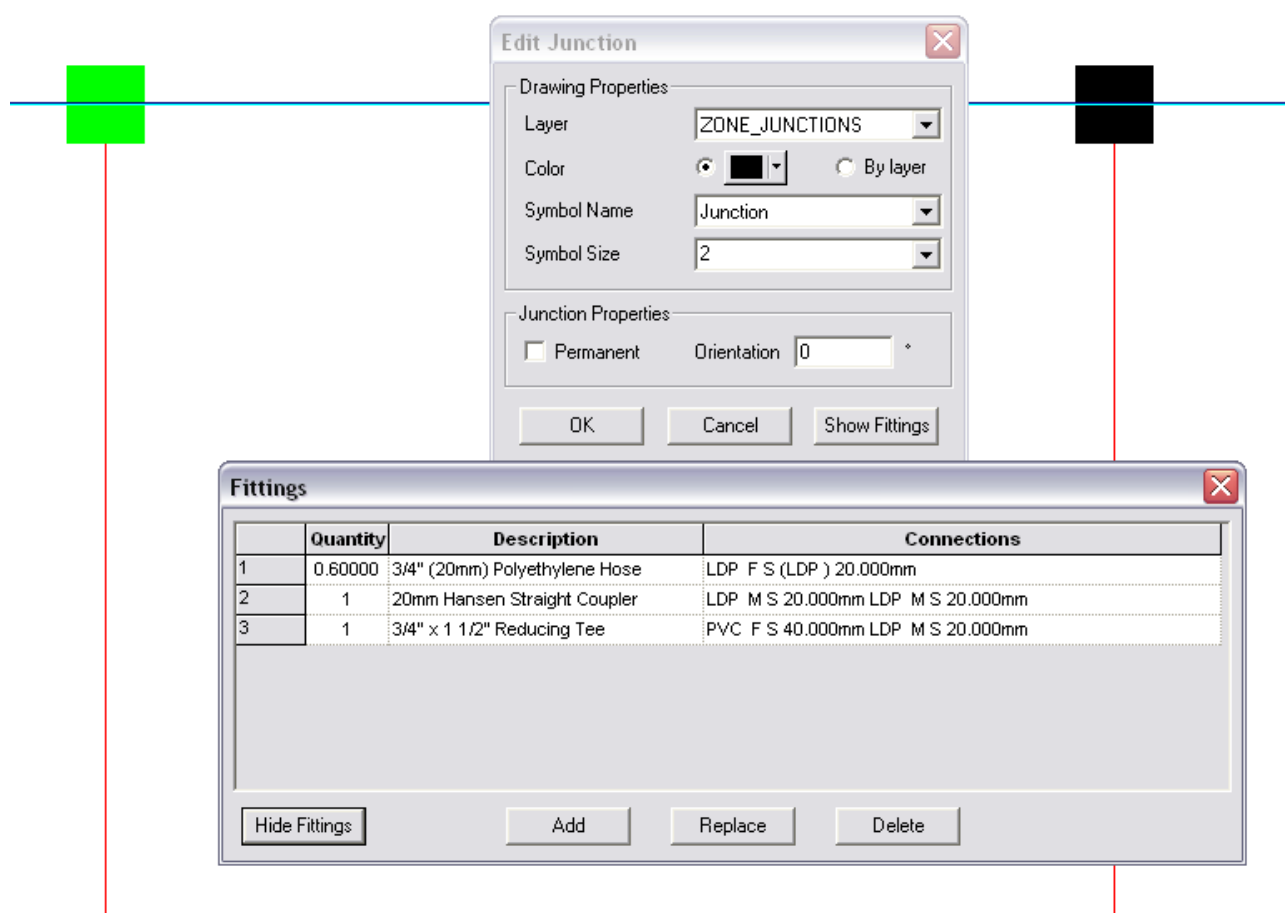
Figure 4-63

4.3.6 MICRO IRRIGATION DESIGN

This tutorial will take you through the steps required to design a Micro Irrigation scheme. The tutorial is intended to introduce you to the procedure required to design systems containing blocks of laterals as would normally be found in an orchard for example. Although the tutorial is based on a micro-sprinkler system the procedure applies equally well to drip and solid set systems. Although this tutorial shows a regular shaped system, irregularly shaped systems can be designed just as easily. There are many methods of completing such a design; this tutorial outlines only one of the possible ways.

4.3.6.1 STARTING THE TUTORIAL

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation – Design Specific* tab and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021" (0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**.
3. Go to the *Misc* tab (*Miscellaneous*) and select the "Medium Design Size" option and set the "Base database symbol size" to **23** (**7**) as in Figure 4-64. Click [OK].
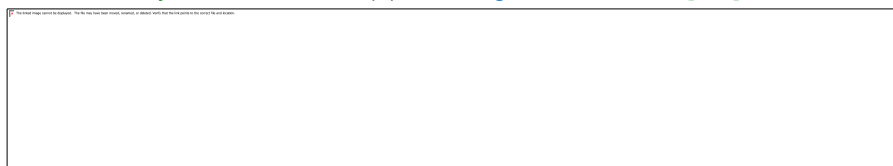
4. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. This settings will be retained for each subsequent design by clicking the [Save As Defaults] button and then [OK] to close the dialog. A message will appear if you have changed the units from what was set previously - click [Yes] to scale the drawing.

4.3.6.2 ENTERING BACKGROUND INFORMATION

This is information that will help to position the elements of the irrigation system. Examples include boundaries, roads, buildings, text and symbols. In this tutorial we will put in an 1155ft x 825ft (350m x 250m) rectangle for the block boundaries. We will use a grid to help with positioning although this is optional.

5. Enter GRID and enter the grid spacing as **15** (**5**). Now use <Ctrl> <B> to toggle on Grid Snap.
6. With ORTHO ON start the POLYLINE by left-clicking on a grid point, move the mouse to the right, type in **1155** (**350**) and then press <Enter>. Use the mouse wheel to scroll out as required. Move the cursor downwards and type **825** (**250**) then press <Enter>. Now move the cursor to the left and type **1155** (**350**) then press <Enter>. Now click the last point on the first point. Press <Esc>. ZOOM EXTENTS.

4.3.6.3 MORE BACKGROUND INFORMATION

7. Inside this area are four blocks that we are going to design an irrigation system for. We need to place four more rectangles inside the current boundary rectangle and then move them into position. To do this draw a closed polyline **495 x 330ft** (**150 x 100m**) with the top left point inside the existing boundary **45ft** (**15m**) - 3 grid points - from the top and left boundaries.
8. COPY this rectangle so that there is one on the top right-hand-side 3 grid points from the top-right boundary, one on the bottom right-hand side 3 grid points from the bottom-right boundary, and one on the bottom left-hand side 3 grid points from the bottom-left boundary. You may need to turn ORTHO off to place the bottom right rectangle. ZOOM OUT.

You need to enter site data if elevation changes over the plan are likely to affect the hydraulics of the system. If the design area is essentially flat you do not need to enter any elevation data and all objects will be given a default height of 0.

9. In this example there is a 5ft (1.5m) fall from the top to the bottom of the screen. To allow for this use *Irricad Tools|Contour* and specify **33** (**10**) as the contour height and click [OK] in the dialog. Now draw one contour line along the top of the screen. Right click to finish. Action *Irricad Tools|Contour* again and specify the contour height as **28** (**8.5**) in the dialog and click [OK]. Now draw a contour similarly along the bottom of the screen below the boundary rectangle. Right click or press <Esc> to finish. Your design should look something like Figure 4-65.

Figure 4-65

4.3.6.4 CREATING THE LATERALS

10. Before placing any laterals go to *Irricad Options|Irrigation - Design Specific*. Uncheck the "Create Sprayline Outlets" checkbox.
11. Now select the *Irrigation Items* tab and uncheck the "Flow Check Enabled" box if it is enabled. Click [OK].
12. Select the small top left rectangle and action *Zone|Spray Irrigation Block*. Click [Yes] on the 'Create Block / Block Entities from Selected Items' message.
13. The Laterals tab dialog for setting block and sprayline properties will be displayed. As you are completing a new design and may not know what pipe size to use you will get IRRICAD to size the laterals the pipe as **Computer Selected**. The laterals will be placed at ground level so the "Depth" field can remain at **0.0**. In the same dialog, select a sprinkler by clicking the down arrow. Highlight the **Micro-sprinkler 360 degrees** and left mouse click to select it. Select the **WHITE 360** as the nozzle by clicking on the down arrow of the "Nozzle" field, highlighting the required nozzle and left clicking the mouse. Enter a pressure of **19psi** (**14m**). Selecting an outlet connector or riser is optional but for this example we will use a Micro-sprinkler stake and tube $^3/_8$" (10mm). If the micro-sprinkler is an assembly already containing a stake and tube you would not need to select another connector. In the same dialog, select the **Micro-sprinkler stake and tube $^3/_8$" (10mm)** from the dropdown list. Enter the "Lateral Spacing" as **13ft** (**4m**). Enter the "Outlet Spacing" as **11.5ft** (**3.5m**). Leave the "Outlet Spacing Properties" as **Rectangular** for a rectangular layout. Leave the "Offset" as **0%**, and ensure that the "Connected" checkbox is checked for connected spraylines. The dialog should look like Figure 4-66.
14. Click the [Options] button and in the dialog that appears leave the "Number of Laterals" as **0** so that IRRICAD fills the blocks completely with laterals. Leave the "Lateral Direction" as **Determine Automatically**. Leave the "Extra Outlets" box unchecked so that IRRICAD does not put additional sprinklers on the ends of the lateral lines when the distance from the last sprinkler to the end of the line is greater than half the outlet spacing. Leave the "Outlet Orientation" at **0°** and the "Reference Outlet" as **Determine Automatically**. Leave the "Layer" as **IRR_IRRIGATION_AREAS**. Leave the "Lateral Line Width" as **0**.
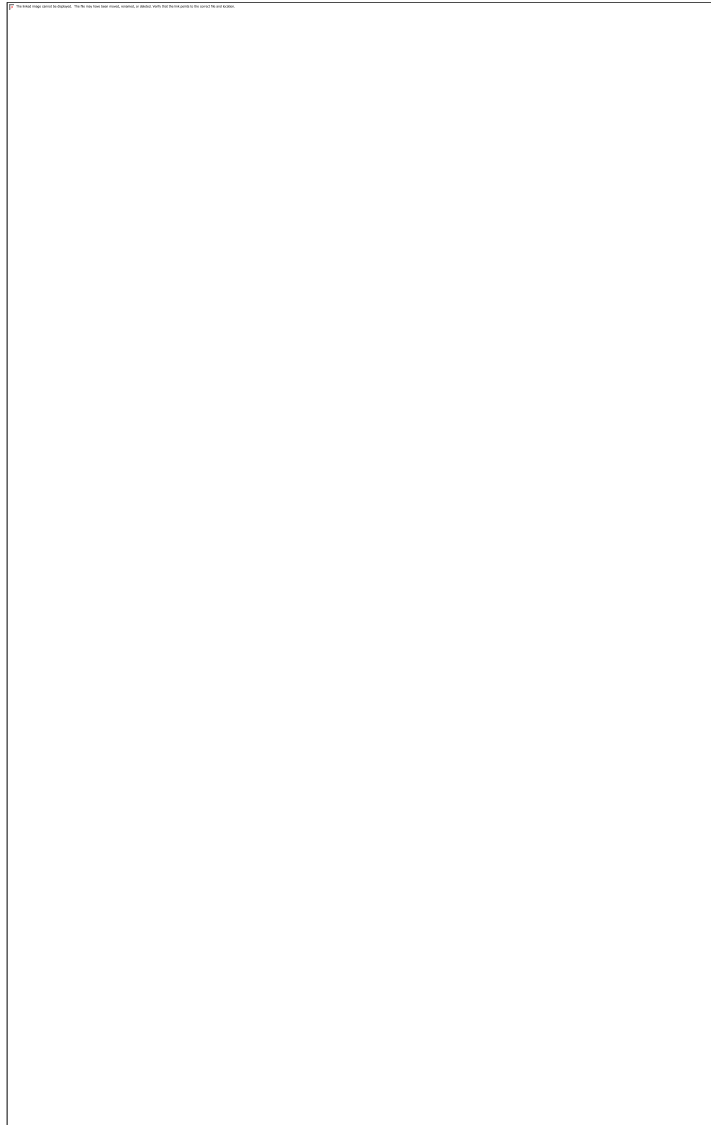
Figure 4-66

4.3.6.5 CREATING THE AUTOMATIC SUBMAIN AND VALVE

15. Click on the Block tab. The laterals are to run the full length of the smaller block rectangles but be about 15ft (5m) inside the side boundaries. Set the Headlands and sidelands as **15ft** (**5m**) each.

16. Ensure the "Create Laterals" check box is checked. The "Scope" determines if an item will be just for design purposes only or for design and costing. Ensure **Design + BOM** is selected.

17. As we want the submain through the center of the block in "Submain Properties" section select **Center** as the "Position". This will now enable a pipe size to be selected, however, we require IRRICAD to size the pipe for us. Enter **20 inches** (**500mm**) as the "Depth" for the submain. Enter a "Stub Length" of **5ft** (**1.5m**) for the submain to extend beyond the last lateral.

18. In the "Control Valve Properties" section select **Start** as the "Position" and now you can select the **3" (80mm) Electric Valve** from the dropdown list. Enter **15ft** (**5m**) as the "Submain Stub" from the valve to the first lateral. Enter the "Depth" as **-4 inches** (**-100mm**) as the height above ground. Leave the "Valve Stub" as **0** as there is no extra length after the submain stub.

19. Click [OK] and select the bottom boundary of the rectangle for IRRICAD to align the laterals with. Press <Esc> to de-select the rectangle.

20. Repeat steps 12 to 19 on each of the remaining rectangles (IRRICAD will remember the selections from above) using the center boundary (bottom edge for top rectangles, top edge

for bottom rectangles) to align the laterals with so that all valves end up in the center. If the valve ends up on the wrong side of the area, do not worry, simply double-click on any block entity boundary and the dialog will appear. Change the Valve "Position" to **End** and it will relocate the valve at the opposite end of the block.

Figure 4-67

4.3.6.6 CONNECTING TO THE MAINLINE

21. Zoom in so the smaller rectangles fill the screen. Action *Mainline|Mainline Pipe*. Leave the pipe as **Computer Selected**. Enter the "Depth" as **20** (**500**). Click [OK]. Connect the pipe to the top left block control valve by clicking on it then connect to the bottom left block control valve similarly. Press <Esc> to finish the pipe. Repeat to connect the two right block control valves.

22. Now connect a *Mainline Pipe* to the midpoint of the existing left-hand mainline. Draw out the pipe to the right-hand existing mainline and once again connect to the midpoint. Press [Esc] to finish. Now find the midpoint of the horizontal mainline pipe and click to attach a new pipe. Draw upwards **10ft** (**3m**). Double <Esc> to finish the pipe tool,

23. Select *Mainline|Water Supply* and place on the screen to connect to the junction on the end of the short piece of pipe by left clicking on it. Leave the name as the default **Supply No. 001**. Enable the "Calculate pressure?" check box (do not enter any flow or pressure requirements, as IRRICAD will determine these during design and analysis and assumes that the water supply is unrestricted). Click [OK]. Press <Esc>.

24. Select *Irricad Tools|Spot Height* and make the height **28.5** (**8.75**). Place a spot height on the water supply and press <Esc>. This is to ensure that the position of the water supply will be allocated the precise elevation at that point. If spot heights are available for a client's property these can be used in conjunction with contour lines. If you have the information it is a good idea to use it. ZOOM EXTENTS. Your design should look like Figure 4-68. This completes the entry of the hydraulic components of the design.
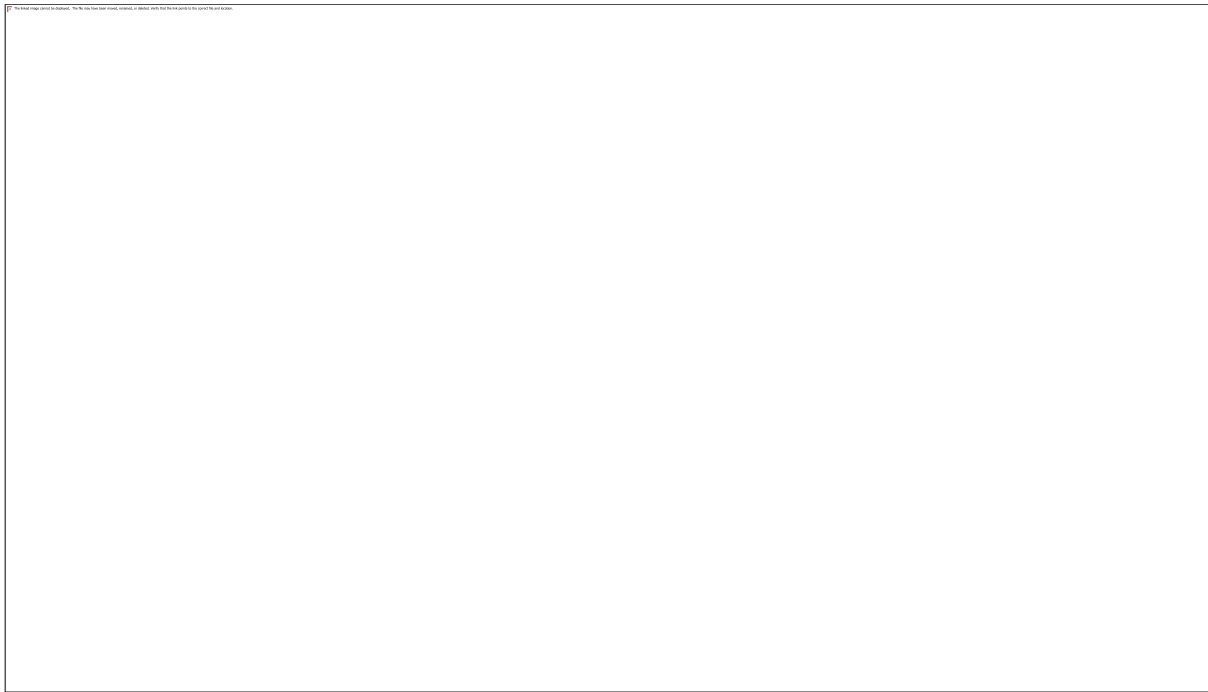
Figure 4-68

4.3.6.7 THE DESIGN PROCESS

We are now ready for the design process.

Checking Connectivity

25. First check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. 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 via *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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet and move the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|Snap* is set to "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.

Note: Outlets do not have to be connected. Control Valves, however, must be connected to the water supply before designing the mainline.

Zone Design and Reporting

26. Select *Design|Zone Design Configuration*. In the dialog you will see all four blocks listed down one side. For each block you can decide if you wish to design / analyze that zone. Leave this box checked for all blocks. The next column allows you to turn on or off the ability to allow for minor losses - leave this checked for all blocks. "Change Diameter at Outlet" only applies to zones with telescoping laterals. A check will ensure that a change in lateral diameter will take place at an outlet location. It is not normally used for dripper or micro-sprinkler systems, so leave this option unchecked for all blocks. "Number of Lateral Sizes" allows you to specify the maximum number of pipe sizes used in each lateral (maximum 3). The default is 1. Change this to **2** for this design. "Number of Submain Sizes" allows you to specify the maximum number of pipe sizes to be used in the submain. Enter this as **2** for all blocks (if this number is left at 0 IRRICAD is unlimited in the amount of submains it can use to solve the design).

"Valve Pressure" is used when you wish to specify a valve pressure for a zone. A **0** entry means that IRRICAD is required to calculate a suitable pressure, so leave this as **0.0** as in Figure 4-69. Click [OK].
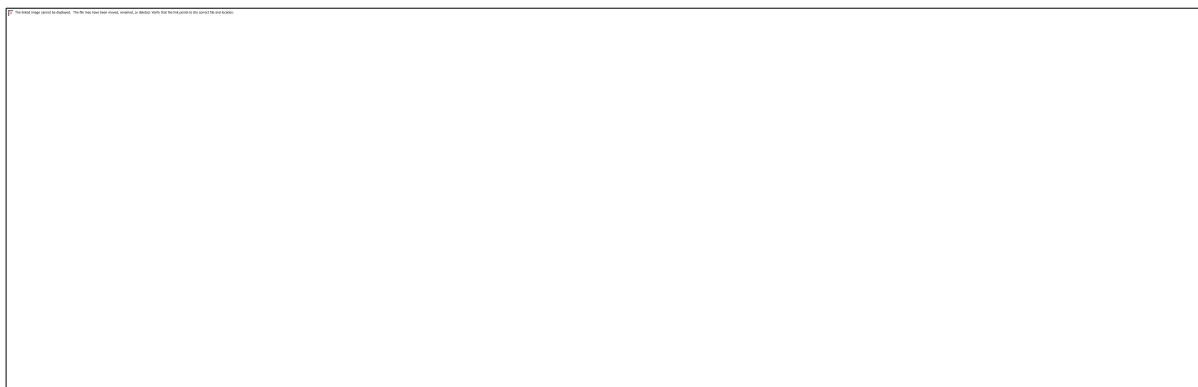
Figure 4-69

27. Select *Design|Design Parameters - Hydraulic Parameters* and enter the "Maximum Zone|Zone Pipe Velocity" as **5ft/s** (**1.5m/s**). Click [OK].
28. Run *Design|Zone Design|Zone 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 submains for the zones. You will get some warning messages during LP Design indicating that some of the blocks have nozzle pressures outside the specified operating range. You should have results similar to Figure 4-70.
29. It is advisable to check the data in the zone reports after zone design, such as the Zone Design Summary report (*Reports|Zone Design Reports|Zone Design Summary*). At this stage the summary report gives a good indication of the overall design of the zones. As you will see, the minimum present outlet pressure is 0.2psi (0.2m) below the allowable minimum outlet pressure. We will not worry about this at this stage. Note down the present downstream pressure of the valve that IRRICAD has calculated for each zone as this will be used later for analysis. It should be between 17-21psi (12m and 15m). Click on the X to close the report window.

Figure 4-70

Entering Management Requirements

We now need to enter some management requirements. The primary purpose of management is to allow you to specify an operating sequence for the zone control valves, which set up a series of flow conditions in the mainline so that the mainline can be correctly sized and analyzed. You have the option of specifying a simple worst case scenario for valve operation or of specifying a full operational sequence for all valves.

30. Since we will be operating each zone separately, on different system flows, select *Design|Assign Each Zone to a Unique System Flow*. A system flow is a zone or group of zones operating at the same time. The resulting dialog will have automatically allocated the four system flows to different time slots and each zone to a different system flow. This table can be edited if required so check the data is correct. Note the number of system flows is 4. The sequential operating times (one hour) for each system flow are listed. If actual start and stop times are not important (and this is the case for this system) the default times should be accepted. System flow operating times cannot overlap. Now note that Area No. 001 will operate on system flow 1, Area No. 002 on system flow 2, and so on as in Figure 4-71. Click [OK].
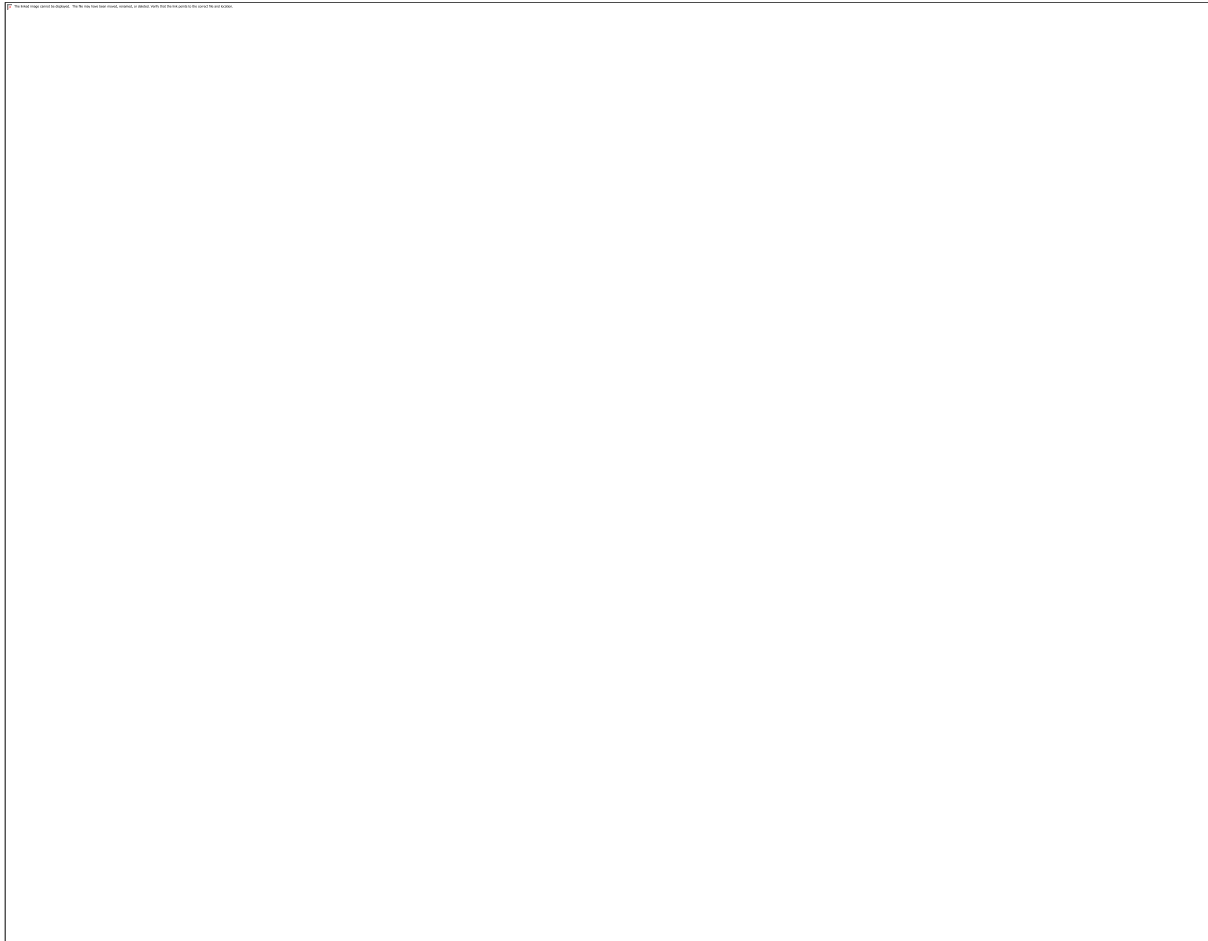
Figure 4-71

Mainline Design

    31. Now have IRRICAD size the mainline for the design. Run *Design|Mainline Design|Mainline LP Design*); IRRICAD will then size the mainline for the design and calculate the water supply pressure so that the zone control valves receive the required pressure.

4.3.6.8 MAKING CHANGES AFTER INITIAL DESIGNING

We now want to tidy up the design as the position where the laterals change size varies. In order to make the system easier to install it is desirable, though optional, to straighten up the size change positions. In this example this will also fix the warning message about some nozzle pressures being outside the specified operating range.

    32. Select *Irricad Tools|Move Size Changes*. On the left side of the submain in the first block find the junction furthermost from the submain where the laterals change size. Draw a line vertically through the laterals such that it passes through this junction by left clicking above the block and then left clicking at the bottom of the block, so that the line passes fully through all the laterals (holding the <Shift> key down will help with a straight line) or use grid points as a guide to help you with this. When you right click a dialog will give you the choice of whether you want the lateral size change to take place at a sprinkler or not and which size you want to move. Uncheck the "Nearest Outlet" checkbox so that the lateral will change size on the line. Select the "Large" option, so that the larger size will be moved out the the line. Click [OK] and IRRICAD will move the junctions to the line.

    33. Repeat for both sides of the submain in all blocks. Your design should now look like Figure 4-72.
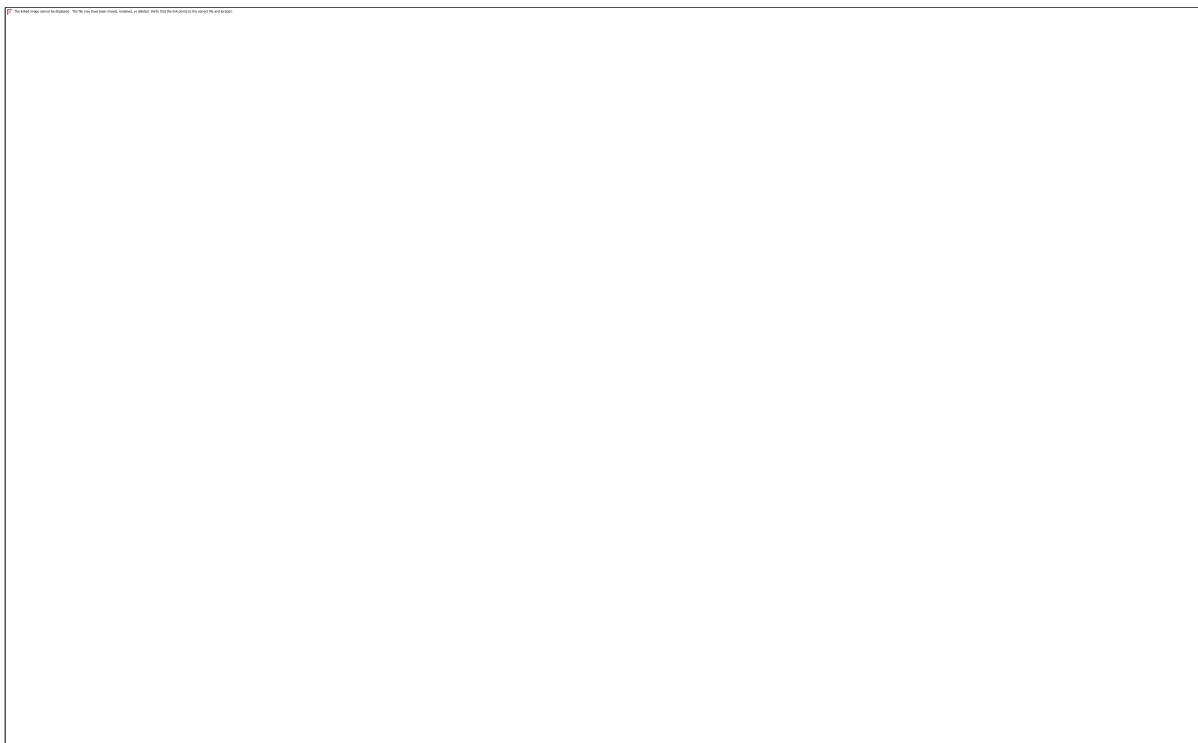
Figure 4-72

34. The system can now be analyzed to assess the effect of the modifications. Go to *Design|Zone Design Configuration* and type in the valve pressures you noted previously as the "Valve Pressure" for the respective zone control valves. You can specify the same pressure at each valve - choose the highest pressure to enter for all. Click [OK].
35. Now run *Zone Detailed Analysis*. This will analyze each block without making any changes to the pipe sizes already selected. *Detailed Analysis* also shows you exactly what is happening at the outlets. When *Zone Detailed Analysis* is completed, re-run *Mainline Analysis*.

4.3.6.9 DISPLAY REPORTS

You may wish to select and view some of the design reports.

As seen previously, the *Zone Design Summary* report gives you a summary of the pressure variation in the block. *Reports|Mainline Design Reports|System Duty Report* gives you the duty required at the water supply for each system flow. *Mainline Summary Report* provides a summary of actual and required pressures at the zone control valve.
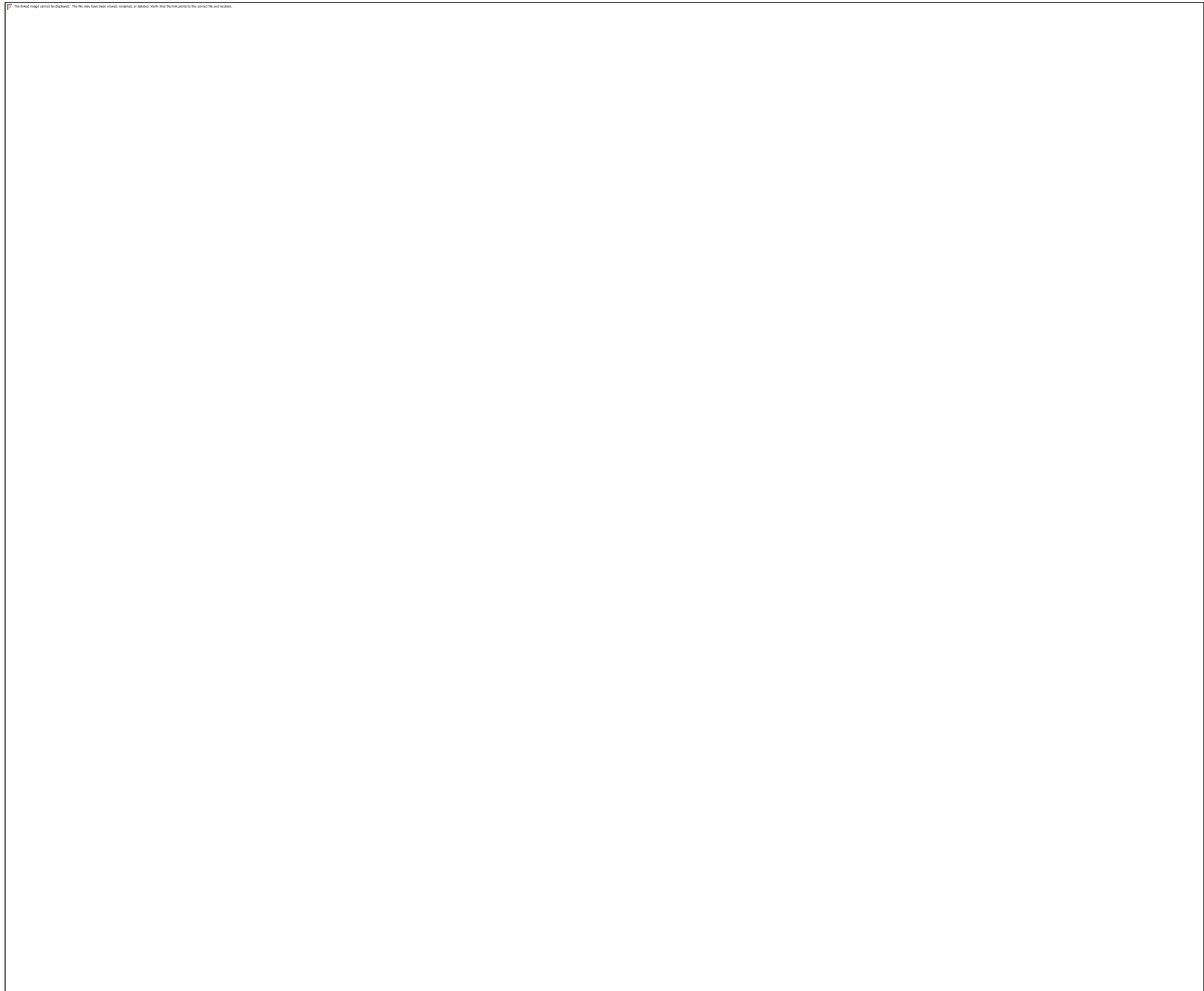
Figure 4-73

37. Check that the outlet pressure variations (as seen in Figure 4-73 in the *Zone Design Summary* report) are within requirements. Note the changes since you have moved the lateral pipe sizes and run *Detailed Analysis*.

If you wish to narrow the pressure variation, there are several things you can do:-

- Move the change of pipe sizes of the laterals as described previously using *Move Size Changes* so that there are longer lengths of the larger pipes.
- Manually change the submain pipe sizes using the IRR_EDITENTITY (double-click) or IRR_CHANGETYPE tools.
- Change the nominal pressure required at the outlets to a value closer to the actual pressure calculated by using IRR_CHANGETYPE on the block entities.

For details on how to use these tools see the Tool & Command Reference, Section 5.

To have IRRICAD automatically select the pipe fittings required for the design you need to run *Design|Computer Selection of Fittings*. IRRICAD will look at each pipe or component junction in the design and from the database select the fittings needed to join these pipes or components together. The internal junction numbers will be displayed on the status bar as it does this.

After running *Computer Selection of Fittings* it is a good idea to look at one of the Bill of Materials reports, e.g., *Costing BOM Reports|BOM* to find out if IRRICAD was able to select all the fittings required for the job. If fittings could not be found to solve particular junctions details of those junctions will be listed at the end of the report.

4.3.6.10 TRAVEL TIMES

Travel Times can be calculated for the zone and mainline by enabling this option in *Design|Design Parameters|Hydraulic Parameters* - "Calculate travel times".
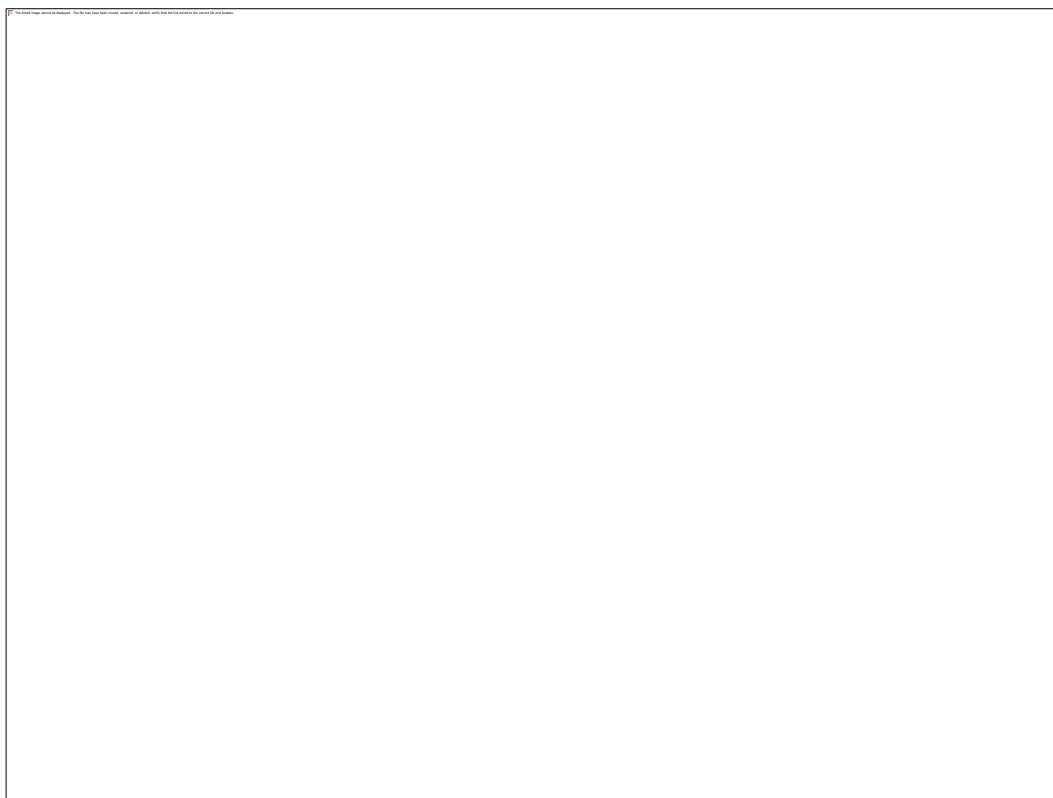
Figure 4-74

Now re-run *Design|Zone Design|Detailed Analysis* and *Design|Mainline Design|Analyze*. There are specific 'Travel Time' reports to view or the zone travel time will also be present in Zone Summary report.

4.3.7 SOLID SET SPRINKLER DESIGN

4.3.7.1 INTRODUCTION

This tutorial will take you through the steps of a setting up a solid set sprinkler design. To achieve the purpose of this tutorial we will proceed to set up a sprinkler system for frost protecting a stone fruit orchard. Although it is a regular shaped system irregular shapes can be designed just as easily. There are many ways of doing such a design, this tutorial outlining only one of the ways.

4.3.7.2 OVERVIEW

A solid set system is one that is non-movable, tends to be unconnected spraylines (though pipes and sprinklers are placed in one action, they remain separately pipes and sprinklers), and has a low number of sprinklers. Because we wish to place water on trees to protect from frost, we require a riser to place the sprinkler 16.5ft (5m) above the pipe in the ground.

4.3.7.3 STARTING THE TUTORIAL

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.

2. Go to the *Irricad Options|Irrigation – Design Specific* tab and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021" (0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. Note - Metric measurements are displayed in brackets. These settings can be retained for each design by clicking the [Save As Default] button. Select the *Misc.* tab and select the "Design Size" as "Medium". Change the "Base Database Symbol Size" to **26** (**8**). This determines the size of the symbols according to the size of the design.
3. Select the *Design Details* tab. Edit the design details for this design. For the site enter **Stone Fruit Orchard** and for the notes type **Solid Set Sprinkler Tutorial**. When you are finished, click [OK]. Save the design.

4.3.7.4 ENTERING BACKGROUND INFORMATION

First we will enter the background or base information which is required in order to position the irrigation system. Examples include property boundaries, roads, buildings, perhaps text and symbols. This client has an area of 37 acres (15ha) in nectarine trees. For the tutorial we will put in an orchard boundary 1640ft (500m) x 980ft (300m) to cover the blocks of trees, water supply, house and some sheds. The rest of the client's property does not concern us for this project.

4. We will use a grid to help position things, though this is optional. Enter GRID and set the spacing as **20**ft (**6**m). Now use <Ctrl> <B> to toggle on Grid Snap.
5. Draw a closed polyline, snapping to the grid points, 1640x980ft (500x300m). With ORTHO on start the polyline by left-clicking on a grid point on the screen, move the mouse to the right, type in **1640** (**500**) and then press <Enter>. Use the mouse wheel to scroll out as required. Move the cursor downwards and type **980** (**300**) then press <Enter>. Now move the cursor to the left and type **1640** (**500**) then press <Enter>. Now click the last point on the first point. ZOOM EXTENTS.
6. This small orchard is divided into blocks of 330ft x 700ft (100m x 210m). Draw a closed polyline so the smaller rectangle is inside the larger one. Start the top right corner 120ft (36m) (6 grid points) from the right boundary and 60ft (18m) (3 grid points) from the top boundary. Enter **330** (**100**) and then move the cursor downwards and enter **700** (**210**). Then move the cursor to the left and enter **330** (**100**). Click the last point on the start point and press <Esc> to finish. Select the small rectangle outline and action ARRAY. Select the Rectangluar option. Enter the Rows as **1**, enter the columns as **4** with an offset of **369** (**112**). Click OK. The 4 rectangles are evenly spaced across as in Figure 4-75. The block rectangles are only 20-40ft (6-12m) apart. This distance between blocks represents a shelterbelt; the grid represents tree spacing within the block. (In AutoCAD© select the rectangle and in the command line enter ARRAY R COL 4 **369** (**112**) R 1 1 <Enter> <Enter>).

Figure 4-75

7. Draw a house and farm building towards the bottom left of the orchard boundary. Make the house 40x60ft (12mx18m) and the buildings 20x20ft (6mx6m). Use grid points to size the rectangles.
8. Toggle off the Grid Snaps using <Ctrl> <B>. Now place a road name using the TEXT command at the top of the boundary - **Luke Road**. Place another road name at the left boundary - **Tyre Road**. A suitable text size for the road names is 45ft (15m). Label the house and buildings in the same way – a suitable text size is 15ft (5m).
9. Turn off the grid by entering GRID OFF in the command line.

4.3.7.5 LAYING OUT FIXED SPACED OUTLETS

10. Highlight the left most inside rectangle. (In AutoCAD© all rectangles will highlight so enter the command EXPLODE before you can select the left most inside rectangle).
11. Now select *Zone|Spray Irrigation Block*. Click [Yes] on the message. On the Laterals tab, leave the pipe as **Computer Selected**. Select the **Big Impact Drive Sprinkler** and the **4.4mm** "Nozzle". Change the "Pressure" for the nozzle to **64psi** (**45m**). The "Radius" will change to 59.05ft (18m). Select the **¾" x 16ft** (**20mm x 5m**) **Galvanized Pipe Riser** and change the "Lateral" and "Outlet Spacing" to **60ft** (**18m**) each. Leave the "Outlet Spacing Properties" as "Rectangular" and **0%** "Offset". Uncheck the "Connected" checkbox. Leave the "Scope" as **Design + BOM**. Click the [Options] button and check the "Extra Outlets on Ends" checkbox as in Figure 4-76. Click [OK] on the Options dialog.
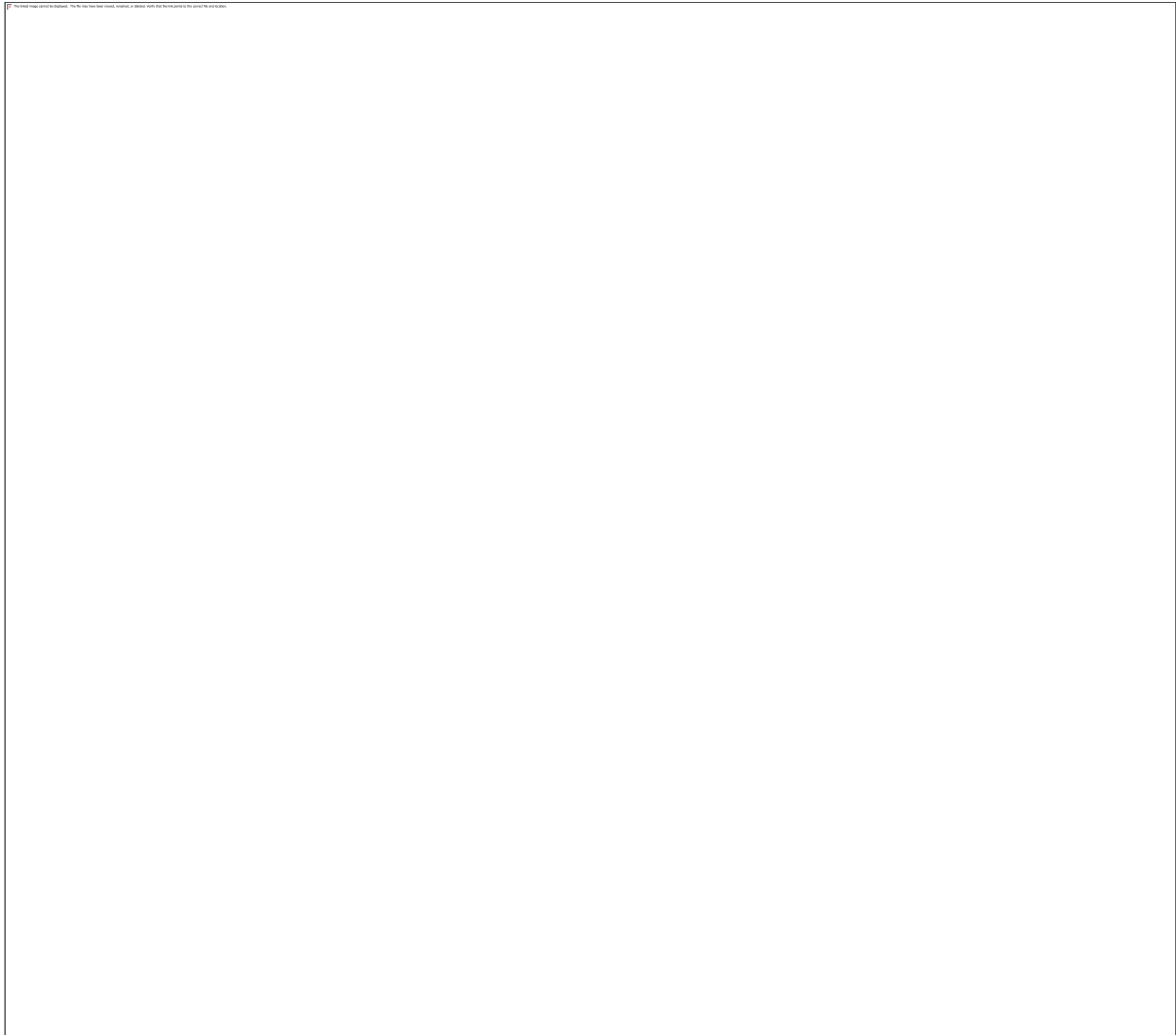
Figure 4-76

12. Click on the Block tab. The "Headlands" and "Sidelands" will be left at **0** and ensure the "Create Laterals" box is checked. The "Scope" should be **Design + BOM**. Leave the "Submain Properties" as **Computer Selected** and select the **Start** "Position" for the submain with a **5ft** (**1.5m**) "Stub Length" and a **20in** (**500mm**) "Depth".

13. In the "Control Valve Properties" select the **End** "Position", select the **4" (100mm) Gate Valve (Flanged)** and enter a **15ft** (**5m**) "Submain Stub" and a **-4in** (**-100mm**) "Depth". Click [OK].

14. Select the top edge of the left most rectangle for the laterals to be aligned with. The rectangle will automatically fill with spraylines at the correct row and outlet spacing. Because we drew the top edge outline first and then the right-hand side the "start' is the left-hand side (submain position) and the "end" is the bottom (valve position). Press <Esc> to de-select the rectangle.

15. Repeat steps 10 to 14 for each of the small rectangles. Turn off the IRR_OUTLET_WETTED_RADII layer in the layer manager. The plan should look like Figure 4-77.

Figure 4-77

16. Select *Mainline|Mainline Pipe* and enter **20in** (**500mm**) as the "Depth" of the pipe. Click [OK] on the dialog.
17. Draw the mainline a short distance away from the valves, along the bottom block boundaries, and past all four valves. Press <Esc> twice to finish the pipe. Then action *Irricad Tools|Connect Valves* for IRRICAD to automatically draw in the stubs of the pipe between the valves and the mainline. Because the water supply cannot be in-line on a mainline, tee-off a short piece of mainline on which to place the water supply by moving to the center of the pipe between the first 2 valves and left clicking, moving down about **65**ft (**20**m) and left click again. Move right about **16ft** (**5m**) and left click again then double <Esc> to finish the pipe tool.
18. The water supply can be positioned by selecting *Mainline|Water Supply*. Enable the "Calculate pressure?" option and click [OK]. We are assuming an unlimited water supply, so IRRICAD will work out the pressure and flow required from the water source. If the water supply is limited (e.g., resource restrictions), these would be entered here. Click on the end of the mainline pipe just created to place the water supply. See Figure 4-78.
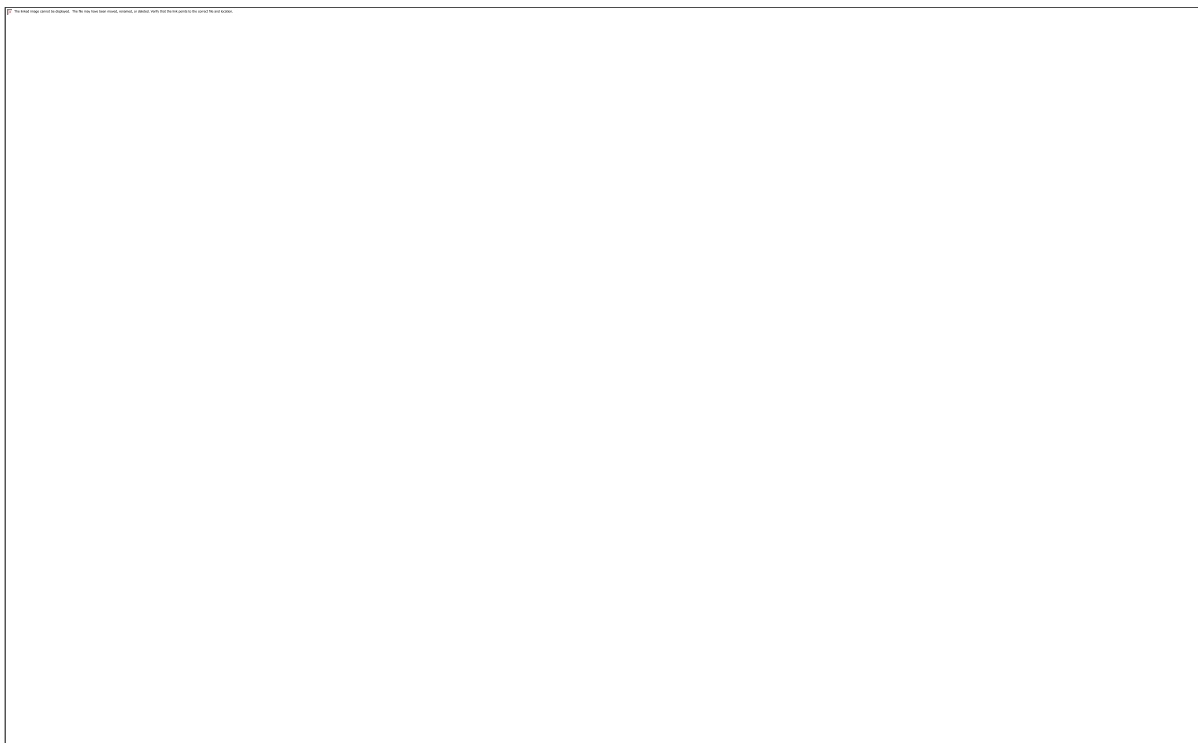
Figure 4-78

4.3.7.6 DESIGNING

Checking Connections

19. First check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. 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 via *Design|Clear Connectivity Marks*.)

20. 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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet and move the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|Snap* is set to "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.

Zone Design

21. In *Design|Design Parameters* - Hydraulic Parameters check the "Max. Zone Pipe Velocity" is **6.5ft/s** (**2m/s**). Click [OK].

22. Before selecting the design process run the Database Editor by clicking on the *Start|All Programs|Irricad Link|Databases*. If the Tutorial database is not your default database, it will not automatically be opened (check the file name at the top of the Database Editor window). If the opened database is not **Tutorial.mdb**, click [Save Changes] and use *File|Open* to open the Tutorial database from in the \Irricad\database folder.

23. The first component tab is the Pipe tab. Find the **4" (100mm) Class C PVC Pipe** and type **ZM** in the usage column (or highlight the pipe and select [Edit / View Pipe]. Select **ZM** from the dropdown list in the "Usage" field). [Save Changes] and close the Database Editor.

24. Run *Design|Zone Design|Zone LP Design*). As *LP Design* is running you will see the pipes being selected for the design.

Entering Management Requirements

25. Management data must now be entered. Run *Design|Assign All Zone to One System Flow* so that all valves operate at the same time.

Mainline Design and Finalising the Design

26. Now run *Design|Mainline Design|Mainline LP Design*. Note that any pipe extending beyond the outer most valves will not be sized because it has not flow. Delete these extra lengths of pipe.
27. Hightlight a pipe and select *Irricad Tools|Object Info*. Enable the "Hydraulic Object Info" checkbox. This info gives you the layer the pipe is on, the pipe size, and the hydraulic information for the pipe since design has been run. This is a quick summary for the selected hydraulic object. More than one item can be selected at a time; however, there is a limit to how many items *Irricad Tools|Object Info* can display.
28. In *Design|Zone Design Configuration* enter the "Valve Pressure" as **78psi** (**55m**) for all zones.
29. Run *Design|Zone Design|Zone Detailed Analysis*.

This will analyze each block without making any changes to the pipe sizes already selected. *Detailed Analysis* uses an iterative process to exactly match the flow of an emitter, sprayline or control valve to the pressure at that point and therefore allows a designer to more accurately gauge how a system would perform in practice. This is especially so when the resulting pressures are substantially different from those specified. In the standard analysis mode IRRICAD uses the selected nominal flows for emitters and spraylines to calculate the flow and resulting pressures in a system. In most circumstances this method is slightly conservative. *Detailed Analysis* gives us a better picture of what is happening at the outlets. Detailed analysis can be used for zone drippers, sprinklers, and spraylines, tapes and also VIH sprinklers in mainline. There is obviously no advantage in running a detailed analysis for systems that only contain pressure compensated emitters. For using *Zone Detailed Analysis* valve pressures must be specified. For running *Mainline Detailed Analysis* a water supply pressure must be specified.

30. Re-run *Design|Mainline Design|Mainline Analysis*.

4.3.7.7 REPORTING

31. Look at the reports via the *Reports* menu. Useful reports which tell you the basics of what is happening in the system at a glance are the *Zone Design Reports|Zone Design Summary* and *Mainline Design Reports|System Duty Report*.

Your Zone Summary Report should look something like Figure 4-79, where each zone flow is approximately 459gpm (121m³/h), the actual outlet pressure variation is 14% and the pressure loss through the valve is small.
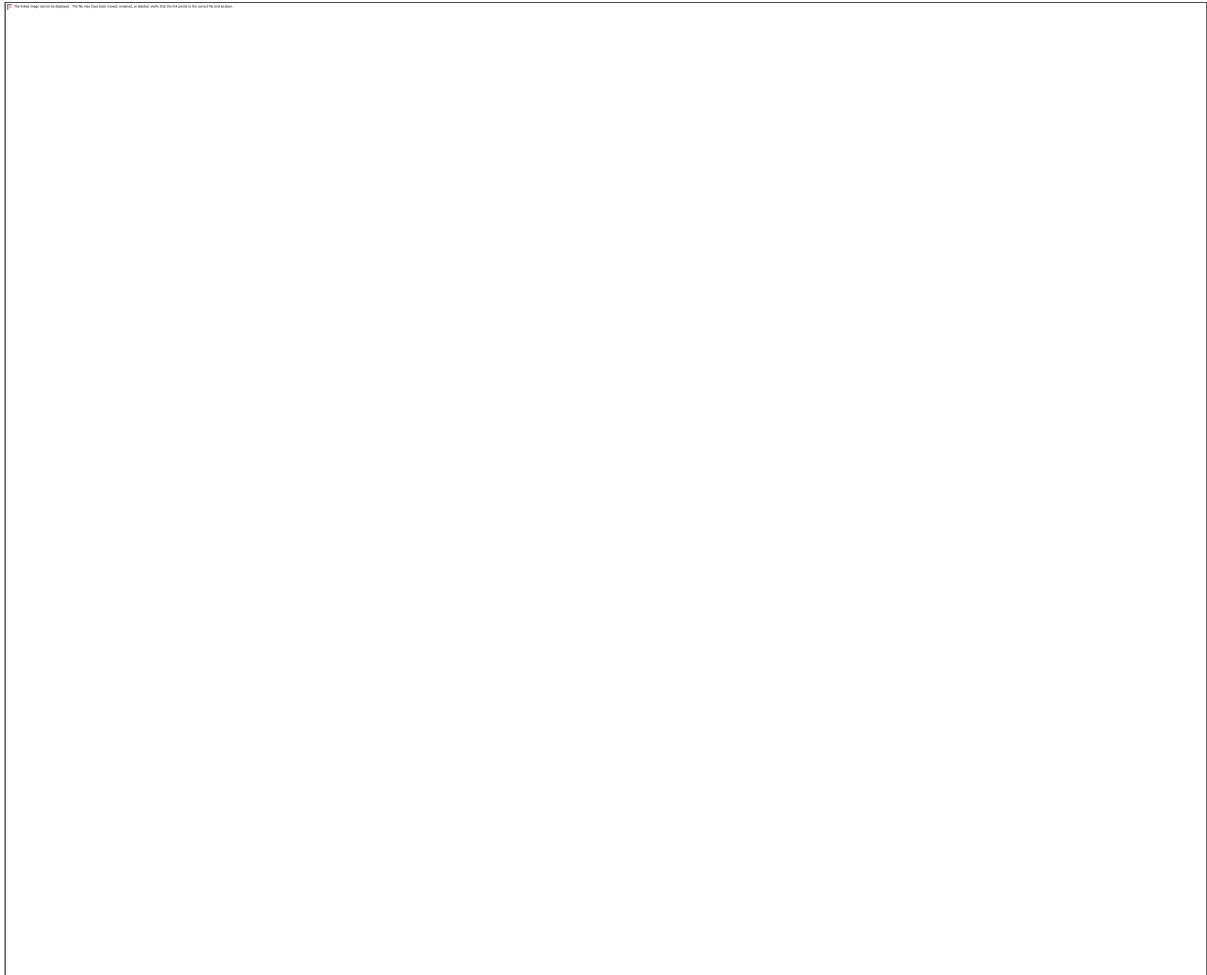
Figure 4-79

Look at some of the other reports for more results on the system.

To acquire a full costing report, we will want to price all the fittings as well as the design we have just laid out. Run *Design|Computer Selection of Fittings*. IRRICAD will automatically find fittings for the junctions. When this is complete, look at any of the *Costing / BOM* reports to find any fittings selection errors. Any junctions that could not be solved with the items currently in the database or flagged for usage will be listed at the end of the report.

See the Correcting Fittings Errors, Section 4.5.3 to find out how to fix these by updating the database.

4.3.8 RESIDENTIAL DESIGN

This tutorial design involves siting sprinklers in a garden and connecting them up to a zone control valve and water supply.

4.3.8.1 STARTING THE TUTORIAL

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation – Design Specific* tab and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Mainline pipes" Lines width to **0.021" (0.53mm)** and the "Zone pipes" Lines width to **0.016" (0.4mm)**.

3. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. Note - Metric measurements are displayed in brackets. These settings can be retained for each design by clicking the [Save As Default] button. Click [OK].
4. Go to the *Misc* tab (*Miscellaneous*) and select the "Medium Design Size" option. Click [OK].

4.3.8.2 BACKGROUND INFORMATION

We need to enter some details about the house and garden we are designing the irrigation system for. The L-shaped house is created with rectangles, and has a 5-sided conservatory on one end. We will use a grid to help us position things, though this is optional.

5. Enter GRID ASPECT into the command line and enter the Horizontal spacing as 16ft (5m) and the Vertical spacing as 10ft (3m). Now use <Ctrl> <B> to toggle on Grid Snap.
6. Select POLYGON 10 CENTER to draw a 10-sided polygon starting from a center point. Click on a grid point in the top left quadrant of the screen and then drag the cursor up one grid point and left click. The polygon boundary should cover 3 grid points vertically, one point at the center and one each at the top and bottom of the boundary. Select RECTANGLE and click on the bottom of the polygon then draw the rectangle up and to the right until it covers 3 grid point vertically and 4 grid points horizontally and is therefore 48x20ft (15x6m). Left click.
7. Turn off Grid Snap by pressing <Ctrl> <B>. Turn off the grid via GRID OFF. Turn ORTHO on.
8. Enter POLYGON 4 Edge and snap to the bottom right of the rectangle. Move the mouse to the left along the base of the existing rectangle and type **23** (**7**) then press <Enter>. ZOOM EXTENTS.
9. Because we want the house and conservatory to be one object we wish to delete the line where the two rectangles join and the polygon sides inside the rectangle. If we were to select this line or a polygon side the whole rectangle or polygon would be selected. If we explode the objects we can delete a line at a time as required. Highlight the objects and enter EXPLODE.
10. Highlight and delete the five polygon sides inside the rectangle and the short recentangle side along the base of the larger rectangle.
11. Enter BREAK in the command line and click on the bottom horizontal line of the first rectangle between the two rectangles. Now click where the line meets the right-hand side vertical line of the two 'rectangles' and then click on the inner corner where the second 'rectangle' starts and left click. The line between has been erased. The house should look like Figure 4-80. Note if the BricsCAD® or AutoCAD© tools works differently than described select the end vertex and move it to the intersection point.
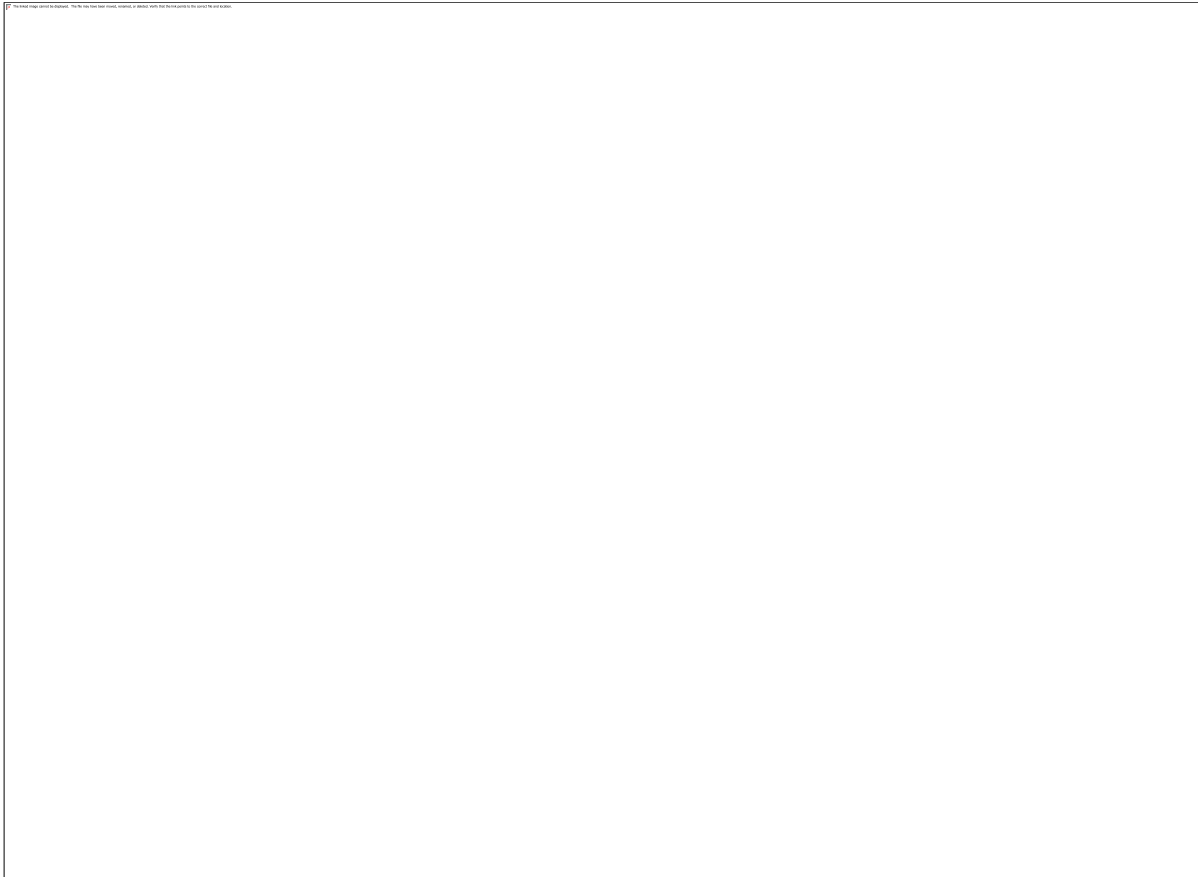
Figure 4-80

The bottom right hand side of the house is a garage. The driveway runs from here straight down to the road. A path continues from the drive up the side of the house to the front door. To draw these items in, we will use a double line for the driveway, and a single line to continue the path.

12. The width of the house at this point is approximately 23ft (7m). The path will be 3ft (1m) wide. With ORTHO still enabled enter MLINE SCALE 26 if working in US units or MLINE SCALE 8 if working in Metric units.
13. Place the cursor at the bottom right hand corner of the house, left click and draw the double lines downward for **11.5 ft** (**3.5 m**) and press <Enter>. <Esc> to finish.
14. Select POLYLINE and snap to the top of the left-hand double line you have just drawn and move the mouse upwards. Type **23** (**7**) and press <Enter>.
15. A sidewalk runs along the road at the bottom of the drive. Using MLINE SCALE 3 (MLINE SCALE 1) place the cursor at the bottom right-hand side of the drive left click, move the coursor to the right, and type **6** (**2**) and press <Enter>. <Esc> to finish.
16. Press the space bar to action MLINE again. Now enter JUSTIFICATION BOTTOM and place the cursor at the bottom left-hand side of the drive, left click, move the cursor to the left, type **66** (**20**) and press <Enter>. If you cannot move this far to the left without going off the edge of the screen use your mouse wheel to zoom out. <Esc> to finish. ZOOM EXTENTS.
17. Using POLYLINE specify the property boundary so that it looks like Figure 4-81. Place the cursor at the left top of the left-hand sidewalk, left click, move the mouse upwards, type **69** (**21**), and press <Enter>. Now move the mouse to the right, type **98** (**30**), and press <Enter>. Now move the cursor down to the end of the sidewalk on the right hand side of the house. Click to place the right vertical boundary line and then <Esc> to finish. Save the design.
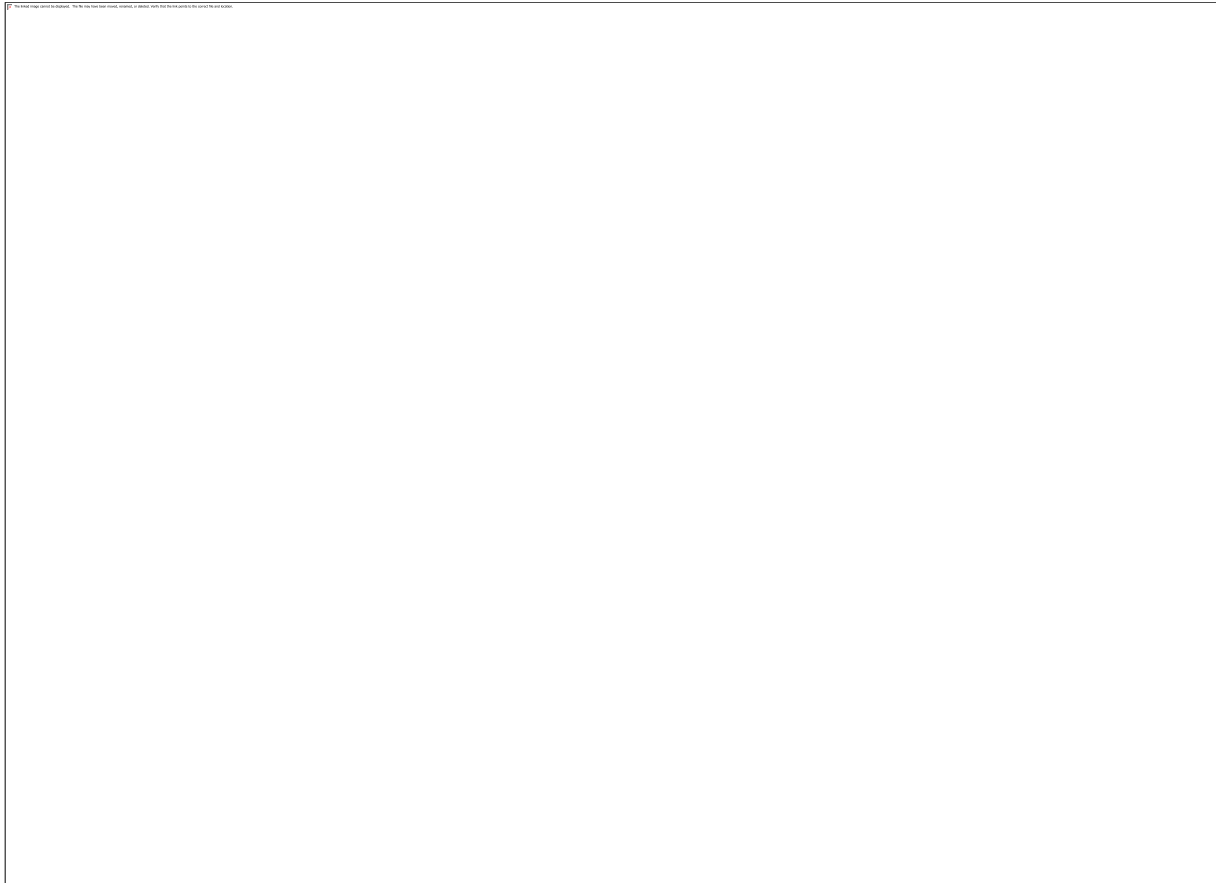
Figure 4-81

18. Along the right-hand side of the house and drive is a row of shrubs. Using INSERT browse for the Irricad Link Symbols\Drawing folder, commonly located in C:\Program Files\Irricad\Irricad Link XX\Symbols\Drawing. In this folder select **BROWN SHRUB**. In the dialog enable the **"Uniform Scale"** option and click [OK]. Move to the bottom right of the property and left click to pinpoint the required center of the symbol inside the left driveway line and bottom property line. Then enter **5ft** (**1.5m**) and press <Enter>. If need be move the symbol so that it is within 0.635ft (0.25m) of the boundary lines. Change the shrub color to brown by selecting it and changing the color in the left-hand Properties bar.
19. Highlight the shrub and then enter ARRAY, set the number of rows to 1 and the number of columns to 7. Enter the column offset as **7.62** (**-3**) so the copies will go on to the left of the original one at 7.62ft (3m) center-to-center gaps.
20. Now INSERT and browse for the Irricad Link Symbols\Drawing folder again (commonly located in C:\Program Files\Irricad\Irricad Link XX\Symbols\Drawing). In this folder select **BROWN TREE** and enable the "Uniform Scale" option and click [OK]. Place a tree in the top right corner of the property by left clicking for the center point and drawing the symbol size out until the diameter is a suitable size. Left click to finish.
21. Turn off ORTHO. By using SPLINE draw a garden area around the bottom and left sides of the property boundary. Make the garden approximately **10ft** (**3m**) wide. By clicking the cursor on the screen you can place the curve as required. When finished, right-click until both ends are fixed. In the same way, draw a garden area around the conservatory about **7ft** (**2m**) wide. You will probably find it useful to set the Circular Cursor via *Irricad Options|Miscellaneous* and enable the "Display Circle" box after setting the "Radius" to **10ft** (**3m**) or **7ft** (**2m**) respectively as required.
22. Place some **BROWN SHRUB** symbols **3ft** (**1m**) in size, as described above in step 19, along the garden boundary parallel with the sidewalk. See Figure 4-82.
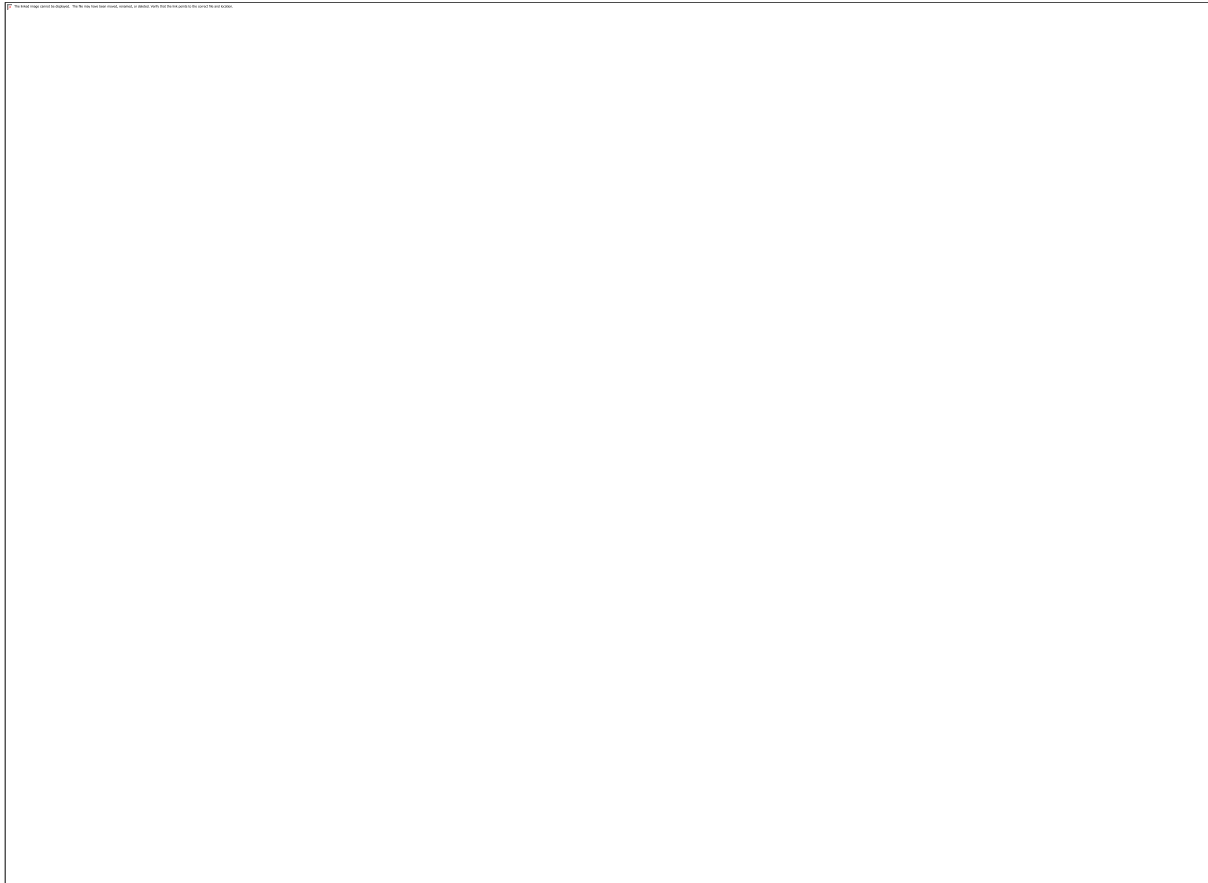
Figure 4-82

4.3.8.3 PLACING SPRINKLERS AND DIVIDING INTO ZONES WITHIN THE AVAILABLE WATER RANGE

The requirements for irrigating the garden involve irrigating the lawn and the garden.

23. To help orientate the sprinklers use *Zone|Area* and draw two area boundaries, one around each piece of garden. Ignore the "Max. Intensity" and "Depth / Volume" values as we are using areas only for orientating arcs. Ensure the "Set Arc Orientation Using Zone|Area" checkbox is checked. Click [OK]. To draw an area place the cursor at a boundary point, left click, then trace over the lines and curves, left clicking where required. Close the area by clicking on the starting point.

24. Select *Zone|Zone Sprayline*. In the Sprinkler edit box, leave the pipe as **Computer Selected** and enter a "Depth" of **12in** (**300mm**). Leave the "Scope" and **Design + BOM**. Select the **Garden Spray Sprinkler** from the dropdown list. The default nozzle (**10 garden**) is the only "Nozzle" available with this outlet. Change the "Pressure" to **20psi** (**14m**). Note that the "Radius" **10.8ft** (**3.3m**) will adequately water the garden. Change the "Arc" to **180°**. Do not select a "Riser" for the outlet, as this is optional and not required in this case. Enter the "Outlet Spacing" as **10ft** (**3m**). Uncheck the "Connected" box. Click the [Options] button and uncheck the "Fixed Spacing" box so IRRICAD will adjust the sprinklers to fit the required area. Click [OK] on both dialogs.

25. Move to the bottom right corner of garden area, just within the area boundary on the driveway side. Click to place the start of the sprayline. Move just inside the bottom left corner and click again. Go to the top left corner, click and then extend the sprayline along the top boundary about **10ft** (**4m**). Click to place and then press <Esc> to finish the sprayline. If the sprayline is snapping to the area boundary and the arc is not being orientated to inside the area turn ESNAPS (OSNAPS) off before left clicking to place each point inside the area.

26. Place a sprayline around the conservatory garden starting next to the path along the garage, placing the sprayline next to the house, again, just inside the area. Several of the wetted radius arcs of the sprinklers in the conservatory garden do not touch the area. Although this is

physically correct since the sprinklers cannot spray water around corners we will change the arcs to make the drawing look better. This is purely cosmetic. Double- click on the outlet symbol for the arc that needs changing. Arc orientation is measured anti-clockwise from the horizontal (0°) so if the start of the arc needs adjusting edit the "Orientation" field. If the end of the arc needs adjusting edit the "Arc" field. Click [OK]. You may need to do this several times to get the arc positioned correctly. Repeat for any other arcs that need adjusting. Your design should look something like Figure 4-83.
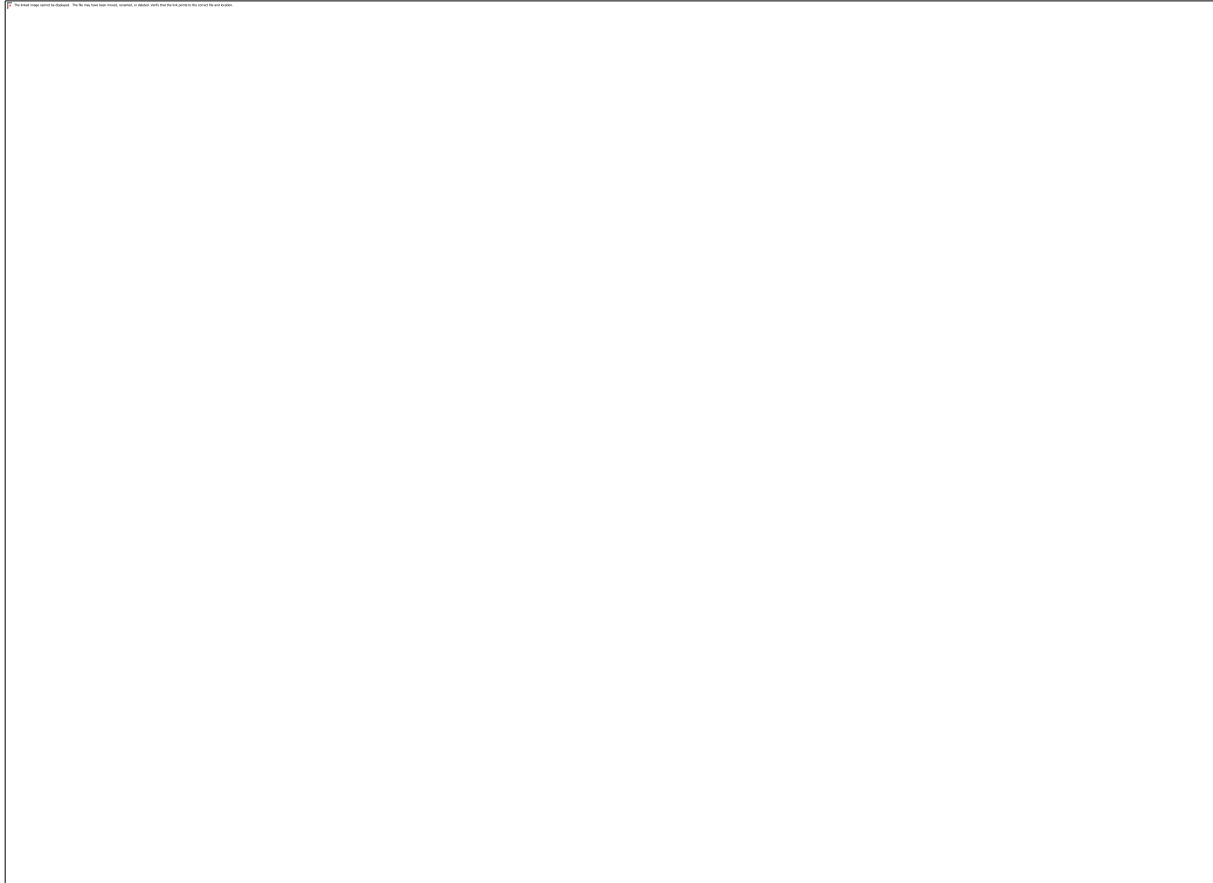

Figure 4-83

27. We are now ready to place the lawn sprinklers. Delete the Areas around the gardens.

Note: *A method to find a particular item when there are more than one in the same proximity is to use DS in AutoCAD© or Shift+Enter in BricsCAD®. For more information see Helpful Hints, Section 4.1.1.9.*

28. Action *Zone|Area* and enable the "Set Arc Orientation Using Area" checkbox. Click [OK] and draw an area that will encompass all the lawn area.
29. Select *Zone|Zone Sprayline*. Leave the pipe as **Computer Selected** and enter a "Depth" of **12in** (**300mm**). Leave the "Scope" and **Design + BOM**. Choose the **Lawn Pop-Up Sprinkler**. Select the **13** "Nozzle" from the dropdown list and change the "Pressure" to **35psi** (**25m**). Type in **180°** for the "Arc". Do not select a "Riser". Enter the "Outlet Spacing" as **13ft** (**4m**). Ensure the "Connected" checkbox is unchecked and also the "Fixed Spacing" box in the [Options] dialog. Click [OK].
30. Draw the spraylines just inside the lawn boundary. Start at the right of the end of the top conservatory garden. Follow the edge of the house, then the right boundary, top boundary and the garden edges (within the Zone|Area you have drawn), clicking at each change of direction to place the sprayline. Right-click at the top end of the conservatory garden to finish. Delete the pipe back to the last sprinkler (do not do this elsewhere, only back to the last lawn sprinkler placed). Use *Zone Outlet* to place a full circle **Lawn Pop-Up Sprinkler** in the center of the larger lawn to ensure good coverage.

31. Adjust any arcs as required. Note, depending on the actual dimension of your design and the placement of the house etc, select outlets with the required radius as needed. If you have a larger area of lawn, select a different nozzle that gives you a larger radius of throw. Note that any outlet can be deleted, placed (select *Zone|Zone Outlet*) or moved to achieve better coverage. See Figure 4-84.
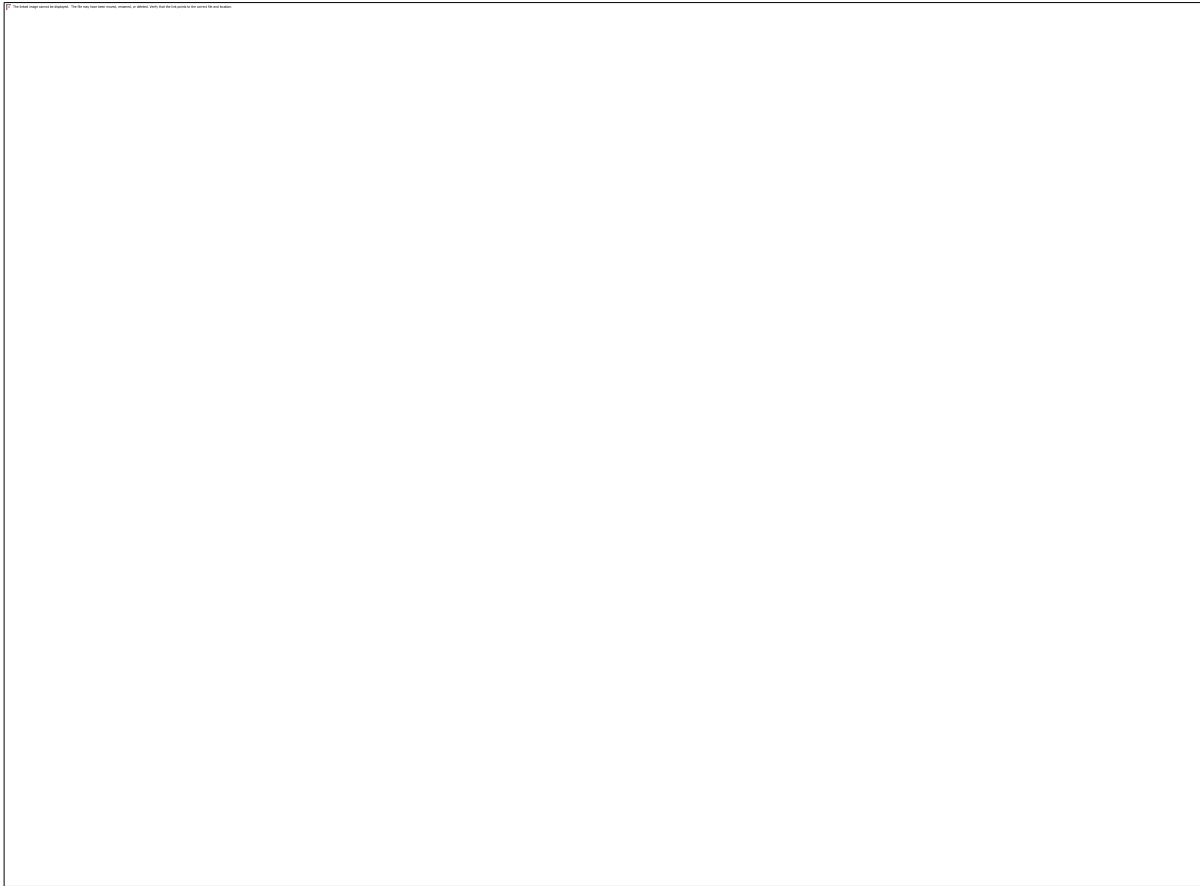
Figure 4-84

32. We wish to place a tape to water the shrubs at the side of the house. The first step is to set up the database to enable the drip tape to be used. Run the IRRICAD Databases from your desktop. When the Database Editor has finished loading the current default database, click the [Save Changes] button. In the screen that remains, select *File|Open*. Browse for the **Tutorial.mdb** database in the Irricad\database folder. Click the [Open] button.

33. Now select the Tapes tab at the top of the screen. Highlight the **Drip Zone|Tape 0.17/100' (1.65lph)** and select the [Edit / View] button. Change the "Usage" to **L** and the spacing at the bottom of the dialog from 4.1ft (1.25m) to **1.6ft** (**0.5m**). Click the [Save] button on this dialog, and then the [Save Changes] button on the main dialog. *Exit* the Database Editor.

34. In IRRICAD action *Zone|Tape* and from the dropdown list select the **Drip Tape 0.17/100' (1.65lph)**. Set the inlet pressure to **14psi** (**10m**). Do not check the "Regulated" checkbox as this tape is not pressure regulated at the inlet. Click [OK] and draw a tape through the line of shrubs at the right-hand side of the house, from about the middle of the bottom shrub up to the middle of the top shrub. Right-click to finish. See Figure 4-85.

Figure 4-85

35. Use *Zone|Zone Pipe*, and leaving the pipe as **Computer Selected**, enter a "Depth" of **12in** (**300mm**). Connect this pipe to the start of the tape and draw it upward to just below the sprayline. Do not connect to the sprayline. You may wish to turn off snaps to avoid connecting to the sprayline.
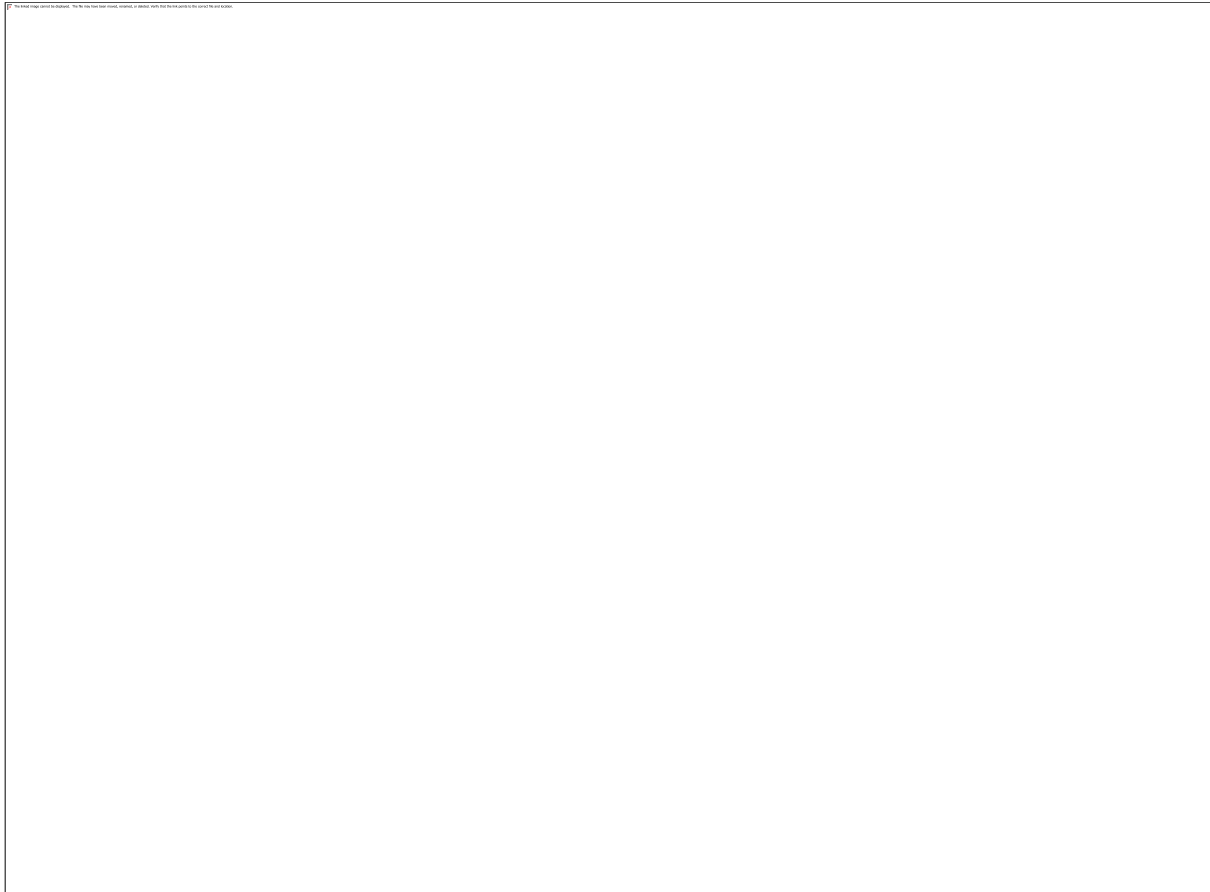
Because we have a maximum flow rate of 6gpm (1.4m^3/h), this limits how many sprinklers we can have running at any one time. Because the garden and lawn sprinkler zones have a water requirement greater than the maximum available flow, we are required to create more zones.

To do this we will be cutting out sections of existing zone pipe, adding control valves and mainline pipes to join to the water source. When we have completed the changes, there will be six zones on this property: The lawn to the right of the water supply, the shrubs with drip tape, the conservatory garden, the front garden piece, the left side garden, and the main lawn piece.

36. First we will enter a water supply to signify the tap that will supply the sprinklers. Select *Mainline|Water Supply* and in the dialog enter the "Name" as **Mains Supply 1**, turn off the "Calculate pressure?" option, enter the "Design dead" of **50psi** (**35m**) and "Max head" as **60ps**i (**42m**), and the "Design flow" and "Max flow" as **7gpm** (**1.6m3h**). Click [OK]. Now place the water supply on the house wall boundary close to the end of the conservatory garden (see Figure 4-73). Although the tap will be above ground level we have not worried about that in this example.
37. Using *Zone|Control Valve* select a **1" (25mm) Electric Valve** from the dropdown list and enter a "Depth" of **12in** (**300mm**) and click [OK]. Click on the zone pipe end after the top conservatory garden sprinkler to connect the valve. Press the <Esc> key.
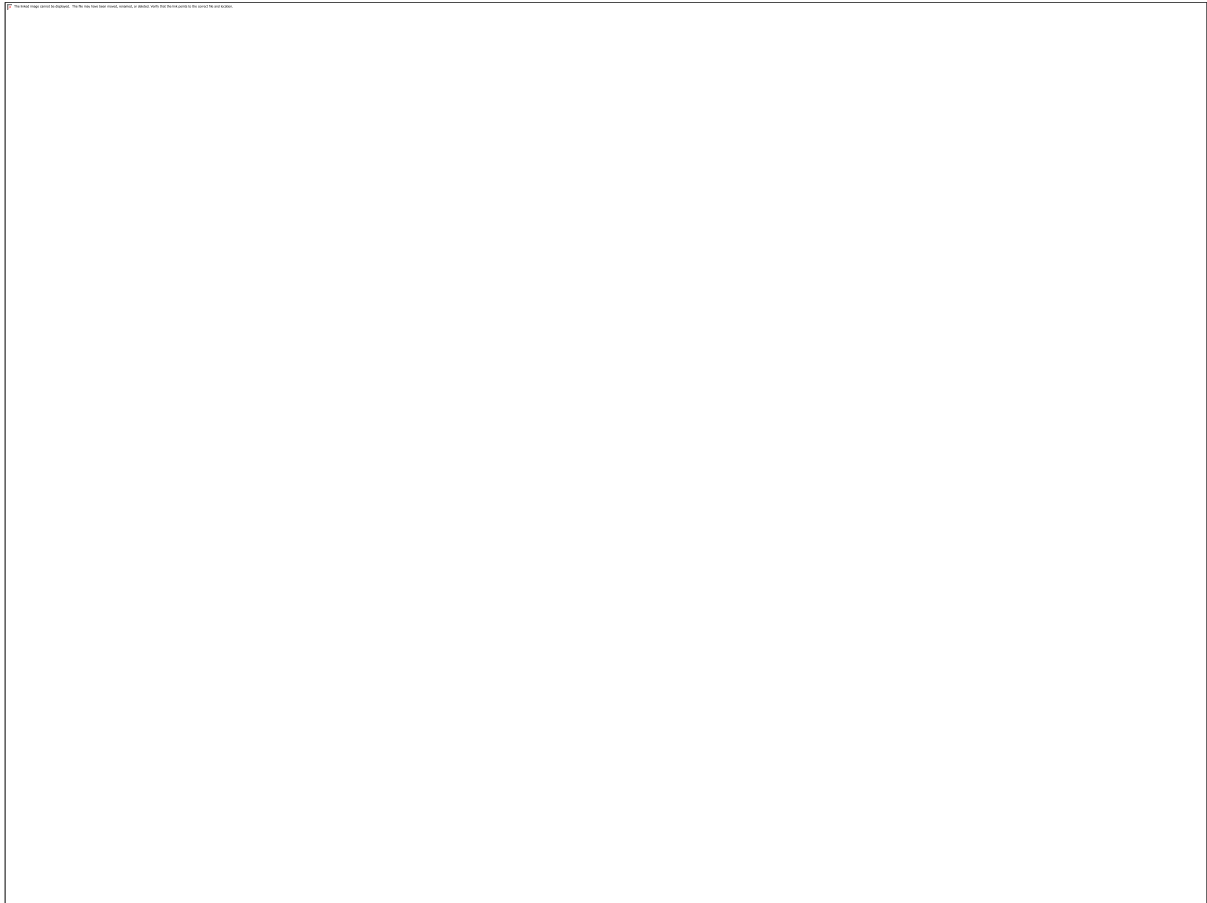
Figure 4-86

38. Click on the pipe between the second and third garden sprinkler from the left on the bottom boundary. Press the <Delete> key. Select *Zone|Zone Pipe* and connect a **Computer Selected** pipe at **12in** (**300mm**) "Depth" to the third sprinkler mentioned above. Extend this pipe approx. **3ft** (**1.0m**). Click to place then right-click to finish. Select *Zone|Control Valve*, the **1" (25mm) Electric Valve** should still be selected. Place a valve on the end of the pipe you have just drawn as in Figure 4-87.
39. Place another valve at the top of the design on the garden sprayline directly above the valve you have just placed.
40. Now connect two valves to the pipe above the water supply. Place them opposite the water supply, one a little to the left and one a little to the right. Press the <Esc> key. Select the piece of pipe between them and <Delete>.
41. Lastly, action *Zone|Control Valve* again and connect a valve to the top of the pipe connecting to the tape. See Figure 4-87.

Figure 4-87

4.3.8.4 CONNECTING THE SYSTEM

42. We will now connect the valves with mainline pipes. Select *Mainline|Mainline Pipe* and select the **1" Class 125 PVC Pipe** and enter a "Depth" of **12in** (**300mm**). Because we know what pipe size we want to use, we have selected it. Click [OK].
43. We need to zoom in near the water supply. Enter ZOOM WINDOW and draw a window around the valves near the water supply and the water supply itself. Using *Mainline|Mainline Pipe* connect a mai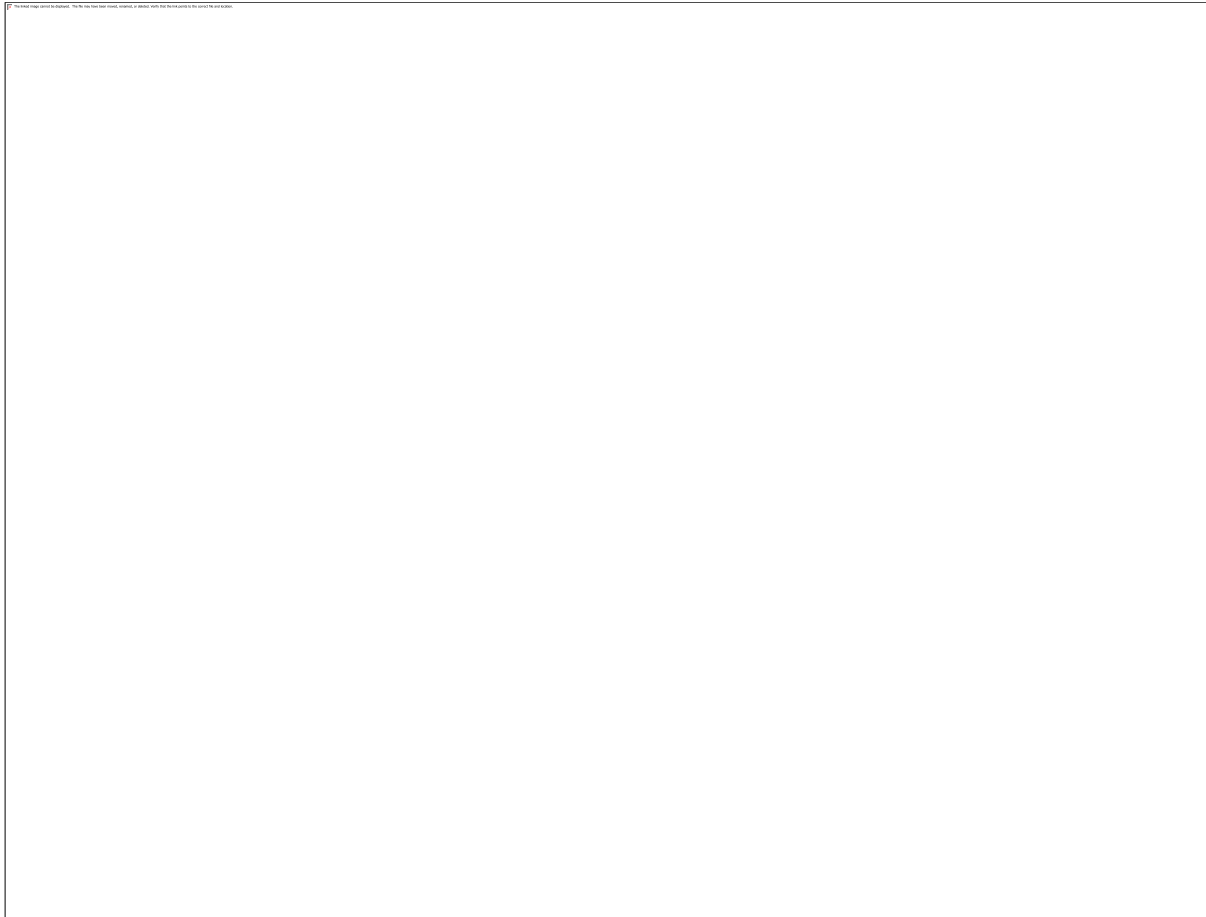nline pipe between the two valves at the top of the design above the water supply by left clicking on them then right-click to finish.
44. Left click on the water supply and draw the pipe vertically up to connect to the pipe you have just drawn between the valves. Left click on the pipe then right-click to finish. Left click on the valve in the conservatory garden near the water supply and draw the pipe horizontally to connect to the mainline pipe from the water supply. Ensure the pipe does not snap to the center of the water supply itself, as only one pipe can connect to the water supply. If this happens select the pipe and delete it. Start again but this time before connecting to the mainline pipe coming from the water supply use your mouse wheel to zoom in on the water supply. Now connect to the existing mainline pipe. Left click on this pipe then right-click to finish. ZOOM EXTENTS.
45. Using *Mainline|Mainline Pipe* connect a pipe between the two garden valves at the top and bottom by left clicking on them then right-click to finish.
46. Enter ZOOM WINDOW and draw a window around the three valves along the top boundary. Using *Mainline|Mainline Pipe* tee off the left-hand side vertical mainline pipe by left clicking on it about 1.5ft (0.5m) below the valve and draw the pipe horizontally to connect to the right-hand side vertical mainline pipe, left click then right-click to finish. ZOOM EXTENTS.
47. Enter ZOOM WINDOW and draw a window to encompass the water supply and the tape valve. Select *Mainline|Mainline Pipe* again and connect to the valve by left clicking on it. Left click again to connect the valve to the mainline pipe above the water supply.

48. There is still an unconnected sprinkler in the middle of the lawn. Due to the water limitation it cannot be attached to any of the other zones. Place a valve on the mainline pipe across from the sprinkler and draw a zone pipe from the valve to connect to the sprinkler. Your garden design should look like Figure 4-88.
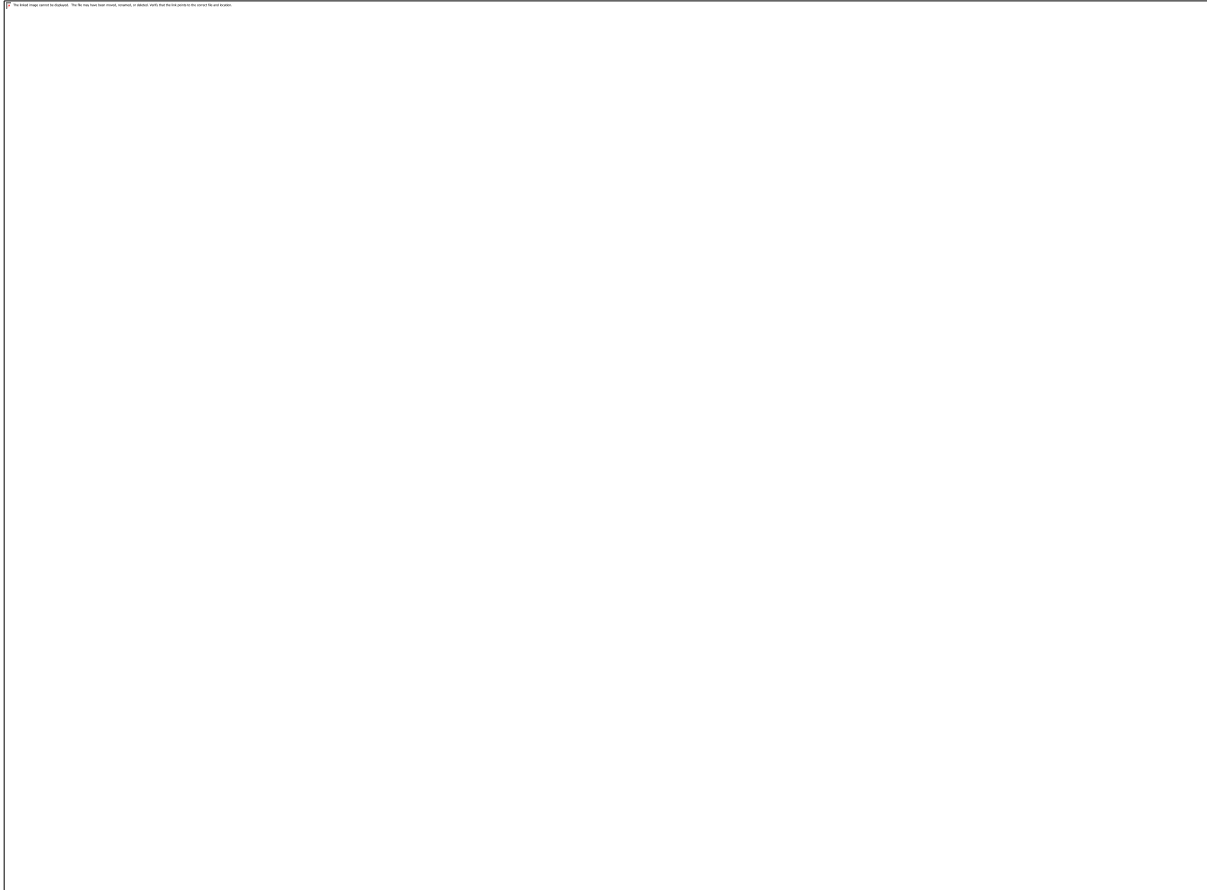
Figure 4-88

4.3.8.5 THE DESIGN PROCESS

Checking Connections

49. 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 via *Design|Clear Connectivity Marks*.

50. 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 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 and move the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|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.

Zone Design

51. We wish to size the zone pipes, so run IRR_ZONEDESIGN LP (*Zone LP Design*). Look at the *Zone Design Summary* report to see what is happening in the zones. The results should be

similar to Figure 4-89. You will notice that the zone flow for the tape zone is 0m^3/hr. This is due to the low flow and the rounding of the numbers in the report. Click the X to close the report window.
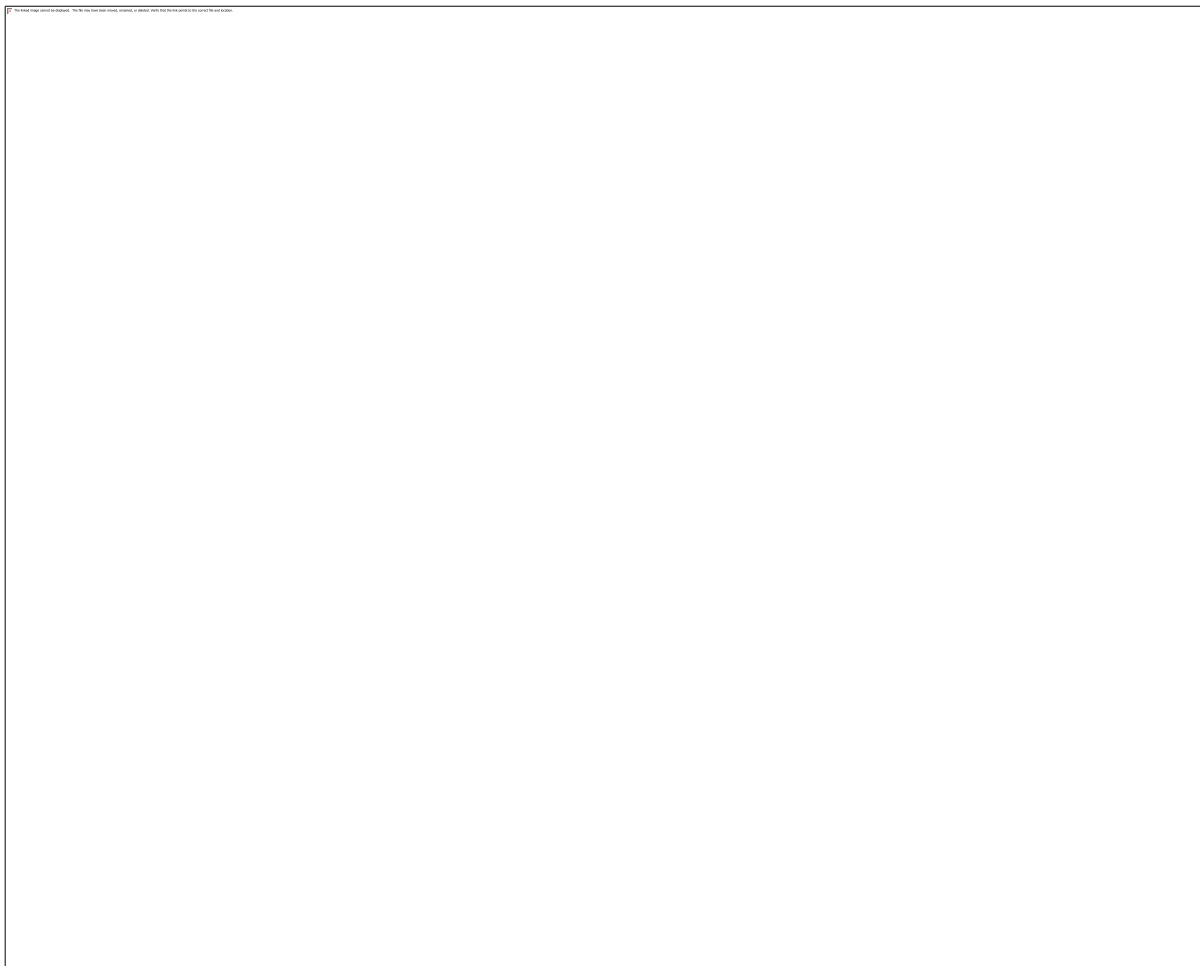
Figure 4-89

52. When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure via *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column. Now run *Design|Zone Design|Zone Detailed Analysis*) to finalise the zone design results. Check the Zone reports.

Entering Management Requirements

53. Now run *Design|Assign Each Zone to a Unique System Flow* and check that there are 7 system flows and each zone is operating on a separate system flow, like Figure 4-90 shows. Click [OK].
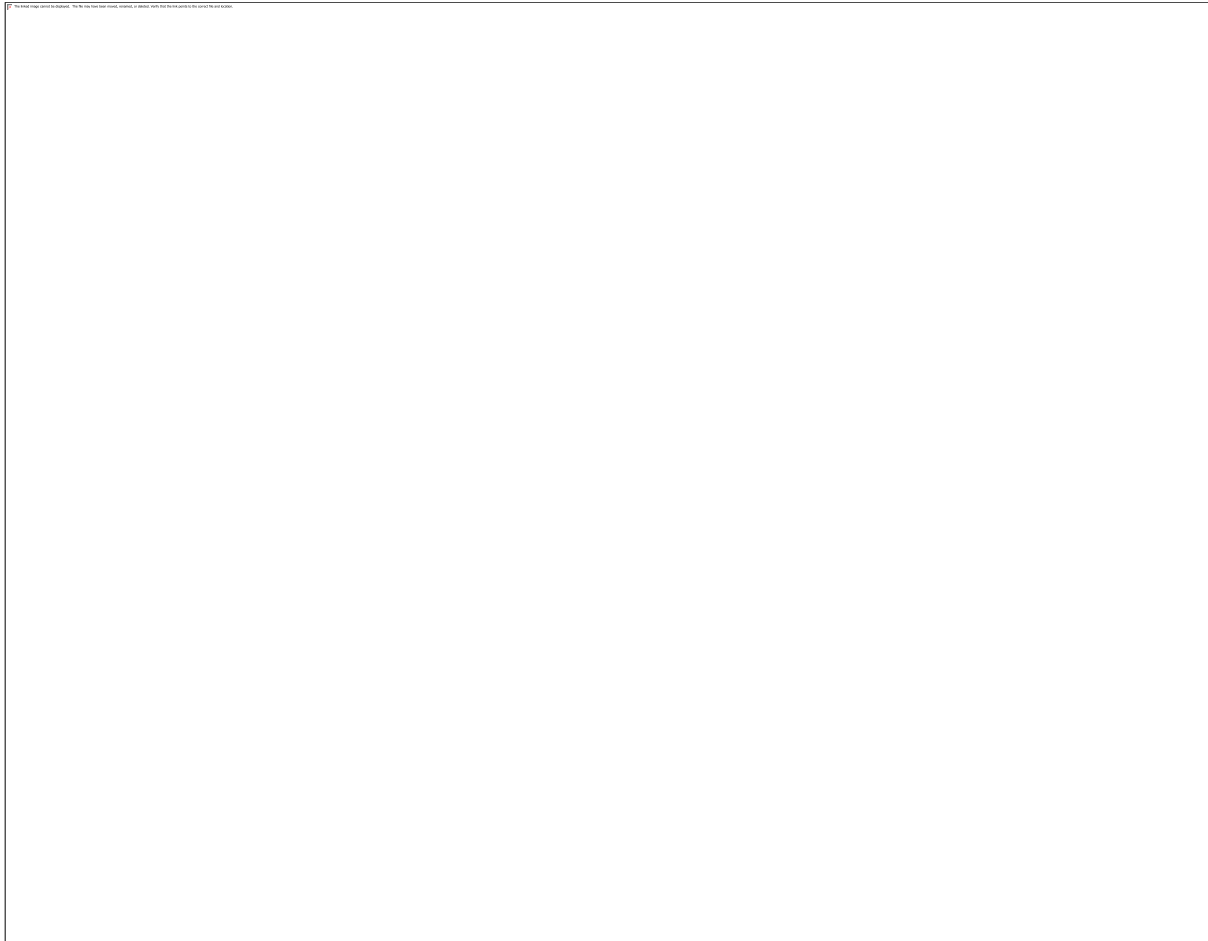
Figure 4-90

Mainline Design

54. Run Design|Mainline Design|Mainline Analysis to analyze the mainline pipes.
55. To have IRRICAD select fittings for the design action *Design|Computer Selection of Fittings*. Select a *Costing / BOM Report* to view any fitting selection errors. For information on how to fix fittings selection errors, see **Correcting Fittings Errors**.

4.4 PRINTING USING LAYOUTS

This is a simple tutorial to explain how to prepare your design ready for printing.

For this example we will use the Micro Irrigation Design, Section 4.3.6

1. Complete the tutorial if you have not done so already. Open the completed tutorial by using OPEN and browsing for a design file.
2. Go to the *Irricad Options|Design Details* tab. Enter the appropriate details in the edit boxes e.g., Site, Description, Notes, and Designer Name, etc. Then go to the *Irricad Options|Client* and *Irricad Options|Company* tabs, as required, to enter the Client Name and Company Name etc. Click [OK].
3. At the bottom of the drawing screen click on the "A3 Key Bottom" tab. Double-click inside the middle of the screen so that red outline becomes a thick red border (this outline depicts the "viewport").
4. Enter ZOOM EXTENTS on the command line and press <Enter>. The design drawn in the Model tab should now fill the viewport. You can zoom in and out to reposition the design within the layout. Your layout should look like Figure 4-91.
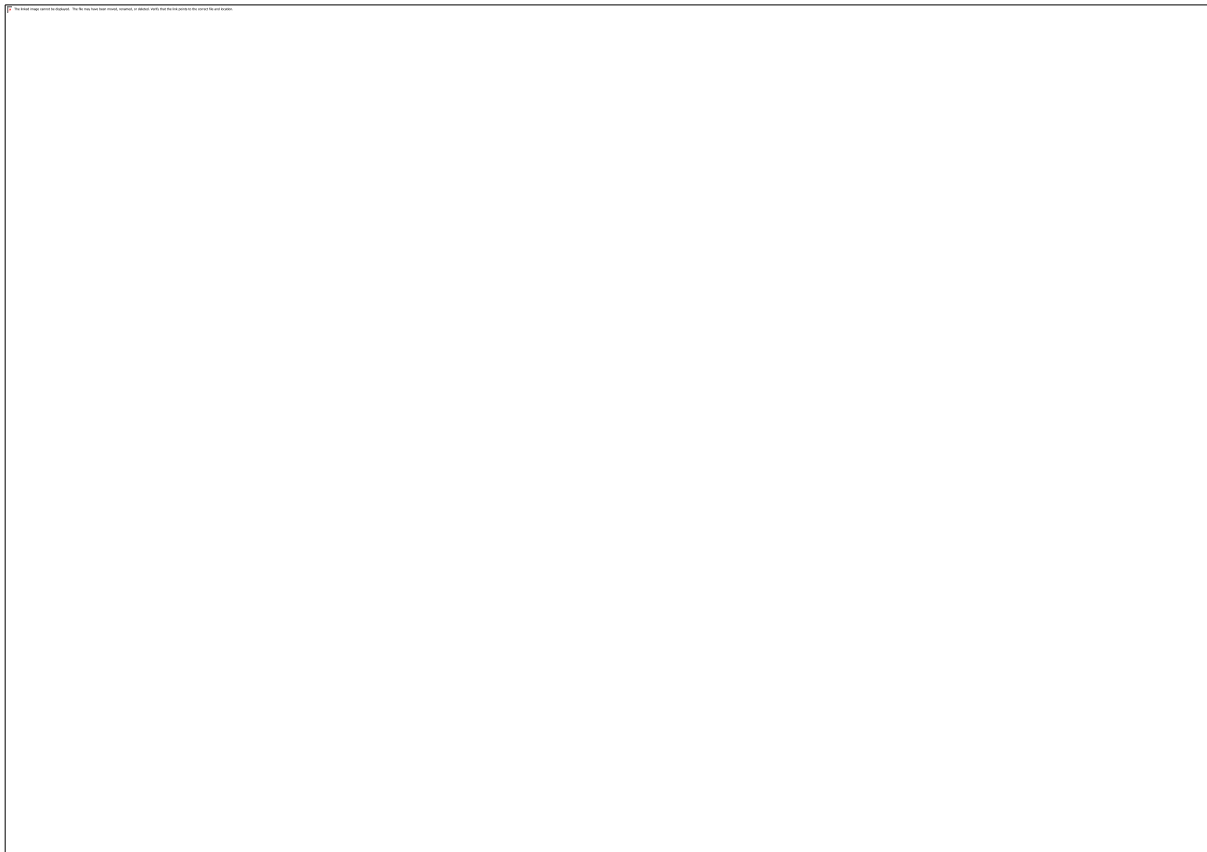
Figure 4-91

5. To scale the plan double-click outside the red viewport so that the viewport is no longer bold. Enter REGEN for the scale to update. It is probable that the scale is not a standard scale, for example it might be something like 1":28.60' (1:1085.11). To set this to the closest standard scale highlight the red viewport boundary by clicking on it once. In the Properties tab (right-click|Properties) find the 'Standard Scale' attribute – it should currently say 'Custom'. Click on this and change the scale to the required scale, such as 1":30' (IRR_1:1000) in this example. The plan will resize accordingly in the viewport.
3. Also in Properties click on the "Display Locked" attribute and change it from No to **Yes**. This ensures that if you accidentally scroll when in model space it won't change the current zoom/placement.

5. To add the pipes, outlets, valves, misc. hydraulic items, wires etc., to the legend select *Irricad Tools|Populate Legend*. The legend will itemize and display every unique item:
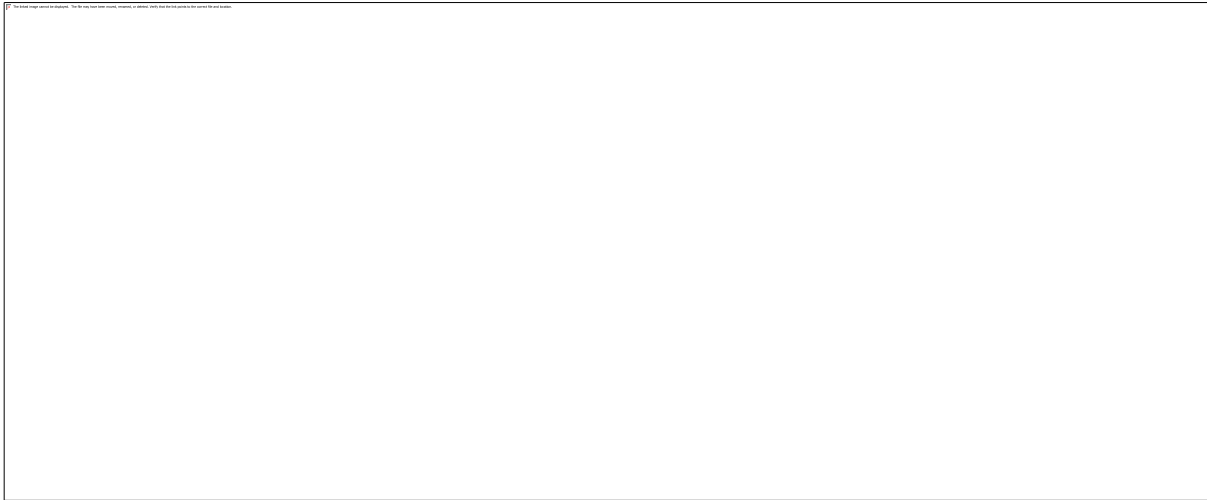
Figure 4-92

7. To print the plan enter PRINT in the command line. If required adjust the print settings as needed, such as the printer or "Plot Offset". Preview the print job. You may wish to centralize the plan/legend before printing – close the dialog and in the Layout use Ctrl + A to select all before moving.When ready press the [Print] button.

See also:

How to Print a Plan   *Section 2.8.2*

4.5 DATABASE AND FITTING SELECTION

Design|Computer Selection of Fittings is a great tool to save time, producing a complete Bill of Materials. 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 Costings report.

4.5.1 CUSTOMIZING YOUR DATABASE

By 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 Database Editor Manual, available in the electronic help or the hard copy manual, explain the fields in database item dialogs so you can easily enter your own items or customize the existing items.

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, and another Stockwater.mdb. 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, you may have more databases, and that you do not have multitudes of extraneous product items you will never use.

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 have both present and decide to use saddles in a particular design, instead of tees, you can turn the cheaper tees off in the database (select **N**) before running *Design|Computer Selection of Fittings*.

4.5.1.1 ENTERING NEW PIPES IN TO THE DATABASE

1. Run the Database Editor (*Start|All Programs|IRRICAD Link |Irricad Databases*. Note the database the editor opens with is your default database – set in IRRICAD in *Irricad Options|Irrigation – Design Specific* and clicking the [Save As Default] button. If the database does not automatically open then go to *Tools|Options* and enable the "Open database on Startup" option. Then select **Default Database** or **Last Database** as per your preference.
2. Enter a new pipe by selecting *Component|Add Item*. IRRICAD will copy the pipe the cursor is currently on so if there is an existing pipe similar to the pipe you are adding to the database, click on this before selecting *Component|Add Item*.
3. 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, Flushing pipes or Mainline pipes. Laterals are connected spraylines, zone pipes are any pipes (other than laterals) used downstream from a control valve, flushing pipes will be eligible for manual selection 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, F, S, U, or M you wish. If the usage code is blank then this item cannot be used or selected.
4. Enter a name for your pipe, describing its basic qualities e.g., 2" (50mm) PVC Class 6.
5. Now enter a unique warehouse code for the pipe. This can be your ordering code or an inventory code.
6. Enter a supplier code (you can make your own in IRRICAD – via *Reports|Supplier Code Multipliers*).
7. Enter a pipe type for your pipe, e.g., PVC, LDP etc. You can make your own in *Design|Pipe Fitting Matching Table* but note IRRICAD uses this pipe type to select fittings so it should match the appropriate fittings.
8. The nominal diameter is the size the pipe is usually referred to by, e.g., 2" (50mm).
9. The actual diameter is very important to be entered precisely as this is the diameter IRRICAD uses in its pipe friction loss calculations.

10. The pipe roughness is the Hazen-Williams C factor, which can be found in Appendix B for all smooth pipes.
11. Enter the maximum allowable pressure as per manufacturers' specifications for that pipe.
12. Enter a wholesale cost and retail price and select a plotting colour and line type for this pipe. Click the [Save] button .

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

The other item dialogs do not differ too much from this format. However, you can find information on this in the IRRICAD Database Editor section of the manual.

4.5.1.2 ENTERING A NEW OUTLET 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 first. To do this you require the manufacturer's technical data sheet for the nozzles.
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 select *Exit* (save changes if required) and then *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. Select *Component|Add Item*. IRRICAD will copy the nozzle the cursor is currently on so if there is an existing nozzle similar to the nozzle you are adding to the database, click on this before selecting *Component|Add Item* and start entering the relevant information into each field.
5. When you get to the "Radius Equation Constant (K)" and "Radius Equation Index (n)" fields, we will use the manufacturer's data in the *Curve Fit* to calculate the Constant (K) and Index (n). If the *Curve Fit* is not currently displayed on the right-hand side of the window, select *View|Curve Fit* and select **Outlet wetted radii from pressure** from the dropdown list.
6. The table you see requires at least three sets of data. Firstly ensure that the units above each column are set to match the units you are reading off the manufacturer's 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. Ensure that R^2 is above 90% or re-check your data. Copy the Constant in to the "Radius Equation Constant (K)" field and the Index into the "Radius Equation Index(n)" field by clicking the green arrow button.
8. When you get down to the "Flow Equation Constant (K)" and "Flow Equation Index (n)" fields below, select **Outlet flow from pressure** from the dropdown list in the *Curve Fit*. Once again read the data off the manufacturer's sheet for this nozzle. Firstly ensure that the units above each column are set to match the units you are reading off the manufacturer's 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. Ensure that R^2 is above 90% or re-check your data. Copy the Constant in to the "Flow Equation Constant (K)" field and the Index into the "Flow Equation Index (n)" field by clicking the green arrow button.
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. Select *Component|Add Item*. IRRICAD will copy the outlet the cursor is currently on so if there is an existing outlet similar to the outlet you are adding to the database, click on this before selecting *Component|Add Item* 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
17. The "Flow Tolerance" is usually 5% above and 5% below as a rule of thumb unless the nozzle is pressure compensating.
18. Finish filling in the fields and [Save] the new outlet.
19. Now with your new outlet highlighted, select *Component|Edit Nozzles*. This will take you to the **Nozzles** component group. In the bottom field you will see any nozzles which were copied for the existing outlet when you create the new one. Select the grey box to the left of the nozzle name. If there are more than one nozzle here (and if they do not belong with your new outlet), you can drag the cursor down to highlight all of the nozzles. Now select *Component|Remove Nozzles*.
20. Now click on the little grey box to the left of the required nozzle name to automatically be added to your outlet. Select all of the new nozzles you have just created for this outlet. You can see the added nozzles in the list below the main grid. Once you have added all the required nozzles, select *Component|Edit Nozzles*.
21. Select *File|Exit* and then the [Yes] button to save the additions to your database and to close the database.

4.5.2 HOW IRRICAD SELECTS FITTINGS AND UNDERSTANDING THE FITTING SELECTION RULES

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

4.5.2.1 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 move 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 than its competitors.

4.5.2.2 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 higher depth. Now select either **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 <u>providing</u> 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 higher 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 Irrigation Block* any size you wish. Select a **Center** submain through the middle of the block, setting the "Depth" to **20in** (**500mm**). Select a valve (at **0** "Depth") and then draw in a mainline pipe (at **20in** (**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.
2. Now run *Design|Computer Selection of Fittings*. Select one junction where the submain connects to a lateral and double-click to open the junction's dialog 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.
3. Go in to *Design|Riser Selection Rules* and set the depths as required (**0** for "Depth 1" and **20"** (**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*.
4. Double-click on one junction where the submain connects to a lateral and click the [Show Fittings] button in the dialog. Because IRRICAD is now looking for a ½" (16mm) PVC pipe and there is none available or turned on in the database, it cannot solve the junction.
5. Now change the "Riser" to **User** in *Design|Riser Selection Rules*. Select the pipe you wish to use for the riser, such as the ¾" (**20mm**) **Polyethylene hose**. Now re-run *Design|Computer Selection of Fittings* and double-click on one junction where the submain connects to a lateral. 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.

4.5.2.3 USING PIPE FITTING MATCHING SETTINGS

The *Design|Pipe Fitting Matching Table* 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 *Costing/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.

4.5.2.4 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, <u>and</u> 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 in Economic Parameters then the costing reports will show the relevant prices or costs.

Remember the Bill of Materials reports 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 *Design|Pipe Fitting Matching Table*.

4.5.3 CORRECTING FITTINGS ERRORS

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:

US Units:

Problem selecting suitable Tee

X: 102.20 Y: 263.82

PVC M S 2.00 PVC M S.00 1.50

Metric Units:

Problem selecting suitable Tee

X: 102.20 Y: 263.82

PVC M S 50.00 PVC M S.00 40.00

1. Zoom in on a piece of your design. Action IRR_GOTO 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 center of the page. Double- 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 which junction IRRICAD is trying to solve. Reading up on the Fitting Selection Rules (in Appendix G) will help you understand the items IRRICAD needs to solve the junction.

2. Run IRRICAD Databases by clicking on the *Start|All Programs|IRRICAD Link|IRRICAD Databases* or double-click on the icon if one is present on your desktop. (Note the database the editor opens with is your default database – set in IRRICAD in *Irricad Options|Irrigation – Design Specific* tab and clicking the [Save As Default] button). Select *File|Open* and browse for the required database in the \Irricad\database folder if your working database has not opened. Open this database and select the required component tab, entering the item or items required to solve the junction.

3. Return to IRRICAD and rerun *Design|Computer Selection of Fittings*. If any other fitting errors are still present in the *BOM / Costing Reports|BOM* report, solve the next junction in the list using the above method to help you.
4. Use the tape irrigation block you drew above. Solve the missing End Cap.

Try an example of your own.

4.5.4 CREATING AND MODIFYING ASSEMBLIES

To create an assembly, it is important to note the following rules:

*   If creating an assembly based on a particular valve, for example a 2" (50mm) Electric Valve Assembly, you still need to add a 2" (50mm) Electric Valve to the assembly.
*   It is not necessary to have all items in the assembly with the correct connections for fitting together as the only connection types used are those entered for the Assembly as the one item. However, for practical reasons, it is beneficial to have the connections required between the assembly items.
*   Outlet assemblies must contain an outlet.

4.5.4.1 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.

1. For example, if you wish to make an assembly in the Tees group, 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). Now select *Component|New Assembly*. Change the "Usage" code to **X**. Change the "Description" so you know this item is an assembly, and possibly what use it has e.g., **2½" (63mm) tee with expanding coupler to 3½" (90mm)**. Change the "Warehouse Code". Change the "Major Connection Code" and "Minor Connection Code" to reflect the ends you wish to connect to e.g., **2½" (63mm) MDP FS** and **3½" (90mm) MDP FS**. Now click the [Continue] button.
2. Most importantly select the tee required in this assembly by clicking on the grey box to the left of the description of the tee e.g., **2½" (63mm) Female Tee** and enter the **1** as the required number of this item. Now select **1** of the **Reducing Coupling 3½" x 2½" (90 x 63mm)**. When you have completed adding items into your assembly, select the *Component|Finish Assembly*. It is your job to ensure the items you are selecting will connect together. Save your database upon closing.
3. Now run *Design|Computer Selection of Fittings* for your assembly to be selected. View the *BOM / Costing 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.

4.5.4.2 CREATING AN ASSEMBLY

Figure 4-93

We wish to create a swing joint assembly for use in small turf irrigation.

This assembly will contain:
- Three 90° street elbows
- ¾" PVC pipe

1. Run the IRRICAD Database Editor (*Start|All Programs|IRRICAD Link|IRRICAD Databases*). The Database Editor opens your default database automatically. If the Tutorial database is not the default database (the name of the database is displayed on the title bar), use *File|Open* browse for the **Tutorial.mdb**. This should be in the Irricad\database folder.
2. Click on the Outlet Connections tab (you may need to scroll along the top to see this tab). Find the **Microsprinkler Stake and Tube ³/₈" (10mm)**. Click on the gray box to the left of the description to select the item. Select *Component|New Assembly*. Note that the characteristics for the existing riser have been copied. Edit the name for the outlet assembly to be: **Pop-Up Swing Joint Assembly**. Change the "Warehouse Code" to **SwingJAssembly** and select a "Supplier Code".
3. The "Inlet Connection" and "Outlet Connection" should correspond with the actual items that will be at either end. In this case a ¾" PVC elbow will be at the inlet end with a connection type of BSP MT to connect into the PVC faucet tee IRRICAD selects. The item that will be at the outlet end of the assembly will be a reducing street elbow, found in the Elbows / Bends tab, with a connection type of PVC MT with a minor diameter of ½" (15mm) to connect directly to the lawn pop-up sprinkler. Check that the "Inlet Connection" and "Outlet Connection" types for the assembly are **BSP MT** and change this if required. The "Inlet Diameter" is **¾"** (**20mm**) and the "Outlet Diameter" is **½"** (**15mm**).

4. The "Height Above Ground" is **0** (zero) because it is below ground. The "Equivalent Length Diameter" is ¾" (**20mm**); this is the diameter to be used in the headloss calculations and represents the average diameter.
5. The "Headloss Equivalent Length" is equal to the complete length water will traverse through. We will use **6.6ft** (**2m**) in this case to represent the length of pipe and elbows: 0.66ft (0.2m) of PVC pipe, 2ft (0.6m) x 3 for equivalent lengths of ¾" elbows. The costs will equal those of the included items added together. Click the [Continue] button.
6. Using the tabs at the top of the screen, click on the Elbows / Bends tab and click on the grey box to the left of the ¾" **(20mm) Female PVC 90 Street Elbow**. Type in **2** for the number to be selected. Click [OK]. Select ¾" x ½" **Male Street Elbow** and type in **1** for the number required. Click [OK].
7. Go to the Pipe tab and select the ¾" **(20mm) Class 125 PVC Pipe**. Type **0.66ft** (**0.2m**) for the length required.
8. As the Assembly is now complete, select *Component|Finish Assembly*.

4.5.4.3 MODIFYING AN ASSEMBLY

We wish to add to an existing assembly - go to the Outlet Connections component group and select the **Lawn Pop-Up Assembly**.

1. Select *Component|Add to Assembly*.

Because the tee branch connecting to the street elbow is PVC FS, and the elbow end of the $^3/_4$" (20mm) female PVC 90 Street Elbow is PVC FS, these items will require a coupler in order to be joined together in the field. A $^3/_4$" (20mm) PVC male coupler that has an inlet and outlet connection type PVC MS is required.

2. Return to the Coupler tab and click on the f=grey box to left of the $^3/_4$" **PVC Male Coupler** to add to the assembly. Type in **1** for the number to be selected. Click [OK]. Select *Component|Finish Assembly*. Exit the database and click the [Yes] button to save changes.

4.6 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|Zone Outlets, where the control valves are the the on / off control for each zone and connection between zone and mainline items. 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 design and analysis 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.

In a mainline design the best report to view for the valve-in-head outlet/valve is the *Mainline Summary Report*.

4.6.1 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.

Figure 4-94

Demand points are only useful if you know the pressure and flow required at a particular point. Demand points can be used to make a quick Mainline Analysis. A hydraulic analysis is only as correct as the information you put in. 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.

Therefore there is no advantage in running *Detailed Analysis* to ascertain the actual flow based on the incoming pressure. This can be quite critical for some designs particularly if the water supply pressure (either specified or calculated where more than one zone is operating at a time) exceeds the minimum required pressure for non-pressure compensating emitters.

4.6.2 A QUICK RURAL WATER SUPPLY

1. Double-click on the Irricad Briscad or Irricad AutoCad desktop icon to start IRRICAD. If IRRICAD is already running enter QNEW on the command line and press the <Enter> key to start a clean design.
2. Go to the *Irricad Options|Irrigation – Design Specific* tab and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Zone pipes" Lines width to **0.016" (0.4mm)** and the "Mainline pipes" Lines width to **0.021" (0.53mm)**.
3. Go to the *Irricad Options|Units* tab and click the [US] ([Metric]) button to restore the default units for this tutorial. For this tutorial select **lp**h as the "Outlet Flow" and **m** as the "Pressure".

4.6.2.1 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 "Calculate pressure?" option enabled, so that IRRICAD will calculate the system duty for the system you draw. Click [OK] to accept and close the dialog.
5. Select *Mainline|Mainline Pipe*. Leave the pipe as **Computer Selected** so that IRRICAD will select the pipe size for you. Click [OK] and click in the center 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 pressing the <Esc> key.
6. Select *Mainline|Mainline Outlet* and select **Demand Flow**. This type of outlet is called a Demand Point. It does not have at a pressure / flow relationship but simply allows us to specify the flow and pressure required a particular point. Enter **30m** and **5m³/h**. Click [OK].

Figure 4-95

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 4-96.
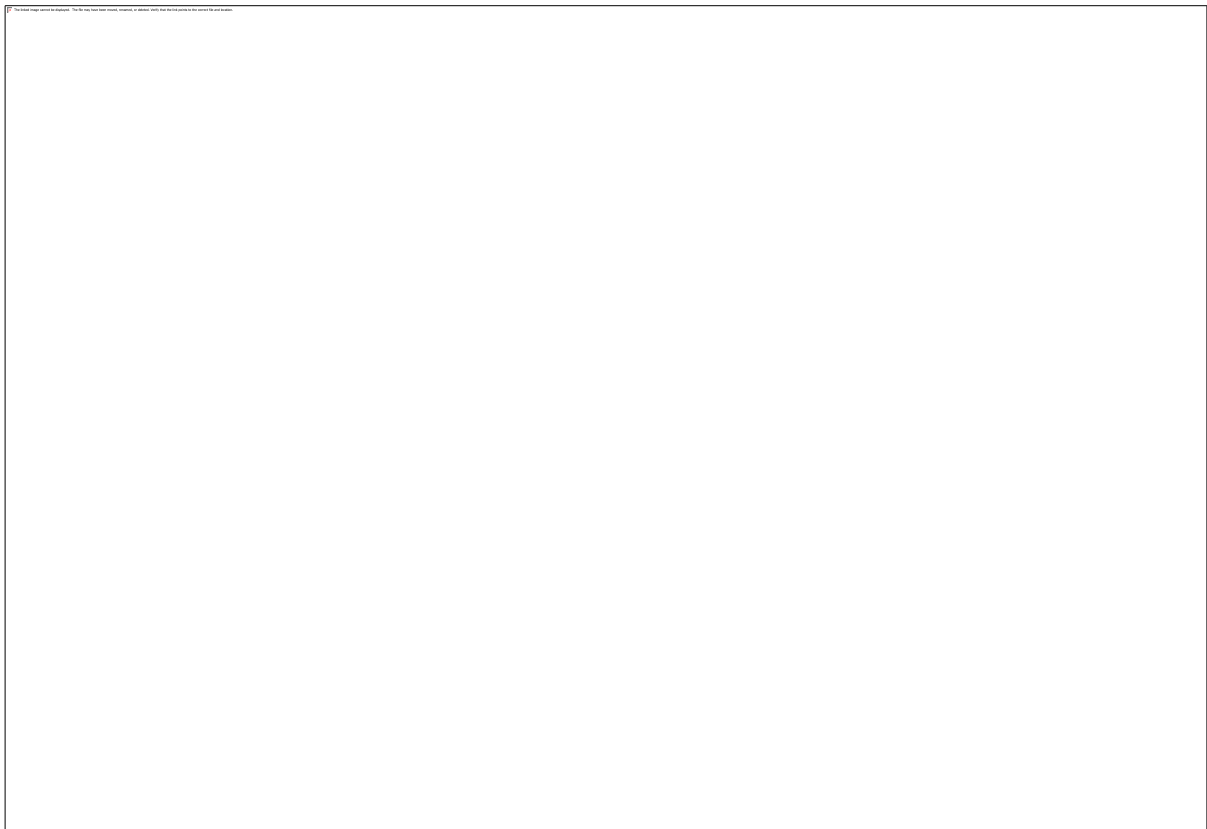
Figure 4-96

8. In *Irricad Options|Miscellaneous* and select or enter the *"Base Database Symbol Size"* most suitable for your design size. Click [OK].

4.6.2.2 DESIGN

9. First check that all the items are connected by selecting *Design|Check Outlet Connectivity*. If everything is connected proceed with the Design process. 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 via *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. If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet and move the item to the center of the junction. The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Irricad Options|Sna* is set to **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.
10. Even though we only have mainline items present in the design, we will still need to analyze the zones i.e. the mainline outlets. Select *Design|Zone Design|Zone Analysis*. This should be quite quick.
11. Now 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].
12. Now run *Design|Mainline Design|Mainline LP Design*). LP design a computer design option that will select pipes based on the pressure required at the outlet.
13. Now view the reports. Because this is a mainline design select *Reports|Mainline Design Reports*. In the *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 Design 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 Design Pipe Report* lists the pressures in the pipes, and also lists the elevations of start and end point so the pipes.

4.6.2.3 VARIATIONS

14. Draw some contours or spot heights on the design. Elevation information can also be imported using *Irricad Import|Import Elevations*. Keep in mind that the elevation information needs to span all hydraulic input. Now redesign the system and view the reports.
15. Size the pipes using *Design|Mainline Design|Mainline 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.
16. Run *Design|Computer Selection of Fittings*. IRRICAD will search the database for fittings for each junction.

Note: You do not have to layout a design in a specific order. You can place the nodes first, then pipe, then water supply if you wish. IRRICAD is very flexible until the Design section where management is required, then Zone Design, 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 via the Database Editor.

4.6.3 STOCK WATER RETICULATION NOTES

Water troughs can be entered as demand points on the design for a quick analysis however, it is best to mirror the water trough valve as an outlet with nozzles for use in this type of mainline design. Then, because the water trough now has a pressure/ flow relationship, *Detailed Analysis* can be used to show actual field conditions where the flow is based on actual pressure at the trough valve. This is particularly important when:-

- more than one trough is filling at a time
- the property has undulating topography
- the troughs that are filling are at very different locations or elevations.

4.6.3.1 ENTERING THE TROUGH VALVE INTO THE DATABASE

Locate the manufacturer's technical specification sheet for the trough valve.

Enter the trough valve as an outlet and nozzle(s) (see Entering a New Outlet Into the Database, Section 4.5.1.2).

In the design place the trough valve where required via *Mainline|Mainline Outlet*. Connect the mainline outlets with *Mainline|Mainline Pipe*.

4.6.3.2 THE DESIGN PROCESS

Set up a "Partial Management", which means that a finite number of system flows (which troughs are running together), is decided based on possible worse case scenarios. This may include troughs close to the water source, at different ends of the farm, or close together at the far end of the farm.

If pipe sizing is required remember that if there are loops in the system or multiple water supplies that *Mainline|Mainline Design|Velocity Design* will have to be used.

Finalise pipe sizes by manual changes if required and analyse those changes. If partial management has been used ensure all pipes have a size (these can be extroplated from sized pipes that have the same number of troughs downstream).

Set the water supply pressure and action that *Mainline|Mainline Design|Detailed Analysis*. This will provide field pressures and flows at each of the running troughs.

4.7 TIPS FOR ADVANCED USERS

4.7.1 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. Enter the water supply details to reflect true conditions of the supply – the height of water relative to ground level, or the existing pressure of the water source.

If the water supply is a river or open water source the pressure may be zero, uncheck the "Calculate pressure?" option and set the "Design head" to **0**.

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., **1** ft (m). Base this on the worse-case scenario, such as the tank is almost empty, so that you know the system will still work under those conditions.

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., **–2** if the water level is 2 feet (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., **2** ft (m).

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 only), suction pipe loss (surface pump), drawdown losses (well only), headworks losses, etc., can be entered in to the design and therefore analyzed as close to field results as possible.
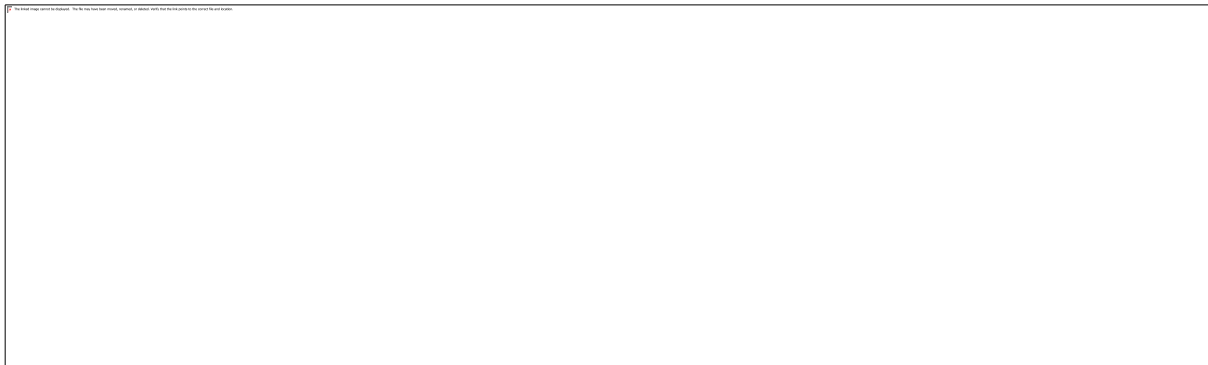
Figure 4-97

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.

4.7.1.1 ENTERING PUMPS IN TO THE DATABASE

Use the manufacturer's data in Figure 4-98 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 Fit* option and the Pumps option. Enter at least three sets of data into the curve fitting utility for pumps (ensure 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 a pump curve.

1. Run IRRICAD Databases from the desktop icon. To open the **Tutorial.mdb** select *File|Open* and browse for the database.
2. Click on the Pumps component group tab and click the [Add Pump] icon or select *Component|Add Item*. Enter the "Usage" (**Y**), "Description", "Warehouse Code", "Connection Types" (use **PUMP F S** so it easy to identify in the reports) and "Diameters".
3. If you cannot see the Curve Fit bar on the right-hand side select *View|Curve Fit*. Ensure the units match the units you are reading off the graph in Figure 4-98. Enter at least 3 sets of points from the curve, particularly around the area you wish to operate the pump in the design.
4. Click the [Fit Curve] button. Ensure the R^2 is greater than 90%. If it is not, re-enter the points. 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 Hydraulic Object Info.
5. Click the green arrow to automatically populate the H/Q Curve factrs A, B and C in the Pump Details dialog.
6. Enter the "Minimum Flow" and "Maximum Flow" for that pump and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [Save] the new pump.

Figure 4-98
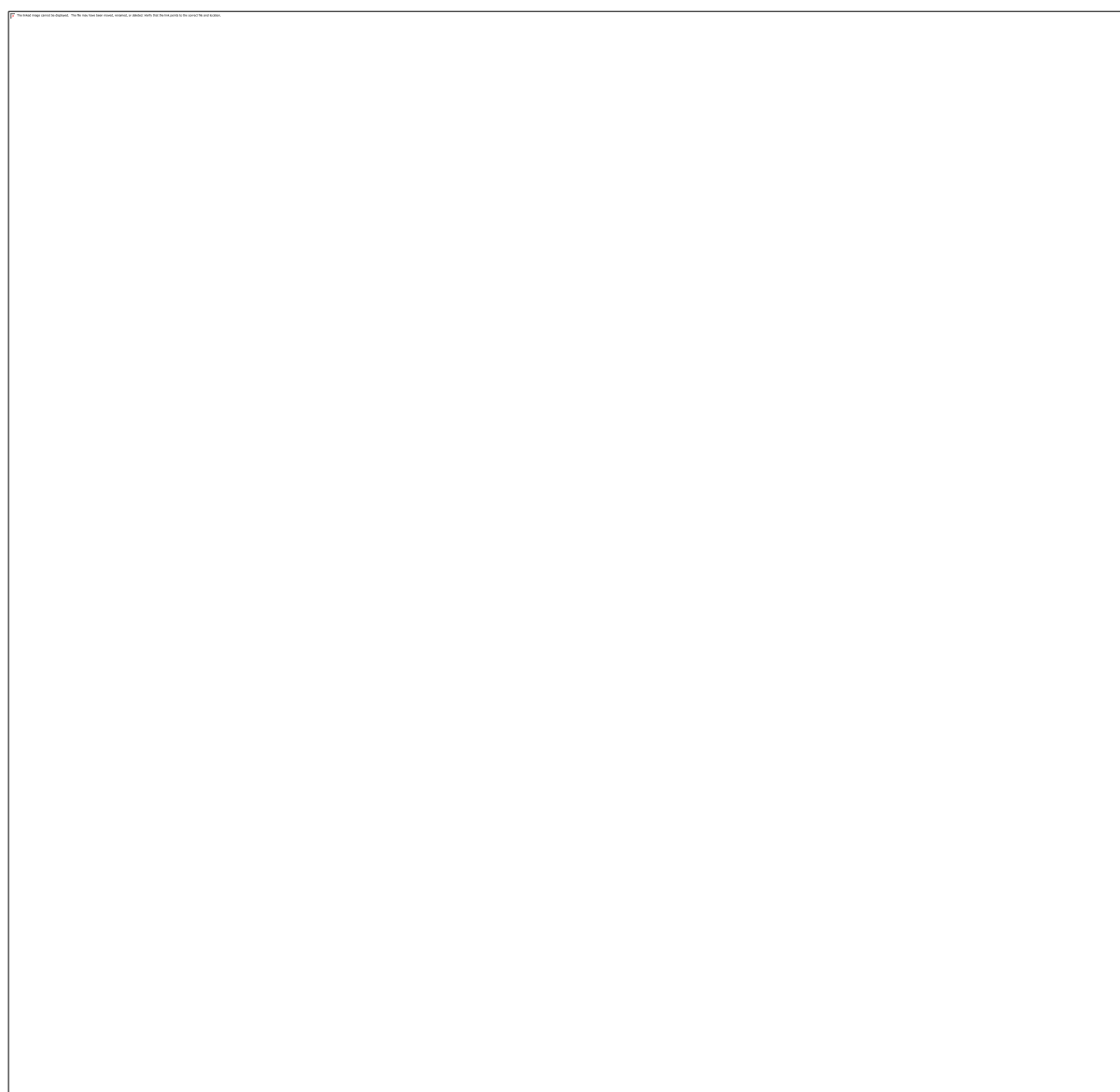
Notes:

> *If a surface pump model is 100 x 65: 100 is the suction diameter, 65 is the diameter of the discharge (outlet). If an extra number is present in the description this is the size of the impeller.*

> *For a submersible pump, enter the inlet and outlet diameter the same.*

4.7.1.2 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).

If you only have one set of pressure vs flow data you can manually solve the formula used for Misc. Hydraulic items: $H = K \times Q^n$ where H is in meters and Q is in m^3/hr. Q is the flow at the well. n is the exponent. The drawdown is equal to the headloss in m (e.g., if the drawdown = 9.6m, then the headloss = 9.6m).

For alluvial aquifers: If there is only one well test (Q-drawdown pair) available estimate the index is around 1.5. For a large flow (> 50 l/s) use 1.7. For wells that are uncased in rock or limestone use an index (n) close to 1.0. 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). $N = \log (D1/D2)/\log (Q1/Q2)$. $K = D1/Q1^n$.

If you have three sets of pressure vs flow data use the *Curve Fit* utility in the Database Editor to calculate the constant, index and intercept for you. In the *Curve Fit* utility select the units applicable to your data: IRRICAD converts internally to m^3/hr and meters.

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.

2. Go to the Other Hydraulics component group tab in the Tutorial database. Click on [Add Item]. Enter the "Usage" (**Y**), "Description", "Warehouse Code", "Connection Types" and "Diameters". Enter the "Constant" and "Index" as you have calculated in the correct fields. Leave the "Fitting Type" blank (only used for PRVs). Enter the "Minimum Flow" and "Maximum Flow" for the item and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [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 galvanized rising columns use the following: These have been calculated for a column 328ft (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 (using the metric)

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

for an 8" rising column which is 85m long - 0.0001479 x 85 / 100 = 0.000126 which is the "Constant".

The rising column of the pump we will be using is **6"** (**150mm**) and is 213ft (65m) long. Calculate the constant relative the length (as above).

1. Go to the Other Hydraulics component group tab in the Tutorial database.
2. Click on [Add Item]. Enter the "Usage" (**Y**), "Description" (ensure the description specifies the length), "Warehouse Code", "Connection Types" and "Diameters". Enter the "Constant" and "Index" as you have calculated in the correct fields. Leave the "Fitting Type" blank (only used for PRVs). Enter the "Minimum Flow" and "Maximum Flow" for the item and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [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 = headloss. For example, if you estimate the pressure loss in the headworks to be 5psi @ 26385gph (3.5m @ 100m^3/h) you can assume n=2 (in most cases) and solve for K.

H= KQ^n Solve for K. K = H/Q^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 5psi @ 26385gph (3.5m @ 100m^3/h).

1. Go to the Other Hydraulics component group tab in the Tutorial database. Click on [Add Item]. Enter the "Usage" (**Y**), "Description", "Warehouse Code", "Connection Types" and "Diameters". Enter the "Constant" and "Index" as you have calculated in the correct fields. Leave the "Fitting Type" blank (only used for PRVs). Enter the "Minimum Flow" and "Maximum Flow" for the item and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [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. Click on [Add Item]. Enter the "Usage" (**Y**), "Description", "Warehouse Code", "Connection Types" and "Diameters". Enter the "Intercept" as **6.5ft** (**2m**), leaving the "Constant" and "Index" as **0**. Leave the "Fitting Type" blank (only used for PRVs). Enter the "Minimum Flow" and "Maximum Flow" for the item and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [Save] the new item.

4.7.1.3 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. Select *Mainline|Water Supply* and set the pressure at as **-33ft** (**-10m**) for both design and maximum heads.
3. Place a **Demand Flow** via *Mainline|Mainline Outlet* with a "Pressure" of **100psi** (**70m**) and a "Flow" of **26385gph** (**100m³/hr**) on the end of the mainline to represent a hydrant.
4. *Design* the system and view the reports to see the effect on the system the above items have. The best report to see this in is the *Mainline Design Full* report.
5. Now change the demand point to a **P of 70m and Q of 50m³/hr**. Re-run *Zone Analysis*, *Valve Analysis* and *Mainline Design|Analyse* and re-look at the *Mainline Full Report*.

4.7.2 MULTIPLE WATER SUPPLIES

If only one water supply exists in a design or there are completely separate systems on the same design you can leave the "Calculate pressure?" option enabled in each water supply for IRRICAD to calculate based on each system duty.

However, if there are 2 or more water supplies present for 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 that you require from each. If the water supplies are supplying the same system then *LP Design* cannot be used. You must use *Velocity Design* to size the pipes.

Note: If the multiple Water Supplies are unconnected in your design (i.e. more than one system on the same design) then they must supply different system flows as set in Management.

1. Draw a design with 2 water supplies, one on each end of an **8-inch** (**200mm**) mainline pipe. **164ft** (**50m**) long. Enter the pressures for the water supplies to be **90psi** (**65m**).
2. Select *Mainline|Mainline Outlet* **Demand Flow** and set the demand point "Pressure" to be **70psi** (**50m**) and the "Flow" to be **13192gph** (**50m³/hr**).
3. Use a mid-point snap (Shift + right-click) to connect the demand point halfway along the pipe.
4. After completing Zone Analysis and Management run *Design|Mainline Design|Mainline Analysis* and view the *System Duty Report*.
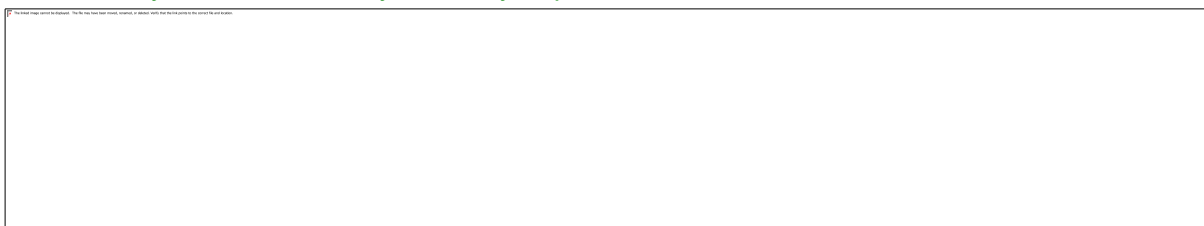
Figure 4-99

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

Figure 4-100

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

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

4.7.2.1 PRVS WITH MULTIPLE WATER SUPPLIES ON A SYSTEM

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 70psi (50m), enter the water supply pressure as 70psi (50m). Never put PRVs in loops. Manually check the PRV is able to regulate at that set pressure and at that flow.

4.7.2.2 MEETING THE FLOW REQUIREMENT FROM THE WATER SUPPLIES

As the flow from the water supplies is determined by the demand of the zones running on a system flow typically in a real design there is a balancing act between the pressure at the water supply and the flow it produces. Change the pressure until you achieve the required flow from each water supply.

There is also the option to 'fix' the flow, rather than the pressure, on one or more water supplies, in the water supply dialog. Typically, at least one water supply will not have a fixed flow and therefore be able to determine the flow not provided by the other water supplies – this is required if each system flow has different demands. The fixed flow water supplies will be able to calculate the required pressure not provided by the fixed pressure water supplies.

4.7.2.3 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:
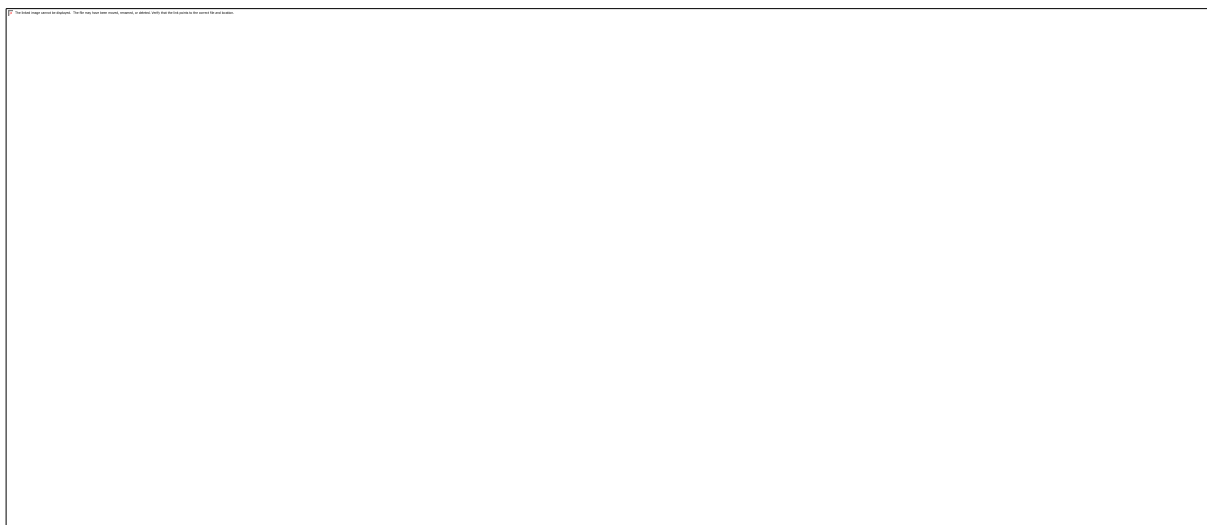
Figure 4-101

Remember using the same pump in parallel doubles the flow.

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

2. Select *Mainline|Water Supply* and enter 25in (**0.1m**) as the "Design Head" and "Max Head" for both water supplies.
3. Using *Mainline|Mainline Pipe* select an **8-inch** (**200mm**) pipe for the mainline pipe. Use *Mainline|Pump* to select the **Pump 350gpm @ 70psi** (**1320lpm @ 50m**) as the pump.
4. Use the **Demand Flow** outlet as the *Mainline Outlet* and enter a "Pressure" of **68psi** (**48m**) and a "Flow" of **39578gph** (**150m³/hr**).
5. Analyze the zone via *Design|Zone Design|Zone Analysis*.
6. Action *Assign all Zones to One System Flow* and enter system flow 1 to be supplied by both water supplies.
7. Run *Design|Mainline Design|Mainline Analysis* and view the *Mainline Design Full* report. Click [OK] on both warning messages about not having pumps in loops.
8. Turn "Hydraulic Object Info" on in *Irricad Tools|Object Info* and view the hydraulic results of each component.

Note that when there is more than one water supply on a system then some pipes and water supplies will report in the opposite direction. This will look like there are negative flows when in reality IRRICAD is simply reporting the pipe end 'P1' in the upstream position from the subsequent water supply.

4.7.2.4 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 to the same pipeline via *Mainline|Pump*.
3. Change the demand point to require **128psi** (**90m**) pressure and **19789gph** (**75m³/hr**).
4. Re-run *Design|Zone Design|Zone Analysis*, management, and *Design|Mainline Design|Mainline Analysis*.
5. Check the *Mainline Design Full* report.
6. Turn "Hydraulic Object Info" on in *Irricad Tools|Object Info* and view the hydraulic results of each component.

Figure 4-102

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

5 Index

A

A Simple Orchard Design 2
ABOS 33
AEI Method 33
Assemblies
  creating 106
  modifying 107

B

Basic Initial Design 9
Block
  definition 3

C

Circular Cursor 14
Commands
  selection cycling 5
Component
  symbol size 36, 42, 51
Computer Selection of Fittings 62
Connected Spraylines 67
  definition 3
Connecting
  check 10
  hydraulic items 14
Control Valve
  manage 61
Coordinates
  absolute 15
  relative 15
Creating and Modifying Assemblies 2, 105

D

Database
  customising 100
  entering new pipes 100
  new outlets 101
DEM Options 33
Design
  basic initial 9
  finalizing 13
  mainline 108
  micro irrigation 67

misc. hydraulic items with pump 115
multiple water supply 118
multi-valve 58
orchard 50
residential 85
rural water supply 109
simple drip tape 36
simple turf 17
solid set 78
stock water design notes 112
using a pump 113
using demand points 108
using pumps in parallel 119
using pumps in series 120
Designing
  process 8
Designs
  printing 97
Direct Entry 15

E

Elevations
  DEM options 33
  importing 33
  methods 33
  trim 33

F

First Steps
  tutorials 7
Fitting Selection 102
  correcting fittings errors 104
  pipe fitting matching settings 103
  riser rules 102
  supplier code and multipliers 104
Fittings
  computer Selection 62

G

Grid 16

H

Help 4
Helpful Hints 3
Hydraulic Items
  connecting 14
Hydraulic Labeling 48

I

Images
  importing 35
  scaling from Google Earth 35
Important Rules 8
Importing