FlowRound

User Guide & Tutorial

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1 Introduction

Welcome to the FlowRound User Guide. This User Guide aims to provide all the information you require to learn and use FlowRound. As you will have noticed this User Guide is an electronic document. Providing the documentation in this format gives you, the user, many advantages in navigating and searching the manual compared to traditional paper documentation and allows us to make amendments and additions more easily, keeping the documentation more up to date.

What is FlowRound?

FlowRound is a graphical tool for developing and analysing traffic flow patterns on roundabouts. It can be used for both conventional and signalled roundabouts and is particularly useful for assessing roundabouts designed with spiral lane markings. It aims to provide the traffic engineer with a canvas on which traffic flow patterns on the roundabout can be developed based on a roundabout design and the engineers knowledge of likely traffic behaviour at the junction. Potential problems with the design can be examined and the consequences of design changes studied. When a feasible design has been arrived at, the software then provides output in a form that assists further, more detailed modelling, in tools such as TRANSYT.

Software Support

Full Software Support for FlowRound is available free of charge for the first 12 months after purchase. Software Support provides the following benefits:

- Free telephone/email advice on the use of FlowRound.

- Basic roundabout design advice for schemes being designed using FlowRound. A full consultancy service is available at additional cost if more detailed advice is required.

- Free access to the FlowRound Software Support Web Site. This web site includes advice on using the software, frequently asked questions and news of software updates.

- Free software updates which can be downloaded from the FlowRound Software Support website. These include both bug fixes and minor feature updates. Major new versions are not included.

- Free attendance at FlowRound User Groups.

To register for your free 12 months software support please return the Software Support Agreement sent to you with FlowRound. After this period has expired, paid software support is available from JCT Consultancy Ltd. Please see the Software Support Agreement or contact JCT Consultancy Ltd. for more information on software support.

Accessing Software Support

Software Support can be accessed by any of the following means:

- On our Web Site at www.jctconsultancy.co.uk

- By Email at support@jctconsultancy.co.uk.

- By Telephone (09:00 to 17:00 UK Time) on (01522) 754681.

- By Fax on (01522) 753606.

- By Post at: JCT Consultancy Ltd., Unit 4, 22 The Green, Nettleham, Lincoln, United Kingdom, LN2 2NR

Training

JCT Consultancy Ltd. provides a wide range of training courses covering both the use of our software and general traffic signal design.

FlowRound is taught both as an integral component of our residential courses and as short standalone courses. For upcoming courses, please see the course diary on our web site www.jctconsultancy.co.uk.

2 Installation and Setup

Hardware Requirements

The minimum hardware requirements for FlowRound are not onerous, however, as with all computer aided design software a well specified graphics system will make the software much easier to use and more productive. The minimum hardware specification should therefore be treated as just that – a minimum on which the software will be useable. The suggested hardware specification will significantly increase FlowRound's usability and should be adhered to wherever possible.

Minimum Hardware specification

- Pentium PC with at least a 400Mhz processor.

- 64Mb RAM. (This is mainly used by Windows)

- 10Mb of free hard disk space.

- Minimum Graphics resolution of 1024x768 with 16.7M colours.

- 17" Monitor – CRT or LCD.

- CD Drive (required for installation only).

- A two-button mouse.

Suggested Hardware specification

- Pentium PC with at least a 1 GHz processor.

- 128Mb RAM. (This is mainly used by Windows)

- 10Mb of free hard disk space.

- Minimum Graphics resolution of 1280x1024 with 16.7M colours.

- 19" Monitor – CRT or LCD.

- An additional monitor (with compatible graphics card(s)) is useful but not essential for very large or complex signal roundabouts.

- CD Drive (required for installation only).

- A three-button wheel mouse. Not essential but extremely useful for zooming graphical views.

Please note that depending on the version of Windows you are using, the hardware requirements for Windows may exceed the above.

Software Requirements

FlowRound can be used on any of the following platforms:

- Microsoft Windows XP

- Microsoft Windows 2000 with Internet Explorer Version 5.5 or above.

- Microsoft Windows 98 with Internet Explorer Version 5.5 or above.

Although FlowRound is not formally supported on earlier versions of Windows, it is envisaged that FlowRound should run successfully on Microsoft Windows NT Version 4 with Internet Explorer Version 5.5 or above.

Installing FlowRound

Before attempting to install FlowRound on Windows XP, Windows 2000 or Windows NT V4.0, please ensure you are logged in as an administrator. Antivirus software may also interfere with installation in which case it should be temporarily disabled until installation is complete. This may require assistance from your IT department.

To install FlowRound:

1. Insert the FlowRound CD into the computers CD Drive.

2. If setup starts automatically, simply follow the on screen prompts from the setup program.

Alternatively if setup does not run automatically

1. Click on the "Start Button".

2. Choose "Run" from the start menu.

3. Enter the command "x:setup.exe" where x is the drive letter of your CD drive.

4. Follow the on-screen prompts from the setup program.

When Setup is complete, FlowRound can be started by choosing "FlowRound" from the Programs section of the Start Menu.

Activating the FlowRound Software Licence.

FlowRound includes a sophisticated copy-protection mechanism to prevent software theft by unlicensed copying or installation of the software. The system has been designed to place as little burden as possible on legitimate licensed users whilst discouraging casual copying of the software. We regret having to require activation; however, it has become increasingly necessary over the past few years due to a high number of often inadvertent but serious breaches of licence conditions.

Definitions

The following definitions are useful in understanding the activation process:

- **Installation ID.** A 16-character code that is unique for an installation of FlowRound on a particular PC. The Installation ID is created by FlowRound and is based on a number of physical characteristics of the PC.

- **Activation Code.** A 20-character code provided by JCT Consultancy to unlock or activate the software on the PC. The Activation Code is calculated to be a match for an Installation ID and is therefore unique for each PC. Only if a copy of FlowRound's Installation ID has a correctly matching Activation Code will FlowRound run.

- **Licence Server.** A separate program that hands out licences to FlowRound workstations. This is only used on sites with Unlimited Network Licences and avoids IT Staff or users having to separately activate each PC on the network. The Licence Server also verifies PCs are actually located on the licensed site. It would normally

be installed and run on a server, or other PC that is switched on most of the time users wish to use FlowRound.

- **Workstation.** The users computer on which FlowRound is run on. Also sometimes referred to as a Client PC.

Product Activation for Individual PCs

Individual PC activation applies only to Single PC, Four PC and Ten PC site licences and is not available for Unlimited Networked PC Site Licences.

Installing FlowRound either from CD or by downloading will install a copy of FlowRound on your PC. The software will however only work as a restricted demonstration copy unless it is activated following the procedure below. You may install the software and use it for demonstration purposes on as many PCs as required; however only the number of PCs actually licensed may be activated to allow fully functional use. Licences can be freely transferred between computers using the procedure described later in this section.

Activating the FlowRound Licence for the First Time

The activation procedure is as follows:

1. When running FlowRound for the first time the software will present a dialog box showing information relating to the activation status of the software on the particular PC. This will show the activation status to be 'Not activated'. If the OK button is clicked, the activation process will be cancelled and FlowRound will run in demonstration mode. It can still be activated later by choosing 'About FlowRound…' from the 'Help…' Menu and proceeding as below.

2. Clicking the 'Activate…' button will start the activation process by requesting the type of activation. In this case, select the first option labelled '1PC, 4PC or 10PC Licence'. Activation for Unlimited Network Licences is covered later in this section.

3. Determine your FlowRound Site Licence ID. This is the six-character code shown on both the order documentation accompanying FlowRound and also on the FlowRound CD. If you do not know your Licence ID please contact JCT Consultancy at this point to obtain it. Having determined your Licence ID enter it as requested and click 'Continue'.

4. FlowRound will provide you with an Installation ID that is a customised code for the installation of FlowRound on your PC. The Installation ID should be sent to JCT Consultancy either by email or by telephone. If your email system is compatible, a hyperlink is provided in the activation dialog box that will email your details to JCT. JCT will provide you with a customised activation code for your PC by return. Whilst waiting for your code you can leave the Activation Dialog box if desired using the 'Activate Later' button. You can return to the dialog at any point following the same procedure as above.

5. When you receive your Activation Code, it should be entered into the 'Activation Code' section of the Activation dialog. Clicking the 'Continue' button will then activate FlowRound and display the relevant licence details, which you should check to ensure they conform to your FlowRound licence agreement.

6. You will now be able to use FlowRound with no restrictions on your PC.

7. If your licence allows, further PCs can be activated using the above procedure.

Updating the FlowRound Licence

Once activated FlowRound can be updated with minor updates without the need to reactivate after each update. It may however be occasionally necessary to update the product activation details; for example, when software support is renewed it will be necessary to apply a new activation code to activate software support features, such as the ability to download updates, for a further year.

To update Product Activation:

1. Choose 'About FlowRound…' from the 'Help…' menu within FlowRound.

2. Click on 'Change Activation'.

3. If your Licence size is not changing, confirm your Licence ID by clicking 'Continue'. If you are upgrading your licence size, a new Licence ID will have been supplied with your upgrade documentation. Please ensure any new Licence ID supplied is used as retaining the old Licence ID may lead to inadvertent copy protection issues in the future.

4. FlowRound will provide a new Installation ID. This will be different from the Installation ID originally used when activating FlowRound for the first time.

5. Send the Installation ID to JCT as described above.

6. JCT will supply a matching Activation Code by return. When you receive the new Activation Code, enter it in the space provided and click 'Continue'.

7. Check the updated licence details displayed are as expected.

Moving FlowRound to a different PC

The Product Activation system used by FlowRound ensures that the software can only be used on the number of PCs actually licensed. If it is necessary to permanently remove, FlowRound from a PC, the licence can easily be transferred to a new PC using the following procedure, by which the licence on the old PC is deactivated, and an Activation Code to activate a new PC provided. **Please note that is essential you deactivate FlowRound on the old PC before uninstalling FlowRound or disposing of the PC.**

On the new PC:

1. Install FlowRound as normal.

2. Follow the instructions in 'Activating FlowRound for the first time' up to the point where FlowRound provides an installation ID. This Installation ID would normally be sent to JCT who would supply an Activation Code. Do not send this code to JCT – the old PC being deactivated will use the new PCs Installation ID to provide the Activation Code for the new PC.

3. Make a careful note of this Installation ID for use in the next step.

On the Old PC:

1. Choose 'About FlowRound' from the 'Help' menu.

2. Click the 'Transfer Licence' button.

3. Enter the Installation ID from the new PC as provided above.

4. An activation code for the new PC is provided. Make a note of this activation code. FlowRound on the Old PC has now been deactivated and can only be used as demonstration software.

On the New PC:

1. Either take up where you left off the new PC above or if FlowRound has been closed follow the activation procedure as described above in 'Activating FlowRound for the first time' up to the point where an activation code is required.

2. Enter the Activation Code provided from the old PC.

3. Click 'Continue'. FlowRound should now report that the new PC has been successfully activated, and provide details of the activated licence.

4. Check that the licence details are as expected.

5. FlowRound is now correctly licensed on the new PC.

Product Activation for Unlimited Networked PC Licences

For users with Unlimited Networked PC Licences (UNPCL) it is not necessary to activate each PC individually, instead workstations obtain a licence from a central licence server, which authorises them to run FlowRound. This benefits users by removing the need to handle large lists of Installation Ids and Activation codes, and also avoids the security risk of JCT handing out a potentially unlimited number of individual PC activations for FlowRound, which may inadvertently migrate away from the licensed site.

Installing FlowRound on Workstations

FlowRound is installed on each workstation the same way as for non-networked installations as detailed above in 'Installing FlowRound'. However, Product Activation does NOT need to be carried out on each Workstation. If desired the FlowRound CD may be copied to a networked server and FlowRound installed over the network, however setup must be run on each Workstation whether locally or using a remote installation system.

Installing and Activating the Licence Server

The Licence Server installation files are located in the 'LicServer' folder on the FlowRound installation CD. Two different versions are provided, one for Licence Servers running on Windows 98 and one for Licence Servers running on Windows 2000 or XP. To install the Licence Server, run setup.exe from the relevant subfolder, and follow the on-screen prompts.

Once the Licence Server has been installed, it needs to be activated to give out FlowRound licences to Workstations. This process is carried out using the Licence Server Administration Utility that is located on the Windows 'Start' menu, under 'JCT Consultancy Licence Server', on the Licence Server PC. This utility allows an administrator to activate the Licence Server for FlowRound using a similar procedure to that described above for activating an individually licensed Workstation. Once activated no further activation is required for the Licence Server or Workstations except for major product upgrades or software support renewals.

The PC on which the Licence Server is installed should be continuously available to Workstations over the network whenever they are in use, however each Workstation will store a local copy of its licence for a number of days allowing server restarts and maintenance to take place without adversely affecting FlowRound users.

Telling Workstations Where to Find a Licence Server

As Workstations default to being individually licensed each Workstation must be told to use a Licence Server and also where the Licence Server is located on the network. This can be achieved either by manually configuring each Workstation or by using a Software Deployment System pre-configure the licence mode and Licence Server location in each Workstation's registry.

Manual Configuration of Workstations

1. When running FlowRound for the first time the software will present a dialog box showing information relating to the activation status of the software on the Workstation. This will show the activation status to be 'Not activated'. If the OK button is clicked, the activation process will be cancelled and FlowRound will run in demonstration mode. It can still be activated later by choosing 'About FlowRound…' from the 'Help…' Menu and proceeding as below.

2. Clicking the 'Activate…' button will start the activation process by requesting the type of activation. In this case, choose 'Network Unlimited Licence'.

3. Click 'Discover IP Address of Licence Server'. FlowRound will search the local network for a FlowRound Licence Server. If one is found its IP address is stored as the Workstations default Licence Server. If the Licence Server has not yet been set up yet or cannot be discovered automatically, the Licence Servers IP address can be entered manually. If you do not know the correct IP address please consult your IT Department, or the person responsible for installing and setting up the FlowRound Licence Server.

4. Click 'Connect' to attempt to connect to the FlowRound Licence Server. If the connection is successful, FlowRound will display details of its licence. If the Workstation cannot connect to the Licence Server, ensure that the Licence Server is running and the Workstation can access the Licence Server across the network without interference of firewalls or similar security software.

Centralised Configuration of Workstations

Workstations can also be configured to use a particular Licence Server by using a third party Software Deployment System such as Microsoft SMS or Operations Manager to deploy additional configuration information to the registry of Workstations at installation. If you wish to use this feature, please obtain the Advanced Configuration User Guide from JCT Consultancy. This describes in detail the registry entries required to fully customise the licensing of Workstations on Unlimited Networked PC Sites.

Technical Note for IT Administrators

Please note that the Licence Server must be visible to the Workstation and be on the same IP subnet to allow the Unlimited Networked PCs Licence to function correctly. To use the Unlimited Networked PCs Licence the network must be configured to allow the Licence Server and Workstation to communicate using TCP on the port selected in the activation configuration. Please also note that the FlowRound Licence forbids the forwarding of broadcasts from the Licence Server to segments of a network geographically located outside of the FlowRound Site.

Obtaining and Installing Updates to FlowRound

Users with current software support have free access to FlowRound updates via the software support section of our web site www.jctconsultancy.co.uk. Updates will generally include bug fixes, minor requested enhancements and documentation updates.

To download updates please access our software support section of our web site www.jctconsultancy.co.uk where full instructions are provided for downloading and installing FlowRound updates.

In the vast majority of cases, updates will not require the FlowRound licence to be reactivated.

Automatic Update Notification

If desired FlowRound can automatically notify you when updates to the software are available to download from the JCT Consultancy Web Site. In order to respect any concerns for privacy FlowRound installs with automatic update notification switched off, and asks whether you would like to enable this when FlowRound is run for the first time. Updates can easily be switched on at any time using the 'Program Options' dialog box accessed from the FlowRound 'File' menu. FlowRound transmits no personal information to JCT Consultancy when checking for updates.

Technical Note

The automatic update notification uses your computers Internet connection and should operate correctly provided your computer or company's firewall allows access to http over port 80. Please contact us if automatic update does not work correctly on your computer, as it MAY be possible (with the agreement of your IT department) for us to reconfigure FlowRound to work with your firewall.

3 FlowRound Basics

Overview

This section introduces some of the more basic FlowRound concepts and aims to familiarise you with the software's main concepts.

Definitions

This section introduces a number of useful concepts and definitions, which it is helpful to become familiar with before starting to use FlowRound.

- **FlowRound Network.** One of the most important elements of FlowRound is a model of the lane structure of the road space forming the roundabout. This model is called the Network as it consists of a linked network of Lanes and other objects describing the possible traffic movements through the roundabout.

- **Arms.** Each Arm represents a one-way section of carriageway forming part of the roundabout. Generally, a different Arm will be used for each roundabout Entry, each Exit and each section of circulatory carriageway. FlowRound gives each Arm a type of Entry, Exit or Circulatory depending on how the Arm is connected to the rest of the Network. Each Arm contains a number of Lanes.

- **Lanes.** Each FlowRound Arm contains a number of Lanes describing the number of lanes of traffic on the ground. Each Lane may be regarded as either infinitely long, which assumes the Lane extends back to any previous Arm, or short, which assumes traffic enters the Arm on a different infinitely long Lane before entering the short Lane.

- **Lane Connectors.** Lane Connectors join each Lane to Lanes on other Arms that are allowed to provide or receive traffic to or from the Lane. The Lane Connectors model how the roundabout's road markings dictate the way traffic should flow between Lanes.

- **Zones.** A Zone represents an origin and/or destination for traffic entering or leaving the roundabout. Each Zone is associated with an Entry Arm, an Exit Arm or both.

- **Routes.** A Route represents a unique path through the roundabout from one Zone to another. As each Route is comprised of a sequence of individual Lanes and Lane connectors, a number of different Routes can exist between any two Zones. Each of the Routes represents a different choice of Lanes for drivers travelling between two Zones.

- **Origin-Destination Matrix.** Traffic Flows through the roundabout are represented by a matrix that specifies the traffic flow between two Zones.

- **Desired Flow.** A Desired Flow is an Origin-Destination Flow specified by the user.

- **Actual Flow.** An Actual Flow is an Origin-Destination flow that is aggregated from all Route Flows between two Zones.

- **Route Flow.** A Route Flow is the flow on an individual Route between two Zones. A Route Flow can either be entered manually or can be estimated by FlowRound based on the desired Origin-Destination Flows and assumptions regarding drivers' behaviour in choosing Routes through the roundabout.

- **Difference Flows.** The Difference Flows are calculated as the difference between the Desired and Actual Origin-Destination Flows. They provide a measure of how

well the current Route Flows aggregate to match the Desired Origin-Destination flow totals.

- **Flow Group.** A Flow Group represents a set of Desired, Actual and Route Flows for a particular period of time, for example the Morning Peak hour.

The FlowRound Modelling Process

FlowRound provides the following features and facilities:

- A graphical editor allows a model of the roundabout's lane structure to be defined. This includes the number of Lanes on each Entry, Exit and Circulatory Arm as well as identifying the feasible movements between Lanes.

- FlowRound automatically analyses the roundabout Lane structure to find all possible Routes through the roundabout between Entries and Exits.

- A graphical Route Manager is used to examine the possible Routes through the roundabout. The Route Manager allows possible but unfeasible Routes to be quickly identified and discarded.

- Desired traffic flows through the roundabout are entered as Origin-Destination matrices. Any number of Flow Groups can be defined with an Origin-Destination matrix for each group.

- Traffic flows are assigned to Routes through the roundabout. The software provides a number of methods of flow assignment allowing a range of choices between accuracy and speed of assessment. For example, an Entry Lane Balancing option is provided which gives an unrefined set of Route Flows very quickly. Alternatively, Route Flows can all be specified manually in great detail, but at a cost of a longer design time. Generally, a combination of both automatic and manual methods is used to find the optimal balance between accuracy and design time.

- FlowRound graphically shows the Route Flows passing through Lanes at a number of levels of aggregation ranging from total Lane Flows to individual Origin-Destination flow components on each Lane. As Route Flows are changed, either automatically or manually, the Lane Flow Diagram is updated allowing the immediate effect of design and flow assumption changes to be seen immediately.

- Detailed study of the Lane Flow Diagram quickly highlights design issues such as poor lane spiralisation or poor lane usage.

- Design changes can be made to address any problems with rapid feedback of the consequences of making changes.

- When a final design has been arrived at, a range of reporting and printing facilities can be used to present the roundabout's traffic flows in a form that facilitates input into more detailed modelling packages such as TRANSYT.

Current Limitations of FlowRound

FlowRound is designed as a tool for working with roundabout traffic flow patterns and visually evaluating the feasibility and sensibleness of a Lane Flow structure. Once a potentially feasible design is arrived at, the further more detailed (and more time consuming!) analysis of the Network, including the design of signal plans and calculation of performance indices, is then carried out in other packages such as LINSIG and/or TRANSYT.

The FlowRound User Interface

The FlowRound model is edited using a sophisticated graphical user interface that has been developed to ensure data can be quickly entered and edited. The user interface also aims to allow the user to control the amount of information displayed at once, providing choice between a data display that is very dense but shows a lot of information at a glance, and a less dense display that is neater but shows less information at once.

The FlowRound user interface consists of the main program window, which contains the following:

- **Main Menu.** The main menu is located along the top of the FlowRound main Window and is the primary method for carrying out tasks in FlowRound. Unless otherwise stated all tasks in FlowRound are carried out by choosing the relevant command from this menu. If a menu command is shown in grey, this means it is not currently possible to carry out the command. For example, the 'Edit Zone' command is shown in grey if no Zone is currently selected, as FlowRound does not know which Zone to edit.

- **Status Bar.** The Status Bar is shown along the bottom of the main window and displays useful information about the current FlowRound model.

- **Network View**. The Network View shows a Lane Flow diagram of the current FlowRound Network and optionally displays the Route Manager to the right of the Network Diagram.

- **Route Manager.** The Route manager is used to manage the display of Route information in the Network View. It displays and allows editing of a list of Routes used by the model, and also provides a number of controls that allow the amount and format of data displayed on the Network Diagram to be controlled.

- **Traffic Flow View.** The Traffic Flow View displays and allows editing of both the traffic Flow Groups used in FlowRound and the Desired Origin-Destination flow matrix for each Flow Group.

- **The Report Builder.** The Report Builder allows Report Templates to be built and detailed reports produced. The reports are in rich-text format that can be imported into most word processors.

Useful User Interface concepts

When editing the FlowRound model a number of standard concepts apply. These are:

- **Data Items.** A data item is a generic term for the different types of data edited in FlowRound. For example, Arms, Lanes, Lane Connectors, Zones, and Routes are all 'Items'. The different areas of the Network View show different items either graphically or as text.

- **Selecting an Item.** Clicking on an item in a FlowRound view will select it. The selected item will be shown in red. Many menu commands require you to first select an item before choosing that command. For example, before choosing the command 'Edit Lane' you must have selected a Lane. Menu commands that cannot be carried out because an Item has not been selected are shown in grey and cannot be chosen. In some instances, more than one item can be selected at once by holding the control (Ctrl) key down whilst selecting the Items.

- **Pop-Up Context Sensitive Menus.** Clicking on a View with the right mouse button will display a 'pop-up' menu containing a choice of commands relevant to the item clicked on. All commands displayed on pop-up menus are also available on the FlowRound main menu. Not all Views will have a pop-up menu.

- **Editing an Item by double clicking.** An Item can always be edited by selecting it and choosing 'Edit' from the main menu or pop-up menu. Alternatively, for some items, as a shortcut, you can double click the item to edit it. This does not apply where there may be more than one way to edit an item.

- **Using a wheel-mouse.** If you have a wheel mouse FlowRound will use the wheel for zooming graphical views and scrolling through lists. The use of a wheel mouse is strongly recommended as they are inexpensive and make zooming graphical views very easy.

- **Undo.** Any command can be undone by choosing 'Undo' from the edit menu. Up to 100 previous commands can be undone and if necessary redone.

- **Options and Preferences.** Many settings such as defaults for new Networks and graphics colours can be customised using the options dialog box on the File menu.

- **Always on Top.** Each of the main Views contain a pushpin button to the right of the views title bar. Clicking the pushpin will force the View to remain on top of other Views even if one of the other Views is the active View where data is being edited. If two or more Views are set to 'Always on Top' and overlap, the most recently active View will be on top. When using this option you should be careful not to lose smaller Views behind larger Views set to 'Always on Top'.

Customising FlowRound with Defaults, Options & Settings

FlowRound has a wide range of options and setting which allow it to be customised to fit your own way of working.

Program Options

Program options specify how FlowRound will work on the computer on which it is installed. The Program Options are changed using the 'Program Options' dialog box accessed from the FlowRound 'File' menu.

- **Auto-Recovery File Location.** This tells FlowRound where to automatically save backup copies of your work whilst you are working. In the event of a software error, FlowRound will automatically retrieve the backup from this location when it is restarted after an error. The location specified is recommended to be a folder on the computers own disk and should have write permission for all users. If the folder does not exist, FlowRound will create the folder automatically provided Windows file permissions allow.

- **Automatic Checking for Updates.** FlowRound can automatically check for updates using your computers Internet connection. This setting sets the frequency at which FlowRound checks, or switches off checking altogether if desired.

- **New Empty Network at Start-up**. By default, FlowRound starts with a new empty Network loaded. This option causes FlowRound to start with no Network loaded.

- **Mouse Wheel.** This option allows the direction of zoom produced by the mouse wheel to be reversed.

Default Options

When FlowRound creates a new File, it uses stored default settings to give default values to a range of FlowRound Network parameters. These default settings can be changed if desired, so all new Networks will be created with customised initial parameter values. As with all defaults it is your responsibility to satisfy yourself that any defaults used, including the ones provided with FlowRound, are acceptable for your particular application.

Remember, changing defaults does not affect any previously created FlowRound file, only new files. If you wish to change parameters for a new file, you should load the file into FlowRound and use the appropriate dialog box to change the relevant parameters, as is described later in this user guide.

The Default Settings are changed using the 'Default Options' dialog box accessed from the FlowRound File menu. This dialog box allows three different categories of defaults to be changed.

Default Network Parameters

The default Network parameters are edited on the 'Default Network Parameters' tab of the 'Default Options' dialog box. It allows the defaults for various Network related parameters to be set. Each new file will be created using the default Network parameters, which can then be customised for each file as required using the normal FlowRound dialog boxes. The use of the parameters is explained later in this user guide.

Default Author Information

The 'Default Author Information' tab allows the default details of the author of the FlowRound File to be entered so they can be used in title blocks when printing the FlowRound Network. Each new file will be created using the default Author Information which can be then customised for the particular file using the 'Network Options' dialog box. This is displayed by selecting 'Edit Project Information' from the Network menu.

Default Graphical Settings

The graphical geometric size of Network Items such as text height, grid size etc. is set for each Network as some Networks may require different settings than others. The 'Default Display Sizes' tab allows you to setup the initial values you would like every Network to be created with. Each Network's display sizes can then be changed independently using the Network Options dialog box, which is displayed by selecting 'Edit Network Graphics Settings' from the Network menu.

Graphics Options

The 'Graphics Options' menu item on the FlowRound File menu allows you to customise many of the cosmetic graphics settings used in FlowRound, such as colours and line thicknesses. This is particularly useful in cases where a user has difficulty distinguishing different colours or where a monitor displays colours in an unusual way. The Graphics Options do not affect the FlowRound file being edited in any way, and if your computer is configured to use user profiles, Graphics Settings can be configured differently for each user.

Although it is easy to customise colours in FlowRound, it is recommended that they are not changed frivolously without reason, as it makes sense to have consistent colours for most

users. It is very easy to make FlowRound more aesthetically pleasing but very difficult for another user to understand

The flow display precision options govern how FlowRound displays traffic flows. FlowRound always works internally with highly precise traffic flows as this allows mathematical operations such as flow balancing to be carried out efficiently and avoids rounding errors accumulating. The flow display precision options allow flows to be displayed rounded to an appropriate level of precision. When building or troubleshooting a Network it is useful to display flows to at least one decimal place as this provides useful information on how balanced flows are split. When presenting results the display precision will usually be set to whole numbers.

Rounding

As FlowRound always stores traffic flows with a high degree of precision and does all calculations using the precise numbers this may occasionally lead to a seemingly arithmetically wrong result.

For example, consider how three Route Flows in a Lane are summed:

	Precise Flow	Displayed Flow (Rounded)
Flow A	100.33333	100
Flow B	100.33333	100
Flow C	100.33333	100
Total	300.99999	301

The displayed flows although correct do not appear to add up correctly. Where this occurs, it may be desirable to manually round some Route Flows to force the rounded flows to add up correctly.

Working with FlowRound Files

Creating a new FlowRound File

A new FlowRound File is created by choosing 'New' from the FlowRound File menu. This closes any current File open in FlowRound before creating a new empty model in FlowRound. The File is not actually saved on disk until saved using 'Save As' as described below.

Opening an existing FlowRound File

An existing file can be opened by choosing 'Open' from FlowRound File menu. If a file is already open in FlowRound it will be closed and you will be prompted to save any changes to the file as described below. FlowRound provides a dialog box that can be used to locate the file you wish to open, either on the local computer, or on a network. Once the FlowRound file is open, FlowRound will not change the file on disk unless you explicitly choose to save it using 'save' or 'save as' as described below.

Saving FlowRound Files

The FlowRound File currently being edited can be saved to disk at any point by choosing 'Save' from the 'File' menu, or if you wish to change the file name, 'Save As'. Be careful not to overwrite files you wish to keep, as you cannot undo file saves from within FlowRound.

4 Building a Roundabout Model using FlowRound

This section will build up a FlowRound model, step by step, explaining what information needs to be entered at each stage and how to enter it. A FlowRound file containing the tutorial model is provided on the FlowRound CD and in the FlowRound installation folder on your PC.

As with much Windows software, there are often a number of alternative methods of carrying out each task. For example, it may be possible to use the main menu, a right-click popup menu, or the toolbar to carry out a task. Sometimes tasks can also be carried out more quickly by dragging graphical items with the mouse. At each stage in this tutorial a number of different methods will be used for different tasks starting with the simpler (but often more long-winded) methods and progressing to shortcut methods later in the tutorial. You can of course use whichever methods you find most convenient when you have mastered FlowRound.

Except where explicitly stated the tutorial assumes that FlowRound has been installed and set up in its default location and using default settings. If your copy of FlowRound has been set up for you in a different location or with pre-configured defaults, you may need to substitute these in the appropriate parts of the tutorial.

The Tutorial Example

The example to be used in this tutorial is shown in Figure 4.1. It is a fictitious four-arm signal roundabout, which represents a typical example of such a junction. The roundabout is marked with spiral lane markings that guide vehicles through the junction avoiding the need for lane changing providing vehicles approach the junction in the correct lane. (i.e. A decent job needs to be done on the approach signing and lining!)

Building the model

Step 1: Creating the Basic Layout using Arms and Lanes

The first steps in creating a FlowRound model involve creating the basic layout of the roundabout by adding Arms to form the Entries, Exits and Circulatory sections of the roundabout. This step will also teach you how to efficiently navigate around your model using the Network View.

- Start FlowRound by clicking on the Windows 'Start' button and choosing 'FlowRound' from the 'Programs' menu.

- FlowRound will start by default with a new empty FlowRound model open.

- Save your empty model to a new filename by choosing 'Save As' from the FlowRound 'File' menu. Locate a folder on your computer or network where you would like to save the files for this example. Enter 'User Guide Example Step 0.rnd' as a filename and click 'Save' to save the file.

- You can re-save the file at any point by choosing 'Save' from the TranEd 'File' menu or by clicking the save button on the toolbar.

> **Tip:** If you ever encounter a software error in FlowRound the Auto-Recovery feature described in Section Two, will in most cases, allow you to recover your unsaved work the next time you start
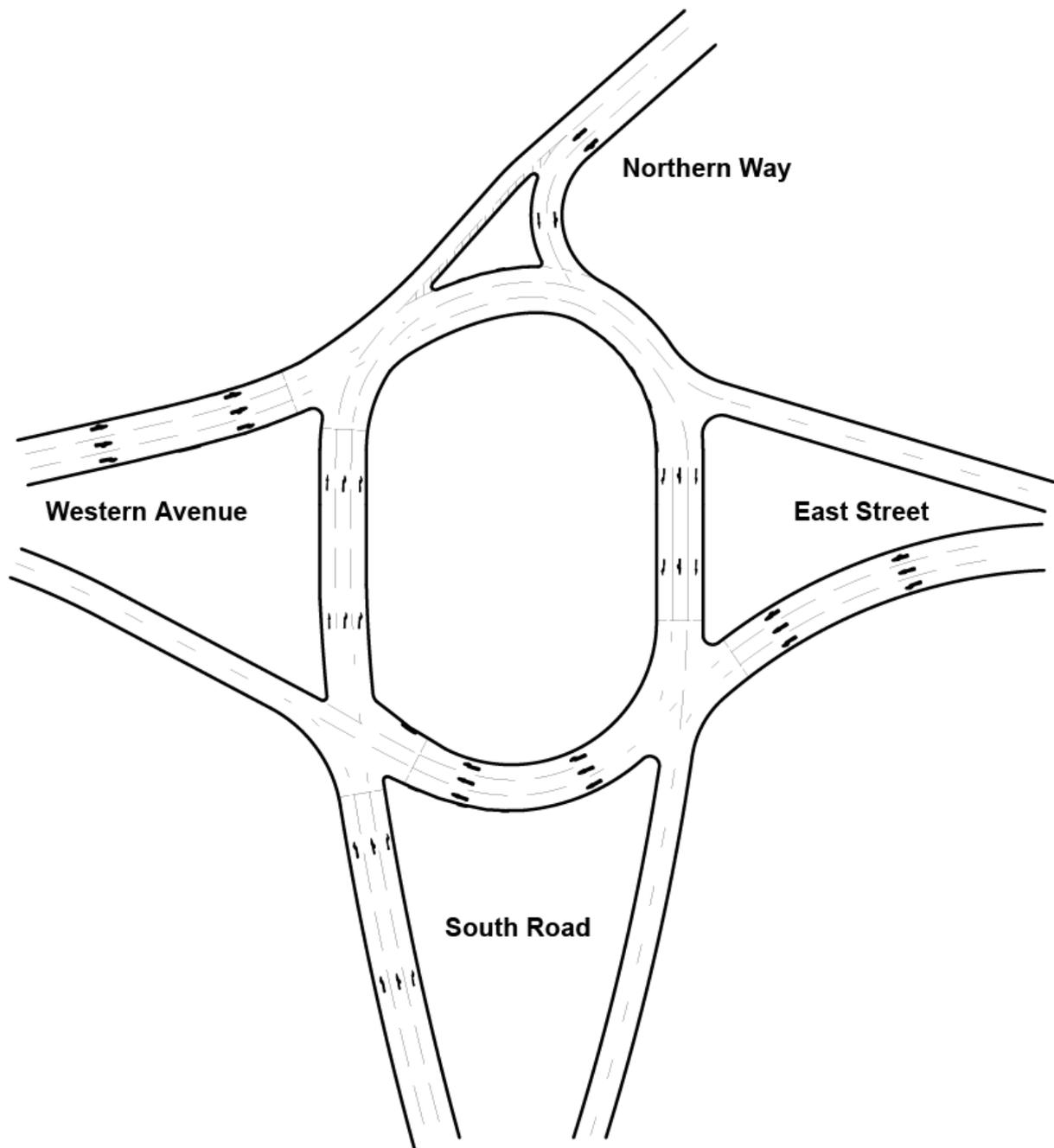
Figure 4.1 - Tutorial Example

- Before starting to add Arms to the Network, first set up the Project Information using the Project Information dialog box which can be opened by choosing 'Edit Project Information…' from the FlowRound 'Network' menu. This dialog box allows you to title your model and add other administrative information. This information is useful later as it can be included in the title blocks of printed Network Diagrams and reports.

> **Tip:** If you find your are constantly entering the same Author Information this can be set up as a default as described in 'Default Options' in Section Two.

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- Position and resize the Network Diagram to have a sensibly sized area for the left hand (currently blank) pane. It is in this pane the Network Diagram will be built to look like Figure 4.2 by the end of this step.
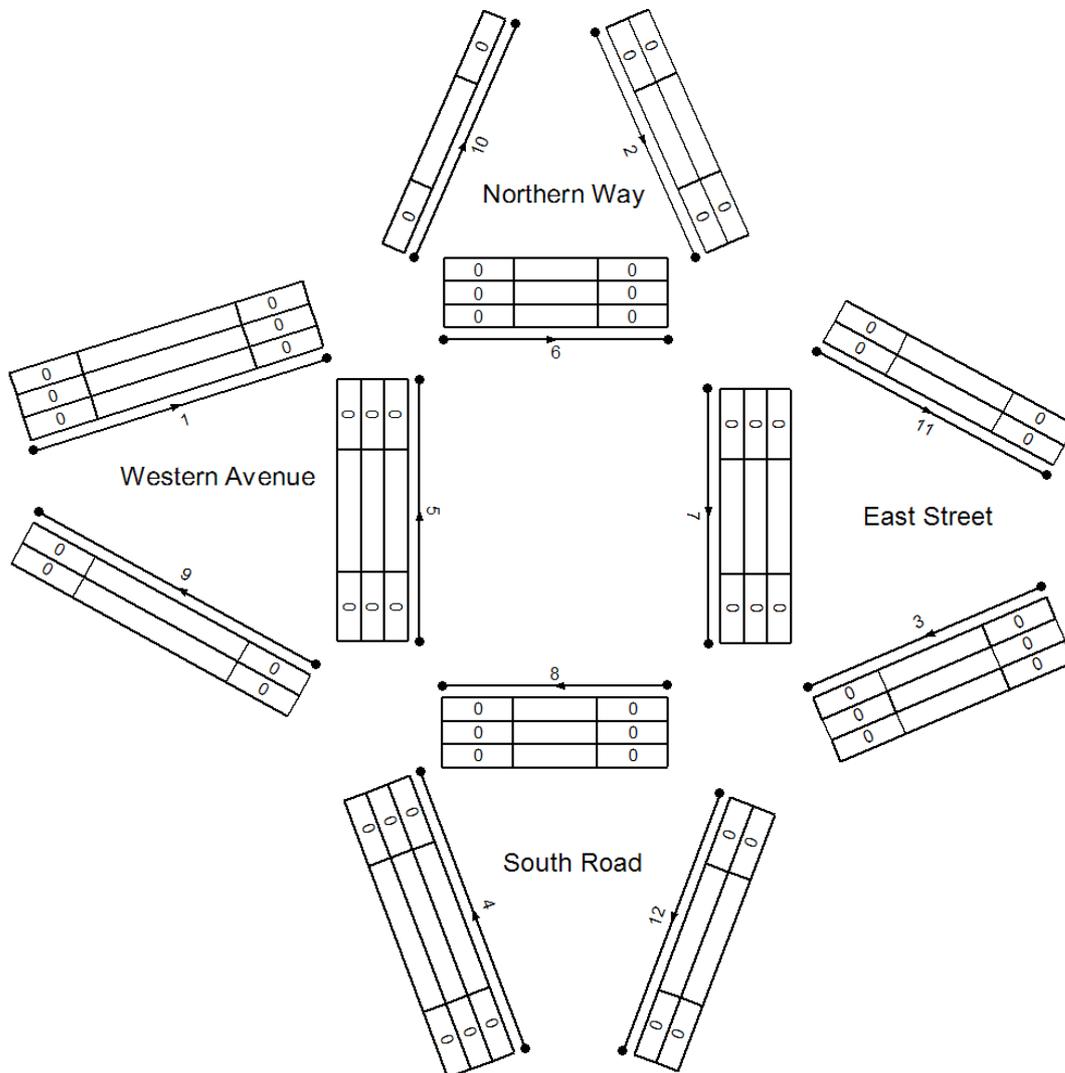
Figure 4.2 : The Network Diagram after Step One

- The Arms can be entered in any order desired; however, in this case we will be systematic and add each of the roundabout Entry Arms in turn, starting with Western Avenue, followed by the Circulatory Arms and Exit Arms.

- On the 'Network' menu, choose 'Arms'. A menu will pop out providing a number of editing choices relating to Arms. Choose 'Add Arm…' from the pop out menu.

- A dialog box will request the Arm's number and the initial number of Lanes on the Arm. These values are only initial values for the new Arm and can be changed later if desired. In this case, the default Arm number 1 can be left as it is and the number of Lanes changed to three, as the Entry Arm from Western Ave. has three Lanes as shown in Figure 4.1. After changing the number of Lanes, click OK to create the Arm and drag the new Arm into approximately the correct position on the Network Diagram.

- The Arms in FlowRound are positioned using the Arm Handles as shown in Figure 4.3 below. The red handles indicate the Arm is the currently selected Arm. The

numbers in each Lane on the Arm relate to traffic flows entering and leaving the Lane. These will be explained in more detail later when traffic flows are added to the model.

Figure 4.3: Arm Details

- Referring to Figure 4.2, drag Arm 1 into position so it represents the Western Avenue entry to the roundabout.

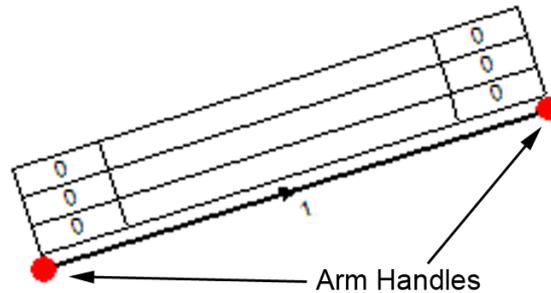> **Tip:** To assist with positioning graphical Items FlowRound can display a grid and also optionally snap the cursor to the grid when dragging. The grid and snapping are controlled from the View menu. The grid size is controlled using 'Edit Network Graphics Settings' on the Network menu.

- The next Arm, Arm 2 – the entry from Northern Way, will be added using a shortcut method. Using the mouse right click on the Network Diagram in the approximate location where Arm 2 is required. A pop up menu will appear providing a number of editing choices. Select 'Add Arm…' from the pop up menu. This will request the new Arm number and number of Lanes as previous, before allowing the new Arm to be dragged into position in the same way as Arm 1.

- Now enter all the other Arms in the same way locating them approximately as shown in Figure 4.2. Make sure that Entry Arms point towards the roundabout, Exit Arms away from the roundabout and Circulatory Arms point in the direction of circulation (clockwise in the UK). As you add Arms, you may find you need to zoom and pan around the Network View. This is described in the next section. Any Arms that are created incorrectly can be deleted by selecting the Arm and choosing 'Delete Arm' from the 'Network…Arms' menu. This will also delete any Lanes belonging to the Arm being deleted.

> **Tip:** Arms can be renumbered at any time by selecting the Arm and choosing 'Network…Arms…Edit Arm…' from the main menu. This will display the Edit Arm dialog box that allows a new Arm number to be selected for the Arm. Other Arms will be renumbered as necessary to provide space for the renumbered Arm within the Arm numbering sequence. Arms must always be numbered sequentially with no gaps in the sequence.

- Choose 'Labels…' from the Network menu. From the pop-out menu choose 'Add Label'. The 'Edit Label' dialog box will be displayed. Enter 'Northern Way' for the Label text and 6.0 mm for the text height. Click 'OK' and position the Label as shown in Figure 4.2. Repeat for the other Road names.

- Save the current file as 'User Guide Example Step 1.rnd' to complete Step One of the tutorial.

Before continuing with Step Two of the tutorial you may like to review the following topics which expand on some of the tasks carried out in Step One.

Navigating around the Network View

One of the most common actions you will carry out whilst using the Network Diagram is zooming and panning the diagram to view different areas. The following exercise demonstrates the different ways to zoom and pan around the FlowRound Network Diagram. Zooming and panning affects only the way the Network Diagram is displayed on the screen and does not in any way affect how the diagram would print.

- On the FlowRound 'View' menu choose 'Zoom'. Choose 'Zoom In' from the pop-out menu. Notice how the Arms get larger as FlowRound zooms in on a smaller area of the Network Diagram, centred on the middle of the Network Diagram. 'Zoom Out' will reverse this operation. Repeat 'Zoom In' a number of times until one of the Arms disappears off the edge of the diagram.

- Click with the left mouse button anywhere in the Network Diagram, other than on one of the Arms. Holding the left mouse button down allows you to pan the Network Diagram by dragging with the mouse.

- Choose 'Zoom to Fit' from the 'Zoom' menu. FlowRound will calculate the correct amount to zoom the display so the Network Diagram just fits within the available screen space of the view. This can be very useful should you get 'lost' within a large Network.

- Zooming using the main FlowRound menu is quite cumbersome; FlowRound therefore includes a number of shortcuts allowing rapid zooming.

- Identify the 'Zoom' toolbar located at the top of the FlowRound main window just below the main menu. Each of the toolbar buttons will carry out a zoom operation. As well as identifying each button's operation from its icon, holding the mouse stationary over a toolbar button for a second or two will display a tool-tip describing the function of the button. Click on 'Zoom In', and 'Zoom Out', a few times before clicking on 'Zoom to Fit' to return to a display showing all of the Arms. Notice how FlowRound always zooms centred on the middle of the visible Network Diagram.

- An even quicker way of zooming is available if your mouse is equipped with a centre wheel button. Hold the mouse pointer over the Network Diagram and turn the mouse wheel. TranEd will zoom the Network Diagram centred on the mouse pointer. The zoom direction is reversed if the wheel is turned in the other direction. This is the recommended way of navigating in TranEd, providing your mouse has a wheel.

> **Tip:** If you wish you can reverse the direction of zoom produced by the mouse wheel. This is described under 'Program Options' in section Two.

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Editing Lanes

So far, we have specified the correct number of Lanes for each Arm at the time the Arm was created. Where the number, or type, of Lanes needs to be changed after an Arm has been created this can be done using the Lane editing commands on the main menu's 'Network…Lanes' menu. Although the tutorial Network is correct at this point, the following steps adds and removes a number of extra Lanes to illustrate how Lanes are added and deleted.

- Select the left most Lane on Arm 1. On the 'Network…Lanes' menu choose 'Add Infinitely Long Lane to Left'. A new Lane will be added to the left of the selected Lane.

- Select the left most Lane on Arm 2. On the 'Network…Lanes' menu choose 'Add Infinitely Long Lane to Right'. This time a new Lane will be added to the right of the selected Lane, effectively inserting a new Lane between the two existing Lanes. As the Lanes have not yet been connected to any other Lanes, it makes no practical difference at this point where Lanes are added on an Arm, so long as the total number of Lanes is correct.

- Select either of the two Lanes added above. Choose 'Delete Lane' from the 'Network…Lanes' menu. The Lane will be deleted and the remaining Lanes moved together to remove the resulting gap. As the Lane was not yet connected to any other items, the Lane is simply deleted. When the model is more developed deleting a Lane will also delete any dependent items such as connections to other Lanes and Routes, and flows passing through the Lane.

- The 'Network…Lanes…' menu also includes a number of commands to add and edit short Lanes. Short Lanes are slightly more complex than long Lanes in that a short Lane is always connected to an adjacent longer Lane. Short Lanes are added in the same way as long Lanes with an additional step where the Lane's length and its parent longer Lane are specified. Currently Short Lanes are only provided for graphical purposes and are not used for any calculations.

Step 2 : Defining Traffic Movements using Lane Connectors.

Once the Arms and Lanes have been entered, the next step is to define which traffic movements are allowed between particular Arms and Lanes. This involves creating Lane Connectors between Lanes where traffic movements are allowed. For example if traffic in the left Lane on a roundabout Entry Arm can proceed into the leftmost Lane of the circulatory carriageway a Lane Connector is created between the exit point of the Left Entry Lane and the entry point of the left Circulatory Arm. If traffic from the left entry Lane can also fan out into the left but one circulatory Lane, an additional Lane Connector is created from the left entry Lane to the left but one circulatory Lane.

The Lane Connectors are heavily dependent on the proposed lane-marking scheme for the roundabout and represent the lane-to-lane movements that the lane markings imply. Before constructing the Lane Connectors in FlowRound, it is important that thought has been given to the roundabout's geometry and likely road markings, to ensure that the Lane Connectors in FlowRound represent a roundabout lane structure that is geometrically build-able.

It is important to understand that as the Lane Connectors represent the physical lane structure of the roundabout they represent which traffic movements are allowed to take place, rather than the traffic movements that will actually take place for a given set of traffic flows. This allows the Lane Connectors to be the same for all Flow Groups and avoids

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changing the Network for each Flow Group. If in a particular Flow Group a Lane Connector is not used, it will simply result in a zero flow on the connector.
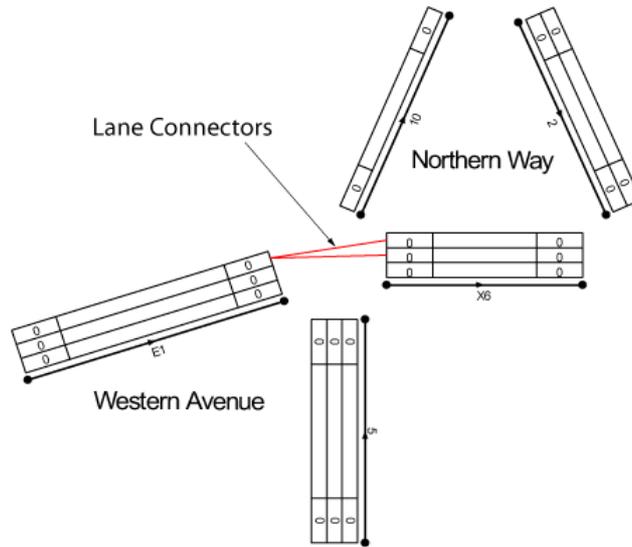

Figure 4.4 : Lane Connectors

Figure 4.5 shows the Tutorial example roundabout with Lane Connectors representing the lane structure shown in the lane marking drawing in Figure 4.1.
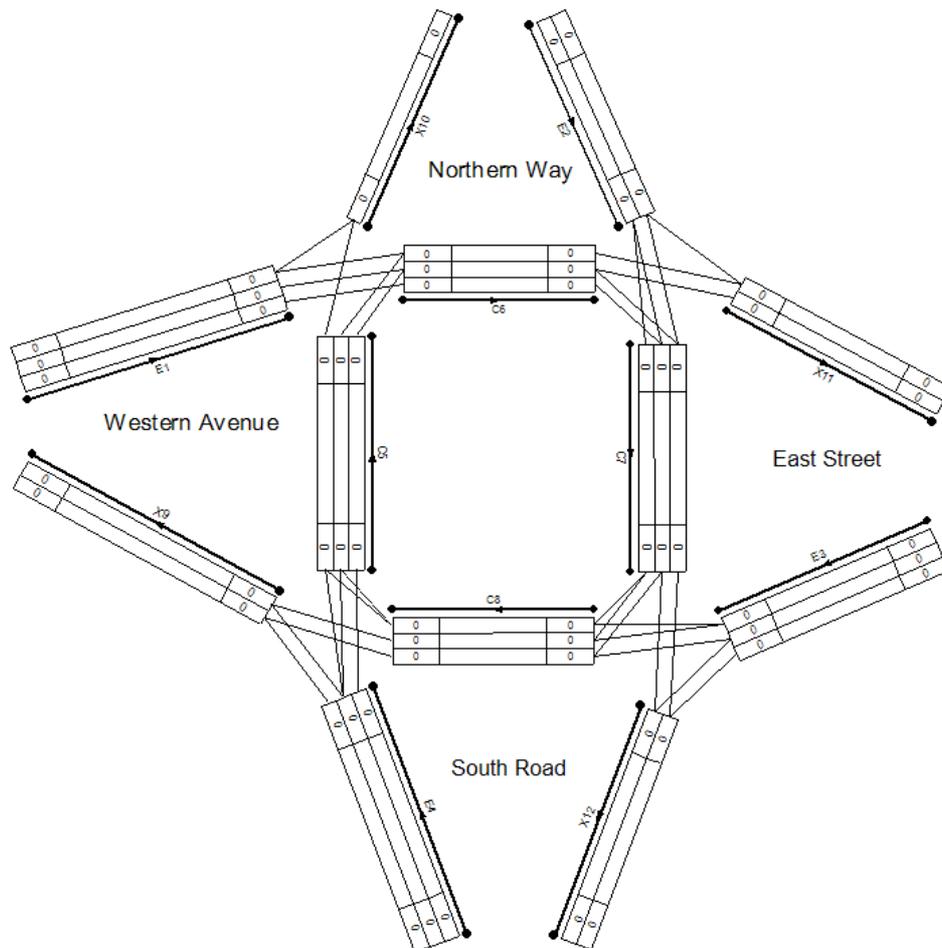

Figure 4.5 The Tutorial Example after adding Lane Connectors in Step 2.

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The Lane Connectors are added in the following manner:

- The Lane Connectors from Entry Arm 1 to Circulatory Arm 6 will be added first. Both Arms have three Lanes and each Lane on the Entry Arm connects to the same Lane on the Circulatory Arm as can be seen in Figure 4.5.

- Click on the exit box of the left Lane of Arm 1.

- Holding down the left mouse button, drag the mouse towards Arm 6 to start the Lane Connector.

- When the mouse is over the entry box of the left Lane on Arm 6, release the left mouse button. This will add a Lane Connector between the left most Lane of Arm 1 to the same Lane on Arm 6.

- Note that as Arm 1 now has Lane Connectors leaving it FlowRound deduces it to be an Entry Arm and prefixes its Arm number with 'E'. Arm 6 is incorrectly deduced to be an Exit Arm as it currently only has Lane Connectors entering it and none leaving. As more Lane Connectors are added, FlowRound will adjust Arm types to be consistent with the overall layout of Lane Connectors.

- Repeat the above to add Lane Connectors between Arm 1 and 6 for the middle and right Lanes on these Arms, referring to Figure 4.5 as necessary.

- Using the left mouse button, click on any of the Lane Connectors. The Lane Connector will turn red indicating it is selected.

- Choose 'Lane Connectors' under 'Network' on the main menu. Choose 'Delete Lane Connector from the pop out menu. The Lane Connector is deleted and is removed from the Network Diagram. Lane Connectors can be deleted at any time, however when the model is more developed, and Routes and traffic flows pass through a Lane Connector, deleting it will delete all Routes and other items that are dependent on the Connector. Do not forget though that you can always use undo if you inadvertently delete a Lane Connector that causes many Routes to be deleted.

- Replace the Lane Connector deleted above and then go on to add all of the other Lane Connectors shown in Figure 4.5. You may find it useful to refer to a copy of the roundabout's lane markings whilst doing this to help understand how the Lane Connector positions were determined.

When all of the Lane Connectors have been successfully entered, Step 2 of the tutorial is complete.

Step 3 : Defining Origins and Destinations

Each road connected to the roundabout can be two-way or one-way. Two-way roads are defined by combining an Entry and an Exit Arm together using a Zone. A Zone defines an origin/destination point for traffic into or out of the roundabout. Zones allow an Entry and an Exit Arm to be combined together and given a common name, making naming of traffic movements simpler, as for example, there is no need to remember that Entry Arm 1 and Exit Arm 9 are both on Western Avenue. One-way roads, either entry or exit, are defined by creating a Zone connected to a single Arm, which may be either an Entry or Exit Arm.

Zones are created as follows:

- Choose 'Zones' from the 'Network' menu on the FlowRound main menu.

- Choose 'Add Zone' from the pop-out menu. The 'Create Zone' dialog box appears.

- Select the name of the new Zone in the 'Zone' drop down list. Zone names are alphabetic and must be consecutively named with no gaps in the naming sequence. Zones can be renamed at any point, and all other Zones are renamed to close or create a gap in the list of Zones. For this example, choose Zone A as the first Zone to add.

- Select the Entry Arm for the Zone. For Zone A the Entry Arm will be Arm 1.

- Similarly, select the Exit Arm for the Zone. Arm 9 in this case.

- Each Zone is allocated a colour, which is used to colour code flow components on different FlowRound views. To change the colour click 'change' and use the standard windows colour selector to choose a new colour. To match the example choose black for Zone A, red for Zone B, blue for Zone C and green for Zone D.

> **Tip:** It is a good idea to change the road name Label colours to match the Zone Colours

- Click on OK to create the Zone.

> **Tip:** Dragging a Zone will reposition its Entry and Exit Arms as well as the Zone.

- Enter each of the other three Zones using Entry and Exit Arms based on the arrangement of Arms set up in step 2.

This completes Step 3 of the tutorial.

Step 4: Building and Validating Routes through the Roundabout

Now the FlowRound Network setup is complete the next step involves using FlowRound to analyse potential Zone-to-Zone Routes through the Network. In later steps, traffic flows will be specified and allocated to each of the Routes to specify in detail how traffic travels through the roundabout.

Building Routes

FlowRound builds Routes through the roundabout by examining each Zone-to-Zone movement and attempting to construct a sequential path of Lanes between Zones. Each Route begins at a Lane on its start Zone's Entry Arm and finishes at a Lane on its end Zone's Exit Arm. As different paths may exist through the roundabout, more than one Route is sometimes possible between an entry Lane and an exit Lane.

All the Routes found by FlowRound are listed in the Route Manager located to the right of the main Network Diagram, and can also be displayed on the Network Diagram itself. The Route Manager provides a number of tools for working with Routes, controlling which Routes are shown, and how they are displayed. The use of the Route Manager is covered in more detail later in this section.

To build Routes between all Zones:

- Choose 'Build Routes' from the 'Routes' menu.

- FlowRound adds all the new Routes to the Route Manager and highlights all the Routes listed in the Route Manager in green in the Network Diagram.

- Click on any Route in the Route Manager. The selected Route will be highlighted in pink in the Network View, similar to Figure 4.6.
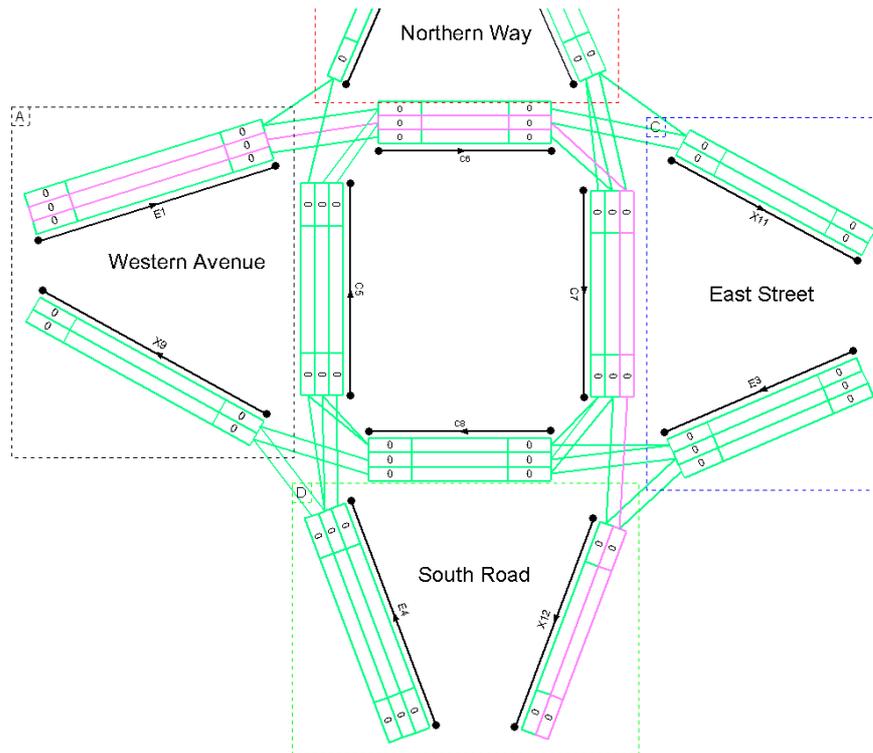
Figure 4.6 : An Example of a Selected Route

- Click on several other Routes in turn, observing how the Network Diagram highlights each Route's path through the Network.

- With a Route selected in the Route Manager, choose 'Edit Selected Route' either from the Route menu, or by right clicking on the Route. The Edit Route dialog box will appear as shown in Figure 4.7.
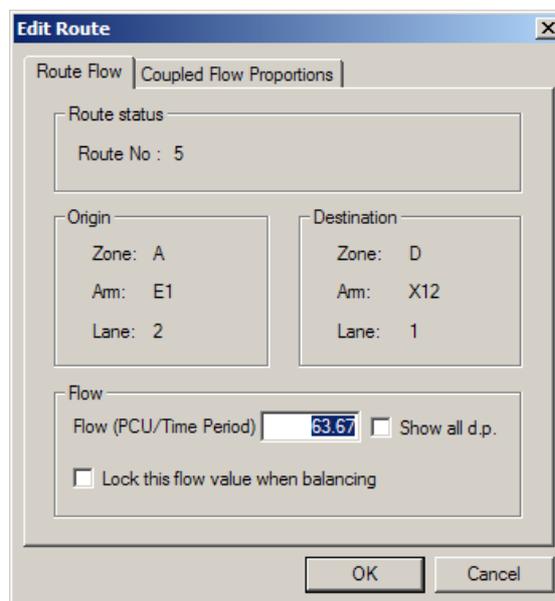
Figure 4.7 : The Edit Route Dialog Box

- The Edit Route dialog box contains two tabs. The 'General' tab shows details of the Routes origin and destination and also allows the traffic flow allocated to a Route to be edited. As we have not yet added flow information to the model all Route Flows

are currently zero. The Flow Locking and 'Coupled Flow Proportions' tab are used to constrain the flow balancing procedure which is covered later in this User Guide.

- Click OK to close the Edit Route dialog box.

Having looked at the basics of how Routes are built and examined, the Route Manager will now be described in more detail before being used to further examine and refine the Routes.

The Route Manager

The Route Manager is located to the right of the main Network Diagram and consists of three panels, which provide tools for editing Routes and changing the way Routes are displayed.
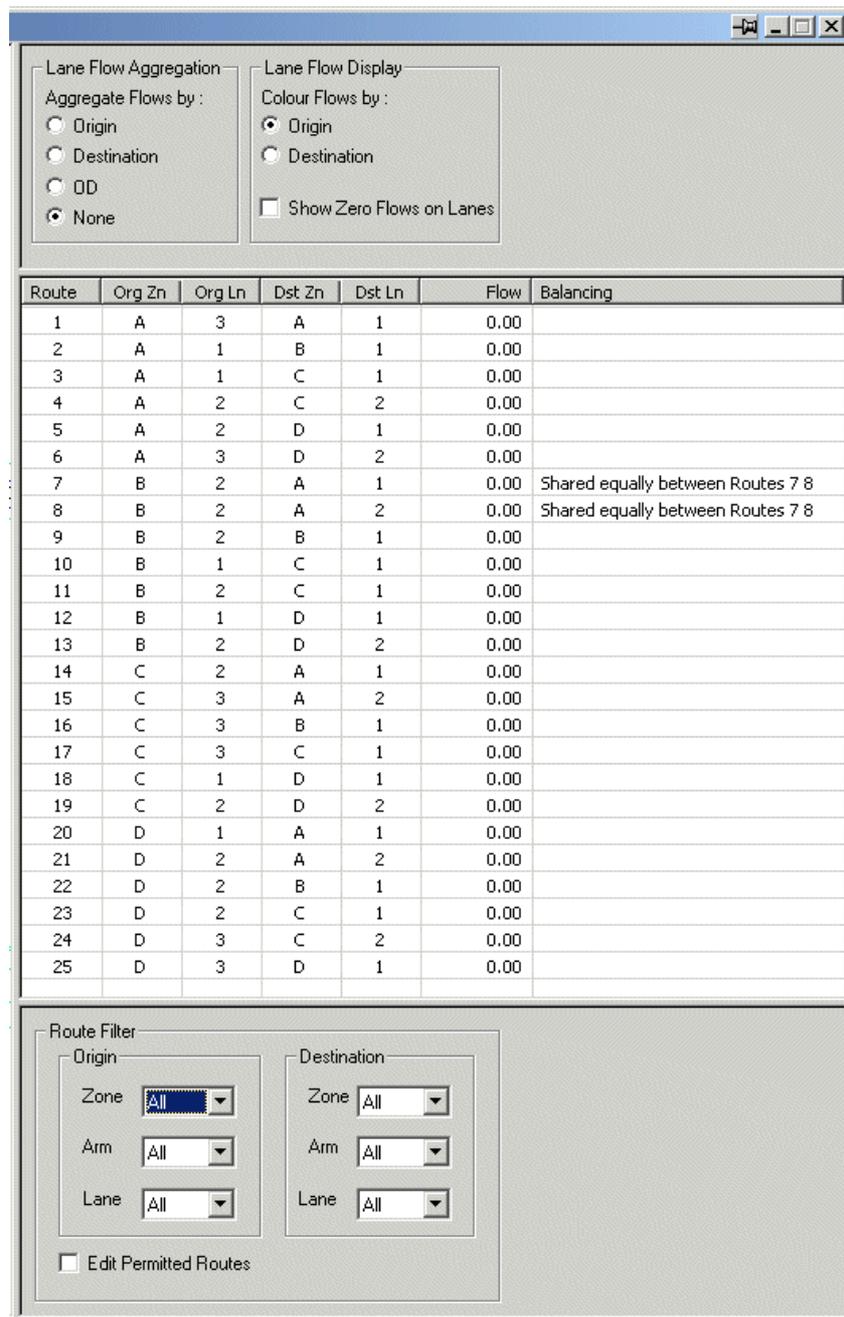
Figure 4.8 : The Route Manager

The Route List

The central panel of the Route Manager lists information about each Route found by FlowRound. The information shown is:

- **Route number.** A unique reference number for each Route.

- **Route Origin.** The Zone, Arm and Lane from which the Route starts.

- **Route Destination.** The Zone, Arm and Lane where the Route finishes.

- **Flow.** The traffic flow allocated to the Route for the current Flow Group.

- **Balancing (Advanced).** Information regarding any flow balancing constraints applied to the Route. Further information is given in the section on flow balancing.

The Route List can be sorted on any column in either direction by clicking on the grey column header with the mouse. Clicking again reverses the sort direction.

Details of each Route can be viewed and edited using the Edit Route dialog box, which can be opened by double-clicking a Route in the Route List. The use of the Edit Route dialog box is covered in more detail in the sections on editing traffic flows and flow balancing below.

The Route Filter

The Route Filter is shown at the bottom of the Route Manager and allows the Routes shown in the Route List to be filtered by Origin and Destination. Only Routes fitting both the Origin and Destination filters will be included in the Route List, allowing the number of Routes shown to be controlled. This is particularly useful for complex roundabouts with many Routes, as Routes can be viewed in manageable sets.

Figure 4.8 : The Route Filter
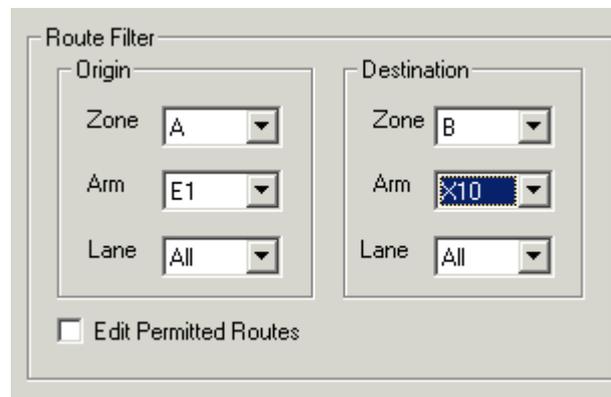
The use of the Route Filter is covered in more depth in 'Investigating Routing' below.

The Lane Flow Aggregation & Display settings

The Lane Flow aggregation and display settings specify how traffic flow components will be shown on Lanes in the Network Diagram. Each of the settings is used in conjunction with the Route Filter to control the level of detail shown on the Network Diagram.
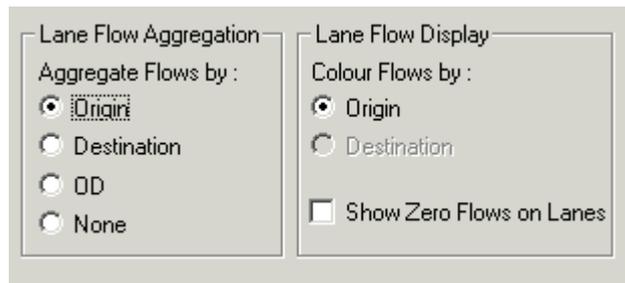
Figure 4.9 : The Lane Flow Aggregation & Display Settings

In some cases, it is not necessary to present the Network Diagram with every flow component shown separately. The Lane Flow aggregation settings allow the exact level of aggregation to be set, the four options being:

- **Origin.** Each Lane shows the total traffic passing through the Lane split by Origin Zone.

- **Destination.** Each Lane shows the total traffic passing through the Lane split by Destination Zone.

- **OD.** Each Lane shows the total traffic passing through the Lane split by Origin-Destination pair. In situations where each Origin-Destination movement has only one Route, this option will be the same as the 'None' option below.

- **None.** Each Lane shows each Routes contribution of traffic to the Lane separately. This is the most detailed view and is usually used with the Route Filter to avoid an excessive amount of detail being shown.

As well as changing the level of flow aggregation to control the amount of traffic flow detail shown, Lane Flow Components can also be coloured to provide information on the traffic using a Lane. The options are:

- **Colour by Origin.** Each traffic flow figure is coloured based on the Zone colour of its origin Zone. This is useful to identify where traffic on a Lane has come from.

- **Colour by Destination.** Each traffic flow figure is coloured based on the Zone colour of its destination Zone. This is useful to identify where traffic on a Lane is travelling.

Defining Non-Permitted Routes

FlowRound allows Routes to be labelled as non-permitted indicating they will not be used in the model. The 'Edit Permitted Routes' tick box sets the Route List to display both permitted and non-permitted Routes matching the current filter. When non-permitted Routes are shown, each Route also displays a tick box that allows its permitted status to be changed. Routes are generally made non-permitted because they are not sensible Routes, for example, spiral Routes around the roundabout. FlowRound detects and automatically suppresses most obvious nonsense Routes but some are less obvious and require a user to make the decision.

Route	Org Zn	Org Ln	Dst Zn	Dst Ln	Flow	Balancing
☑ 4	A	2	C	2	0.00	
☑ 5	A	2	D	1	0.00	
☑ 6	A	3	D	2	0.00	
☑ 7	B	2	A	2	0.00	Shared ed
☑ 8	B	2	B	1	0.00	
☑ 9	B	1	C	1	0.00	
☐ 10	B	2	C	1	0.00	
☑ 11	B	1	D	1	0.00	
☑ 12	C	2	A	1	0.00	
☑ 13	C	3	A	2	0.00	
☑ 14	C	3	B	1	0.00	

Figure 4.10 : The Route List Showing Non-Permitted Routes

Filtering Routes

We will now use the Route Manager and Route Filter to examine the Routes through the roundabout, which FlowRound has generated.

- Position the various windows so that the whole of the Network Diagram and Route Manager can be seen. If the Route Manager is not visible, it can be switched on by choosing 'Show Route Manager' from the Routes menu.

- In the Route Filter, choose Zone A from the Origin Zone drop down list. The Route List will be filtered to show only Routes starting at Zone A and the Network Diagram will highlight only these Routes.

- Select Route 1 from Zone A to Zone A in the Route List this will highlight this Route in pink on the Network Diagram. It can be clearly seen that this Route is a U-turn.

- Using the up–down cursor keys, select each Route in turn from the Route List. As each Route is selected, it is shown in pink in the Network Diagram. This method provides a quick way of checking a large number of Routes in a Network.

- Change the Route Filter's Origin Zone to Zone B. A different set of Routes will now be displayed in the Route Filter.

- Looking at circulatory Arm C6 to the north of the roundabout, notice that the left Lane is shown highlighted indicating that a Route from Zone B passes through it. This is potentially incorrect as it would not normally be necessary for any traffic movement from Zone B to use this Lane.

- To investigate further select Zone C in the Route Filter destination Zone drop down list. The Route List is further filtered to show only Routes between Zones B and C. Arm C6 still has a Lane highlighted indicating that one of the Routes between Zones B and C passes through it.

- Further filter the Routes by selecting Arm E2 and Lane 2 in the Route Filter Origin drop down lists. This filters the Route List down to a single Route, Route 11. This can clearly be seen from the Network Diagram to be a spiral Route that in most cases would not be desirable to use when allocating flows to Routes.

- In the Route Filter, tick 'Edit Permitted Routes'. A tick box appears to the left of the Routes in the Route List.

- As Route 11 is not required, untick the box to its left in the Route List. Route 11 will turn blue in the Network Diagram showing it is now a non-permitted Route. Currently

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Route 11 has no traffic flow allocated to it, but if it did, the flow would be set to zero as traffic is now not allowed to use the Route.

- Change the Route Filter to show all Routes between Zones B and C for all Lanes. The Route List will now show two Routes, Route 10, which is permitted, and Route 11, which is not.

- In the Route Filter untick the 'Edit Permitted Routes' option. The non-permitted Routes (just Route 11 in this case) are no longer displayed in the Route List together with the permitted Route tick boxes next to each Route.

The above procedure should always be used after building Routes through the roundabout to validate that all Routes are sensible. This may appear tedious, especially with a larger roundabout, but is an essential check that the routing system produced by the computer makes traffic-engineering sense.

This completes Step 4 of the tutorial. Many of the techniques in this section are useful in a number of FlowRound situations and should be learned thoroughly before proceeding to the later tutorial steps.

Step 5 : Entering Traffic Demand Flow Matrices.

This step of the tutorial will enter traffic information into FlowRound and demonstrate how to use different traffic Flow Groups.

Traffic flow movements in FlowRound are entered using Demand Flow Origin-Destination (OD) matrices that specify the amount of traffic wishing to move from each Zone to each other Zone. The matrices do not specify what routes traffic takes through the roundabout to satisfy these demands – this is done using the Routes in 'Section 6 : Assigning Traffic Flows to Routes'. The matrices are used to provide constraints on the total levels of traffic passing through the roundabout. This helps in detecting errors in the traffic flows allocated to Routes in Section 6.

Traffic Flow Groups

FlowRound uses Traffic Flow Groups to allow any number of different sets of traffic flows to be defined. Each Flow Group can represent a different a time period of any duration, for example, morning and evening peak periods, or for different development generated traffic scenarios such as with and without superstore traffic.

The Traffic Flows View

The Traffic Flows View is used both to create and manage traffic Flow Groups and to enter traffic flow OD matrices. The View is split into two parts:

Figure 4.11 : The Traffic Flows View

- The Traffic Flow Group List, to the left of the view, lists the different traffic Flow Groups defined in FlowRound. Selecting a Flow Group defines it as the model's 'current' Flow Group that will be is used for all calculations and displays. A Flow Group's description and start and end times can be edited by selecting the Flow Group and choosing 'Edit Current Flow Group' from the Traffic Flows menu.

- The matrix display to the right of the View displays the traffic flow matrices for the currently selected Flow Group. As explained below only the Desired Flows matrix can be edited, the other matrices being used to display information calculated from the roundabout's Route Flows.

Traffic Flow Matrices

FlowRound uses three types of traffic flow matrices, one for input and two for output. These are:

- **Desired Flows Matrix.** This matrix displays and allows editing of the desired Zone-to-Zone traffic flows. As is customary with origin-destination (OD) matrices Origin Zones are shown to the left of the matrix and Destination Zones above. Each cell contains the desired total traffic flow by any Route from the Origin Zone to the Destination Zone. Any units can be used, as FlowRound will display output results using the same units as the input traffic flows.

- **Actual Flows Matrix.** The Actual Flows Matrix is derived from the traffic flows assigned to each Route by the process described in Step 6 below. Each Zone-to-Zone total is calculated by summing the Route traffic flows for all Routes connecting an Origin and Destination Zone. It represents the total Zone-to-Zone flow actually assigned to Routes rather than the flow that we are aiming to assign to Routes.

- **The Difference Matrix.** The Difference Matrix shows the numerical differences between a cell in the Desired Flows Matrix and the same cell in the Actual Flows Matrix. It represents Zone-to-Zone movements for which too little or too much flow has been allocated to Routes. Where the Difference Matrix is non-zero, this should be investigated and corrections made to Route Flows as detailed in Step 6. This will ensure the total Zone-to-Zone Route Flows equal the desired Zone-to-Zone traffic movements.

Entering the Desired Traffic Flows

The tutorial includes two Flow Groups: A Morning Peak period (AM Peak) and an Evening Peak Period (PM Peak). The Desired Traffic Flow Matrices are:

Morning (AM) Peak					
	A	B	C	D	Tot.
A	0	342	731	632	1705
B	165	0	211	564	940
C	831	206	0	327	1364
D	453	231	421	0.0	1105
Tot.	1449	779	1363	1523	5114

Evening (PM) Peak				
	A	B	C	D	Tot.
A	0	172	421	321	914
B	221	0	281	432	934
C	342	210	0	429	981
D	563	310	453	0	1326
Tot.	1126	692	1155	1182	4155

In this case, the units used are Passenger Car Units (PCUs).

- Open the Traffic Flow View by choosing 'Show Traffic Flows View' from the 'Traffic Flows' menu. Click the Pushpin button on the View's title bar to make the View 'Always on Top' and prevent it disappearing behind the larger Network View.

- In the Traffic Flow Group List on the right side of the View, select the initial Flow Group that was created automatically using default settings.

- Choose 'Edit Current Flow Group' from the 'Traffic Flows' menu. This opens the 'Edit Flow Group' dialog box.

- Change the Flow Group's title from 'Flow Group 1' to 'Friday AM Peak'. Check the peak period's start and end times are 08:00 and 09:00 respectively. Close the 'Edit Flow Group' dialog by clicking on OK.

- In the Desired Traffic Flows Matrix display click on a cell and enter the traffic flows from the Morning Peak shown above. The active cell can be moved using the arrow keys in a similar manner to a spreadsheet. The View will recalculate row and column totals as each cell value is entered.

- When the Morning Peak is complete right mouse click on the Flow Groups List and choose 'Add Flow Group' from the popup menu. This creates a new Flow Group, which is listed in the Flow Groups List.

- Edit the new Flow Group to change its title to 'Friday PM Peak' and change the start and end times to 17:00 and 18:00 respectively.

- Enter the Evening Peak traffic flows shown above in the same manner as the Morning Peak flows.

> **Tip:** The traffic flow Matrix for the current Flow Group can be shown superimposed on the Network Diagram using 'Show OD Matrix in Network View' on the View menu.

This concludes Step 5 of the tutorial.

Step 6 : Assigning Traffic Flows to Routes

This step of the tutorial covers the most important part of building a FlowRound model – that of allocating traffic flows to FlowRound Routes. The Route Flows are used by FlowRound to calculate and display the Lane usage pattern for each arm of the roundabout. This step looks at how to carry out a basic automatic assignment of traffic to Routes. This is further refined in Step 7 by making manual adjustments and using more advanced techniques to distribute traffic between Routes.

Each FlowRound Route is allocated a volume of traffic that represents the traffic flow travelling from an Origin Zone to a Destination Zone following a particular sequential path of Lanes. It is possible to have more then one Route from one Zone to another Zone, for

example, where the Entry or Exit Arms for the Zones have more than one Lane. FlowRound sums Route Flows on each Lane to calculate Lane Flow totals, and also sums Route Flows between Zones to calculate Zone-to-Zone Actual Flows as shown in the Actual Flows Matrix.

The Assignment Process

The process of assigning traffic flows to Routes can be carried out in two different ways, but most commonly a mix of both methods is used.

These methods are:

- Automatic Entry Lane Flow Balancing

- Manual assignment of traffic to Routes

The Automatic Entry Lane Flow Balancing method is intended to provide a rapid way of assigning traffic to Routes whilst being reasonably accurate. Like all automatic methods, it will never produce as good a distribution of Route Flows compared with a full manual assignment carried out by an experienced engineer with local knowledge. A full manual assignment is, however, a lengthy process and the Lane Flow Balancing method will generally be sufficiently accurate to provide a starting point, which can be further refined to add engineering knowledge of local traffic flow patterns. Simple roundabouts will often require little or no refinement; more complex roundabouts can be refined to a lesser or greater extent depending on the level of detail required. One of the key benefits of FlowRound is that it allows changes to be made rapidly, providing instant feedback on their consequences. This Step of the tutorial concentrates on explaining Automatic Entry Lane Flow Balancing, and how display options can be used to assist in reviewing the generated Route Flows. Step 7 then refines the automatically generated flows by making manual adjustments and using more advanced techniques to influence the automatic method.

Automatic Entry Lane Flow Balancing

Automatic Lane Flow Balancing attempts to distribute the traffic volumes on a roundabout Entry Arm, as specified in the Desired Flows Matrix, between Routes to achieve equal traffic flows in each entry Lane. This is achieved by adjusting Route Flows to balance flows on entry Lanes, subject to constraints such as Zone-to-Zone movement totals, and taking into account movements that can only take place in specific entry Lanes.

It is important to note that no balancing of Lane Flows on Circulatory Arms takes place as in practice, providing the roundabout's lane markings are well designed, drivers tend to choose lanes based on entry queues and signing/white lining, rather than anticipating what may happen further downstream on the circulatory carriageway. In some situations with other near-by junctions, a high proportion of commuting drivers with good knowledge of the junction, or poor signing/lining, this assumption may be less correct and traffic may well choose to create unbalanced flows on an Entry Arm. In these cases, manual adjustments to Route Flows may be necessary to build the effects of these external non-standard influences into the model.

To carry out Automatic Entry Lane Flow Balancing:

- Position the various windows so that the whole of the Network Diagram and Route Manager can be seen. If the Route Manager is not visible, it can be switched on by choosing 'Show Route Manager' from the Routes menu.

- Choose 'Balance Lane Flows on all Entry Arms' from the 'Traffic Flows' menu. Route Flows are generated and displayed in the Route Manager. The Network Diagram is updated to show Lane Flows and Flow components derived from the Route Flows.

After carrying out Automatic Entry Lane Flow Balancing it important that the resulting flows are critically examined to allow the need for their further refinement to be assessed. The remainder of this tutorial step concentrates on the use of graphical display options in FlowRound, which can be used to make a detailed examination of the Route Flows assigned by FlowRound's Automatic Entry Lane Flow Balancing.

Examining the Route Flows

Now that an initial set of Route Flows have been generated the Route List, Route Filter and Lane Flow Aggregation and Display Settings sections of the Route Manager can be used to examine the generated routing patterns. This is an important exercise as it allows the Route Flows to be checked for sensibleness.

The Route List

The Route List, described in detail in Step 4, lists the Routes through the roundabout displaying key information for each Route. Now that an initial flow assignment has been generated, each Route has been allocated a Route Flow, which is displayed in the Route List. For larger roundabouts, the Route List can be filtered if necessary using the techniques described in Step 4.

Lane Flow Display

Each Lane displays a detailed breakdown of the traffic flow components passing through it. A typical three Lane Arm – Arm C8 - is shown in Figure 4.12.
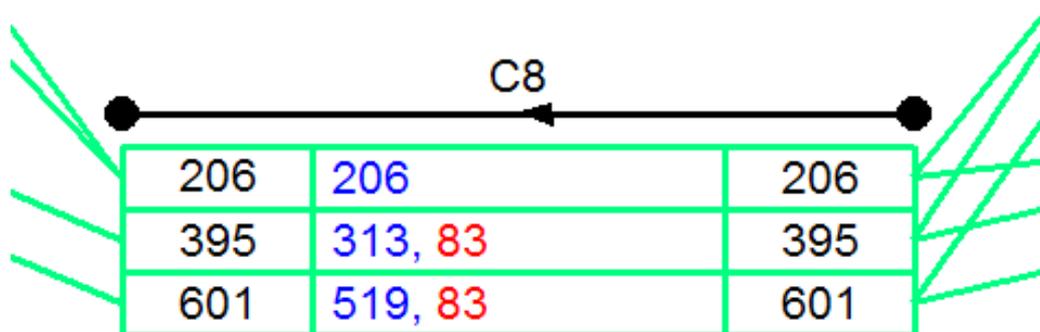

Figure 4.12 : FlowRound Arm showing Lane Flow Components Coloured by Origin

Arm C8 shows three main items of information. These are:

- The Lane Entry Flow at the upstream end of each Lane

- The Lane Exit Flow at the downstream end of each Lane. As this Arm contains no short Lane (flares) all the Lane Entry Flows match the Lane Exit Flows.

- The Lane Flow Components shown in colour in the centre of each Lane. The Lane Flow Components correspond to flows on Routes passing through the Lane. Depending on the level of flow aggregation chosen each flow component may represents the flow on one Route or an aggregation of a number of Routes. For

example, in this case no flow aggregation is set so the blue 206 in the offside Lane represents the flow of 206 pcus on Route 14.

Lane Flow Component Colour Coding

Lane Flow Components can be colour coded to display flow information in different ways. The following steps illustrate how the colour coding can be used to examine the roundabout's traffic flows:

- In the Lane Flow Aggregation and Display Settings section of the Route Manager, select 'none' for the aggregation setting, and 'Origin' for the 'Colour Flows by' setting. Ensure the Route Filter settings are set to 'All' to ensure all Route Component Flows are shown. Each Arm in the Network Diagram will resemble Arm C8 shown above in Figure 4.12.

- Each Flow Component is colour coded based on its origin or destination. In this case as the 'Colour Flows by' setting is set to 'Origin', each number is coloured based on the colour code of its Origin Zone. For example, the blue 206 is from Zone C which is colour coded blue. The red 83s are from Zone B.

- In the Route Manager's 'Lane Flow Display' section, change the display setting to 'Destination'. Arm C8 now displays as shown in Figure 4.13. The Arm now uses colour to indicate the Destination Zone of Flow Components. For example, the red 206 indicates this Flow Component is travelling to Zone B.
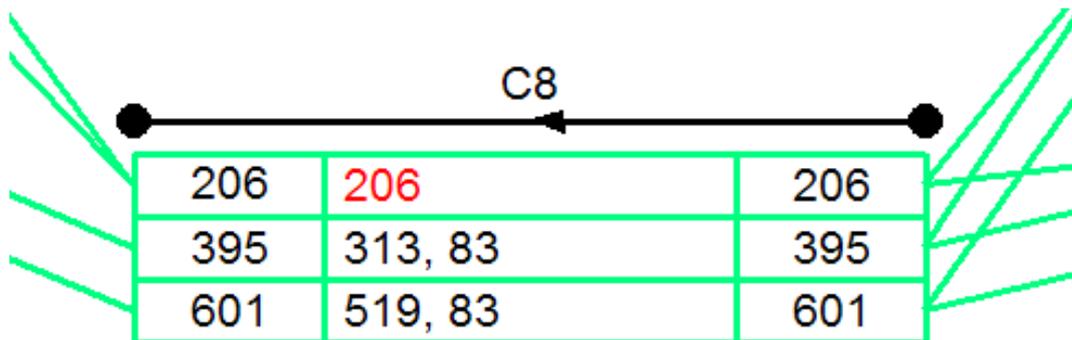

Figure 4.13 - FlowRound Arm Showing Flow Components Coloured by Destination

Lane Flow Component Aggregation

The Lane Flow Aggregation settings in the Route Manager allow the Route Flows to be displayed on the Lanes with different levels of aggregation. This is most useful with very complex roundabouts as it allows the amount of information shown on each Lane to be controlled. A choice can be made between a highly detailed Network Diagram showing a lot of densely displayed information, and a Network Diagram showing less detail but in a clearer manner. Of course, the best option is often to use a larger screen/printer to avoid compromises regarding how much detail to display.

- In the Lane Flow Aggregation and Display Settings section of the Route Manager, select 'none' for the aggregation setting and 'Origin' for the 'Colour Flows by' setting. Ensure the Route Filter settings are set to 'All' to ensure all Route Component Flows are shown. Arm E2 will be as shown in Figure 4.14 with the Lane Flow Components showing each individual Route Flow.

- Change the Lane Flow Aggregation setting to 'OD'. The Lane Flow Components displayed in Arm E2 change to reflect the higher level of aggregation as shown in Figure 4.15. In this case the two Routes carrying 83 PCU are both between Zones B and A and are therefore aggregated together to show a total flow of 165 PCU. (The one PCU difference is due rounding effects).
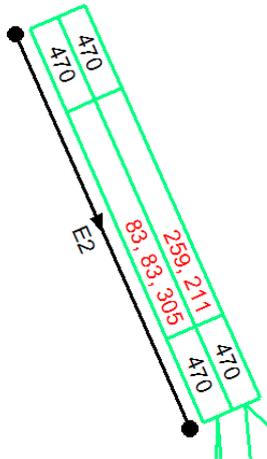

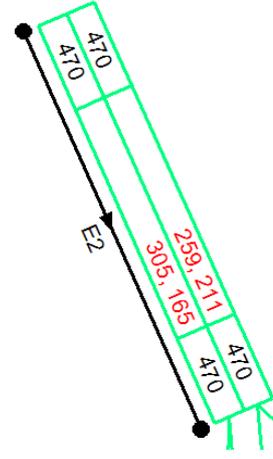**Figure 4.14 : Lane Flow Components with no Flow Aggregation**

Figure 4.15 : Lane Flow Components Aggregated by OD Movement

- Change the Lane Flow Aggregation setting to 'Origin'. This further aggregates the Lane Flow Components so all Route Flows from an Origin are aggregated together. For example, in the nearside Lane the Lane Flow Components 259 and 211 PCU to Zones D & C respectively are aggregated together to give a total of 470 PCU. Only 'Colouring by Origin' is available, as each number may be comprised of Route Flows travelling to a number of different Zones.
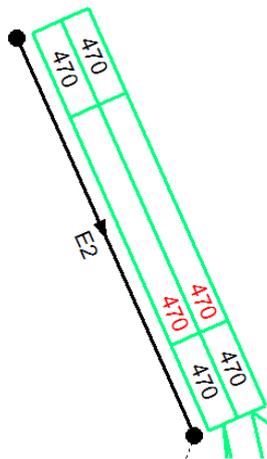

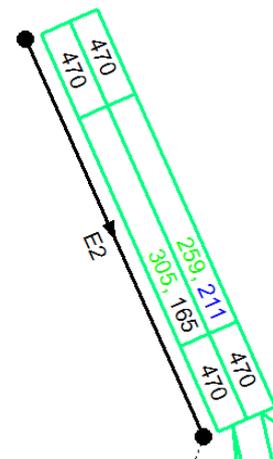**Figure 4.16 : Lane Flow Components Aggregated by Origin**

Figure 4.17 : Lane Flow Components Aggregated by Destination

- Lane Flow Components can be aggregated in a similar manner based on Route Destination as shown in Figure 4.17. Each number represents the total traffic in each Lane travelling to a Destination Zone. For example in the nearside Lane 259 PCU are travelling to Zone D and 211 PCU to Zone C.

Step 7 : Refining the flow assignment.

As discussed in Step 6 above the Automatic Entry Lane Flow Balancing provides an initial assignment of traffic flows to Routes. This Step looks at how this initial assignment can be improved using manual adjustments and a number of more advanced techniques.

The techniques available include:

- **Manual Route Flow Adjustment.** This involves examining the Lane Flows and manually reallocating flows between Routes to achieve a 'custom' assignment. This allows local traffic knowledge and other external factors to be included in the Route Flows.

- **Route Flow Locking.** This allows individual Route Flows to be locked to a custom value and other Route Flows to be rebalanced around the locked values using the Automatic Entry Lane Flow Balancing.

- **Coupled Route Flow Proportions.** Where one or more Routes originate from a single Entry Lane and finish at the same Destination Zone, FlowRound's Automatic Entry Lane Flow Balancing assumes the total Lane Flow calculated by the flow balancing, is split equally between the Routes originating in the Lane. The Coupled Route Flow Proportions feature allows an unequal split to be defined where desired.

The following demonstrates each of the above techniques using the roundabout which has been built up as part of this tutorial.

Manual Route Flow Adjustment

Figure 4.18 shows the Roundabout after Tutorial Step 6 with the Route Filter set to show only Lane Flow Components originating from Zone D. Flow Components are coloured by Destination Zone.

For the purposes of this tutorial, the flows of interest are the right turning flows from Zone D to Zone C. These are shown in blue in Figure 4.18. It can be seen that two parallel Routes starting in Lanes 2 & 3 on Arm E4 are used by traffic making this movement. The total Zone-to-Zone flow of 421 pcu is split unevenly between the two Routes due to the heavy ahead and left turning flows in Lane 2. The first downstream Circulatory Arm can be seen to have very unbalanced flows with only 53 pcu using the centre Lane. This is not necessarily incorrect as it is reflecting the fact that the lane markings suggest only one Route uses this Lane – the right turn of 53 pcu. To illustrate how this situation could be manually adjusted it is assumed that local driver behaviour means that 100 pcu of right turning traffic in Lane 3 choose to instead use Lane 2 in order to take advantage of the relatively underused centre Lane on the circulatory Arm C5.
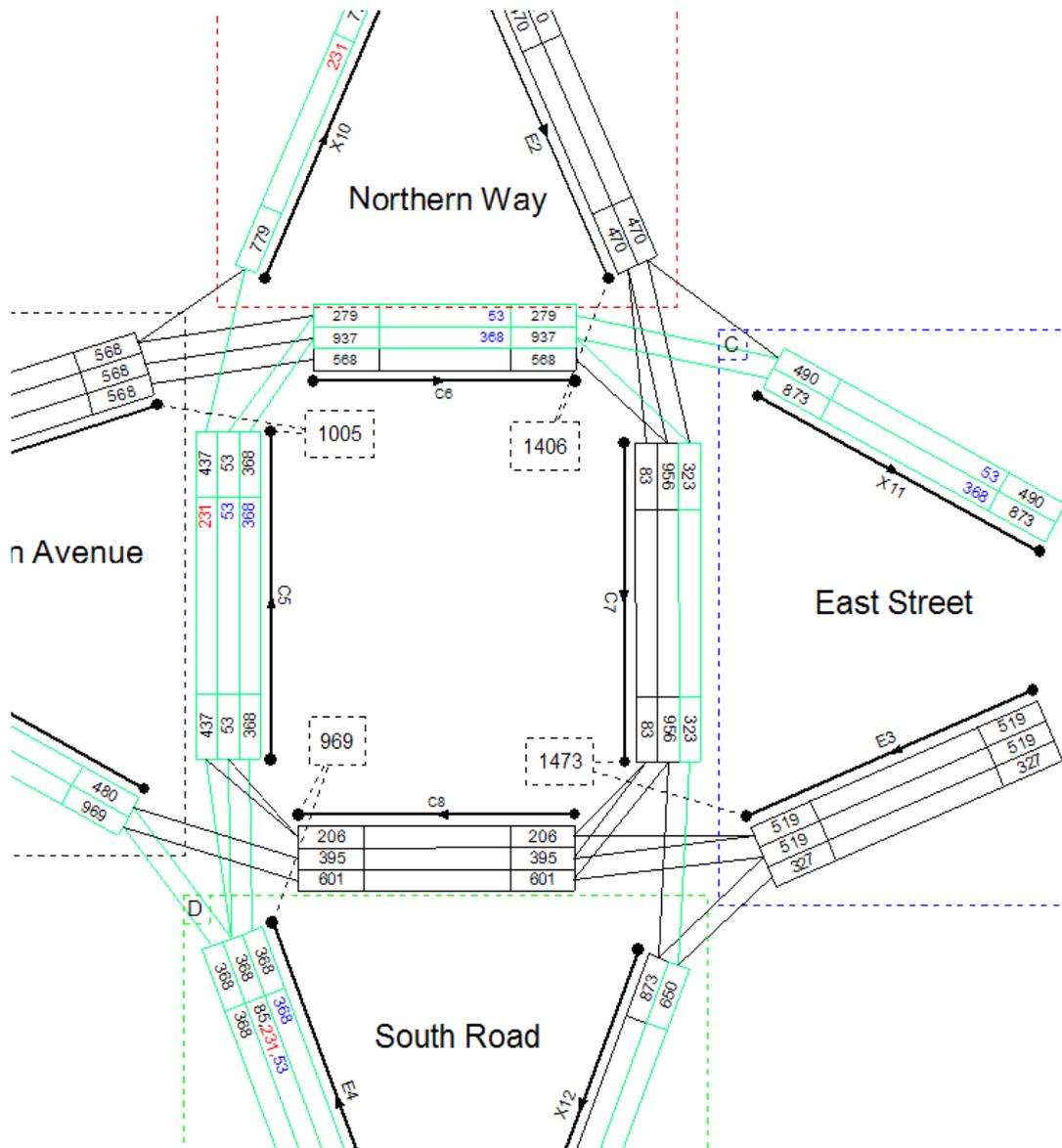
Figure 4.18 - Lane Flow Components for Traffic from Zone D

The flows can be manually redistributed as follows:

- Ensure the Network View shows Lane Flow Components with no aggregation, coloured by destination, with the Route Filter set to display only Routes starting from Zone D.

- Open the Traffic Flows View and select the Difference Flow Matrix for the AM Peak Period. This will ensure any manual adjustments made do not erroneously change the total Zone-to-Zone traffic movements.

- Examining the Route List it can be seen that the two Routes of interest are Routes 21 & 22, which carry 53 and 368 pcu respectively.

- In the Route List, open the Edit Route dialog box for Route 21. As we are moving 100 pcu to this Route change the Route Flow from 52.67 pcu to 152.67pcu. It is good practice to retain a high degree of numerical precision to avoid spurious rounding issues causing display ambiguities in outputs.

- The Network View updates to show the new Lane Flow totals along the edited Route. The Traffic Flow View's Difference Matrix indicates an excess flow of 100 pcu on the

Zone-to-Zone movement D to C. This is correct, as we have added flow to a Route without yet having removed it from another Route.

- Now edit Route 22 in the Route List. Change the Route Flow from 368.33 pcu to 268.33 pcu.

- The Network View is again updated to reflect the new Route Flow and the Traffic Flow View's Difference Matrix now shows the total Zone-to-Zone flows back in balance.

- The Network View now shows that the Lane Flows on Circulatory Arm C5 are more balanced. Entry Arm E4 is now less balanced with slightly more traffic using the centre Lane.

Route Flow Locking

Route Flow Locking allows Route Flows that have been manually edited to be locked preventing subsequent use of Automatic Entry Lane Flow Balancing from changing their values. For this example, having made the manual Route Flow changes in the previous section it is assumed that traffic in other Lanes on Entry Arm E4 will rebalance to try to equalise the unequal Lane Flows caused by the manual Route Flow adjustments. This can be achieved in FlowRound as follows:

- In the Route List open the 'Edit Route' dialog box for Route 21. Tick the 'Lock this flow value when balancing' box.

- Repeat the above to also lock Route 22.

- Choose 'Balance Lane Flows on all Entry Arms' from the Traffic Flows menu. FlowRound rebalances the Route Flows, in this case moving 63 pcu from Route 19 to Route 18. As Routes 21 & 22 are locked, the Route Flows on these Routes are unchanged.

Coupled Route Flow Proportions

FlowRound's Automatic Entry Lane Balancing facility attempts to distribute traffic flows between Routes with the objective of equally balancing Lane Flows on Entry Arms where possible. In the situation where more than one Route to the same destination start from the same Entry Lane, FlowRound is unable to accurately balance Route Flows without more information on how to share the total Zone-to-Zone traffic movement in this Entry Lane between Routes. By default, FlowRound assumes equal sharing between these Routes but the following procedure can be used to set custom sharing proportions, which will be used by the Automatic Entry Lane Balancer.

- Using the tutorial example at the end of Step 6, open the Network View and set the Route Filter to display Routes between Zones B and A. Figure 4.19 shows that two Routes, each carrying 83 pcu, travel from Zone B's Arm E2, Lane 2 to Zone A. FlowRound's Automatic Entry Lane Flow Balancing has split this flow equally as it has no information to do otherwise.
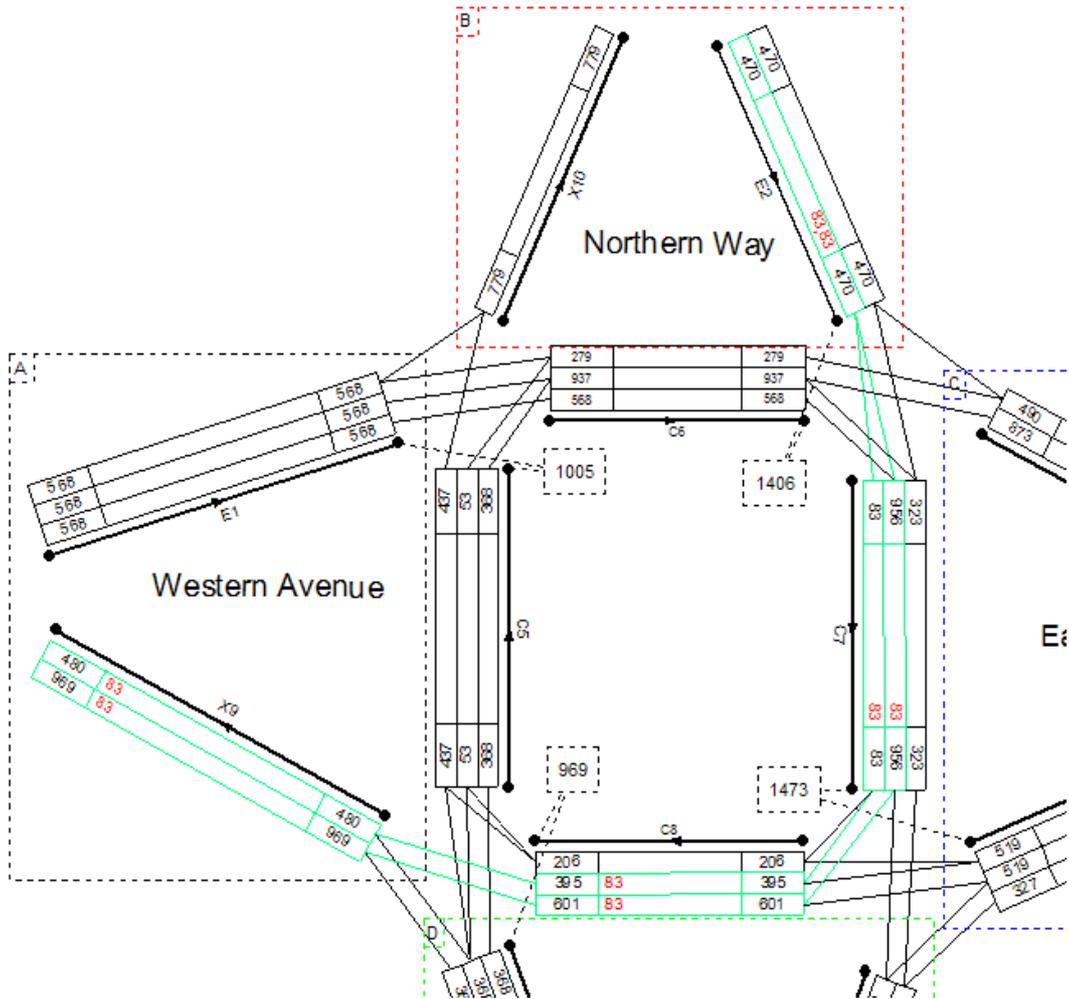
Figure 4.19 : Lane Flow Components for Traffic from Zones B to A

- Open the 'Edit Route' dialog box from the Route List for Route 7 and select the 'Coupled Flow Proportions' tab as shown in Figure 4.20.
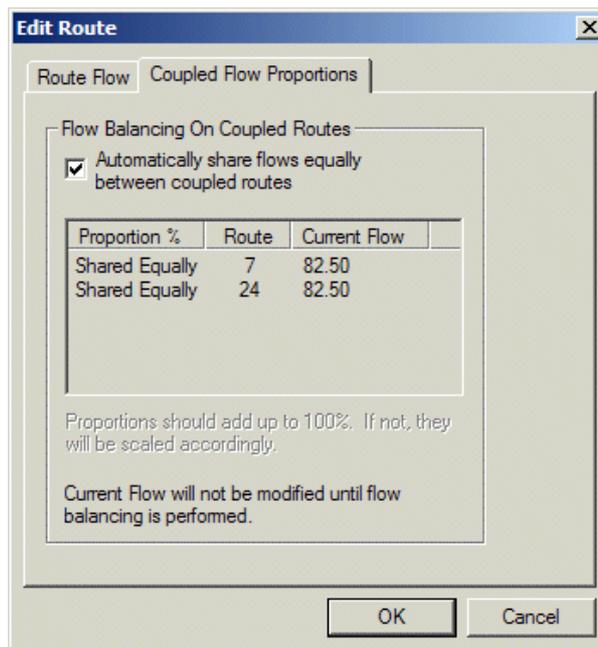

Figure 4.20 : Coupled Route Flow Proportions Dialog

- Untick the 'Automatically Share Flows between Coupled Routes' box.

- In the table now available, enter the flow proportion for each of the coupled Routes. In this case, we are assuming that traffic would be biased towards using the Route passing through the more lightly trafficked Lane 3 or circulatory Arm C7. Therefore, enter 90% for Route 7 and 10% for Route 24. Click OK to close the dialog box.
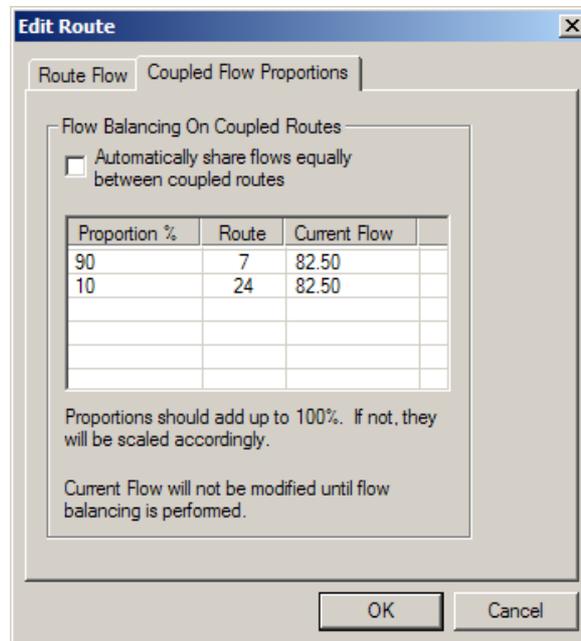

Figure 4.21 : Coupled Route Flow Proportions Dialog with Custom Route Proportions

- Select Arm E2 using the mouse.

- Choose 'Balance Lane Flows on Selected Entry Arm' from the 'Traffic Flows' menu. Balancing just a single Entry Arm will avoid changing flows on any unlocked Routes on other Entry Arms.

- The Route Flows on Routes 7 and 24 are rebalanced from 83 pcu each to 149 and 17 pcu respectively.

Further Refinement

The above tutorial has looked briefly at the techniques available in FlowRound for refining FlowRound's automatic assignment of traffic to Routes. The amount of refinement necessary or desirable in a real case will be dependent on a number of factors including:

- **The design stage of the junction**. Less detail and refinement may be acceptable in the earlier stages of a design. FlowRound is designed to allow models to be progressively refined as a project progresses. For example, in the early stage of a project a rapid 'will it ever work' assessment can be carried out very quickly often using purely automatic assignment. This model can then be further refined to improve the operational efficiency of a design at later detail design stages.

- **The complexity of the junction.** Complex junctions will tend to have more Route and Lane choice and hence more scope for non-typical Lane choice behaviour to produce different flow patterns.

- **The amount of non-typical local driver behaviour with respect to Lane choice**. Driver behaviour varies considerably between different geographical areas and local behaviour with respect to Lane changing and choice should be taken into account when adjusting Route Flows.

Step 8 : Basic Network Assessment.

Currently FlowRound is intended as a tool for preparing roundabout Lane Flow Diagrams and for assessing the feasibility of Lane Flow patterns by manual inspection. Feasible designs can then be progressed for more in depth analysis using other modelling packages such as LINSIG and TRANSYT. However, to allow a basic assessment of the roundabouts capacity to be made from within FlowRound, a rule of thumb assessment method, commonly used when manually assessing Lane Flow Diagrams, is provided using capacity assessors. Capacity Assessors are connected to an Entry Arm and a Circulatory Arm and display the sum of the worst Lane Flow on each of the two Arms. Making some simplifying assumptions, and using basic traffic signal capacity equations, a maximum threshold for this value can be calculated which will imply the Lanes degree of saturation are within acceptable limits.

Capacity Assessor Assumptions

- The Intergreens between Entry and Circulatory Arms are the same.

- The Saturation Flows for all Lanes are the same.

- Green times are such that the degree of saturation of Entry and Circulatory Arms are equalised.

- Short Lanes are assumed to be infinitely long.

Capacity Assessor Theory

Cycle Time = C seconds

Intergreens = I seconds

Lost Time = L = I − 1 seconds

Saturation Flow = S pcu/hour

Desired maximum degree of saturation = d

Max Entry Lane Flow = FE

Max Circulatory Lane Flow = FC

Then the Capacity Assessor threshold value FC+FE is calculated using:

$$FC+FE = (d*S*(C-2*L))/C$$

Therefore assuming typical values of C = 60 Seconds; I = 5 Seconds; S = 1900 pcu/hour and a maximum degree of saturation of 90%: this implies that FC+FE must not exceed 1482 pcu/hour to ensure the worst Lane degree of saturation is 90%.

The use of Capacity assessors is best illustrated by example:

- Position the Network View so Arms E1 and C5 can be seen.

- Right mouse click on the Network View and choose 'Add Capacity Assessor'.

- Select Arm E1 as the Entry Arm and C5 as the Circulatory Arm.

- Accept 1500 as the Threshold Value by clicking 'OK'.

- Position the Capacity Assessor using the mouse.

- The Capacity Assessor will show the sum of the highest Lane Flow on the Entry and Circulatory Arms.

- Add the other three Capacity Assessors as above.

- Edit the Capacity Assessor linked to Arms C6 and E2 by double clicking with the mouse.

- Change the threshold value to 1400 pcu/hour and click OK.

- As the Capacity Assessors value is now exceeding the threshold the Capacity Assessor is displayed in red indicating further investigation is required to avoid capacity issues at a node.

It is important to understand that Capacity Assessors are only intended as a first line of assessment to help to quickly weed out obviously unfeasible designs. Further more detailed modelling may be required to fully test a design. This will usually require significantly more effort than the use of Capacity Assessors.

5 Reporting & Printing

FlowRound provides a number of options for printing and reporting the design and results of a FlowRound model. These include:

- Printing of all or selected Zones of the Network Diagram to any size of printer including large format plotters.

- Export of the Network Diagram to DXF (Drawing Exchange Format) format that can be imported into most CAD software for further enhancement.

- A Report Generator that allows reports of any degree of complexity, including graphics, to be defined and exported to a Rich Text Format file. This Format can be opened, edited and printed using most modern word processors including Microsoft Word.

FlowRound Network Printing

The Network Diagram can be printed in two ways:

- A quick draft print, which requires no set up but has a relatively basic page layout.

- A more sophisticated multi page printing system that allows Print Zones to be defined to specify which part of the Network Diagram is printed on each page. Each Print Zone can have scaling defined independently and pre-defined title blocks can be added to each page.

The Network Diagram can of course also be embedded in a FlowRound Report and printed with the rest of the report via a word processor. This is covered under 'Report Generator' below.

Quick Printing

A quick draft print of the Network Diagram is intended to allow a print of the full Network to be obtained quickly without the need to get involved with Print Zones etc. This is particularly useful to print a working Network Diagram to discuss with colleagues in meetings or design reviews. The main restrictions are that the full FlowRound Network is printed in landscape orientation only and that no title block is printed.

> **Tip:** The OD Matrix can be added to the Network Diagram using 'Show OD Matrix on Network View' on the View Menu. This is useful for including the matrix when printing the Network

To do a Quick Print of the current FlowRound Network Diagram:

- Choose 'Print Setup…' from the File menu in FlowRound to open the Print Setup dialog box. Check that the printer you wish to print to and the desired Paper size is selected in the drop down list. As Quick Print always prints in landscape orientation, the orientation setting is ignored. Click 'OK' to close the Print Setup dialog box.

- Choose 'Draft Print Entire Network…' from the File menu. FlowRound will display a preview of the printed page. If the preview is satisfactory click 'Print' followed by 'OK' to print the Network Diagram.

Multi-Page Printing using Print Zones

FlowRound allows multi-page print layouts to be set up and stored enabling consistent layout and scaling between print sessions. Print Zones are used to set up the scaling and other settings for each printed page, each Zone corresponding to one page.
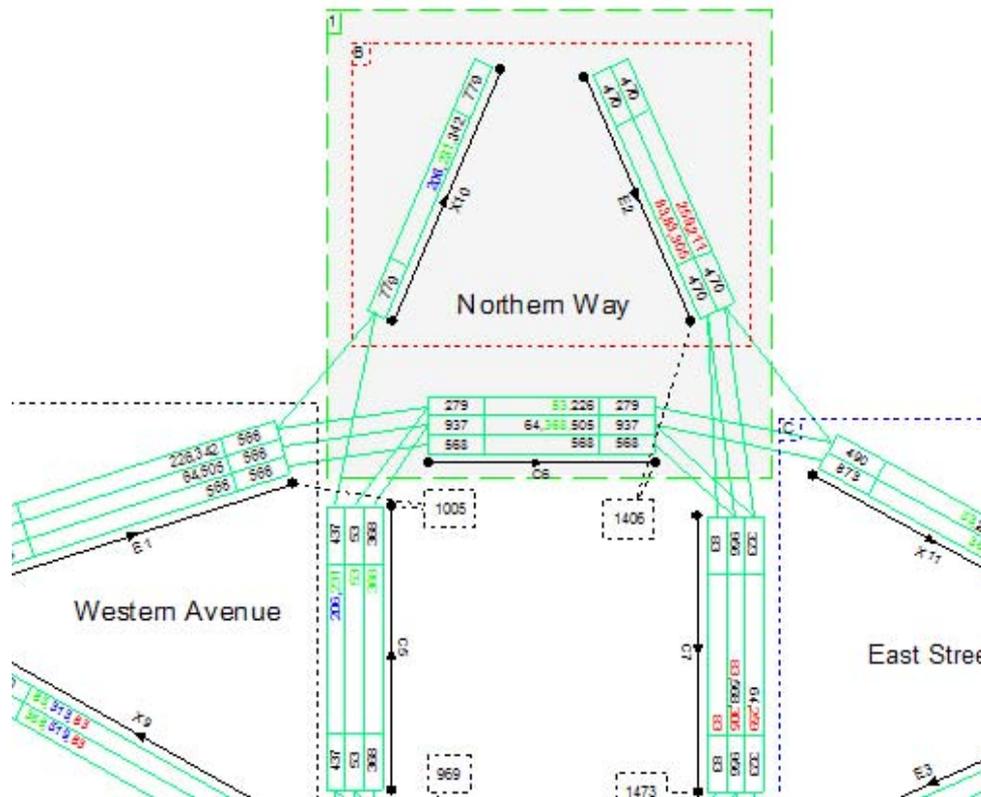

Figure 5.1 : A Print Zone

As shown in Figure 5.1 a Print Zone is a rectangular area of the Network Diagram and defines the content that will be included on the printed page corresponding to the Print Zone. Any number of Print Zones can be defined, with each Print Zone corresponding to a Printed Page.

Creating Print Zones

All creation and editing of Print Zones is carried out with FlowRound's Network View in Print Layout Mode. This special mode allows Print Zones to be created and edited but does not allow changes to be made to the Network.

- To switch the Network View into Print Layout Mode choose 'Print Layout Mode' from the View menu. Print Layout Mode can be switched off at any point by choosing 'Print Layout Mode' again.

A new Print Zone/Printable Page can be created as follows:

- On the File menu pop out the Print Layout menu and choose 'Create a new Print Page…' from the pop out menu.

- The Print Page Settings dialog box will appear. This allows settings relating to scaling and layout of the print page to be changed. These can be changed at any point so for now click 'OK' to accept the defaults.

- A light green rectangle is displayed indicating the current extents of the Print Zone corresponding to the new page. The Print Zone can be repositioned and resized using the mouse.

Editing Print Zones

Print Zone Settings are edited using the Print Page Layout dialog box. This can be opened by selecting a Print Zone and choosing 'Edit Print Zone' from the Print Layout pop-out menu. The settings for each page are independent of the settings for other pages.
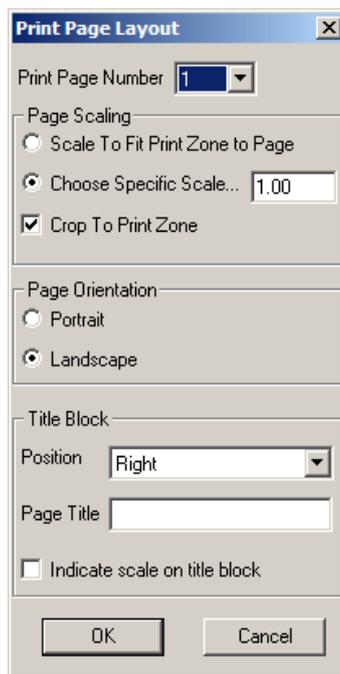

Figure 5.2 : The Print Page Layout Dialog Box

The main settings are:

- **Page Number.** When more than one page is defined, pages can be renumbered by choosing a new page number in the drop down list. Other pages will be renumbered to create a gap in the numbering sequence if required.

- **Page Scaling.** Each Page either can scale the section of Network Diagram within its Print Zone to fit onto the current printers default paper size, or can specify an absolute scale. Absolute scales are less flexible than scale-to-fit but are useful in ensuring each pages text and detail sizes are identical.

- **Page Orientation.** Allows each pages orientation to be set independently. The shape of the print Zone has no bearing on its page orientation.

- **Title Block.** Optionally inserts a title block onto each page populating it with the project information defined by 'Edit Project Information…' on the Network Menu. Each page can also have a separate Page Title defined.

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Printing the Network Diagram

Having defined the desired number of Print Zones, the Network Diagram can be printed as follows:

- Choose 'Print…' from the FlowRound File menu. FlowRound will display the Print dialog box.

- If necessary, select the desired printer from the drop down list.

- If necessary, specify the pages to be printed.

- If necessary, click on 'Properties' to display and change any printer specific settings such as paper size, colour or print quality.

- Click 'OK' to send to the printer.

The FlowRound Report Builder

The FlowRound Report Builder allows detailed reports to be designed and generated as Rich Text Format (RTF) files. The RTF format is supported by most modern word processors including Microsoft Word and Corel WordPerfect. Reports can then be edited and enhanced, for example with company logos, before being printed from within the word processor. The Rich Text Format is particularly suited to this task as it allows graphics and tables to be easily integrated into reports as well as providing comprehensive support for different page sizes and orientations.

Building a Report Definition

Figure 5.3 shows the Report Builder which is used to design and work with reports. Each Report consists of a sequence of Report Fragments, each Fragment representing a component of the Report, such as a diagram or table. The left pane of the Report Builder provides tools to create new reports and to define the Fragments in the current report. The pane lists the Report Fragments currently included in the report, and allows new fragments to be added as well as the order of fragments changed. The right pane of the Report Builder displays options for the Report Fragment currently selected in the left pane. Each Fragment has a different set of options with the number of options available reflecting the complexity of the Fragment. The Reports defined are stored in the FlowRound file being edited, however, they can be transferred between files using Report Templates as described below.

In FlowRound available Fragments are:

- **Header.** The Header is a special Fragment that is repeated at the top of each page. It includes information such as titles and filenames.

- **Footer.** The Footer is also a special Fragment and is repeated at the foot of each page. It can include similar information to the Header.

- **Network Diagram.** The Network Diagram is similar to the FlowRound Network View. The Fragment Options allow the Flow Group, Flow Aggregation and colouring to be set along with other display details. More than one Network Fragment can be included in a Report with each Fragment having different settings for the Fragment Options. This allows several Network Diagrams to be included in the report with, for example, a different Flow Group set for each Fragment.

- **Traffic Flows Matrix.** The Traffic Flows Matrix Fragment inserts a table showing the traffic flow matrix for a single Flow Group. Options allow Demand, Actual or

Difference flows to be selected as well as the degree of flow precision included. The higher levels of precision are provided more for trouble shooting rounding issues than for practical output. Again several Matrix Fragments each showing a different Flow Group can be used in the Report.

- **Routes List.** The Routes List provides a detailed table showing all the Route information for a Flow Group. This is intended for archiving and providing detailed appendices rather than being a necessary part of every FlowRound Report. Again several Route List Fragments can be used in a Report where desired.
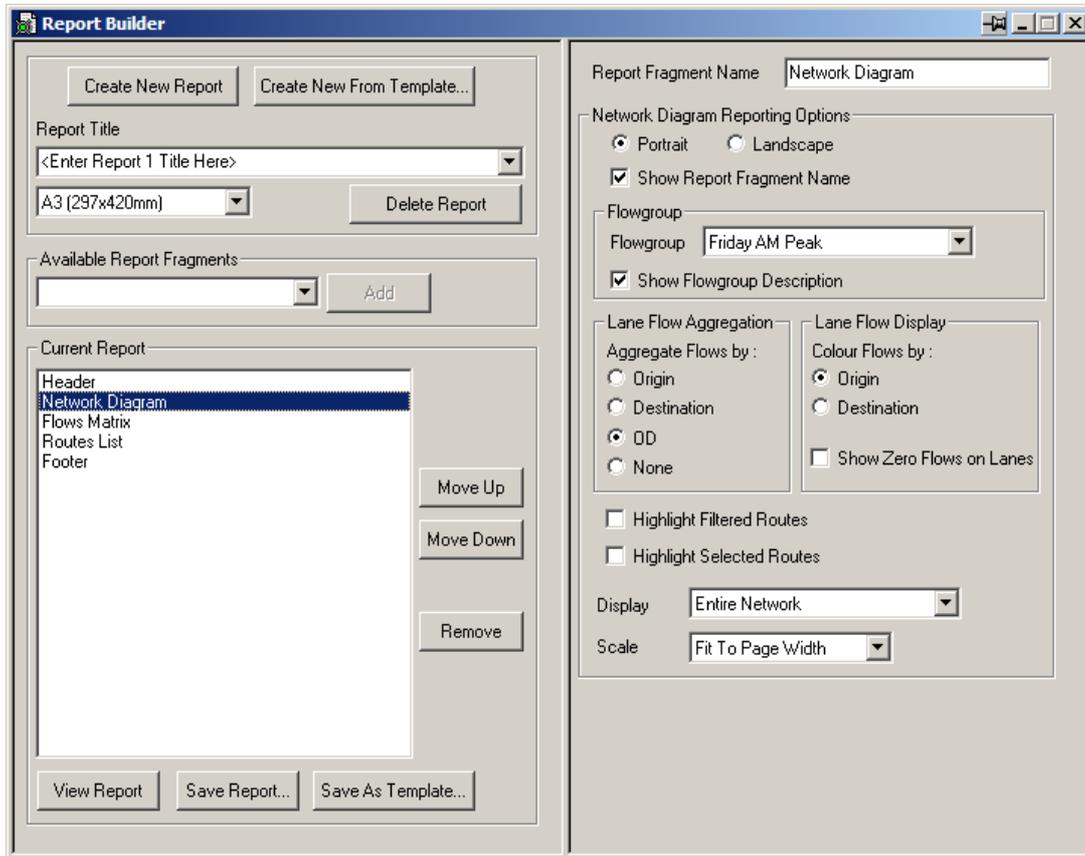

Figure 5.3 : The Report Builder

Viewing and Printing a Report

As FlowRound Reports are created in RTF format, they are viewed, edited and printed using an external RTF compatible Word Processor or viewer. It is anticipated that almost all users will have a modern word processor available to them on their PC, however for users who do not have such software available a free Word Viewer can be downloaded from Microsoft's web site www.microsoft.com. You may need to consult you IT department before downloading or installing the viewer. Although JCT will always try to assist with any Word Processor or Viewer related problems, it may sometimes be quicker to contact your Word Processor Vendor or Helpdesk to assist with purely Word Processor related problems.

You should ensure the software you wish to use to view FlowRound Reports is set up as the default application for opening *.RTF files. Sometimes other applications can 'hijack' the *.RTF extension leading to Reports inadvertently opening in an incorrect application. To correct this use your Word Processor, or Windows, settings to re-associate the *.RTF extension with your Word Processor of choice.

Once a Report has been defined, the Report RTF file can be viewed by clicking 'View Report' in the Report Builder. This will open the Report in your Word Processor. The Report can then be edited, reformatted or printed within the Word Processor.

Report Templates

The Reports defined in FlowRound are stored in the FlowRound file being edited. Report Templates allow Report Definitions to be transferred between FlowRound files. Any Report can be saved as a FlowRound *.rep file at any point by clicking 'Save Report Template' in the Report Builder and choosing where to save the template file.

A Report Template can be imported into a different FlowRound file by clicking 'Create Report from Template' in the Report Builder and selecting a template *.rep file.

Where a Report format includes file specific information such as a selected Flow Group in a Fragment these settings are not included in a template as they are likely to be different in the FlowRound file to which the template is being imported. It is therefore necessary to review each Fragment of the imported template and adjust any settings as required.

Exporting Graphics

The FlowRound Network Diagram can be exported to a number of graphics file formats to allow it to be used in engineering drawings or Desk Top Publishing (DTP) applications.

Exporting the Network Diagram to CAD

The Network Diagram is exported to CAD using the universal DXF (Drawing Interchange Format) file format. This file can then be imported to any CAD software that supports DXF import.

Exporting the Network Diagram to DTP and Word Processors

Many DTP packages support DXF and this can be used in this case. As a quicker alternative FlowRound allows the current Network Diagram to be copied to the Windows Clipboard as a scalable metafile. This can then be pasted into many Desktop Publishing and Word Processing packages using standard Windows cut and paste techniques. As the format used is a scalable metafile, the pasted diagram can be resized within the DTP software with no loss of quality.